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Return

University of Mumbai

No. AAMS_UGS/ICC/2022-23/ 106

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/107 of 2017 dated 27th July, 2017 relating to the revised syllabus S.Y.B.Sc.(Computer Science) (Sem . III & IV) (CBCS).

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in **Computer Science** at its meeting held on 02nd June, 2022 and subsequently passed in the Faculty and then by the Board of Deans at its meeting held on 5th July, 2022 **vide** item No. 6.6 (R) have been accepted by the Academic Council at its meeting held on 11th July, 2022 **vide** item No. 6.6 (R) and that in accordance therewith, the revised syllabus of S.Y.B.Sc.(Computer Science) (Sem.III & IV) (CBCS), has been brought into force with effect from the academic year 2022-23. (The same is available on the University's website www.mu.ac.in).

(Dr. Shailendra Deolankar)
I/c Registrar

MUMBAI – 400 032
11th October, 2022

To

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.6(R)/11/07/2022

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No. AAMS_UGS/ICC/ 2022-23/ 106

11th October, 2022

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Ad-hoc Board of Studies Computer Science,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

(Dr. Shailendra Deolankar)
I/c Registrar

Desktop/Circular Faculty of Science/priya

Copy to :-

1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),
2. The Deputy Registrar, College Affiliations & Development Department (CAD),
3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),
4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),
5. The Deputy Registrar, Executive Authorities Section (EA),
6. The Deputy Registrar, PRO, Fort, (Publication Section),
7. The Deputy Registrar, (Special Cell),
8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,
9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

1. P.A to Hon'ble Vice-Chancellor,
2. P.A Pro-Vice-Chancellor,
3. P.A to Registrar,
4. All Deans of all Faculties,
5. P.A to Finance & Account Officers, (F.& A.O),
6. P.A to Director, Board of Examinations and Evaluation,
7. P.A to Director, Innovation, Incubation and Linkages,
8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),
9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,
10. The Director of Board of Student Development,
11. The Director, Department of Students Walfare (DSD),
12. All Deputy Registrar, Examination House,
13. The Deputy Registrars, Finance & Accounts Section,
14. The Assistant Registrar, Administrative sub-Campus Thane,
15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,
16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,
17. The Assistant Registrar, Constituent Colleges Unit,
18. BUCTU,
19. The Receptionist,
20. The Telephone Operator,
21. The Secretary MUASA

for information.

AC – 11/7/2022
Item No. – 6.6 (R)

University of Mumbai

Revised Syllabus for

S.Y. B.Sc. (Computer Science)

Semester – III & IV

(Choice Based Credit System)

(With effect from the academic year 2022-23)

University of Mumbai

Syllabus for Approval

O: _____ **Title of Course**	**S.Y.B.Sc. (Computer Science)**
O: _____ **Eligibility**	As per University Regulations
Passing Marks	**40%**
Ordinances / Regulations (if, any)	
No. of years/Semesters:	Three years – Six Semesters
Level:	~~P.G.~~ / **U.G.** ~~/ Diploma / Certificate~~
Pattern:	~~Yearly~~ / **Semester**
Status:	~~New~~ / **Revised**
To be implemented from Academic Year :	**From the Academic Year 2022 – 2023**

Date:

Signature:
Name: DR. JAGDISH W. BAKAL
Chairman of Ad-hoc/BoS of
Computer Science

Signature:
Dr. Anuradha Majumdar
Dean, Science and Technology

Preamble

The revised and restructured curriculum for the Three-year integrated course is systematically designed considering the current industry needs in terms of skills sets demanded under new technological environment. It also endeavors to align the programme structure and course curriculum with student aspirations and corporate expectations. The proposed curriculum is more contextual, industry affable and suitable to cater the needs of society and nation in present day context.

The Core Subjects offers to develop strong theoretical foundations in Computer Science to build computational thinking, analytical, and problem solving skills. Principles of Operating Systems course provides an overview of computer operating systems, their functionalities, processes, and computing resource management. Linear Algebra course covers concepts crucial to many areas of computer science, such as graphics, image processing, cryptography, machine learning, computer vision, optimization, graph algorithms, quantum computation, computational biology, information retrieval and web search. Data Structures course provides an understanding of different types of data structures and how to use them per the requirements of a given application. Advanced Database Concepts course touches the touches security, recovery, and transaction aspects of database. Theory of Computation course helps to develop capabilities to design and develop formulations for computing models and identify its applications in diverse areas. Computer Networks course include topics such as application layer protocols, Internet protocols, network interfaces, local and wide area networks, wireless networks, bridging and routing, among other current topics. Software Engineering course embodies an engineering approach to the development of software. It discusses the nature of software and software projects, software development models, software process maturity, project planning, management, and estimations along with topics on software testing and quality assurance. The course on IoTTechnologies will definitelyopen future area as Embedded Engineer, involvement in IoT projects, Robotics and many more. Skill Enhancement courses such as Java based Application Development, Web Technologies, Android Application Development and Advanced Application Developmentcater to present day needs of web and mobile based platforms and applications. These courses aims to produce skilled graduates with a creative mind-set who can recognize a computational problem either in IT industry or society, and develop effective solutions. The General Elective courses offers the students the option to explore disciplines of interest beyond the choicesthey make in Core and Discipline Specific Elective papers. The course on Creative Content Writing prepare students to comprehend, refine, and enhance their writing abilities and enter the industry with enhanced skill and substantial competence. The course on Green Technologies emphasizes the use of principles and practices of green services and regulatory standards for addressing the carbon issues and related concerns. The Research Methodology instills basic research skills for students who wish to pursue a research or an academic career.Management& Entrepreneurship course aims to focus on giving students the business management and innovation skills required to succeed in a startup.

We sincerely believe that any student taking this programme will get very strong foundation and exposure to basics, advanced and emerging trends of the subject.

We wholeheartedly thank all experts who shared their valuable feedbacks and suggestions in order to improvise the contents, we have sincerely attempted to incorporate each of them. We further thank Chairperson and members of Board of Studies for their confidence in us. Special thanks to University Department of Computer Science and colleagues from various colleges, who volunteered or have indirectly helped designing certain specialized courses and the syllabus as a whole.

S.Y.B.Sc. Computer Science Syllabus

Choice Based Credit System (CBCS)

with effect from

Academic year 2022-2023

Semester – III				
Course Code	**Course Type**	**Course Title**	**Credits**	**Lectures/Week**
USCS301	Core Subject	Principles of Operating Systems	2	3
USCSP301	Core Subject Practical	Principles of Operating Systems – Practical	1	3
USCS302	Core Subject	Linear Algebra	2	3
USCSP302	Core Subject Practical	Linear Algebra – Practical	1	3
USCS303	Core Subject	Data Structures	2	3
USCSP303	Core Subject Practical	Data Structures – Practical	1	3
USCS304	Core Subject	Advanced Database Concepts	2	3
USCSP304	Core Subject Practical	Advanced Database Concepts – Practical	1	3
USCS305	Skill Enhancement Course (SEC)	Java based Application Development	2	3
USCSP305	Skill Enhancement Course (SEC)	Java based Application Development – Practical	1	3
USCS306	Skill Enhancement Course (SEC)	Web Technologies	2	3
USCSP306	Skill Enhancement Course (SEC)	Web Technologies – Practical	1	3
USCS3071	Practical Generic Elective	Creative Content Writing	2	3
USCS3072	Generic Elective	Green Technologies	2	3

** Any one Generic Elective to be selected by the student.*

S.Y.B.Sc. Computer Science Syllabus

Choice Based Credit System (CBCS)

with effect from

Academic year 2022-2023

Semester – IV				
Course Code	**Course Type**	**Course Title**	**Credits**	**Lectures/Week**
USCS401 USCSP401	Core Subject Practical	Theory of Computation	2	3
USCS402 USCSP402	Core Subject Practical	Theory of Computation – Practical	1	3
USCS403 USCSP403	Core Subject Practical	Computer Networks	2	3
USCS404 USCSP404	Core Subject Practical	Computer Networks – Practical	1	3
	Core Subject Practical	Software Engineering	2	3
	Core Subject Practical	Software Engineering – Practical	1	3
	Skill Enhancement Course (SEC) Practical	IoT Technologies	2	3
	Skill Enhancement Course (SEC) Practical	IoT Technologies – Practical	1	3
USCS405	Skill Enhancement Course (SEC)	Android Application Development	2	3
USCSP405	Skill Enhancement Course (SEC) Practical	Android Application Development – Practical	1	3
USCS406	Skill Enhancement Course (SEC)	Advanced Application Development	2	3
USCSP406	Skill Enhancement Course (SEC) Practical	Advanced Application Development – Practical	1	3
USCS4071	Generic Elective*	Research Methodology	2	3
USCS4072	Generic Elective*	Management & Entrepreneurship	2	3

** Any one Generic Elective has to be selected by the student.*

Semester III

Course Code	Course Title	Credits	Lectures /Week
USCS301	Principles of Operating Systems	2	3

About the Course: The purpose of this course is to provide an overview of computer operating systems, their functionalities, processes, and computing resource management. In particular, the course will cover processes and threads, mutual exclusion, CPU scheduling, deadlock, memory management, and file systems.

Course Objectives:

- To learn basic concepts and structure of operating systems
- To learn about process and synchronization in operating system level
- To learn CPU scheduling algorithms
- To learn Memory and File system management

Learning Outcomes:

After successful completion of this course, students would be able to

- Work with any type of operating system
- Handle threads, processes, process synchronization
- Implement CPU scheduling algorithms
- Understand the background role of memory management
- Design file system.

Unit	Topics	No of Lectures
I	**Introduction to Operating-Systems:** Definition of Operating System, Operating System's role, Operating-System Operations, Functions of Operating System, Computing Environments **Operating-System Structures:** Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, Operating-System Structure **Processes:** Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication **Threads:** Overview, Multicore Programming, Multithreading Models	15
II	**Process Synchronization:** General structure of a typical process, race condition, The Critical-Section Problem, Peterson's solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors **CPU Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms (FCFS, SJF, SRTF, Priority, RR, Multilevel Queue Scheduling,	15

	Multilevel Feedback Queue Scheduling), Thread Scheduling **Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock	
III	**Main Memory:** Background, Logical address space, Physical address space, MMU, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table **Virtual Memory:** Background, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing **Mass-Storage Structure:** Overview, Disk Structure, Disk Scheduling, Disk Management **File-System Interface:** File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing **File-System Implementation:** File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management	**15**

Textbook(s):

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, Operating System Concepts, Wiley, 2021

Additional Reference(s):

1. Achyut S. Godbole, AtulKahate, Operating Systems, Tata McGraw Hill, 2017
2. Naresh Chauhan, Principles of Operating Systems, Oxford Press, 2014
3. Andrew S Tanenbaum, Herbert Bos, Modern Operating Systems, 4e Fourth Edition, Pearson Education, 2016

Course Code	Course Title	Credits	Lectures /Week
USCSP301	**Principles of Operating Systems – Practical**	**1**	**3**
1	Process Communication: a. Write a program to give a solution to the producer–consumer problem using shared memory. b. Write a program to give a solution to the producer–consumer problem using message passing.		
2	Threads: a. Write a program to work with a single thread. b. Write a program to work with multi threads. c. The Fibonacci sequence is the series of numbers 0, 1, 1, 2, 3, 5. 8, … Formally, it can be expressed as: fib0 = 0, fib1 = 1, fibn = fibn-1 + fibn-2. Write a multithreaded program that generates the Fibonacci sequence.		
3	Synchronization: a. Write a program to give a solution to the Bounded buffer problem. b. Write a program to give a solution to the readers–writers problem.		
4	Write a program that implements FCFS scheduling algorithm.		
5	Write a program that implements (with no premption) scheduling algorithm.		
6	Write a program that implements RR scheduling algorithm.		
7	Write a program that implements the banker‘s algorithm		
8	Write a program that implements the FIFO page-replacement algorithm.		
9	Write a program that implements the LRU page-replacement algorithm.		
10	Write a program to design a File System.		

Course Code	Course Title	Credits	Lectures /Week
USCS302	Linear Algebra	2	3

About the Course:

Linear algebra, a branch of mathematics, provides concepts that are crucial to many areas of computer science, such as graphics, image processing, cryptography, machine learning, computer vision, optimization, graph algorithms, quantum computation, computational biology, information retrieval and web search. The course covers topics such as fields, vectors, matrices, eigenvalues and eigenvectors.

Course Objectives:

- To offer the learner the relevant Linear Algebra concepts through Computer Science applications.
- To interpret existence and analyze the solution set of a system of linear equations.
- To formulate, solve, apply, and interpret properties of linear systems.
- To learn about the concept of linear independence of vectors over a field, and the dimension of a vector space.
- To interpret basic concepts of linear transformations, dimension, matrix representation of a linear transformation, and the change of coordinate matrix.

Learning Outcomes:

After successful completion of this course, students would be able to

- Appreciate the relevance and applications of Linear Algebra in the field of Computer Science.
- Understand the concepts through program implementation.
- Instill a computational thinking while learning linear algebra.
- Express clear understanding of the concept of a solution to a system of equations.
- Find eigenvalues and corresponding eigenvectors for a square matrix.

Unit	Topics	No of Lectures
I	**Field:** Introduction to complex numbers, complex numbers in Python, abstracting over fields, Playing with GF (2). **Vectors:** Vectors are functions, Vector addition, multiplication, combining vector addition and scalar multiplication, Dictionary-based representations of vectors, Dot-product, Solving a triangular system of linear equations, Support Vector Machine – Introduction, Mechanism. **The Vector Space:** Linear combination, Span, The geometry of sets of vectors, Vector spaces, Linear systems, homogeneous and otherwise	15
II	**Matrix**: Matrices as vectors, Column space and row space, Matrix-vector and vector-matrix multiplication in terms of linear combinations, Matrix-	15

	vector multiplication in terms of dot-products, Null space, Computing sparse matrix-vector product, Linear functions, Matrix-matrix multiplication, Inner product and outer product, From function inverse to matrix inverse **Basis**: Coordinate systems, two greedy algorithms for finding a set of generators, Linear dependence, Basis, Unique representation, Change of basis, first look, Computational problems involving finding a basis **Dimension:** Dimension and rank, Direct sum, Dimension and linear functions, The annihilator **Gaussian elimination**: Echelon form, Gaussian elimination over GF(2), Solving a matrix-vector equation using Gaussian elimination.	
III	**Inner Product**: The inner product for vectors over the reals, Orthogonality. **Orthogonalization**: Projection orthogonal to multiple vectors, projecting orthogonal to mutually orthogonal vectors, Building an orthogonal set of generators, orthogonal complement. **Eigenvalues and Eigenvectors:** Characteristic Polynomials of degree 2 and 3, Eigenvalues and eigenvectors, Properties of eigenvalues and eigenvectors, Cayley–Hamilton Theorem, Minimal Polynomial. Coordinate representation in terms of eigenvectors, The Internet worm, Markov Chains, Google Page Rank algorithm.	**15**

Textbooks:

1. Coding the Matrix Linear Algebra through Applications to Computer Science, First Edition, Philip N. Klein, Newtonian Press 2013
2. Schaum's Outline of Linear Algebra, Sixth Edition by Seymour Lipschutz, Marc Lipson, McGraw Hill 2017

Additional References:

1. Linear Algebra and Probability for Computer Science Applications, First Edition, Ernest Davis, A K Peters/CRC Press, 2012.
2. Linear Algebra and Its Applications, Gilbert Strang, Cengage Learning, 4th Edition, 2007
3. Linear Algebra and Its Applications, David C Lay, Pearson Education India; 3rd Edition, 2002
4. Introduction to Information Retrieval, Christopher D. Manning, PrabhakarRaghavan and HinrichSchütze, Cambridge University Press, 2008.
5. Computer Networking With Internet Protocols and Technology, William Stallings, Pearson Education India, 2013.

Course Code	Course Title	Credits	Lectures /Week
USCSP302	**Linear Algebra – Practical**	**1**	**3**

1	Write a program which demonstrates the following: ● Addition of two complex numbers ● Displaying the conjugate of a complex number ● Plotting a set of complex numbers ● Creating a new plot by rotating the given number by a degree 90, 180, 270 degrees and also by scaling by a number a = 1/2, a = 1/3, a = 2 etc.
2	Write a program to do the following: ● Enter a vector u as a n-list ● Enter another vector v as a n-list ● Find the vector au + bv for different values of a and b ● Find the dot product of u and v
3	Vector Applications: Classify given data using support vector machines (SVM)
4	Basic Matrix Operations: ● Matrix Addition, Subtraction, Multiplication ● Check if matrix is invertible. ● If yes then find Inverse
5	Write a program to convert a matrix into its row echelon form. (Order 2). Write a program to find rank of a matrix.
6	Basic Matrix Application – I Representation of Image in Matrix Format and Image Transformations
7	~~Basic Matrix Application – II~~ Perform Image addition, multiplication and subtraction
8	~~Write a program to do the following:~~ ● Enter a vector b and find the projection of b orthogonal to a given vector u. ● Find the projection of b orthogonal to a set of given vectors
9	Write a program to calculate eigenvalue and eigenvector (Order 2 and 3)
10	Implement Google's Page rank algorithm.

Course Code	Course Title	Credits	Lectures /Week
USCS303	Data Structures	2	3

About the Course:

The course focuses to give an understanding of different types of data structures that can be used to store data in memory, how to create-manipulate them and to use them in the best possible manner as per the requirements of the application.

Course Objectives:

- To introduce data abstraction and data representation in memory
- To describe, design and use of elementary data structures such as stack, queue, linked list, tree and graph
- How and why different data structures are used for different types of problems.

Learning Outcomes:

After successful completion of this course, students would be able to-

- Create different types of data structures.
- Understand which data structure to be used based on the type of the problem.
- Apply combined knowledge of algorithms and data structures to write highly effective programs in various domains.

Unit	Topics	No of Lectures
I	**Abstract Data Type:** Different Data Types, different types of data structures & their classifications, Introduction to ADT, Creating user-specific ADT **Linked Structures**: ADT for linked list, Advantages & Disadvantages, Singly Linked List-Traversing, Searching, Prepending and Removing Nodes, applications of linked list like polynomial equation **Stacks**: Stack ADT for Stack, Advantages & Disadvantages, Applications of stack like balanced delimiter, prefix to postfix notation **Queues**: Queue ADT, Advantages &Disadvantages, linked representations.	15
II	**Doubly Linked list:** ADT of Doubly linked list, Advantages & Disadvantages, Insertion and deletion of nodes at various positions **Trees**: ADT for Tree Structure. Advantages &disadvantages, Binary Tree-Properties, Implementation and Traversals, Binary Search Tree, Balanced BST,Threaded Binary Trees, AVL Trees, Applications of Tree like Huffman Coding, **Priority Queues & Heaps:** Priority Queue, Priority Queue ADT,	

	Advantages and Disadvantages, Applications, Heaps, types of heaps, Heapifying the element,	
III	**Graph:** Introduction, Graph ADT, Advantages and Disadvantages, Graph Representation using adjacency matrix and adjacency list, Graph operations like insertion and deletion of nodes, Graph Traversals using BFS & DFS, Applications of Graphs like shortest path algorithms, **Hashing:** Hash Table ADT, Advantages & Disadvantages, Concept of avoidance hashing, hash table, hash functions, collision, collision techniques, Applications of hashing	

Textbooks:

1. Introduction to Algorithm, Thomas H Cormen, PHI
2. Data Structures And Algorithms Made Easy, NarasimhaKarumanchi, 2021

Additional References:

1. Fundamentals of Computer Algorithms, SartajSahni and SanguthevarRajasekaran Ellis Horowitz, Universities Press, 2018
2. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Wiley, 2016

Course Code	Course Title	Credits	Lectures /Week
USCSP303	**Data Structures – Practical**	**1**	**3**
1	Write a program to implement Abstract Data Types (ADT)		
2	Write a program to implement Singly Linked list with insertion, deletion, traversal operations		
3	Write a program to implement Doubly Linked list with insertion, deletion, traversal operations		
4	Write a program to implement Stack with insertion, deletion, traversal operations		
5	Write a program to implement Queue with insertion, deletion, traversal operations		
6	Write a program to implement Priority Queue with insertion, deletion, traversal operations Write a program to implement Binary Tree with insertion, deletion, traversal operations		
7	Write a program to implement Huffman Coding		
8	Write a program to implement Graph with insertion, deletion, traversal operations		
9	Write a program to implement Travelling Salesman Problem		
10			
11	Write a program to create basic Hash Table for insertion, deletion, traversal operations(assume that there are no collisions)		
12	Write a program to create hash table to handle collisions using overflow chaining		

Course Code	Course Title	Credits	Lectures /Week
USCS304	Advanced Database Concepts	2	3

About the Course:

This course deals with the basic understanding of programming in database. It touches security, recovery, and transaction aspects of database. The course will increase the confidence among the learner while dealing with database.

Course Objectives:

- To develop understanding of concepts and techniques for data management and learn about widely used systems for implementation and usage.
- To develop understanding of Transaction management and crash recovery.
- To develop concepts of programming concepts of database.

Learning Outcomes:

After successful completion of this course, students would be able to

- Master concepts of stored procedure, functions, cursors and triggers and its use.
- Learn about using PL/SQL for data management.
- Use efficiently Collections and records.
- Understand concepts and implementations of transaction management and crash recovery.

Unit	Topics	No of Lectures
I	**Overview of PL/SQL:** Advantages of PL/SQL, Main Features of PL/SQL, Architecture of PL/SQL **Fundamentals of PL/SQL:** Character Sets, Lexical Units, Declarations, References to Identifiers, Scope and Visibility of Identifiers, Assigning Values to Variables, Expressions, Error-Reporting Functions, Data Types. **Control Statements:** Conditional Selection Statements, LOOP Statements, Sequential Control Statements, GOTO, and NULL Statements. **Sequences:** creating sequences, referencing, altering, and dropping a sequence. **Stored Procedures and Functions:** Procedures: Types and benefits of stored procedures, creating stored procedures, executing stored procedures, altering stored procedures, viewing stored procedures. Functions:	15
II	**Collections and Records:** Associative Arrays, Varrays (Variable-Size Arrays), Nested Tables, Collection Constructors, Assigning Values to Collection Variables, Multidimensional Collections, Collection Comparisons, Collection Methods, Collection Types Defined in Package	15

	Specifications, Record Variables, Assigning Values to Record Variables. **Error Handling:** Compile-Time Warnings, Overview of Exception Handling, Internally Defined Exceptions, Predefined Exceptions, User-Defined Exceptions, Redeclared Predefined Exceptions, Raising Exceptions Explicitly, Exception Propagation, Unhandled Exceptions. **Cursors:** Overview of Cursor, Types of cursors, Invalid cursor Exception. **Static and Dynamic SQL:** Static SQL: Description of Static SQL, Cursors Overview, Processing Query Result Sets, Cursor Variables, CURSOR Expressions, Autonomous Transaction Processing and Control Transactions. Dynamic SQL: Native Dynamic SQL, DBMS_SQL Package, SQL Injection.	
III	**Triggers:** Overview of Triggers, implementing triggers – creating triggers, Insert, delete, and update triggers, nested triggers, viewing, deleting, and modifying triggers, and enforcing data integrity through triggers. **Packages:** Overview of a Package. Need of Packages, Package Specification, Package Body, Package Instantiation and Initialization. **Transaction Management:** ACID Properties, Serializability, Two-phase Commit Protocol, Concurrency Control, Lock Management, Lost Update Problem, Inconsistent Read Problem, Read-Write Locks, Deadlocks Handling, Two Phase Locking protocol. **Crash Recovery:** ARIES algorithm. The log-based recovery, recovery related structures like transaction and dirty page table, Write-ahead log protocol, checkpoints, recovery from a system crash, media recovery.	**15**

Textbooks:

1. Mastering PL/SQL: Through Illustrations, Learning Fundamentals and Developing Efficient PL/SQL Blocks, Dr. B. Chandra, BPB Publication, 2020
2. Oracle Pl/Sql Training Guide., Training guide, BPB Publications, 2016
3. Raghu Ramakrishnam, Gehrke, Database Management Systems, McGraw-Hill,3rd Edition, 2014
4. Abraham Silberschatz, Henry F. Korth,S.Sudarshan , Database System Concepts, 6th Edition 2019

Additional References:

1. Ivan Bayross, —SQL, PL/SQL -The Programming language of Oracle||, B.P.B. Publications 2009
2. RamezElmasri&ShamkantB.Navathe, Fundamentals of Database Systems, Pearson Education, 2008

Course Code	Course Title	Credits	Lectures /Week
USCSP304	**Advanced Database Concepts – Practical**	**1**	**3**

1	Writing PL/SQL Blocks with basic programming constructs by including following: a. Sequential Statements b. unconstrained loop
2	Sequences: a. Creating simple Sequences with clauses like START WITH, INCREMENT BY, MAXVALUE, MINVALUE, CYCLE | NOCYCLE, CACHE | NOCACHE, ORDER | NOORECER. b. Creating and using Sequences for tables.
3	Writing PL/SQL Blocks with basic programming constructs by including following: a. If...then...Else, IF...ELSIF...ELSE... END IF b. Case statement
4	Writing PL/SQL Blocks with basic programming constructs for following Iterative Structure: a. While-loop Statements b. For-loop Statements.
5	Writing PL/SQL Blocks with basic programming constructs by including a GoTO to jump out of a loop and NULL as a statement inside IF.
6	Writing Procedures in PL/SQL Block a. Create an empty procedure, replace a procedure and call procedure b. Create a stored procedure and call it c. Define procedure to insert data d. A forward declaration of procedure
7	Writing Functions in PL/SQL Block. a. Define and call a function b. Define and use function in select clause, c. Call function in dbms_output.put_line d. Recursive function e. Count Employee from a function and return value back f. Call function and store the return value to a variable
8	Creating and working with Insert/Update/Delete Trigger using Before/After clause.
9	Write an Implicit and explicit cursor to complete the task.
10	Create packages and use it in SQL black to complete the task.
11	Write a SQL block to handle exception by writing: a. Predefined Exceptions, b. User-Defined Exceptions,

	c. Redeclared Predefined Exceptions,
12	Create nested tables and work with nested tables.

Course Code	Course Title	Credits	Lectures /Week
USCS305	**Java based Application Development**	**2**	**3**

About the Course:

The objective of this course is to teach the learner how to use Object Oriented paradigm to develop code and understand the concepts of Core Java and explore advanced topic of Java programming for solving problems.

Course Objectives:

- To provide insight into java based applications using OOP concepts.
- To provide understanding of developing GUI based desktop applications in java.
- To provide knowledge of web based applications through servlet and jsp.
- To provide understanding and implementation of basic JSON

Learning Outcomes:

After successful completion of this course, students would be able to

- Design basic application in java using Graphical User Interface.
- The learner will be able to develop applications using swings
- The learner will be able to develop web based applications using servlet and jsp
- The learner will be able to connect databases with java through
- The learner will be able to perform programs using JSON objects

Unit	Topics	No of Lectures
I	**Introduction:** History, Features of Java, Java Development Kit, Java Application Programming Interface, Java Virtual Machine Java Program Structure, Java Tokens. **OOPS**: Introduction, Class, Object, Static Keywords, Constructors, this keyword, Inheritance,Inner class, Anonymous Inner class, super keyword, Polymorphism (overloading and overriding), Abstraction, Encapsulation, Abstract Classes, Interfaces **Packages:** Introduction to predefined packages, User Defined Packages, Access specifiers **Exception Handling:** Introduction, Pre-Defined Exceptions, try-catch-finally, throws, throw, User Defined Exceptions **Multithreading:** Thread Creations, Thread Life Cycle, Life Cycle Methods,Synchronization, wait() notify() notify all() methods	**15**
II	**Collection Framework**: Introduction, java.util Package interfaces, List,	**15**

	Set, Map,List interface & its classes, Set interface & its classes, Map interface & its classes. **Introduction to JFC and Swing-** Features of the Java Foundation Classes, Swing API Components, JComponent Class, Windows, Dialog Boxes, and Panels, Labels, Buttons, Check Boxes, Menus, Toolbars, Implementing Action interface, Pane, JScrollPane, Desktop pane, Scrollbars, Lists and Combo Boxes, Text-Entry Components, Colors and File Choosers, Tables and Printing with 2D API and Java Print Service API. **Event Handling:** Delegation Event Model, Events, Event classes, Event listener interfaces, Using delegation event model, adapter classes. **JDBC:** Introduction, JDBC Architecture, JDBC Drivers, JDBC Connectivity Model, java.sql package, Using Statement, PreparedStatement, CallableStatement, ResultSet, Scrollable and Updatable ResultSet, Navigating and manipulating data, ResultSetMetaData, Maintaining Transactions using JDBC, JDBC Exception classes, BLOB & CLOB	
III	**Servlets:** Introduction, Servlet Life Cycle, Types of Servlet, Servlet Configuration with Deployment Descriptor, Working with ServletContext and ServletConfig Object, Attributes in Servelt,, Response and Redirection using Request Dispacher and using sendRedirect Method, Filter API, Manipulating Responses using Filter API, Session Tracking: using Cookies, HTTPSession, Hidden Form Fields and URL Rewriting,Types of Servlet Event: ContextLevel and SessionLevel. **Java Server Pages (JSP)**: Introduction to JSP , Comparison with Servlet, JSP Architecture, JSP Life Cycle, JSP Scripting Elements, JSP Directives, JSP Action, JSP Implicit Objects, JSP Expression Language, JSP Standard Tag Libraries, JSP Custom Tag, JSP Session Management, JSP Exception Handling, JSP CRUD Applications **JSON:** Overview, Syntax, DataTypes, Objects, Schema, Comparison with XML, JSON with Java	**15**

Textbooks:

1. Herbert Schildt, Java The Complete Reference, Eleventh Edition, McGraw-Hill Education, 2020
2. Bryan Basham, Kathy Sierra, Bert Bates, Head First Servlets and JSP, O'reilly (SPD), 2018
3. Cay S. Horstmann, Gary Cornell, Core Java™ 2: Volume II–Advanced Features Prentice Hall PTR, 2004
4. Ivan Bayross, Web Enabled Commercial Applications Development Using Java 2, BPB Publications
5. Java XML and JSON: Document Processing for Java SE by Jeff Friesen January 2019, Apress

Additional References:

1. **E. Balagurusamy, Programming with Java- A Primer, Tata McGraw-Hill Education India, 2014**
2. **Programming in JAVA, 2nd Ed, Sachin Malhotra &SaurabhChoudhary, Oxford Press, 2018**

3. **Joe Wigglesworth and Paula McMillan, Java Programming: Advanced Topics, Thomson Course Technology (SPD)**
4. **Eric Jendrock, Jennifer Ball, D Carson and others, The Java EE 5 Tutorial, Pearson Education**
5. **The Java Tutorials: http://docs.oracle.com/javase/tutorial/**
6. **Java Parsing Collection XML JSON: Map List XML JSON Transform by Yang Hu, 2019**

Course Code	Course Title	Credits	Lectures /Week
USCSP305	**Java based Application Development – Practical**	**1**	**3**

1	a. Write a program to create a class and implement the concepts of Constructor Overloading, Method Overloading, Static methods b. Write a program to implement the concept of Inheritance and Method Overriding
2	a. Write a program to implement the concepts of Abstract classes and methods b. Write a program to implement the concept of interfaces
3	Write a program to define user defined exceptions and raise them as per the requirements
4	Write a program to demonstrate the methods of: a. List interface b. Set interface c. Map interface
5	Write a program using various swing components design Java application to accept a student's resume. (Design form)
6	a. Write a JDBC program that displays the data of a given table b. Write a JDBC program to return the data of a specified record from a given table c. Write a JDBC program to insert / update / delete records into a given table
7	a. Construct a simple calculator using the JAVA Swings with minimum functionality. b. Construct a GUI using JAVA Swings to accept details of a record of a given table and submit it to the database using JDBC technology on the click of a button.
8	a. Write a Servlet that accepts a User Name from a HTML form and stores it as a cookie. Write another Servlet that returns the value of this cookie and displays it. b. Write a Servlet that displays the names and values of the cookie stored on the client. c. Write a Servlet that accepts a User Name from a HTML form and stores it as a session variable. Write another Servlet that returns the value of this session variable and displays it.

9	a. Write a registration Servlet that accepts the data for a given table and stores it in the database. b. Write a Servlet that displays all the records of a table.
10	a. Write a JSP that accepts a User Name from a HTML form and stores it as a cookie. Write another JSP that returns the value of this cookie and displays it. b. Write a JSP that displays the names and values of the cookie stored on the client. c. Write a JSP that accepts a User Name from a HTML form and stores it as a session variable. Write another JSP that returns the value of this session variable and displays it.
11	a. Write a JSP code that accepts username and password from HTML file and validates the user from the database b. Write a registration JSP that accept the data for a given table and stores it in the database. c. Write a JSP that displays all the records of a table
12	. Write Java application to encoding and decoding JSON in Java.

Course Code	Course Title	Credits	Lectures /Week
USCS306	Web Technologies	2	3

About the Course:

The course providesan insight into emerging technologies to design and develop state of the art web applications using client-side scripting, server-side scripting, and database connectivity

Course Objectives:

- To understand the concepts of Hyper Text Markup Language and Cascading Style Sheets.
- To learn JavaScript for creating dynamic websites.
- To learn various operations performed on data among web applications using XML
- To learn Server-Side Programming using PHP

Learning Outcomes:

After successful completion of this course, students would be able to

- Design valid, well-formed, scalable, and meaningful pages using emerging technologies.
- Understand the various platforms, devices, display resolutions, viewports, and browsers that render websites
- Develop and implement client-side and server-side scripting language programs.
- Develop and implement Database Driven Websites.
- Design and apply XML to create a markup language for data and document centric applications.

Unit	Topics	No of Lectures
I	**HTML5:** Fundamental Elements of HTML, Formatting Text in HTML, Organizing Text in HTML, Links and URLs in HTML, Tables in HTML, Images on a Web Page, Image Formats, Image Maps, Colors, FORMs in HTML, Interactive Elements, Working with Multimedia - Audio and Video File Formats, HTML elements for inserting Audio / Video on a web page **CSS:** Understanding the Syntax of CSS, CSS Selectors, Inserting CSS in an HTML Document, CSS properties to work with background of a Page, properties to work with Fonts and Text Styles, CSS properties for positioning an element	15
II	**JavaScript:** Using JavaScript in an HTML Document, Programming Fundamentals of JavaScript – Variables, Operators, Control Flow Statements, Popup Boxes, Functions – Defining and Invoking a Function, Defining Function arguments, defining a return Statement, Calling Functions with Timer, JavaScript Objects - String, RegExp, Math, Date, Browser Objects - Window, Navigator, History, Location, Document, Cookies, Document Object Model, Form Validation using JavaScript **XML:** Comparing XML with HTML, Advantages and Disadvantages of XML, Structure of an XML Document, XML Entity References, DTD, XSLT: XSLT Elements and Attributes - xsl:template, xsl:apply-templates	15

	xsl:import, xsl:call-template, xsl:include, xsl:element, xsl:attribute,xsl:attribute-set, xsl:value-of	
III	**AJAX**: AJAX Web Application Model, How AJAX Works, XMLHttpRequest Object – Properties and Methods, handling asynchronous requests using AJAX **PHP**: Variables and Operators, Program Flow, Arrays, working with Files and Directories, working with Databases, Working with Cookies, Sessions and Headers **Introduction to jQuery**: Fundamentals, Selectors, methods to access HTML attributes, methods for traversing, manipulators, events, effects.	**15**

Textbooks:

1. HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, 2ed, Dreamtech Press, 2016
2. Web Programming and Interactive Technologies, scriptDemics, StarEdu Solutions India, 2018
3. PHP: A Beginners Guide, VikramVaswani, TMH

Additional References:

1. **HTML, XHTML, and CSS Bible Fifth Edition, Steven M. Schafer, WILEY, 2011**
2. **Learning PHP, MySQL, JavaScript, CSS & HTML5, Robin Nixon, O'Reilly, 2018**
3. **PHP, MySQL, JavaScript & HTML5 All-in-one for Dummies, Steve Suehring, Janet Valade Wiley, 2018**

Course Code	Course Title	Credits	Lectures /Week
USCSP306	**Web Technologies – Practical**	**1**	**3**
1	Design a webpage that makes use of a. Document Structure Tags b. Various Text Formatting Tags c. List Tags d. Image and Image Maps		
2	Design a webpage that makes use of a. Table tags b. Form Tags (forms with various form elements) c. Navigation across multiple pages d. Embedded Multimedia elements		
3	Design a webpage that make use of Cascading Style Sheets with a. CSS properties to change the background of a Page b. CSS properties to change Fonts and Text Styles c. CSS properties for positioning an element		
4	Write JavaScript code for a. Performing various mathematical operations such as calculating factorial / finding Fibonacci Series / Displaying Prime Numbers in a given range / Evaluating Expressions / Calculating reverse of a number b. Validating the various Form Elements		
5	Write JavaScript code for a. Demonstrating different JavaScript Objects such as String, RegExp, Math, Date b. Demonstrating different JavaScript Objects such as Window, Navigator, History, Location, Document, c. Storing and Retrieving Cookies		
6	Create a XML file with Internal / External DTD and display it using a. CSS b. XSL		
7	Design a webpage to handle asynchronous requests using AJAX on a. Mouseover b. button click		
8	Write PHP scripts for a. Retrieving data from HTML forms b. Performing certain mathematical operations such as calculating factorial / finding Fibonacci Series / Displaying Prime Numbers in a given range / Evaluating Expressions / Calculating reverse of a number c. Working with Arrays		

	d. Working with Files (Reading / Writing)
9	Write PHP scripts for a. Working with Databases (Storing Records / Reprieving Records and Display them) b. Storing and Retrieving Cookies c. Storing and Retrieving Sessions
10	Design a webpage with some jQuery animation effects.

Course Code	Course Title	Credits	Lectures /Week
USCS3071	Creative Content Writing	2	3

About the Course:

With the advent of the internet, content writing has become a very lucrative and promising career. The course is designed to equip students to comprehend, refine, and enhance their writing abilities so that they may become proficient web content developers. The course aims to prepare students to enter the industry with enhanced skill and substantial competence.

Course Objectives:

- To introduce students to the concepts of content writing.
- To connect them with various writing and editing styles and techniques.
- To help them develop their creative abilities.
- To improve the learners' employability

Learning Outcomes:

After successful completion of this course, students would be able to

- Understand the fundamentals of content creation for Blog, Website etc.
- Acquire the ability to write and edit in a variety of styles and procedures
- To develop the creative abilities.
- To acquire essential language skills for editors.

Unit	Topics	No of Lectures
I	**Basics of Content writing:** Introduction to Content Writing, Learning Tone in Writing and Its Types, Comprehending style in writing and its Types, Common Grammatical Errors. **Best Practices for Writing for the Web:** Making our story Elegant, Professional, Write with an Attitude, Keep Verbs Active, List Items, Chunk Information, Title and Subtitle, Organize for Your Audience.	15
II	**Social Media Writing:** Writing for Twitter, Writing with Hashtags, **Things Marketers Write:** The Ideal Length for Blog Posts, Podcast, Facebook Posts, Tweets, and Other Marketing Content. Writing Social Media with Humor, writing for Facebook, writing for LinkedIn, Writing Your LinkedIn Profile, writing for Email, Writing Landing Pages, Writing Headlines, writing a Home Page, Writing the About Us Page, Writing Better Blog Posts, Writing Annual Reports. **Infographics:** Visual Communication-What Are Infographics?, The Science of Visualization, Creating Infographics-Purpose, The Art of Observation, Processing Your Ideas, Designing Your Infographics, Publishing Your Infographics.	15

III	**Content Tools:** Research and Knowledge Management Tools, Writing Tools, Productivity Tools, Editing Tools, A Few Great Style Guides, Non-Text Writing Tools, Blog Idea Generators, Google Authorship, Image Sources,Tools for Content Writing. **Ethical and Legal aspects of content writing:** Learn Legal English, Learn Legal Vocabulary In Legal Writing, IPR Laws, and Copywriting, Plagiarism laws in Content Writing**.**	**15**

Textbooks:

1. Content Writing Handbook, Author:Kounal Gupta, 2020, Henry Harvin.
2. Feldar, Lynda. Writing for the Web: Creating Compelling Web Content Using Words, Pictures, and Sound. New Riders, CA, USA, 2011

Additional References:

1. **Everybody Writes: Your Go-To Guide to Creating Ridiculously Good Content Paperback Ann Handley Pan Macmillan India 2016**
2. **The Power of Infographics: Using Pictures to Communicate and Connect With Your Audiences Paperback – 15 June 2012 Mark Smiciklas**
3. **Law Relating to Intellectual Property Rights Book by V. K. Ahuja, 2017**

Web Resources:

1. https://www.locationrebel.com/b2b-writing/
2. https://www.mindler.com/blog/how-to-become-a-content-writer-in-india/
3. https://study.com/articles/What_is_a_Content_Writer.html
4. https://www.mondaq.com/india/contracts-and-commercial-law/445620/legal-contractsagreements-drafting-and-legal-vetting
5. https://www.crazyegg.com/blog/copywriting/

Course Code	Course Title	Credits	Lectures /Week
USCS3072	Green Technologies	2	3

About the Course:

This course focuses on familiarizing learners with the need and relevance of Green Computing, Technology, and its practices for creating a sustainable work and production environment for the IT-enabled sector. The course emphasizes the use of principles and practices of green services and regulatory standards for addressing the carbon issues and related concerns.

Course Objectives:

- Know about Green IT Fundamentals: Business, IT, and the Environment
- Green IT Strategies and Significance of Green IT Strategies
- Green Enterprise Architecture and Green Information Systems
- Sociocultural Aspects of Green IT and Green Compliance

Learning Outcomes:

After successful completion of this course, students would be able to

- Explain drivers and dimensions of change for Green Technology
- Appreciate Virtualization; smart meters and optimization in achieving green IT
- Gain knowledge about green assets, green processes, and green enterprise architecture
- ISO 14001 and related standards for Audit for Green Compliance

Unit	Topics	No of Lectures
I	**Green IT Fundamentals:** Information Technology and Environment, Business, Environment, and Green Enterprise Characteristics, Green Vision and Strategic Points, Green Value, Green IT Opportunity, Challenges of a Carbon Economy, Environmental Intelligence, Envisioning the Green Future **Green IT Strategies**: Green strategic alignment, Green IT Drivers-Cost, Regulatory and Legal, Sociocultural and Political, Business ecosystem, New market opportunities, Green IT Business Dimensions, KPIs in Green Strategies **Environmentally Responsible Business:** Developing ERBS, Policies, Practices, and Metrics, Mobility and Environment, Green It Metrics and Measurements, Green IT Readiness and CMM, Context Sensitivity and Automation in Green IT Measures	15
II	**Green Assets:** Introduction, Green Assets, Green IT Hardware, Green Data Centers and ICT Equipment, Server and Data **Green Assets and emerging Trends:** Data Servers Optimization and Virtualization, Physical Data Server Organization and Cooling, Cloud Computing and Data Centers, Networking and Communications Strategy	15

	Infrastructure, End-User Devices, Smart Meters in Real-Time, Managing Devices for Central Green Services, Devices and Organizational Boundaries for Measurements, Mobile Devices, and Sustainability **Green Business Process Management:** Introduction, Reengineering, Green Process, Green BPM and standards, Green Business Analysis, Green Requirements Modelling, Green IT Governance, Green Business Process and Applications, QoS, Achieving green BPM, Green Mobile Business Process, Digital Library **Green Enterprise Architecture:** Green IT and organizational Systems, Aspects of Green Solutions Architecture, Contents and Integration with Service-Oriented Architecture, Green Supply Chain Management, Green Portals in Green Enterprise Architecture, Environmental Intelligence	
III	**Green Information Systems(GIS): Design and Development Models:** Describing GIS, GIS Requirements **Sociocultural Aspects of Green IT:** Green IT's Social Impact, Learning Organization, Green Social Stakeholders, Role-Based View of Green IT, Green User Practices, Attitude and Subjectivity in Green IT, Green IT Ethics and Code of Conduct, Privacy and Security of Green Information, Green Washing, Communications in Green Transformation Projects, Green HR and Changing Organizational Structures, Green-Collar Workers: Roles and Skill Sets, Green Virtual Communities **Green Compliance:** **Protocols, Standards, and Audits:** Protocols and Standards, ISO 14000-2004 Standard, Various initiatives by stakeholders, Green Audits and types, Audit and use of Carbon emission management software **Emerging Carbon Issues:** Technologies and Future: Future Carbon Landscape, Green ICT and Technology Trends, Cloud Computing, Nanotechnology, Quantum computing, Renewable energies, eco-design, Collaborative environmental intelligence	**15**

Textbooks:

1. Green IT Strategies and Applications Using Environmental Intelligence, BhuvanUnhelkar, CRC Press, 2016
2. Green Information and Communication Systems for a Sustainable Future, Rajshree Srivastava, Sandeep Kautish, Rajeev Tiwari. CRC Press, 2020

Additional References:

1. **Emerging Green Technologies, Matthew N. O. Sadiku, Taylor and Francis (CRC Press), 2022**
2. **Sustainability Awareness and Green Information Technologies, TomayessIssa, Springer, 2021**
3. **Environmental Sustainability Role of Green Technologies, P. Thangavel, and G. Sridevi, Springer, 2016**

Semester IV

Course Code	Course Title	Credits	Lectures /Week
USCS401	**Theory of Computation**	**2**	**3**

About the Course:

The course providesa comprehensive insight into theory of computation by understanding grammar, languages and other elements of modern language design. It also helps to develop capabilities to design and develop formulations for computing models and identify its applications in diverse areas.

Course Objectives:

- To give an overview of the theoretical foundations of computer science from the perspective
- of formal languages
- To illustrate finite state machines to solve problems in computing
- To explain the hierarchy of problems arising in the computer sciences.
- To familiarize Regular grammars, context frees grammar.

Learning Outcomes:

After successful completion of this course, students would be able to

- Understand Grammar and Languages
- Learn about Automata theory and its application in Language Design
- Learn about Turing Machines and Pushdown Automata
- Understand Linear Bound Automata and its applications

Unit	Topics	No of Lectures
I	**Automata Theory:** Defining Automaton, Finite Automaton, Transitions and Its properties, Acceptability by Finite Automaton, Nondeterministic Finite State Machines, DFA and NDFA equivalence, Mealy and Moore Machines, Minimizing Automata. **Formal Languages:** Defining Grammar, Derivations, Languages generated by Grammar, Chomsky Classification of Grammar and Languages, Recursive Enumerable Sets, Operations on Languages, Languages and Automata	**15**
II	**Regular Sets and Regular Grammar:** Regular Grammar, Regular Expressions, Finite automata and Regular Expressions, Pumping Lemma and its Applications, Closure Properties, Regular Sets and Regular Grammar **Context Free Languages:** Context-free Languages, Derivation Tree, Ambiguity of Grammar, CFG simplification, Normal Forms, Pumping	**15**

	Lemma for CFG **Pushdown Automata:** Definitions, Acceptance by PDA, PDA and CFG	
III	**Linear Bound Automata:** The Linear Bound Automata Model, Linear Bound Automata and Languages. **Turing Machines:** Turing Machine Definition, Representations, Acceptability by Turing Machines, Designing and Description of Turing Machines, Turing Machine Construction, Variants of Turing Machine, **Undecidability:** The Church-Turing thesis, Universal Turing Machine, Halting Problem, Introduction to Unsolvable Problems	**15**

Textbooks:

1. Theory of Computer Science, K. L. P Mishra, Chandrasekharan, PHI,3rd Edition 2019
2. Introduction to Computer Theory, Daniel Cohen, Wiley,2nd Edition, 2007
3. Introductory Theory of Computer Science, E.V. Krishnamurthy, Affiliated East-West Press, 2009

Additional References:

1. **Theory of Computation, Kavi Mahesh, Wiley India, 2018**
2. **Elements of The Theory of Computation, Lewis, Papadimitriou, PHI, 2015**
3. **Introduction to Languages and the Theory of Computation, John E Martin, McGraw-Hill Education, 2010**
4. **Introduction to Theory of Computation, Michel Sipser, Thomson**
5. **Introduction to Automata Theory, Languages and Computation, John E. Hopcroft, Pearson Education, 2014**

Course Code	Course Title	Credits	Lectures /Week
USCSP401	Theory of Computation – Practical	1	3

1	Write a program for tokenization of given input
2	Write a program for generating regular expressions for regular grammar
3	Write a program for generating derivation sequence / language for the given sequence of productions
4	Design a Program for creating machine that accepts three consecutive one.
5	Design a Program for creating machine that accepts the string always ending with 101.
6	Design a program for accepting decimal number divisible by 2.
7	Design a program for creating a machine which accepts string having equal no. of 1's and 0's.
8	Design a program for creating a machine which count number of 1's and 0's in a given string.
9	Design a PDA to accept WCWR where w is any string and WR is reverse of that string and C is a Special symbol.
10	Design a Turing machine that's accepts the following language an b n c n where n>0

Course Code	Course Title	Credits	Lectures /Week
USCS402	Computer Networks	2	3

About the Course:

This course introduces computer networks, with a special focus on the Internet architecture and protocols. The course includes topics such as network architectures, addressing, naming, forwarding, routing, communication reliability, the client-server model, web, email and other application layer protocols.

Course Objectives:

- To Understand Basic Concepts of Networking.
- To Understand Working of Network Layer Architecture.
- To Learn Practical Implementation of Basic Routing Algorithms.
- To Learn Different Networking Protocols.

Learning Outcomes:

After successful completion of this course, students would be able to

- Learn basic networking concepts and layered architecture.
- Understand the concepts of networking, which are important for them to be known as a _networking professionals'.

Unit	Topics	No of Lectures
I	**Introduction:** Networking standards and Administrations, networks, network types – LAN, MAN, WAN. **Network Models:** The OSI model, TCP/IP protocol suite, **Introduction to Physical layer:** Data and signals, periodic analog signals, digital signals, transmission impairment, data rate limits, performance. **Digital transmissions:** Digital-to-digital conversion, analog-to-digital conversion, transmission modes **Analog transmissions:** digital-to-analog conversion, analog-to-analog conversion. **Bandwidth Utilization – Multiplexing and Spectrum spreading:** Multiplexing, Spread Spectrum **Transmission media:** Guided Media, Unguided Media **Switching:** Introduction, Circuit Switched Network, Packet Switching.	15
II	**Introduction to Data Link Layer:** Link layer addressing, Data Link Layer Design Issues. **Error detection and correction**: -Block coding, cyclic codes, checksum,	15

	forward error correction, error correcting codes, error detecting codes. **Data Link Control:** DLC services, data link layer protocols, HDLC, Point-to-point protocol. **Media Access Control:** Random access, controlled access, channelization, **Wired LANs – Ethernet:** Ethernet Protocol, standard Ethernet, fast Ethernet, gigabit Ethernet, 10 gigabit Ethernet **Wired Network:** Telephone Network, Cable Network, SONET, ATM **Wireless LANs:** Introduction, IEEE 802.11 project, Bluetooth, WiMAX, Cellular telephony, Satellite networks. **Introduction to Network Layer:** Network layer services, packet switching, network layer performance, IPv4 addressing, forwarding of IP packets, **Network Layer Protocols** : Internet Protocol, ICMPv4, Mobile IP **Unicast Routing:** Introduction, routing algorithms, unicast routing protocols. **Next generation IP:** IPv6 addressing, IPv6 protocol, ICMPv6 protocol, transition from IPv4 to IPv6. **Introduction to the Transport Layer:** Transport Layer Protocol, User Datagram Protocol, Transmission Control Protocol, SCTP **Introduction to Application Layer:** Client Server Programming, Iterative Programming. **Standard Client-Server Protocols:** WWW, HTTP, FTP, Electronic Mail, TELNET, Secure Cell, DNS, SNMP **Quality of Service:** Data Flow to improve QoS, Flow control to improve QoS, Integrated service (Intserv), Differentiated Service(Diffserv).	
III		**15**

Textbooks:

1. Data Communications and Networking, Behrouz A. Forouzan, Fifth Edition, TMH, 2018.
2. Computer Network, Andrew S. Tanenbaum, David J. Wetherall, Fifth Edition, Pearson Education, 2018.

Additional References:

1. **Computer Network, Bhushan Trivedi, Oxford University Press, 2016**
2. **Data and Computer Communication, William Stallings, PHI, 2017**

Course Code	Course Title	Credits	Lectures /Week
USCSP402	**Computer Networks – Practical**	**1**	**3**
1	Using, linux-terminal or Windows-cmd, execute following networking commands and note the output: ping, traceroute, netstat, arp, ipconfig, Getmac, hostname, NSLookUp, pathping, SystemInfo		
2	Using Packet Tracer, create a basic network of two computers using appropriate network wire. Use Static IP address allocation and show connectivity		
3	Using Packet Tracer, create a basic network of One server and two computers using appropriate network wire. Use Dynamic IP address allocation and show connectivity		
4	Using Packet Tracer, create a basic network of One server and two computers and two mobile / movable devices using appropriate network wire. Show connectivity		
5	Using Packet Tracer, create a network with three routers with RIPv1 and each router associated network will have minimum three PC. Show Connectivity		
6	Using Packet Tracer, create a network with three routers with RIPv2 and each router associated network will have minimum three PC. Show Connectivity		
7	Using Packet Tracer, create a network with three routers with OSPF and each router associated network will have minimum three PC. Show Connectivity		
8	Using Packet Tracer, create a network with three routers with BGP and each router associated network will have minimum three PC. Show Connectivity		
9	Using Packet Tracer, create a wireless network of multiple PCs using appropriate access point.		
10	Using Wireshark, network analyzer, set the filter for ICMP, TCP, HTTP, UDP, FTP and perform respective protocol transactions to show/prove that the network analyzer is working		

Course Code	Course Title	Credits	Lectures /Week
USCS403	Software Engineering	2	3

About the Course:

This course covers a collection of methods which embody an "engineering" approach to the development of software. It discusses the nature of software and software projects, software development models, software process maturity, project planning, management, and estimations. It also underlines the topics on software testing and quality assurance. **Course Objectives:**

- To learn and understand the Concepts of Software Engineering
- To learn and understand Software Development Life Cycle
- To apply the project management and analysis principles to software project development.
- To apply the design & testing principles to software project development.

Learning Outcomes:

After successful completion of this course, students would be able to

- Plan a software engineering process life cycle, including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements
- Analyze and translate a specification into a design, and then realize that design practically, using an appropriate software engineering methodology.
- Know how to develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice
- Able to use modern engineering tools necessary for software project management, time management and software reuse.

Unit	Topics	No of Lectures
I	**Introduction:** The Nature of Software, Software Engineering, The Unique Nature of Software, Software Development Technology, Process framework, CMM, Process Patterns and Assessment Prescriptive Models: Waterfall Model, Incremental, RAD Models Evolutionary Process Models: Prototyping, Spiral and Concurrent Development Model Specialized Models: Component based, Aspect Oriented development, The Unified Process Phases, Agile Development- Agility, Agile Process, Extreme Programming **Requirement Analysis and System Modeling:** Requirements Engineering, Eliciting Requirements, SRS Validation, Components of SRS, Characteristics of SRS, Object-oriented design using the UML - Class diagram, Object diagram, Use case diagram, Sequence diagram, Collaboration diagram, State chart diagram, Activity diagram, Component diagram, Deployment diagram	15

II	**System Design:** System/Software Design, Architectural Design, Low- Level Design Coupling and Cohesion, Functional-Oriented Versus Object-Oriented Approach, Design Specifications, Verification for Design, Monitoring and Control for Design **Software Measurement and Metrics:** Process Metrics and Project Metrics, Software Measurement, Object Oriented Metrics, Software Project Estimation, Decomposition Techniques, LOC based, FP based and Use case based estimations, Empirical estimation Models **SoftwareProjectManagement:Estimation**inProjectPlanningProcess –Software Scope and Feasibility, Resource Estimation, Empirical Estimation Models – COCOMO II, Estimation for Agile Development, The Make/Buy Decision **Project Scheduling** - Basic Principles, Relationship Between People and Effort, Effort Distribution, Time-Line Charts	**15**
III	**RiskManagement**-Risk strategies, Software risks, Risk Identification, projection, RMMM Quality Concepts **Software Quality Assurance** SQA activities, Software reviews, FTR, Software reliability and measures, SQA plan Software Configuration Management, elements of SCM, SCM Process, Change Control Capability Maturity Model **Software Testing :**Verification and Validation, Introduction to Testing, Testing Principles, Testing Objectives, Test Oracles, Levels of Testing, White-Box Testing/Structural Testing, Functional/Black-Box Testing, Test Plan, Test-CaseDesign	**15**

Textbooks:

1. Software Engineering, A Practitioner‘s Approach, Roger S, Pressman, 2019
2. Software Engineering: principles and Practices, Deepak Jain, OXFORD University Press, 2008

Additional References:

1. **Software Engineering, Ian Sommerville, Pearson Education, 2017**
2. **Fundamentals of Software Engineering, Fourth Edition, Rajib Mall, PHI, 2018**
3. **Software Engineering: Principles and Practices, Hans Van Vliet, John Wiley & Sons, 2010**
4. **A Concise Introduction to Software Engineering, Pankaj Jalote, Springer**

Course Code	Course Title	Credits	Lectures /Week
USCSP403	Software Engineering – Practical	1	3

Perform the following exercises for any two projects given in the list of sample projects or any other projects:

1	Write down the problem statement for a suggested system of relevance
2	Perform requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
3	Draw the function oriented diagram: Data Flow Diagram (DFD) and Structured chart.
4	Draw the user's view analysis for the suggested system: Use case diagram.
5	Draw the structural view diagram for the system: Class diagram, object diagram.
6	Draw the behavioral view diagram : State-chart diagram, Activity diagram
7	Draw the behavioral view diagram for the suggested system: Sequence diagram, Collaboration diagram
8	Draw the implementation and environmental view diagram: Component diagram, Deployment diagram
9	Perform Estimation of effort using FP Estimation
10	Prepare time line chart/Gantt Chart/PERT Chart
11	Develop test cases for unit testing and integration testing
12	Develop test cases for various white box and black box testing

List of sample projects

a. **Student Result Management System**
b. **Library management system**
c. **Inventory control system**
d. **Accounting system**
e. **Fast food billing system**
f. **Bank loan system**
g. **Blood bank system**
h. **Railway reservation system**
i. **Automatic teller machine**
j. **Video library management system**
k. **Hotel management system**
l. **Hostel management system**
m. **Share online trading**
n. **Hostel management system**
o. **Resource management system**
p. **Court case management system**

Course Code	Course Title	Credits	Lectures /Week
USCS404	IoT Technologies	2	3

About the Course:

The course aims to provide basic understanding of SoC architectures; IoT, different types of IoT platforms and different types of applications that can be built.

Course Objectives:

- Introduce concepts of SoC and IoT
- Introduce various types of IoT platforms
- Interfacing various types of devices using different protocols with IoT
- Understand practical applications of IoT in real life world

Learning Outcomes:

After successful completion of this course, students would be able to

- understand SoC and IoT
- use different types of IoT Platforms and interfaces
- understand and implement an idea of various types of applications built using IoT

Unit	Topics	No of Lectures
I	**Fundamentals of IoT:** Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M. **System on Chip:** What is System on chip? Structure of System on Chip. SoCElements: FPGA, GPU, APU, Compute Units. **Different types of IoT/SoC Platforms:** Introduction to Raspberry Pi, Arduino &NodeMCU, Introduction to SoC-ARM Architecture, atmega328 architecture	15
II	**Interfacing with IoT Platforms:** Basic hardware components like LED, Button, Camera, 8X8 LED Grid, Motor etc and interfacing them for input/output with IoT devices using PWM, UART, GPIO, I2C, SPI **Using Sensor &Actuators**:Overview of Sensors working, Analog and Digital Sensors, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor, Level Sensors, Ultrasonic sensors, Interfacing of Actuators, Interfacing of Relay Switch and Servo Motor	15
III	**IoT and Protocols IoT Security:** HTTP, UPnP, CoAP, MQTT, XMPP, Protocol and Security Issues in IoT. **IoT & Web:** Web server for IoT, Sending/Receiving data between web server &IoT device,Cloud for IoT, Node RED, M2M vs IoT	15

	Communication Protocols, Basics of WSNs, WSN architecture and types, **IoT Applications:** Modern IoT case studies / applications used in the areas of transportation, agriculture, health care etc **Edge Computing:** Edge computing purpose anddefinition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge Fog Computing, Communication Models - Edge, Fog and M2M.	

Textbooks:

1. Introduction to IoT, Paperback by SudipMisra , Anandarup Mukherjee , Arijit Roy , Cambridge Press, 2022
2. Jain, Prof. Satish, Singh, Shashi, —Internet of Things and its Applications||, 1st Edition, BPB, 2020.
3. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things, Wiley, India, 2019
4. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: PacktPublishing, 2020

Additional References:

1. Internet of Things by VinayakShinde, SYBGEN Learning India Pvt. Ltd, 2020
2. Internet of things, Dr. KamleshLakhwani, Dr. Hemant kumarGianey, Josef Kofi Wireko, KamalkantHiran, BPB Publication, 2020
3. Arduino, Raspberry Pi, NodeMCU Simple projects in easy way by Anbazhagan k and AmbikaParameswari k, 2019.
4. IoT based Projects: Realization with Raspberry Pi, NodeMCU Paperback – February 2020, by Rajesh Singh Anita Gehlot, 2020
5. Mastering the Raspberry Pi, Warren Gay, Apress, 2014

Course Code	Course Title	Credits	Lectures /Week
USCSP404	**IoT Technologies – Practical**	**1**	**3**

1	Preparing Raspberry Pi: Hardware preparation and Installation
2	Demonstrate Arduino Uno and its pins interfacing with IDE.
3	GPIO: Light the LED with Python with/without a button using either Uno/Raspberry Pi.
4	SPI: Camera Connection and capturing Images/Videos using SPI
5	GPIO: LED Grid Module: Program the 8X8 Grid with Different Formulas
6	Stepper Motor Control: PWM to manage stepper motor speed using Uno/Raspberry Pi.
7	Node RED: Connect LED to Internet of Things
8	Use different types of sensors (LDR, Temperature) with Raspberry Pi/Uno.
9	Trigger a set of led GPIO on any IoT platform via any related web server
10	Interface with any sensor and send its value over the internet to the server using any suitable protocol

Course Code	Course Title	Credits	Lectures /Week
USCS405	**Android Application Development**	**2**	**3**

About the Course:

This course is aimed at creating a skilled IT workforce that is focused on developing Apps for mobile and smart Android-based computing platforms. It familiarises the development of android applications using Kotlin for problems that address real-life needs ranging from intuitive UI to rich multimedia experience.

Course Objectives:

- Kotlin Programming Language for application development
- Creating robust mobile applications on simulators and physical devices
- Creating intuitive, reliable mobile apps using the android services and components
- Handling data local and remote data storage
- Create a seamless user interface that works with different mobile screens

Learning Outcomes:

After successful completion of this course, students would be able to

- Build useful mobile applications using Kotlin language on Android
- Install and configure Android Studio for application development
- Master basic to intermediate concepts of Kotlin required for mobile application development
- Use built-in widgets and components, work with the database to store data
- Master key Android programming concepts and deploy the application on Google Play

Unit	Topics	No of Lectures
I	**Introduction to Kotlin**: Basics of Kotlin, type conversions, comments, Kotlin operators, variables in Kotlin, packages, visibility modifiers, control flow statements, Concept of OOPS in Kotlin, classes in Kotlin, delegation and extension functions, the companion object, **Advanced Concepts in Kotlin:** declaring and calling functions, parameters, and arguments in Kotlin, default argument, variable number of arguments, unit-returning function, explicit return type, lambda expression, coroutines, Collections in Kotlin, Mutable and Immutable Collections, Ranges, type Checks, casting concept, this expression, Null safety, exception handling, annotations **App Development with Android Studio**: Android Architecture, Android Application Framework, Android Virtual Device, Creating and running First Android Application, working with Physical Android Device, Adding Kotlin Files in Android Studio **Basics Of Android**- Application Components: Activities, Intent, and Broadcast Receiver, Services, Fragment, Activity Life Cycle, Content Provider, Widgets, and Notifications	**15**

II	**Designing Android UI**: User Interface (UI), Layout and Its Types, Layout Attribute, working with Views, Android UI Controls, Styles and Themes, Event Handler, setting up themes in Manifest and from the application, dialog in activity, using intents, fragments **Handle Images, ListviewAnd Menu**: ImageView, ImageSwitcher, ListView, Menu, and its types,Designing menu in XML, Option menu, Context menu, popup menu, **Screen** Navigation, RecyclerView, Interaction of Views **Data binding in Android-**AdapterView, Spinner, Gallery view, AutotextCompleteView, screen orientation, Designtheviewdynamically **Implementing Data Persistence**: Data Storage-Shared Preference, Internal And External Storage Storing Data Using SQLite Databases, Content Provider, Firebase Real-Time Data	**15**
III	**Graphics, Animations, and Integrating Media in Android:**Drawable Class, Animation in Android, MediaPlayer API and in Android, Mediaplayer and AudioManger Class, **Interacting With Camera** and input gestures: Android Camera, Input gestures-multiple touch, swipe, drag, scroll, zoom, Recording **Gathering Location Data:** **Managing Background Tasks:**Broadcaset Receivers, Services, Threads and Process, AsyncTask, JobScheduler, Manage device Awake State **Deploying Android applications on Google Play**-Publishing/Deploy the application, Versioning, signing Application	**15**

Textbooks:

1. How to Build Android Apps with Kotlin: A hands-on guide to developing, testing, and publishing your first apps with Android, Alex Forrester, Packt Publishing, 2021
2. Android Programming: Crafting UI/UX using Kotlin, SYBGEN Learning, 2020

Additional References:

1. **Head First Android Development: A Learner's Guide to Building Android Apps with Kotlin Dawn Griffiths, 3rd Edition, O'Reilly Media, 2021**
2. **Android Studio 4.2 Development Essentials - Kotlin Edition: Developing Android Apps Using Android Studio 4.2, Kotlin and Android Jetpack, Neil Smyth, Payload Media, 2021**
3. **Android Programming with Kotlin for Beginners, John Horton, Packt Publishing, 2019**
4. **Android Development with Kotlin: Enhance your skills for Android development using Kotlin, Marcin Moskala, Packt Publishing**

Course Code	Course Title	Credits	Lectures /Week
USCSP405	**Android Application Development – Practical**	**1**	**3**

1	i. Write a program using Kotlin to implement control structures and loops. ii. Write a program to implement object-oriented concepts in Kotlin.
2	i. Create an Android application to design screens using different layouts and UI including Button, Edittext, Textview, Radio Button etc. ii. Write an android application demonstrating response to event/user interaction for a. Checkbox b. Radio button c. Button d. Spinner
3	i. Create an application to create Image Flipper and Image Gallery. On click on the image display the information about the image. ii. Create an application to use Gridview for shopping cart application.
4	i. Create an Android application to demonstrate implicit and explicit intents ii. Create an application to demonstrate shared preferences
5	i. Create an Android application to demonstrate the use of Broadcast listeners. ii. Create an Android application to create and use services.
6	i. Create an Android application to demonstrate XML based animation ii. Create an Android application to display canvas and allow the user to draw on it.
7	i. Create a media player application in android that plays audio. Implement play, pause, and loop features. ii. Create an Android application to use a camera and capture image/video and display them on the screen. Create an android application to implement Asynctask and threading concepts.
8	i. Create an Android application to demonstrate the different types of menus. ii. a. Pop-up Menu b. Context Menu c. Option Menu
9	Create an Android application to record the current location. Based on the current location allow the user to use some useful services/applications
10	Create a suitable Android application to store and retrieve data in the SQLite database.
11	Create a suitable Android application to work with Firebase for storing and manipulating data.

Course Code	Course Title	Credits	Lectures /Week
USCS406	Advanced Application Development	2	3

About the Course:

The course aims at developing scalable, robust, and maintainable web applications using MEAN stack and developing advanced mobile applications using Flutter

Course Objectives:

- To understand all the necessary and important technologies such as MongoDB, Express.js, AngularJS, and Node.js.
- To understand modern app development using Flutter

Learning Outcomes:

After successful completion of this course, students would be able to

- Store the data in NoSQL, document-oriented MongoDB database that brings performance and scalability.
- Use Node.js and Express Framework for building fast, scalable network applications
- Use AngularJS framework that offers declarative, two-way data binding for web applications.
- Integrate the front-end and back-end components of the MEAN stack.
- Develop robust mobile applications using Flutter.

Unit	Topics	No of Lectures
I	**Node.js (N):** Introduction to Node.js. Installing Node.js. The package.json File. The Node.js Event Loop. The I/O Cycle. The Anatomy of a Node.js Module. Creating Node Modules. Exploring the Node.js HTTP Module. Creating an HTTP Webserver with Node.js. Responding to HTTP Requests. Routing in Node.js. Creating a Sample Node.js Application. **MongoDB(M):** Introduction to MongoDB. Installing MongoDB. Using MongoDB Compass. Using Mongo Shell Interface. Connecting to MongoDB. Creating Schemas and Models. Querying Documents Using find(). Inserting Documents Using create(). Updating Documents Using findOneAndUpdate(). Deleting Documents Using findOneAndDelete() deleteMany()	15
II	**Server Side Development with Express (E):** Introduction to the Express Framework. Installing and Testing Express. Creating a Node.js Express App. Restructuring an Express App. Creating Templates. Using Express Middleware Functions. Creating the List Page. Creating the Details Page. Creating the Edit Page. Creating the Add Page. Deleting Data. REST API Basics. Testing REST APIs. Refactoring APIs. **Understanding Angular.JS(A):** Getting Started with Angular. Creating an Angular Application. Angular Project File Structure. Anatomy of an Angular Component. One-way Data Binding. Two-way Data Binding.	15

	Using NglfDirective. Using NgForOf Directive. Angular Modules. Creating NgModulesUsing Angular Router. Configuring Templates. Creating Navigations. Working with Template-driven Forms. Working with Reactive Forms. Validating Form Data. Services Dependency Injection (DI). Reading Data from Database. Inserting Data into Database. Updating Data in the Database. Delete Data from Database.	
III	**Understanding Flutter:** Importance of Flutter, Flutter Framework, Android Studio, Flutter SDK, Installing and Configuring Flutter SDK. **Dart Programming**: main() function, Dart Variables, Dart Data Types, Dart Conditional Operators, Control Flow & Loops. Dart Functions - Functions, Function Structure, creating a Function, Function Returning Expression. Object-Oriented Programming (OOP) - Creating a Class, Adding Methods to Classes, Class — Getters and Setters, Class Inheritance, Abstract Class. **Flutter Widgets Fundamentals**: Scaffold Widget, Image Widget, Container Widget, Column and Row Widgets, Icon Widget, Layouts in Flutter, Card Widget, Hot Reload and Hot Restart, Stateful and Stateless Widgets **Navigation and Routing:** Button Widget, App Structure and Navigation, Navigate to a New Screen and Back, Navigate with Named Routes, Send and Return Data among Screens, Animate a Widget across Screens, WebView Widget in Flutter	**15**

Textbooks:

1. Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications by Brad Dayley, Brendan Dayley, Caleb Dayley, Pearson, 2018.
2. Beginning Flutter: A Hands On Guide to App Development by Marco L. Napoli, Wrox, 2019

Additional References:

1. **Full Stack Javascript Development with Mean - MongoDB, Express, AngularJS, and Node.JS by Adam Bretz, Colin J Ihrig, Shroff/SitePoint, 2015**
2. **Practical Flutter by Zammetti Frank, Apress, 2019**

Course Code	Course Title	Credits	Lectures /Week
USCSP406	**Advanced Application Development – Practical**	**1**	**3**

1	Write a program to implement MongoDB data models
2	Write a program to implement CRUD operations on MongoDB
3	Write a program to perform validation of a form using AngularJS
4	Write a program to create and implement modules and controllers in Angular JS
5	Write a program to implement Error Handling in Angular JS
6	Create an application for Customer / Students records using AngularJS
7	Write a program to create a simple web application using Express, Node JS and Angular JS
8	Create a simple HTML —Hello World|| Project using AngularJS Framework and apply ng-controller, ng-model and expressions Create an app using Flutter for User Authentication
9	Create an app using Flutter to implement an Image Gallery
10	Create an app using Flutter to demonstrate the use of different layouts
11	Create an app using Flutter to demonstrate navigation in an App
12	

Course Code	Course Title	Credits	Lectures /Week
USCS4071	Research Methodology	2	3

About the Course:

The course aims to understand the basics research, how research problems are defined, research methods are adopted and/or developed, research is undertaken, and how research results are communicated to the peers.

Course Objectives:

- The research methodology course is proposed to assist students in planning and carrying out research projects.
- The students are exposed to the principles, procedures and techniques of implementing research project.
- The course starts with an introduction to research and carries through the various methodologies involved.
- It continues with finding out the literature using technology, basic statistics required for research and finally report writing.

Learning Outcomes:

After successful completion of this course, students would be able to

- Define research, formulate problem and describe the research process and research methods.
- Understand and apply basic research methods including research design, data analysis and interpretation.
- Understand ethical issues in research, write research report, research paper and publish the paper.

Unit	Topics	No of Lectures
I	**Introduction to Research Methodology:** Meaning of Research, Objectives of Research, Motivations in Research, types of Research, Research Approaches, Significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research. **Defining the Research Problem:** Concept and need, Identification of Research problem, defining and delimiting Research problem. **Formulating a Research Problem:** Reviewing Literature, formulating a Research Problem, Research Question, Identifying Variables, Constructing Hypothesis	15
II	**The Research Design**: Meaning, Need for Research Design, Important Concepts, Different Research Designs, Basic Principles of Experimental Designs. **Tools for Data Collection**: Collections of Primary Data, Collection of Data	15

	through questionnaire and Schedules, other Observation Interview Methods, Collection of Secondary Data, Selection of appropriate method for data collection, Case Study, Focus Group Discussion, Techniques of developing research tools, viz. Questionnaire and rating scales etc. Reliability and validity of Research tools. **Sampling Design:** Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, how to Select a Random Sample. Probability and Non-Probability sampling types and criteria for selection, Developing sampling Frames. **Overview of Hypothesis Testing:** What is a Hypothesis?Characteristics of good Hypothesis. Basic Concepts, Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing,Tests of Hypotheses, and One sided and two-sided hypothesis,Type – I and Type – II errors, Null Hypothesis-Alternative Hypothesis.	
III	**Technical Writing:** Writing a Research Proposal, what is a Scientific Paper? Ethics in Scientific Publishing. **Preparing the Text:** How to Prepare the Title, how to List the Authors and Addresses, how to Prepare the Abstract, how to Write the Introduction, how to Write the Materials and Methods Section, how to Write the Results, how to Write the Discussion, how to State the Acknowledgments, how to Cite the References. **Preparing the Tables and Figures:** How to Design Effective Tables, how to Prepare Effective Graphs, how to Prepare Effective Photographs. **Publishing the Paper:** Rights and Permissions, How to Submit the Manuscript, How and When to Use Abbreviations, How to Write a thesis, Outcome of Research, Ethical issues in research	**15**

Textbooks:

1. Kothari C.R., Research Methodology, New Age International Publication, 2019
2. Research Methodology-A Step-by-Step Guide for Beginners, (4th ed.), Ranjit Kumar, Singapore, Pearson Education, 2018
3. Research Methodology, VaishaliKhairnar, Staredu Solutions India Pvt Ltd, 2020

Additional References:

1. **Research Methodology: Methods and Techniques, Dr. R. K. Jain, , Fifth Edition, VEI, 2021**
2. **Research Methodology, R. Panneerselvam, Second Edition, PHI, 2014**
3. **Dr. Rachna Jain, Research Methodology, Maximax Publishing House**
4. **How to Write and Publish a Scientific Paper, Cambridge University Press, Barbara Gastel and Robert A. Day, 2017**

Course Code	Course Title	Credits	Lectures /Week
USCS4072	Management & Entrepreneurship	2	3

About the Course:

The aim of the course is to develop conceptual understanding of management and administration, and comprehend the environment of making of an entrepreneur. The course focuses on giving students the business management and innovation skills required to succeed in a startup

Course Objectives:

- To understand the idea of management, process and its levels.
- To understand the perception of entrepreneurship, process and its types.
- To understand the concept SSI and steps to start SSI.
- To understand the selection of project, project report, project appraisal, and its feasibility.

Learning Outcomes:

After successful completion of this course, students would be able to

- Understand the meaning of management, functions, administration and its process.
- Understand the foundation of entrepreneurship and its theory, types and its process.
- Identify the steps involved in an entrepreneurial venture (SSI).
- Understand an entrepreneur is converting his business ideas into running concern by selecting the project.

Unit	Topics	No of Lectures
I	**Introduction: Meaning,** Meaning, Characteristics of Management, Nature of Management, Management Functions, Functional Areas of Management, Management and Administration, Role of Management, Levels of Management, Evolution of Management **Planning:** Meaning, Nature, importance, types of planning, types of plans, planning process, decision-making. **Organizing and staffing:** Meaning and Definitions of Organizing, Steps in Organizing, Nature of Organization, Organization Structure, Purpose of Organization, Principles of Organization, Departmentation, Types of Organization, Span of Control, Authority, Power and Responsibility, Delegation of Authority, Centralization and Decentralization, Delegation vs Decentralization, Management by Objectives [MBO], Meaning of Staffing, Nature and Importance of Staffing, Recruitment, Selection.	15
II	**Directing and Controlling:** Meaning and Nature of Direction, Principles of Directing, Leadership and Leadership Styles, Motivation, Communication, Noise and Feedback in Communication, Importance of Communication, Channels of Communication, Types of Communication, Forms of Communication, Coordination, Coordination and Cooperation, Importance of Coordination, Techniques of Coordination, Managerial	15

	Control, Steps in a Control Process, Essentials of a Sound Control System, Control Methods. **Entrepreneurship:** Evolution of Concept of Entrepreneur, Concept of Entrepreneur, Characteristics of Entrepreneur, Distinction between Entrepreneur and Manager, Technical Entrepreneur, Charms of Being an Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneurs, Ultrapreneurs, Concept of Entrepreneurship, Evolution of Entrepreneurship, Role of Entrepreneurship in Economic Development, Stages in the Entrepreneurial Process, Barriers to Entrepreneurship	
III	**Small Scale Industry:** Meaning and Definition of Small-Scale Industry, Characteristics of SSI, Objectives, Scope, Role of SSI in Economic Development, Advantages of Small-Scale Industries, steps to Start an SSI,Government Policy towards SSI **Preparation of Project:** Meaning, Project Classification, Project Identification, Project Report and its significance, Contents of a Project Report, Formulation of Project Report, Planning Commission Guidelines, Network Analysis, Common Mistakes by Entrepreneurs in Project Formulation, Project Appraisal, Identification of Opportunity, Project Feasibility study.	**15**

Textbooks:

1. HavinalVeerabhadrappa, Management and Entrepreneurship, New Age International Publishers.
2. KanishkaBedi, Management and Entrepreneurship, Oxford University Press
3. Dr. R. K. Singal, Entrepreneurship Development and Management

Additional References:

1. **P. N. Singh, J. C. Saboo, Entrepreneurship Management, 6th Edition, Dr. P. N. Singh Centre for Hrd Publications.**
2. **Donald L. Sexton & Raymond W. Smilor, The Art and Science of Entrepreneurship, Ballinger, 2022**
3. **Clifford M.Baumback& Joseph R.Mancuso, Entrepreneurship And Venture Management, Prentice Hall**

EvaluationScheme

I. Internal Evaluation for Theory Courses – 25 Marks

(i) Mid-Term Class Test– 15Marks

- It should be conducted using any **learning management system** such as **Moodle**(Modularobject-orienteddynamiclearning environment)
- The test should have **15 MCQ's** which should be solved in a time duration of **30 minutes.**

(ii) Assignment/ Case study/ Presentations– 10 Marks

- Assignment / Case Study Report / Presentation can be uploaded onany**learning management system**.

II. External Examination for Theory Courses – 75 Marks

- Duration: **2.5 Hours**
- Theory question paper pattern:

	All questions are compulsory.		
Question	**Based on**	**Options**	**Marks**
Q.1	Unit I	*Any 4 out of 6*	20
Q.2	Unit II	*Any 4 out of 6*	20
Q.3	Unit III	*Any 4 out of 6*	20
Q.4	Unit I,II and III	*Any 5 out of 6*	15

- All questions shall be compulsorywith internal choicewithinthequestions.
- Each Question maybe sub-divided into subquestions as a, b, c, d, etc.&the allocation ofMarksdependsontheweightageofthetopic.

III. Practical Examination

- Each core subjectcarries50 Marks
  40 marks + 05 marks (journal) + 05 marks (viva)
- Duration: **2 Hours**for each practical course.
- Minimum **80% practical** from each core subjects are required to be completed.
- **Certified Journal is compulsory for appearing at the time of Practical Exam**
- The final submission and evaluation of **journal in electronic form** using a Learning Management System / Platform can be promoted by college.