Maharashtra Education Society

Abasaheb Garware College

(Autonomous)

(Savitribai Phule Pune University)

Three Year B.Sc. Degree Program **in Computer Science**

(Faculty of Science and Technology)

Syllabi under Autonomy

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

Choice Based Credit System Syllabus

To be implemented from Academic Year 2022-2023

Preamble

The B. Sc. (Computer Science) course is systematically designed three year degree program under the faculty of Science and Technology. The objective of the course is to prepare students to undertake careers involving problem solving using computer science and technologies, careers in developing Web based applications or to pursue advanced studies and research in computer science.

The syllabus which comprises of Computer Science subjects along with the three allied subjects, Mathematics, Electronics and Statistics, covers the foundational aspects of computing sciences, gives understanding of working of computers, develops mathematical ability within students and develops the requisite professional skills and problem solving abilities using computing sciences.

The first year of graduation creates the foundation of the students by imparting essential logic development and programming skills in students. Also, students will learn the basic web application development techniques and the fundamentals of databases. The practical courses are designed in such a way that students will learn the implementation of the concepts they have acquired in theory.

Along with Computer Science, the two theoretical and one practical course each in Statistics, Mathematics and Electronics help in building a strong foundation.

At the second year of under-graduation, computational problem solving skills and programming skills are further strengthened by introducing the concept of Object-oriented programming language and Object oriented software design techniques. A course in Data structures will provide the ability to the students to develop better and efficient solutions to the problems. In this semester also, students will continue to gain more knowledge in the subjects of Electronic Science and Mathematics.

At the third year of under-graduation, the students will get more knowledge on the core areas of Computer science. They will learn another object-oriented language which is widely used in IT industry, Java. They will learn advanced concepts of Web Application development. In short, all the subjects are designed to fulfil core Computer Science requirements as well as to meet the needs of the software industry. Theory courses are

appropriately supplemented by hands-on practical courses. The program provides opportunities of hands-on learning through project which encourages a student to work effectively as team member and demonstrate professional behaviour.

Skill Enhancement courses enable the students to acquire additional value-added skills.

Learning Outcomes:

- To develop problem solving abilities using a computer.
- To build the necessary skill set and analytical abilities for developing computer-based solutions for real life problems.
- To train students in professional skills related to Software Industry.
- To prepare necessary knowledge base for research and development in Computer Science.
- To help student's build-up a successful career in Computer Science and to produce entrepreneurs who develop software products

Eligibility:

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

a. Higher Secondary School Certificate (10+2) in Science Stream with Mathematics or its equivalent examination
b. Three Years Diploma Course, after S.S.C. (10^{th} standard) of Board of Technical Education conducted by Government of Maharashtra or its equivalent.

Direct Second Year B.Sc.

In addition to above qualifications student who have passed three years Diploma Course, after S.S.C. and two years Diploma course after H.S.C. of M.S.B.T.E. in IT/Computer Engineering/ Electronics Engineering or E&TC Engineering are eligible. However such cases should be approved by Equivalence Committee of Science Faculty**.**

Structure of the Course: B.Sc. (Computer Science)

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Lectures /Practical to be conducted
1	I	CC-I	USCS-111	Problem Solving using Computer and 'C' Programming		2	36
			USCS-112	Basics of Web Designing		2	36
			USCSP-113	Computer Science Laboratory		1.5	12
		CC-II	USCSMT-111	Linear Algebra I		2	36
			USCSMT-112	Discrete Mathematics		2	36
			USCSMTP-113	Mathematics Laboratory		1.5	12
		CC-III	USCSEL-111	Semiconductor Devices and Basic Electronic Systems		2	36
			USCSEL-112	Principles of Digital Electronics		2	36
			USCSELP-113	Electronics Laboratory		1.5	12
		CC-IV	USCSST-111	Descriptive Statistics		2	36
			USCSST-112	Theory of Probability and Discrete Probability Distributions		2	36
			USCSSTP-113	Statistics Laboratory		1.5	12
	II	CC-V	USCS-121	Advanced 'C' Programming		2	36
			USCS-122	Database Management System		2	36
			USCSP-123	Computer Science Laboratory		1.5	12
		CC-VI	USCSMT-121	Linear Algebra II		2	36
			USCSMT-122	Graph Theory		2	36
			USCSMTP-123	Mathematics Laboratory		1.5	12
		CC-VII	USCSEL-121	Instrumentation System		2	36
			USCSEL-122	Sequential circuits and Computer Organization		2	36
			USCSELP-123	Electronics Laboratory		1.5	12

		CC-VIII	USCSST-121	Multiple Regression, Time Series and Simulation		2	36
			USCSST-122	Continuous probability distributions and Testing of Hypothesis		2	36
			USCSSTP-123	Statistics Laboratory		1.5	12
2	III	CC-IX	USCS-231	Data Structures using C		2	36
			USCS-232	Relational Database Management System		2	36
			USCSP-233	Computer Science Laboratory		2	12
		CC-X	USCSMT-231	Groups and Coding Theory		2	36
			USCSMT-232	Numerical Analysis		2	36
			USCSMTP-233	Mathematics Laboratory		2	12
		CC-XI	USCSEL-231	Microcontroller Architecture & Programming		2	36
			USCSEL-232	Digital Communication and Networking		2	36
			USCSELP-233	Electronics Laboratory		2	12
		AECC-I	UEVS-231	Environmental Science - I		2	36
		AECC-II	USLGA-231	Language Communication – I		2	36
	IV	CC-XII	USCS-241	Object Oriented Programming using C++		2	36
			USCS-242	Software Engineering		2	36
			USCSP-243	Computer Science Laboratory		2	12
		CC-XIII	USCSMT-241	Computational Geometry		2	36
			USCSMT-242	Operations Research		2	36
			USCSMTP-243	Mathematics Laboratory		2	12
		CC-XIV	USCSEL-241	Embedded System Design		2	36
			USCSEL-242	Wireless Communication and Internet of Things		2	36
			USCSELP-243	Electronics Laboratory		2	12
		AECC-III	UEVS-241	Environmental Science - II		2	36

		AECC-IV	USLGA-241	Language Communication - II		2	36
3	V	DSEC-I	USCS-351	Operating Systems – I		2	36
			USCS-352	Computer Networks – I		2	36
			USCSP-357	Practical based on USCS-351		2	12
		DSEC-II	USCS-353	Web Technologies – I		2	36
			USCS-354	Foundations of Data Science		2	36
			USCSP-358	Practical based on USCS-353and USCS-354		2	12
		DSEC-III	USCS-355	Object Oriented Programming using Java – I		2	36
			USCS-356	Theoretical Computer Science		2	36
			USCSP-359	Practical based on USCS-355		2	12
		SECC-I	USCSSEC-3510	Python Programming		2	36
		SECC-II	USCSSEC-3511	Blockchain Technology		2	36
	VI	DSEC-IV	USCS-361	Operating Systems – II		2	36
			USCS-362	Computer Networks – II		2	36
			USCSP-367	Practical based on USCS-361		2	12
		DSEC-V	USCS-363	Web Technologies – II		2	36
			USCS-364	Data Analytics		2	36
			USCSP-368	Practical based on USCS-363and USCS-364		2	12
		DSEC-VI	USCS-365	Object Oriented Programming using Java – II		2	36
			USCS-366	Principles of Compiler Construction		2	36
			USCSP-369	Practical based on USCS-365		2	12
		SECC-III	USCSSEC-3610	Software Testing Tools		2	36
		SECC-IV	USCSSEC-3611	Project		2	36

FIRST YEAR SEMESTER-I

Course Code and Title: USCS-111 Problem Solving using Computer and 'C' Programming

Lectures: 36 (Credits-2)

Prerequisites: None

Course Objectives:

1. To introduce the foundations of computing, programming and problem- solving using computers.
2. To develop the ability to analyze a problem and devise an algorithm to solve it.
3. To develop the basic concepts and terminology of programming in general.
4. To implement algorithms in the 'C' language.
5. To test, debug and execute programs.

Learning Outcomes: On completion of this course, students will be able to:

1. Explore algorithmic approaches to problem solving.
2. Develop modular programs using control structures and arrays in 'C'.

Unit 1: Problem Solving Aspects **05**

1.1 Introduction to problem solving using computers
1.2 Problem solving steps
1.3 Algorithms-definition, characteristics, examples, advantages and limitations
1.4 Flowcharts - definition, notations, examples, advantages and limitations, Comparison with algorithms
1.5 Programming Languages as tools, types of languages

Unit 2: Introduction to 'C' programming **07**

2.1 Evolution / History of 'C' language
2.2 Application areas
2.3 Structure and example of first 'C' program
2.4 Compilation process (compilers, interpreters), linking and loading, syntax and semantic errors, testing a program
2.5 Good Programming Practices (naming conventions, documentation, indentation)
2.6 Character set, Keywords, Identifiers
2.7 Variables, Constants (character, integer, float, string, escape sequences, enumeration constant)
2.8 Data Types (Built-in and user defined data types)
2.9 Operators, Expressions, Types of operators
2.10 Arithmetic operators, Increment Decrement operators, Relational and logical operators, Bitwise operators, Assignment operators, Comma operator, sizeof operator, conditional operator, Operator precedence and Order of evaluation

Unit 3: Input Output Statements **02**

3.1 Character input and output
3.2 String input and output
3.3 Formatted input and output
3.4 Format specifiers

Unit 4: Control Structures **06**

4.1 Decision making structures:- if ,if-else, else-if ladder, switch
4.2 Loop control structures - while ,do while, for
4.3 Use of break and continue
4.4 Nested control structures
4.5 Unconditional branching (goto statement)

Unit 5: Function **08**

5.1 Concept of function, Advantages of Modular design
5.2 Types of functions (Standard library functions, User defined functions)
5.3 Function parameters/arguments (Actual, Formal)
5.4 Parameter passing method (by value), return statement
5.5 Recursive functions
5.6 Scope of variables and Storage classes

Unit 6: Array **08**

6.1 Concept of array, advantages, disadvantages
6.2 Types of Arrays – One, Two dimensional array
6.3 Array Operations - declaration, initialization, accessing array elements
6.4 Memory representation of two-dimensional array (row major and column major)
6.5 Passing arrays to function
6.6 Array applications - Linear search, sorting an array (bubble sort)

Reference Books:

1. A Structured Programming Approach Using C, Behrouz A. Forouzan, Richard F. Gilberg, Cengage Learning India
2. Programming in ANSI C, E. Balagurusamy, 7th Edition, McGraw Hill
3. Programming in ANSI C, Ram Kumar and Rakesh Agrawal
4. The ‘C’ programming language, Brian Kernighan, Dennis Ritchie, PHI

Course Code and Title: USCS-112 Basics of Web Designing
Lectures: 36 (Credits-2)

Prerequisites: None

Course Objectives:

1. To learn HTML, CSS, Bootstrap, Java Scripts basics of Web designing
2. To understand web-based applications development process

Learning Outcomes: On completion of this course, students will be able to:

1. Design a responsive website using HTML and CSS
2. Design simple web application

Unit 1: HTML **08**

1.1 Introduction to HTML, Structure of HTML
1.2 HTML tags and attributes
1.3 HTML formatting tags
1.4 HTML comment
1.5 Headings, Paragraph
1.6 Ways to define color – Plain color, RGB, Hex value, HSL value
1.7 Inserting an Image
1.8 List
1.9 Tables
1.10 Hyperlinks and Image links
1.11 Frames and iFrame

Unit 2: HTML form designing and HTML 5 **06**

2.1 Inserting text box, text area, buttons, List box, radio, checkbox
2.2 Designing of Forms
2.3 GET and POST methods
2.4 Designing form using HTML 5 input tags

Unit3: CSS **08**

3.1 Introduction to Style Sheet
3.2 Ways to apply CSS to HTML
3.3 CSS Border, margin, Positioning, color, text, link, background, list, table, padding, image, display properties, z-index, opacity
3.4 Use of Id and classes in CSS
3.5 Use of and
3.6 Introduction of CSS3 : Gradients, Transitions, Animations, multiple columns

Unit 4: Bootstrap **04**

4.1 Introduction to Bootstrap
4.2 Tables, Images, Button, alerts
4.3 Button, Button Groups

4.4 Progress Bar, Pagination, Pagers

Unit 5: Javascript **10**

5.1 Concept of script
5.2 Introduction to Javascript
5.3 Variables, identifiers and operators, control structures
5.4 Functions
5.5 Event Handling in Javascript
5.6 Concept of array, how to use it in Javascript, types of array
5.7 Math and date object
5.8 String object and predefined String functions
5.9 DOM concept in Javascript, DOM objects
5.10 Validations in Javascript

Reference Books

1. HTML Black Book by Steven Holzner, Dremtech press.
2. The Complete Reference by Thomas A. Powell, Mc Graw Hill
3. https://getbootstrap.com/

Course Code and Title: USCSP-113 Computer Science Laboratory
No. of Sessions: 12 (Credits-1.5)

Assignments of C Programming:

1. Assignment on use of data types, simple operators (expressions)
2. Assignment on decision making statements (if and if-else, nested structures)
3. Assignment on decision making statements (switch case)
4. Assignment on use of while loops
5. Assignment on use of for loops
6. Assignment on nested loops
7. Assignment on menu driven programs
8. Assignment on writing C programs in modular way (use of user defined functions)
9. Assignment on recursive functions
10. Assignment on use of arrays (1-D array) and functions
11. Assignment on use of multidimensional array (2-D arrays) and functions
12. Assignment on Standard Library Function

Assignments of Web Designing:

1. Basic HTML Tags - headings, paragraphs, line break, colors, fonts, links, Images
2. Creating List, tables and Frames by using HTML Tags
3. Creating forms by using HTML and HTML5 Tags
4. Styling HTML pages using CSS
5. Styling HTML pages using CSS3 and bootstrap
6. Basics of JavaScript
7. Functions in JavaScript
8. Field and Form validation using JavaScript

Course Code and Title: USCSMT-111 Linear Algebra I

Lectures: 36 (Credits-2)

Learning Outcomes:

1. Students should get sufficient understanding of fundamental mathematical tool-matrix as concept and concerned structures.
2. Students should be able to apply it various branches of Mathematics and computer Science.

Unit 1: Introduction **04**

1.1 Matrix Operations
1.2 The Inverse of a Matrix
1.3 Characterization of invertible matrices

Unit 2: Linear Equations in Linear Algebra-I **12**

2.1 System of Linear equations
2.2 Row reduction and echelon forms
2.3 Vector equations
2.4 The matrix equation Ax=b
2.5 Solution sets of linear systems

Unit 3: Linear Equations in Linear Algebra -II **12**

3.1 Partitioned Matrices
3.2 Matrix factorization [LU decomposition]
3.3 Linear Independence
3.4 Introduction to linear transformation
3.5 The matrix of linear transformation
3.6 Subspaces of Rn
3.7 Dimension and Rank

Unit 4: Determinants **08**

4.1 Introduction to determinants
4.2 Properties of determinants
4.3 Cramer's rule, Volume and linear transformations

Text Book:

1. **Linear Algebra and its Applications, David C Lay, Steven R. Lay, Judi J. MacDonald Pearson Publication,2016, Fifth Edition.**

Unit 1: Chapter 2: Sec. 2.1, 2.2, 2.3
Unit 2: Chapter 1: Sec. 1.1, 1.2, 1.3, 1.4, 1.5
Unit 3: Chapter 2: Sec. 2.4, 2.5,2.8, 2.9, Chapter 1: 1.7, 1.8, 1.9
Unit 4: Chapter 3: Sec. 3.1, 3.2, 3.3

Reference Books:

1. Elementary Linear Algebra with supplemental Applications, Howard Anton and others, Wiley Student Edition.
2. Matrix and Linear Algebra (aided with MATLAB), Kanti Bhushan Datta, Eastern Economic Edition.

Course Code and Title: USCSMT-112 Discrete Mathematics

Lectures: 36 (Credits-2)

Learning Outcomes:

1. Student will be able to understand the logic behind the validation of statements in programming.
2. Student should be confident of analysing algorithms in particular using recurrence relations.
3. Students will be acquainted with basics of relations and lattices.

UNIT 1: LOGIC **10**

1.1 Revision: Propositional Logic, Propositional Equivalences
1.2 Rules of Inference: Argument in propositional Logic, Validity Argument (Direct and Indirect methods), Rules of Inference for Propositional Logic, Building Arguments
1.3 Predicates and Quantifiers: Predicate, n-Place Predicate or, n-ary Predicate, Quantification and Quantifiers, Universal Quantifier, Existential Quantifier, Quantifiers with restricted domains, Logical Equivalences involving Quantifiers
1.4 Application of logic in AI

Unit 2: Relations **06**

2.1 Relations, functions, types of relations, equivalence relations, Partial ordering relations
2.2 Digraphs of relations, matrix representation and composition of relations.
2.3 Transitive closure and Warshall's Algorithm

Unit 3: Lattices **06**

3.1 Poset, Hasse diagram
3.2 Lattices, Complemented lattice, Bounded lattice and Distributive lattice

Unit 4: Recurrence Relations **14**

4.1 Recurrence Relations: Introduction, Formation.
4.2 Linear Recurrence Relations with constant coefficients.
4.3 Homogeneous Solutions.
4.4 Particular Solutions.
4.5 Total Solutions.
4.6 Master theorem (Only statement, without proof), Solving recurrence relations using master theorem
4.7 Binary Search, Bubble/ quick sort – formation of recurrence relation

Text Books:

1. Discrete Mathematics and its applications, by Kenneth Rosen, Tata McGraw Hill, Seventh Edition.
2. Discrete Mathematical Structures, by Kolman, Busby, Ross, Rehman, Prentice Hall,
3. Elements of Discrete Mathematics, by C. L. Liu, Tata McGraw Hill

Unit 1: Text Book 1: Chapter 1: Sec. 1.1, 1.2, 1.3, 1.4, 1.5, 1.6
Unit 2 and 3: Text Book 2: Chapter 6: Sec. 6.1, 6.2, 6.3, 6.4, 6.5
Unit 4: Text Book 3: Chapter 10: Sec. 10.1, 10.2, 10.3, 10.4, 10.5, 10.6

Course Code and Title: USCSMTP-113 Mathematics Practical
No. of Sessions: 12 (Credits-1.5)

List of Practical

Practical 1 : Problems on Unit 1 from USCSMT-111.
Practical 2 : Problems on Unit 2 from USCSMT-111.
Practical 3: Problems on Unit 2 from USCSMT-111. (Based on 3.1, 3.2, 3.3)
Practical 4 : Problems on Unit 3 from USCSMT-111. (Based on 3.4, 3.5, 3.6)
Practical 5 : Problems on Unit 3 from USCSMT-111.
Practical 6 : Problems on Unit 1 from USCSMT-112. (Propositional logic)
Practical 7 : Problems on Unit 1 from USCSMT-112. (Predicate logic)
Practical 8: Problems on Unit 2 from USCSMT-112.
Practical 9 : Problems on Unit 3 from USCSMT-112.
Practical 10 : Problems on Unit 4 from USCSMT-112.
Practical 11 : Miscellaneous Problems based on USCSMT-111.
Practical 12 : Miscellaneous Problems based on USCSMT-112.

Course Code and Title: USCSEL-111: Semiconductor Devices and Basic Electronic Systems

Lectures: 36 (Credits-2)

Learning Outcomes: On completion of the course, student will be able to

1. Understand working principles of various types of semiconductor devices.
2. Understand the design of elementary electronic circuits and systems.
3. Solve some problems based on various topics.
4. Implement some circuits during the practical.

Unit 1: Semiconductor Diodes and their applications **10**

1.1 Semiconductor, P and N type semiconductors, Formation of PN junction diode, it's working,Forward and Reverse bias characteristics

1.2 Rectifiers (half wave, full wave, Bridge), rectifierwith capacitor-filter

1.3 Zener diode: working principle, breakdown mechanism and characteristics, Use of Zener Diode as a Voltage Regulator

1.4 Working principle of Light emitting diode, photo diode, optocoupler, Solar cell working principle and characteristics

Unit 2: BJT and MODFET **10**

2.1 Bipolar Junction Transistor (BJT) symbol, types, construction, working principle, Transistor amplifier configurations - CB, CC (only concept), CE configuration: input and output characteristics, Definition of α, β and Υ

2.2 Concept of Biasing (numerical problems not expected), Potential Divider bias

2.3 Transistor as amplifier (Concept of Gain and Bandwidth expected), Transistor as a switch.

2.4 MOSFET types, working principle, Characteristics, Application of MOSFET as a Switch

Unit 3: OSCILLATORS **10**

3.1 Barkhauson Criteria, Low frequency Wein-bridge oscillator, High frequency crystal oscillator

3.2 IC 555 as Astable multivibrator used as square wave generator / clock

Unit 4: Data Converters **06**

4.1 Need of Digital to Analog converters, parameters

4.2 Weighted resistive network, R-2R ladder network

4.3 Need of Analog to Digital converters, parameters, Flash ADC, successive approximation ADC.

Reference books:

1. Electronic Devices and Circuits I – T. L. Floyd- PHI Fifth Edition
2. Principles of Analog Electronics - A.P.Malvino
3. Sedha R.S., A Text Book Of Applied Electronics, S.Chand& CompanyLtd

Course Code and Title: USCSEL-112 Principles of Digital Electronics
Lectures: 36 (Credits: 2)

Learning Outcomes: On completion of the course, student will be able to

1. Get familiar with concepts of digital electronics.
2. Learn number systems, codes and their representation.
3. Understand basic logic gates, Boolean algebra and K-maps.
4. Study arithmetic circuits, combinational and sequential circuits.

Unit 1: Number Systems and Digital codes 10

1.1 Introduction to Decimal, Binary and Hexadecimal Number Systems and their inter conversions

1.2 Binary addition and binary subtraction using 2's complement, Binary Coded Decimal Number

1.3 Gray Code, Gray to Binary and Binary to Gray conversion. Alphanumeric representation in ASCII codes

Unit 2: Logic gates and Boolean Algebra 14

2.1 Logic gates (NOT, AND, OR, NAND, NOR, XOR gate) With their symbol, Boolean Equation and truth table, Universal gates

2.2 Introduction of logic families TTL, ECL and CMOS, TTL logic family: Parameters like power supply, propagation delay, noise margin, fan in, fan out, Power Dissipation

2.3 Boolean algebra rules and Boolean Laws, De Morgan's theorem, Simplifications of Logic equations using Boolean algebra rules, Min terms, Max terms

2.4 Boolean expression in SOP and POS form, conversion of SOP/POS expression to its standard SOP/POS form

2.5 Introduction to Karnaugh Map, problems based on the same (Up to 4 variables), Digital Designing using K Map for: Gray to Binary and Binary to Gray conversion

Unit 3: Combinational Circuits 12

3.1 Half adder and full adder, 4-Bit Universal adder/ Subtractor, Applications of Ex-OR gates as parity checker and generator

3.2 Study of Multiplexer (4:1) and Demultiplexer (1:4)

3.3 Encoders - Decimal/ BCD to binary, 3X4 matrix keyboard encoder, priority encoder, Decoder- BCD to seven segment decoder

3.4 IC 74138 and IC 7447, Digital comparator

Reference Books:

1. Digital Fundamentals: Floyd T.M., Jain R.P., Pearson Education.
2. Digital Electronics: Jain R.P., Tata McGraw Hill.
3. Digital Principles and Applications: Malvino Leach, Tata McGraw-Hill.
4. M. Morris Mano, "Digital Design", 3rd Edition, PHI, New Delhi.

Course Code and Title: USCSELP-113 Electronics Laboratory

No. of sessions: 12 (Credits: 1.5)

Preparatory Experiments (Minimum 2/3)

1. Identification of Components (Passive and Active) /Tools
    - Minimum 10 different types of components must be given
    - Identification based on visual inspection / data sheets be carried out

2. Use of Digital Multimeters
    - Measurement of AC/DC voltage and Current – on different ranges
    - Measurement of R &C
    - Testing of Diodes &Transistors
    - Measurement of β.
    - Use of Multimeter in measurement of Resistance of LDR and Thermistor

3. Study of Signal Generator & CRO
    - Understand how to use Signal Generator, CRO
    - Study of front panel controls of both
    - Measurement of amplitude and frequency of Sine/Square waveform
    - Measurement of Phase with the help of RC circuit
    - Demonstration of Lissajous figures
    - Demonstrate the use of Component testing facility

Assignment on Semiconductor Devices and Basic Electronic Systems

1. Study of breakdown characteristics and voltage regulation action of Zener diode
2. Study of half wave, full wave and bridge rectifier circuit with and without capacitor filters.
3. Study of Bipolar Junction Transistor as a Switch.
4. Study of IC 555 as an Astable Multivibrator.
5. Study of 4-Bit R-2R Ladder Network type of DAC.

Assignment on Principles of Digital Electronics

1. Study of Logic Gates and interconversion of Logic gates.
2. Study of Binary to Gray & Gray to Binary Converter (K- Map based design).
3. Study of Half Adder and Full Adder using Logic Gates and nibble adder Subtractor.
4. Use of Ex-OR as a 4-bit Parity Checker and Generator.

Course Code and Title: USCSST-111 Descriptive Statistics
Lectures: 36 (Credits-2)

Learning Outcomes:

1. Learning to describe basic features of the data in an investigation.
2. Provide summary about the sample data using different measures.
3. Try to infer about the behaviour of population from the sample.
4. Learn tools to analyse qualitative data.

UNIT 1: Data Condensation and Graphical methods 08

1.1 Data Condensation: Types of data (Primary and secondary), attributes and variables, discrete and continuous variables

1.2 Presentation of data using frequency distribution, cumulative frequency distribution and relative frequency distribution. (Construction of frequency distribution is not expected.)

1.3 Graphical Presentation of frequency distribution: Histogram, stem and leaf chart, less than and more than type ogive curves

1.4 Numerical problems related to real life situations

UNIT 2: Summary Statistics 12

2.1 Concept of central tendency, measures of central tendency: Arithmetic mean, median, mode. Examples where each one of these is most appropriate. Empirical relation between mean, median and mode (without proof.)

2.2 Partition Values: Quartiles, deciles, percentiles, Box Plot

2.3 Notion of dispersion: Concept of absolute and relative measures of dispersion, range, coefficient of range, quartile deviation, coefficient of quartile deviation, variance, standard deviation, coefficient of variation. (Section 2.1 to 2.3 should be covered for raw data, ungrouped frequency distribution and exclusive type grouped frequency distribution.)

2.4 Numerical problems related to real life situations

UNIT 3: Moments, Skewness and Kurtosis 10

3.1 Raw and central moments: definition, computations for ungrouped and grouped data. (only first four moments.)

3.2 Relation between central and raw moments upto fourth order (without proof)

3.3 Numerical problems related to real life situations

3.4 Concept of symmetric frequency distribution, skewness, positive and negative skewness

3.5 Measures of Skewness : Karl Pearson's coefficient of skewness , Bowley's coefficient of skewness and Measure of skewness based on moments

3.6 Kurtosis of a frequency distribution, measure of kurtosis based on moments, type

of kurtosis: leptokurtic, platykurtic and mesokurtic

3.7 Numerical problems related to real life situations

UNIT 4: Theory of Attributes **06**

4.1 Attributes: Concept of a Likert scale, classification, notion of manifold classification, dichotomy, class- frequency, order of a class, positive class frequency, negative class frequency, ultimate class frequency, relationship among different class frequencies. (Up to two attributes.)

4.2 Consistency of data upto 2 attributes

4.3 Concepts of independence and association of two attributes

4.4 Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, interpretation

4.5 Numerical Problems related to real life situations

Reference Books:

1. Freedman, D.A., Pisani, R., Purves, R.(2007).Statistics, fourth edition, Nortan & company.
2. Freund J.E. (2005), Modern Elementary Statistics, Pearson.
3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, 6th revised edition, The World Press Pvt. Ltd., Calcutta.
4. Gupta and Kapoor (1987), Fundamentals of Applied Statistics, 3rd edition, S. Chand and Sons, New Delhi.
5. Kennedy and Gentle. An Introductory Statistics.
6. Moore, Notz, Fligner (2010). The Basic Practice of Statistics, 7th edition, Macmillan.
7. Snedecor, G. W., & Cochran, W. G. (1989). Statistical Methods, 8th edition, Wiley.

Course Code and Title: USCSST-112 Theory of Probability and Discrete Probability Distributions

Lectures: 36 (Credits-2)

Learning Outcomes:

1. Develop analytical thinking by using the ability to see a problem or solution or possibilities from different points of view.
2. To help make informed judgments based on a pattern of data observed previously.
3. To apply different forms of probability law when the values of observed phenomenon are discrete.

UNIT 1: Revision of Theory of Probability **08**

1.1 Counting principles, permutation, and combination.
1.2 Deterministic and non-deterministic models.
1.3 Random experiment, sample spaces (discrete and continuous)
1.4 Events: Types of events, operations on events.
1.5 Probability - classical definition, probability models, axioms of probability, probability of an event.
1.6 Theorems of probability. (with proof)
   i. $0 \leq P(A) \leq 1$
   ii. $P(A) + P(A') = 1$
   iii. $P(\Phi) = 0$
   iv. $P(A) \leq P(B)$ when $A \subset B$
   v. $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
1.7 Numerical problems related to real life situations

UNIT 2: Advanced Theory of Probability **07**

2.1 Concepts and definitions of conditional probability, multiplication theorem- $P(A \cap B)=P(A).P(B|A), P(A)>0$
2.2 Bayes' theorem (without proof)
2.3 Concept of posterior probability, problems on posterior probability.
2.4 Definition of sensitivity of a procedure, specificity of a procedure. Application of Bayes' theorem to design a procedure for false positive and false negative
2.5 Concept and definition of independence of two events
2.6 Numerical problems related to real life situations

UNIT 3: Random Variable **09**

3.1 Definition of random variable (r.v.) , discrete and continuous random variable
3.2 Definition of probability mass function (p.m.f.) of discrete r.v. and probability

density function of continuous r.v.. Cumulative distribution function (c.d.f.) of discrete and continuous r.v. and its properties. (Characteristic properties only)

3.3 Definition of expectation and variance of discrete r.v. and continuous r.v., theorems on expectation and variance (statement only)

3.4 Determination of median and mode using p.m.f. only

3.5 Numerical problems related to real life situations

UNIT 4: Standard Discrete Distributions 12

4.1 Degenerate distribution: definition, mean, variance

4.2 Discrete Uniform Distribution: definition, mean, variance

4.3 Bernoulli Distribution: definition, mean, variance, additive property

4.4 Binomial Distribution: definition, mean, variance, additive property

4.5 Geometric Distribution (p.m.f $p(x) = pqx$, $x = 0,1,2.$): definition, mean, variance

4.6 Poisson Distribution: definition, mean, mode, variance, additive property, limiting case of B(n, p)

4.7 Illustration of real-life situations

4.8 Numerical problems related to real life situations

(Only statement of mean and variance, derivation is not expected.)

Reference Books:

1. Freund J.E. (2005). Modern Elementary Statistics, Pearson Publication.
2. Gupta S. C. and Kapoor V. K. (1987).Fundamentals of Mathematical Statistics, 12th edition, S. Chand and Sons, New Delhi.
3. Kulkarni M.B., Ghatpande S.B. (2007). Introduction to Discrete Probability and Probability Distributions, SIPF Academy.
4. Medhi J.(1992). Statistical Methods (An Introductory Text), New Age International.
5. Mukhopadhyay P. (2015). Mathematical Statistics, third edition, Books and Allied (P), Ltd.
6. Sheldon Ross (2004). Introduction to Probability and Statistics for Engineers and Scientists. 3rd edition, Academic Press, an imprint of Elsevier.
7. Sheldon Ross (2006).A First course in Probability, sixth edition, Pearson Publication.
8. Trivedi K.S. (2001). Probability, Statistics, Design of Experiments and Queuing Theory with Applications of Computer Science, Prentice Hall of India, New Delhi.

Course Code and Title: USCSSTP-113 Statistics Practical-I
No. of Sessions: 12 (Credits-1.5)

List of Experiment/ Practical:

1. Tabulation and construction of frequency distribution and pivot table. (Use a data set more than 50 observations for constructing frequency distribution.)
2. Introduction to R software, diagrammatic and graphical methods using R software.
3. Summary statistics for ungrouped data and comparison for consistency.
4. Measures of central tendency and dispersion. Also verification using R software.
5. Measures of skewness and kurtosis. Also verification using R software.
6. Theory of probability. (Basic and advanced.)
7. Fitting of binomial distribution and computation of expected frequencies.
8. Fitting of Poisson distribution and computation of expected frequencies.
9. Measures of Attributes. (Two attributes only.)
10. Project (Part-I) -Data collection, its condensation and representation.

FIRST YEAR SEMESTER-II

Course Code and Title: USCS-121 Advanced 'C' Programming

Lectures: 36 (Credits-2)

Prerequisites:

- Basic knowledge of 'C' language.

Course Objectives:

1. To study advanced concepts of programming using the 'C' language.
2. To understand code organization with complex data types and structures.
3. To work with files.

Learning Outcomes: On completion of this course, students will be able to:

1. Develop modular programs using control structures, pointers, arrays, strings and structures.
2. Design and develop solutions to real world problems using C.

Unit 1: Pointer **10**

1.1 Introduction to Pointers.
1.2 Declaration, definition, initialization, dereferencing
1.3 Pointer arithmetic
1.4 Relationship between Arrays & Pointers- Pointer to array, Array of pointers.
1.5 Multiple indirection (pointer to pointer)
1.6 Functions and pointers- Passing pointer to function, returning pointer from function, function pointer
1.7 Dynamic memory management- Allocation (malloc(), calloc()), Resizing(realloc()), Releasing(free()), Memory leak, dangling pointers

Unit 2: String **06**

2.1 String Literals, string variables, declaration, definition, initialization
2.2 Syntax and use of predefined string functions
2.3 Array of strings
2.4 Strings and Pointers
2.5 Command line arguments

Unit 3: Structure and Union **08**

3.1 Concept of structure, definition and initialization, use of typedef
3.2 Accessing structure members
3.3 Nested Structures
3.4 Arrays of Structures
3.5 Structures and functions- Passing each member of structure as a separate argument, passing structure by value / address
3.6 Pointers and structures.
3.7 Self-referential structure and its application
3.8 Concept of Union, declaration, definition, accessing union members

3.9 Difference between structures and union

Unit 4: File Handling **08**

4.1 Introduction to streams
4.2 Types of files
4.3 Operations on text files
4.4 Standard library input/output functions
4.5 Random access to files

Unit 5: Preprocessor **04**

5.1 Role of Preprocessor
5.2 Format of preprocessor directive
5.3 File inclusion directives (#include)
5.4 Macro substitution directive, argumented and nested macro
5.5 Macros versus functions

Reference Books

1. Programming in ANSI C, E. Balagurusamy, 7th Edition, McGraw Hill
2. The 'C' programming language, Brian Kernighan, Dennis Ritchie, PHI
3. Programming in C ,A Practical Approach, Ajay Mittal, Pearson
4. Problem Solving and Programming Concept, Maureen Sprankle, 7th Edition, Pearson Publication

Course Code and Title: USCS-122 Database Management System
Lectures: 36 (Credits-2)

Prerequisites:

- Basic Knowledge of Files
- Basics of Set Theory

Course Objectives:

1. To understand the fundamental concepts of database
2. To understand user requirements and frame it in data model.
3. To understand creations, manipulation and querying of data in databases.

Learning Outcomes: On completion of this course, students will be able to:

1. design data models, schemas and instances
2. design E-R Model for given requirements and convert the same into database tables.
3. implement SQL: Data definition, constraints, schema, queries and operations in SQL

Unit 1: Introduction to DBMS **03**

1.1 Introduction
1.2 File system Vs DBMS
1.3 Types of Data Models – Relational, Hierarchical, Network
1.4 Levels of abstraction & data independence
1.5 Structure of DBMS
1.6 Users of DBMS
1.7 Advantages of DBMS

Unit 2: Database Design and ER Model **12**

2.1 Over view of DB design process
2.2 Conceptual Design using ER data model (entities, attributes, entity sets, relations, relationship sets)
2.3 Constraints (Key constraints, Integrity constraints, referential integrity, unique constraint, Null/Not Null constraint, Domain, Check constraint, Mapping constraints)
2.4 Keys Concept with Examples: Primary Key, Candidate Keys and Super Keys
2.5 Extended features – Specialization, Aggregation, Generalization
2.6 Structure of Relational Databases (concepts of a table)
2.7 DBMS Versus RDBMS
2.8 Examples of E-R Model

Unit 3: SQL **12**

3.1 Introduction to query languages
3.2 Basic structure
3.3 DDL Commands

3.4 DML Commands
3.5 Forms of a basic SQL query (Expression and strings in SQL)
3.6 Set operations
3.7 Aggregate Operators and functions
3.8 Null value
3.9 Nested Subqueries
3.10 SQL mechanisms for joining relations (inner joins, outer joins and their types)
3.11Examples on SQL

Unit 4: Relational Algebra and Calculus **06**

4.1 Preliminaries
4.2 Relational Algebra
4.3 Selection
4.4 Projection
4.5 Set Operations
4.6 Renaming
4.7 Joins

Unit 5: Case Studies **03**

Any 3 case studies
Every case study will include -
5.1 Describe Case study
5.2 Construct E-R model
5.3 Design DB by converting E-R into relational form
5.4 Write at-least 5 SQL queries

Reference Books

1. Database System Concepts, Henry F. Korth, Abraham Silberschatz, S.Sudarshan, Tata McGraw-Hill Education
2. Database Management Systems, RaghuRamakrishnan, Mcgraw-hill higher Education
3. Beginning Databases with PostgreSQL: From Novice to Professional, Richard Stones, Neil Matthew, Apress
4. Practical Postgresql, By Joshua D. Drake, John C Worsley, O'Reilly

Course Code and Title: USCSP-123 Computer Science Laboratory
No. of Sessions: 12 (Credits-1.5)

Assignments of Advanced C:

1. To demonstrate use of preprocessor directives
2. To demonstrate use of pointers
3. To demonstrate advanced use of pointers
4. To demonstrate concept of strings, array of strings
5. To demonstrate string operations using pointers
6. To demonstrate command line arguments
7. To demonstrate structures (using array and functions)
8. To demonstrate nested structures and Unions
9. To demonstrate file handling

Assignments of DBMS:

1. To create simple tables with the primary key constraint (as a table level constraint & as a field level constraint) (include all data types). Inserting data in the tables.
2. Write simple queries based on single table
3. To create one or more tables with following constraints
   Primary Key
   Foreign Key
   Check constraint
   Unique constraint
   Not null constraint
4. To drop a table, alter schema of a table, insert / update / delete records using tables created in previous Assignments. (Use simple forms of insert / update / delete statements)
5. To query the tables using simple form of select statement
   Select <field-list>
   from table
   [where <condition> order by <field list>]
   Select <field-list, aggregate functions >
   from table
   [where <condition> group by <> having <> order by <>]
6. To query table, using set operations (union, intersect)
7. To query tables using nested queries (use of except, exists, not exists, all clauses)

Course Code and Title: USCSMT-121: Linear Algebra II
Lectures: 36 (Credits-2)

Learning Outcomes:

1. Student should understand fundamentals of vector spaces.
2. Student should be able apply the concepts of linear algebra to Computational geometry.

Unit 1: Vector Spaces **11**

1.1 Vector spaces and subspaces
1.2 Null spaces, column spaces and linear transformations.
1.3 Linearly independent sets: Bases
1.4 Coordinate systems
1.5 The dimension of a vector space
1.6 Rank

Unit 2: Eigen values and Eigen vectors **12**

2.1 Eigen values and Eigen vectors
2.2 The characteristic equation
2.3 Diagonalization
2.4 Singular Values Decomposition

Unit 3: Orthogonality and Symmetric Matrices **11**

3.1 Inner product, length and orthogonality
3.2 Orthogonal sets
3.3 Orthogonal Projections
3.4 Diagonalization of Symmetric Matrices
3.5 Quadratic forms

Unit 4: Applications of Linear Algebra **02**

4.1 Computer Aided Tomography (CT Scan)

Text Book:

Linear Algebra and its Applications (5th Edition) David C Lay, Steven R. Lay, Judi J. MacDonald Pearson Publication, Fifth Edition, 2016.

Unit 1: Chapter 4: Sec.4.1, 4.2, 4.3, 4.4, 4.5, 4.6
Unit 2: Chapter 5: Sec. 5.1, 5.2, 5.3, 5.4
Unit 3: Chapter 6: Sec. 6.1, 6.2, 6.3, Chapter 7: 7.1,7.2
Unit 4: RB1

Reference Books:

1. Elementary Linear Algebra with supplemental Applications, by Howard Anton and others, Wiley Student Edition, Fourth edition.
2. Matrix and Linear Algebra (aided with MATLAB), by Kanti Bhushan Datta, Eastern Economic Edition, Fourth edition.

Course Code and Title: USCSMT-122 Graph Theory
Lectures: 36 (Credits-2)

Learning Objectives:

1. Students are introduced to basics of Graph Theory and various graph theory algorithms which are widely used in real life applications.
2. Students should feel confident of Graph theory concepts so that understanding data structures becomes simple

Unit 1: An Introduction to graph **10**

1.1 Definitions, Basic terminologies and properties of graph, Graph models
1.2 Special types of graphs, basic terminologies, properties and examples of directed graphs
1.3 Types of diagraphs
1.4 Some applications of special types of graph
1.5 Matrix representation and elementary results, Isomorphism of graphs

Unit 2: Connected graph **08**

2.1 Walk, trail, path, cycle, elementary properties of connectedness. Counting paths between vertices (Warshall's algorithm).
2.2 Cut edge (Bridge), Cut vertex, cut set, vertex connectivity, edge connectivity, and
2.3 Properties.
2.4 Shortest path problem, Dijkstra's algorithm.

Unit 3: Euler and Hamilton path **08**

3.1 The Konigsberg bridge problem, Euler trail, path, circuit and tour, elementary properties and Fleury's algorithm.
3.2 Hamilton path, circuit, elementary properties and examples.
3.3 Introduction of Travelling salesman problem, Chinese postman problem.

Unit 4: Trees **10**

4.1 Definitions, basic terminologies, properties and applications of trees.
4.2 Weighted graph, definition and properties of spanning tree, shortest spanning tree,
4.3 Kruskal's algorithm, Prim's algorithm.
4.4 Binary tree, definitions and properties, tree traversal, infix, prefix, postfix notations.

Text Book:

Kenneth Rosen, Discrete Mathematics and its applications, Tata McGraw Hill, Seventh Edition.

Unit 1: Chapter 8: Sec. 8.1, 8.2, 8.3
Unit 2: Chapter 8: Sec. 8.4
Unit 3: Chapter 8: Sec. 8.5, 8.6

Unit 4: Chapter 9: Sec. 9.1,9.2,9.3,9.4,9.5.

Reference Books:

1. John Clark and Derek Holton, A first look at Graph theory, Allied Publishers.
2. Narsingh Deo, Graph Theory with applications to computer science and engineering, Prentice Hall.
3. C.L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill, Fourth edition
4. Douglas B. West, Introduction to Graph Theory, Pearson Education, second edition.

Course Code and Title: USCSMTP-123 Mathematics Practical
No. of Sessions: 12 (Credits-1.5)

List of Practicals:

Practical 1 : Problems on Unit 1 from USCSMT-121.
Practical 2 : Problems on Unit 1 from USCSMT-121.
Practical 3 : Problems on Unit 2 from USCSMT-121.
Practical 4 : Problems on Unit 2 from USCSMT-121.
Practical 5 : Problems on Unit 3 from USCSMT-121.
Practical 6 : Problems on Unit 3 from USCSMT-121.
Practical 7 : Miscellaneous Problems based on USCSMT-121.
Practical 8 : Problems on Unit 1 from USCSMT-122.
Practical 9 : Problems on Unit 2 from USCSMT-122.
Practical 10 : Problems on Unit 2 from USCSMT-122.(Dijkstra's algorithm)
Practical 11 : Problems on Unit 3 from USCSMT-122.
Practical 12 : Problems on Unit 4 from USCSMT-122.
Practical 13 : Miscellaneous Problems based on USCSMT-122.

Course Code and Title: USCSEL- 121: Instrumentation Systems
Lectures: 36 (Credits: 2)

Learning Outcomes: On completion of the course, student will be able to

1. Understand working principles of Instrumentation System
2. Understand the design of various blocks of Instrumentation System
3. Solve some problems based on various topics.
4. Implement some circuits during the practical.

Unit 1: Introduction to Instrumentation System **08**

1.1 Block diagram of Instrumentation system
1.2 Definition of sensor, transducer and Actuators
1.3 Classification of sensors: Active and passive sensors
1.4 Specifications of sensors: Accuracy, range, linearity, sensitivity, resolution, reproducibility

Unit 2: Sensors and Actuators **16**

2.1 Temperature sensor (Thermistor, LM-35, thermocouple,RTD), optical sensor (LDR), Passive Infrared sensor (PIR), Tilt Sensor, ultrasonic sensor, Motion sensor, Image Sensor
2.2 Introduction to Film sensors, Nano sensors
2.3 Actuators: DC Motor, stepper motor

Unit 3: Introduction to OPAMP **05**

3.1 Concept, block diagram of Op amp
3.2 Basic parameters (ideal and practical): input and output impedance, bandwidth, differential and common mode gain, CMRR, slew rate, IC741/ LM324, Concept of virtual ground

Unit 4: Applications of OPAMP **07**

4.1 Op amp as inverting and non-inverting amplifier
4.2 Unity gain follower, Op amp as comparator
4.3 Opamp as adder, subtractor
4.4 Op amp as current to voltage and voltage to current convertor
4.5 Problems based on above Op Amp applications

Reference Books:

1. Sensors and Transducers: D. Patranabis, PHI publication, 2nd Edition
2. Sensors and Transducers: Prof A.D.Shaligram
3. Op Amp and Linear Integrated Circuits: Ramakant Gaykwad

Course Code and Title: USCSEL-122 Sequential circuits and Computer Organization

Lectures: 36 (Credits: 2)

Learning Outcomes:

1. To study sequential circuits.
2. To study architecture and functioning of computer systems.
3. To learn the basic concept behind the architecture and organization of computers.

Unit 1: Flip-flops **06**

1.1 RS Flip Flop using NAND gate
1.2 concept of clock, clocked RS Flip Flop
1.3 D Latch, J K Flip Flop, T Flip Flop, master slave Flip Flop

Unit 2: Shift registers and Counters **10**

2.1 Shift registers: SISO, SIPO, PISO, PIPO shift registers, Ring Counter using D Flip flop
2.2 Counters: Synchronous and Asynchronous type, 3-bit Up, Down and UpDown counter, Concept of modulus Counters IC 7490 (Timing Diagram of all above are expected)

Unit 3: Basics of Computer System **20**

3.1 Basic Computer Organization: Concept of Address Bus, Data Bus, Control Bus, CPU Block Diagram and Explanation of each block, Register based CPU organization
3.2 I/O organization: need of interface, block diagram of general I/O interface
3.3 Memory Organization: Memory Architecture, Memory hierarchy
3.4 Types of Memories, Concept of Stack & its organization, Data Read/ Write process, Vertical and Horizontal Memory Expansion, Role of Cache memory, Virtual Memory, USB

Reference Books:

1. Digital Fundamentals: Floyd T.M., Jain R.P., Pearson Education
2. Digital Electronics: Jain R.P., Tata McGraw Hill
3. Digital Logic and Computer Design: M. Morris Mano, Pearson Education
   Computer Organization and Architecture, William Stallings, Pearson, 10th Ed

Course Code and Title: USCSELP -123 Electronics Laboratory
No. of sessions: 12 (Credits: 1.5)

Assignment on Instrumentation Systems

The practical course consists of **10 experiments** out of which one will be activity equivalent to2 practical sessions.
Activity will carry 15% marks at internal and external semester examination. Activity can be any oneof the following:

1. Hobby projects
2. Industrial visit/live work experience
3. Market Survey of Electronic Systems

GROUP A (Minimum 4/7)

1. To study temperature sensor LM 35
2. Use of LDR to control light intensity
3. Use of OPAMP as comparator and its use in DC motor driving.
4. Build and test Inverting, and non inverting amplifier using OPAMP.
5. Build and test adder and subtractor using OPAMP

Assignment on Sequential circuits and Computer Organization

1. Study of RS and D flip flops using NAND gates and 4-bit SISO Shift register and its use as Ring Counter.
2. Study of asynchronous Up/Down Counter using IC 7493.
3. Study of decade counter using IC 7490 and Interfacing of decade counter to Seven Segment Display using IC 7447.
4. Study of Diode Matrix ROM and Computer hardware system.

Course Code and Title: USCSST-121 Multiple Regression, Time Series and Simulation

Lectures: 36 (Credits- 2)

Learning Outcomes:

1. To fit predictive models for the sample data.
2. Study data related to time and predict its future behaviour.
3. To study different models of forecasting.
4. To strengthen the skill set required for data analysis.

UNIT 1: Correlation and Regression Analysis 12

1.1 Bivariate data, scatter diagram
1.2 Correlation, positive correlation, negative correlation, zero correlation.
1.3 Karl Pearson's coefficient of correlation(r), limits of r ($-1 \leq r \leq 1$), interpretation of correlation coefficient (r), coefficient of determination (R^2) with interpretation. Auto-correlation upto lag 2
1.4 Meaning of regression, difference between correlation and regression
1.5 Fitting of line $Y=a+bX$ using least square method
1.6 Concept of residual plot and mean residual sum of squares
1.7 Non-linear regression models
  1.7.1 Second degree curve ($Y = a + b X + cX^2$)
  1.7.2 Growth curve models ($Y = a\,bX$ and $Y = aX^b$)
  1.7.3 Logistic model
1.8 Numerical Problems related to real life situations

UNIT 2: Multiple Regression and Multiple, Partial Correlation (For Tri-variate Data) 08

2.1 Concept of multiple regression, Yule's Notations
2.2 Fitting of multiple regression plane. (Derivation of equation to the plane of regression of Y on X1 and X2 is expected.)
2.3 Partial regression coefficient, interpretation
2.4 Multiple correlation : concept, definition, computation and interpretation
2.5 Partial correlation: concept, definition, computation and interpretation
2.6 Numerical problems related to real life situations

UNIT 3: Time series 10

3.1 Meaning and utility
3.2 Components of time series
3.3 Additive and multiplicative models
3.4 Methods of estimating trend : moving average method, least squares method and exponential smoothing method(with graph and interpretation)
3.5 Elimination of trend using additive and multiplicative models
3.6 Autoregressive (AR (1)) model

3.7 Numerical problems related to real life situations

UNIT4: Simulation **06**

4.1 Introduction to simulation, merits and demerits
4.2 Pseudo-random number generator, requisites of a good random number generator, linear congruential generator
4.3 Monte Carlo method for numerical integration
4.4 Simulations from standard distributions
4.5 Numerical problems related to real life situations

Reference Books:

1. Box and Jenkin (2008).Time Series Analysis, 4th edition, Wiley.
2. Brockwell and Davis (2006).Time Series Methods, Springer.
3. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining (2021).Introduction to Linear Regression Analysis, 6th edition, Wiley.
4. Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983).Fundamentals of Statistics, Vol. 1, 6th Revised Edition, The World Press Pvt. Ltd., Calcutta.
5. Gupta and Kapoor (1987). Fundamentals of Applied Statistics , 3rd edition, S. Chand and Sons, New Delhi.
6. Law A. M. and Kelton W.D.(2007).Simulation Modelling and Analysis ,Tata McGraw Hill.

Course Code and Title: USCSST-122 Continuous Probability Distributions and Testing of Hypotheses

Lectures:36 (Credits- 2)

Learning Outcomes:

1. To apply different forms of probability distribution when the values of observed data are continuous.
2. How to use sample data to answer research questions.
3. To study how hypothesis ensures the entire research process remains scientific and reliable

UNIT 1: Standard Continuous Probability Distributions 12

1.1 Uniform Distribution: statement of p.d.f., mean, variance, nature of probability curve. Theorem (without proof): The distribution function of any continuous r.v. if it is invertible follows U(0, 1) distribution. Model sampling from uniform distribution

1.2 Exponential Distribution: statement of p.d.f. of the form,f(x) = $(1/\theta)$ exp(-x/θ), mean, variance, nature of probability curve, lack of memory property (with proof). Model sampling from exponential distribution

1.3 Pareto distribution:

$(x) = \frac{\alpha}{x^{\alpha+1}}$; $x \geq 1, \alpha > 0$. Mean, variance, symmetry, applications

1.4 Normal Distribution: statement of p.d.f., identification of parameters, nature of probability density curve, standard normal distribution, symmetry, distribution of aX+b, aX+bY+c where X and Y are independent normal variables, computations of probabilities using normal probability table, normal approximation to binomial and Poisson distribution, central limit theorem (statement only), Box Muller transformation

1.5 Numerical problems related to real life situations

UNIT 2: Testing of hypothesis 04

2.1 Concepts of population and sample.

2.2 Definitions: random sample from a probability distribution, parameter, statistic standard error of estimator.

2.3 Concept of null hypothesis and alternative hypothesis (Research hypothesis), critical region, level of significance, type I and type II error, one sided and two sided tests, test of hypothesis, p-value

UNIT 3: Parametric Tests 14

3.1 Large sample tests

3.1.1 $H_0: \mu = \mu_0$ Vs $H_1: \mu \neq \mu_0, \mu < \mu_0, \mu > \mu_0$ (One sided and two sided tests).

3.1.2 $H_0: \mu_1 = \mu_2$ Vs $H_1: \mu_1 \neq \mu_2, \mu_1 < \mu_2, \mu_1 > \mu_2$ (One sided and two sided tests).

3.1.3 $H_0: P = P_0$ Vs $H_1: P \neq P_0, P < P_0, P > P_0$ (One sided and two sided tests).

3.1.4 $H_0: P_1 = P_2$ Vs $H_1: P_1 \neq P_2, P_1 < P_2, P_1 > P_2$ (One sided and two sided tests)

3.2 Tests based on Chi square distribution

3.2.1 Chi-square test for goodness of fit

3.2.2 Test for independence of attributes. (mxn and 2x2 contingency table.)

3.3 Tests based on F – distribution

3.3.1 F-test for testing significance of equality of two population variances.

3.4 Tests based on t – distribution

3.4.1 H0: $\mu = \mu_0$ Vs H1: $\mu \neq \mu_0, \mu < \mu_0, \mu > \mu_0$ (One sided and two sided tests).

3.4.2 H0: $\mu_1 = \mu_2$ Vs H1: $\mu_1 \neq \mu_2, \mu_1 < \mu_2, \mu_1 > \mu_2$ (One sided and two sided tests)

3.4.3 Paired t-test

3.5 Numerical problems related to real life situations

UNIT4: Non-parametric tests **06**

4.1 Run test

4.2 Sign test

4.3 Kolmogorov-Smirnov test

4.4 Mann-Whitney test

4.5 Numerical problems related to real life situations

Reference Books:

1. Freund J.E. (2005).Modern Elementary Statistics, Pearson Publication.
2. Kulkarni M.B., Ghatpande, S.B., Gore S.D.(1999). Common Statistical Tests ,Satyajeet Prakashan, Pune.
3. Medhi J.(1992). Statistical Methods (An Introductory Text), New Age International.
4. Mukhopadhyay P. (2015). Mathematical Statistics,third edition, Books and Allied (P), Ltd.
5. Sheldon Ross (2006).A First course in Probability, sixth edition, Pearson .
6. Sheldon Ross (2021). Introduction to Probability and Statistics for Engineers and Scientists, sixth edition, Elsevier.
7. Trivedi K. S. (2001). Probability, Statistics, Design of Experiments and Queuing Theory. with Applications of Computer Science, Prentice Hall of India, New Delhi.

Course Code and Title: USCSSTP-123 Statistics Practical-II

No of Sessions: 12 (Credits-1.5)

List of Assignments:

1. Correlation and linear regression. Also verification using R software.
2. Fitting of second degree and exponential curves. Also verification using R software.
3. Fitting of multiple regression model and computation of multiple and partial correlation coefficients. Also verification using R software.
4. Estimation of trend by using the method of moving averages and least square method. Fitting of AR(1) model to time series data.
5. Model sampling from continuous uniform, exponential and normal distributions.
6. Fitting of normal distribution and computation of expected frequencies.
7. Large sample tests.
8. Simulation using R software. Non-parametric tests –run test and Kolmogorov Smirnov test. Monte Carlo method for numerical integration. Using R software.
9. Tests based on chi-square, t and F distribution. Also using R software.
10. Project (Part-II) - Analysis of data collected in semester-I.