CHRIST
(DEEMED TO BE UNIVERSITY)
DELHI-NCR, INDIA

School of Sciences
Delhi NCR Campus

Syllabus
Bachelor of Science
(Computer Science, Mathematics and Statistics)
2020-21

CHRIST(Deemed to be University)
Delhi NCR Campus
www.ncr.christuniversity.in

CHRIST
(DEEMED TO BE UNIVERSITY)
BANGALORE · INDIA

Department of
COMPUTER-SCIENCE

Syllabus for
Bachelor of Science (Computer Science, Mathematics, Statistics)
Academic Year (2020)

1 Semester - 2020 - Batch				
Paper Code	Paper	Hours Per Week	Credits	Marks
CSC131	PROGRAMMING USING C AND DIGITAL COMPUTER FUNDAMENTALS	4	4	100
CSC151	C PROGRAMMING LAB	2	2	50
ENG121	ENGLISH - I	3	2	100
FRN121	FRENCH	3	3	100
MAT131	DIFFERENTIAL CALCULUS	4	4	100
MAT151	DIFFERENTIAL CALCULUS USING MAXIMA	2	2	50
STA131	DESCRIPTIVE STATISTICS AND PROBABILITY THEORY	4	4	100
STA151	DESCRIPTIVE STATISTICS AND PROBABILITY PRACTICAL	2	2	50

2 Semester - 2020 - Batch				
Paper Code	Paper	Hours Per Week	Credits	Marks
CSC231	DATA STRUCTURES AND OPERATING SYSTEMS	4	4	100
CSC251	DATA STRUCTURES LAB	2	2	50
ENG221	ENGLISH - II	3	2	100
FRN221	FRENCH	3	3	100
MAT231	DIFFERENTIAL EQUATIONS	4	4	100
MAT251	DIFFERENTIAL EQUATIONS USING MAXIMA	2	2	50
STA231	STATISTICAL METHODS	4	4	100
STA232	R PROGRAMMING	4	4	100
STA251	STATISTICAL METHODS PRACTICAL	2	2	50
3 Semester - 2019 - Batch				
Paper Code	Paper	Hours Per Week	Credits	Marks
AEN321	ADDITIONAL ENGLISH	3	3	100
CSC331	DATABASE MANAGEMENT SYSTEM AND JAVA PROGRAMMING	4	4	100
CSC351	JAVA PROGRAMMING LAB	2	2	50
ENG321	ENGLISH-III	3	3	100
FRN321	FRENCH	3	3	100
HIN321	HINDI	3	2	50
KAN321	KANNADA	3	03	100
MAT331	REAL ANALYSIS	4	4	100
MAT351	INTRODUCTION TO PYTHON PROGRAMMING FOR MATHEMATICS	2	2	50
STA331	STATISTICAL INFERENCE	4	4	100
STA332	APPLIED EXCEL	4	4	100
STA351	STATISTICAL INFERENCE PRACTICAL	2	2	50
4 Semester - 2019 - Batch				
Paper Code	Paper	Hours Per Week	Credits	Marks
AEN421	ADDITIONAL ENGLISH	3	3	100
CSC431	SOFTWARE ENGINEERING AND COMPUTER NETWORKS	4	4	100
CSC451	WEB TECHNOLOGY LAB	2	2	50
ENG421	ENGLISH-IV	3	3	100
FRN421	FRENCH	3	3	100

HIN421	HINDI	3	2	50
KAN421	KANNADA	3	03	100
MAT431	ALGEBRA	4	4	100
MAT451	INTRODUCTION TO MATHEMATICAL MODELLING USING PYTHON	2	2	50
STA431	SAMPLING TECHNIQUES	4	4	100
STA451	SAMPLING TECHNIQUES PRACTICAL	2	2	50

5 Semester - 2018 - Batch

Paper Code	Paper	Hours Per Week	Credits	Marks
CSC541A	DATA ANALYTICS	3	3	100
CSC541B	INTERNET OF THINGS	3	3	100
CSC541C	DIGITAL IMAGE PROCESSING	3	3	100
CSC541D	BUSINESS INTELLIGENCE	3	3	100
CSC542A	UNIX OPERATING SYSTEM	3	3	100
CSC542B	PYTHON PROGRAMMING	3	3	100
CSC542D	GRAPHICS AND ANIMATION	3	3	100
CSC542E	.NET TECHNOLOGY	3	3	100
CSC551A	DATA ANALYTICS LAB	2	2	50
CSC551B	INTERNET OF THINGS LAB	2	2	50
CSC551C	DIGITAL IMAGE PROCESSING LAB	2	2	50
CSC551D	BUSINESS INTELLIGENCE LAB	2	2	50
CSC552A	UNIX OPERATING SYSTEM LAB	2	2	50
CSC552B	PYTHON PROGRAMMING LAB	2	2	50
CSC552D	GRAPHICS AND ANIMATION LAB	2	2	50
CSC552E	.NET TECHNOLOGY LAB	2	2	50
MAT531	LINEAR ALGEBRA	3	3	100
MAT541A	INTEGRAL TRANSFORMS	3	3	100
MAT541B	MATHEMATICAL MODELLING	3	3	100
MAT541C	GRAPH THEORY	3	3	100
MAT541D	CALCULUS OF SEVERAL VARIABLES	3	3	100
MAT541E	OPERATIONS RESEARCH	3	3	100
MAT551	LINEAR ALGEBRA USING PYTHON	2	2	50
MAT551A	INTEGRAL TRANSFORMS USING PYTHON	2	2	50
MAT551B	MATHEMATICAL MODELLING USING PYTHON	2	2	50
MAT551C	GRAPH THEORY USING PYTHON	2	2	50
MAT551D	CALCULUS OF SEVERAL VARIABLES USING PYTHON	2	2	50
STA531	LINEAR REGRESSION MODELS	3	3	100

STA541A	STATISTICAL QUALITY CONTROL	3	3	100
STA541B	DESIGN OF EXPERIMENTS	3	3	100
STA541C	ACTUARIAL STATISTICS	3	3	100
STA541D	INTRODUCTION TO SPATIAL STATISTICS	3	3	100
STA551	LINEAR REGRESSION MODELS PRACTICAL	2	2	50
STA552A	STATISTICAL QUALITY CONTROL PRACTICAL	2	2	50
STA552B	DESIGN OF EXPERIMENTS PRACTICAL	2	2	50
STA552C	ACTUARIAL STATISTICS PRACTICAL	2	2	50
STA552D	SPATIAL STATISTICS PRACTICAL	2	2	50
6 Semester - 2018 - Batch				
Paper Code	Paper	Hours Per Week	Credits	Marks
CSC631	DESIGN AND ANALYSIS OF ALGORITHMS	3	3	100
CSC641A	INTRODUCTION TO SOFT COMPUTING	3	3	100
CSC641B	CLOUD COMPUTING	3	3	100
CSC641C	COMPUTER ARCHITECTURE	3	3	100
CSC641D	OOAD USING UML	3	3	100
CSC641E	USER EXPERIENCE DESIGN(UX)	3	3	100
CSC681	MAIN PROJECT	4	04	100
MAT631	COMPLEX ANALYSIS	3	3	100
MAT641B	NUMERICAL METHODS	3	3	100
MAT641C	DISCRETE MATHEMATICS	3	3	100
MAT641D	NUMBER THEORY	3	3	100
MAT641E	FINANCIAL MATHEMATICS	3	3	100
MAT651	COMPLEX ANALYSIS USING PYTHON	2	2	50
MAT651A	MECHANICS USING PYTHON	2	2	50
MAT651B	NUMERICAL METHODS USING PYTHON	2	2	50
MAT651C	DISCRETE MATHEMATICS USING PYTHON	2	2	50
MAT651D	NUMBER THEORY USING PYTHON	2	2	50
MAT651E	FINANCIAL MATHEMATICS USING PYTHON	2	2	50
MAT681	PROJECT ON MATHEMATICAL MODELS	5	5	150
STA631	TIME SERIES ANALYSIS AND FORECASTING TECHNIQUES	3	3	100
STA641A	APPLIED STATISTICS	3	3	100

STA641B	**ELEMENTS OF STOCHASTIC PROCESS**	**3**	**3**	**100**
STA641C	**BIOSTATISTICS**	**3**	**3**	**100**
STA641D	**STATISTICAL GENETICS**	**3**	**3**	**100**
STA651	**TIME SERIES ANALYSIS AND FORECASTING TECHNIQUES PRACTICAL**	**2**	**2**	**50**
STA652A	**APPLIED STATISTICS PRACTICAL**	**2**	**2**	**50**
STA652B	**ELEMENTS OF STOCHASTIC PROCESS PRACTICAL**	**2**	**2**	**50**
STA652C	**BIOSTATISTICS PRACTICAL**	**2**	**2**	**50**
STA652D	**STATISTICAL GENETICS PRACTICAL**	**2**	**2**	**50**

Assesment Pattern

Exam pattern for theory

Component	**Marks**
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

Exam Pattern for practical

Component	**Points**
CIA of experiments	80
Test 1	25
Test 2	35
Viva-Voce Exam	10
Total	150

Total Marks : 50

Examination And Assesments

- Continuous Internal assessment (CIA) forms 50% and the end semester examination forms the other 50% of the marks in both theory and practical.
- The MSE & ESE for each theory paper is of two and three hours respectively.

- The CIA for the practical sessions are done on a day-to-day basis depending upon their performance in the pre-lab, the conduct of the experiment, viva questions etc. Only those who qualify with minimum require attendance and CIA will be allowed to appear for the ESE.

Department Overview:

Department of Computer Science of CHRIST(Deemed to be University) strives to shape outstanding computer professionals with ethical and human values to reshape nation?s destiny. The training imparted aims to prepare young minds for the challenging opportunities in the IT industry with a global awareness rooted in the Indian soil, nourished and supported by experts in the field. Department of Mathematics, CHRIST (Deemed to be University) is one of the oldest departments of the University, established in the year 1969. It offers programmes in Mathematics at the undergraduate level, post graduate level as well as M.Phil and Ph.D. It is equipped with the highly committed team of instructors having versatile experience in teaching, research and has a passion to explore and innovate. Department is committed to provide the quality education in Mathematics, facilitate the holistic development, encourage students for pursuing higher studies in mathematics and motivate students to uphold scientific integrity and objectivity in professional endeavors. Department of Statistics is committed to excellence in teaching and equipping students to become practicing statisticians. The main objectives of the department are: 1. To acquaint students with various statistical methods and their applications in different fields 2. To cultivate statistical thinking among students 3. To develop skills in handling complex problems in data analysis and research design 4. To prepare students for futu

Mission Statement:

Vission: EXCELLENCE AND SERVICE Mission(Computer science department): To develop IT professionals with ethical and human values. Mission(Department of Mathematics): To organize, connect, create and communicate mathematical ideas effectively, through 4D's; Dedication, Discipline, Direction and Determination. Mission:The department of Statistics is committed to excellence in teaching and equipping students to become practicing statisticians.

Introduction to Program:

Bachelor of Science (BSc - Computer Science, Mathematics ,Statistics) is a 3-year undergraduate triple main programme spread over six semesters. It is an interdisciplinary program aimed at fostering sound fundamentals in computer science, mathematics statistics. The curriculum in computer science scales from imparting basic concepts in lower semesters to fine grain level along with electives in the higher semesters. Programming labs and projects strengthen the domain knowledge and exposure during the triple main course.The students are imparted both theoretical as well as practical knowledge in statistics using multiple statistical software. Mathematics: The undergraduate course in Mathematics is designed to enable the students to lay a strong foundation in various fields of Mathematics. The course enables the students to develop a respectable intellectual level seeking to expose the various

concepts in Mathematics. It also aims at enhancing the students reasoning, analytical and problem solving skills. The first four semesters are devoted to appreciate the beauty of mathematics through Differential Calculus, Differential Equations, Real Analysis and Algebra. In order to help the students in exploration of mathematical concepts through activities and exploration, FOSS (Free and Open Source Software) tool MAXIMA and the computer language "Python" are introduced. Students find better perceptions of the classical courses like Linear Algebra, Complex Analysis and the elective co

Program Objective:

Programme Objective:The programme aims at providing theoretical and practical exposure to students to a varied range of statistical techniques in order to equip them to face the challenges of Industry and Higher Education. Programme Outcomes: On successful completions of the BSc Programme students will be able to PO1. Understand and apply the fundamental principles, concepts and methods in key areas of science and multidisciplinary fields PO2. Demonstrate problem solving, analytical and logical skills to provide solutions for the scientific requirements PO3. Develop the critical thinking with scientific temper PO4. Communicate the subject effectively PO5. Understand the importance and judicious use of technology for the sustainable growth of mankind in synergy with nature PO6. Understand the professional, ethical and social responsibilities PO7. Enhance the research culture and uphold the scientific integrity and objectivity PO8. Engage in continuous reflective learning in the context of technological and scientific advancements Programme Specific Outcomes: PSO1. Apply the theoretical concepts to design and develop software. PSO2. Demonstrate the problem solving skills in mathematical and digital sciences. PSO3. Provide a comprehensive understanding of Data Science and its applications. PSO4. Acquire a strong foundation in Statistical analytics PSO5. Express proficiency in oral and written communications to appreciate innovation in research. PSO6. Use sof

Assesment Pattern

CIA : 50%

ESE : 50%

Examination And Assesments

CIA : 50%

ESE : 50%

Department Overview:

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AEN121N - ADDITIONAL ENGLISH (2020 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

The Additional English course is offered as a second language course and seeks to introduce the students to the nuances of English literature in its varied forms and genres. The students who choose Additional English are generally proficient in the English language. Hence, instead of focusing on introducing them to language, challenging texts in terms of ideas, form, and technique are chosen. Additional English as a course is designed for students in place of a regional language. Non-Resident Indians (NRIs), foreign nationals and students who have not taken Hindi, Kannada, Tamil or French at the Plus 2 or Class XII levels are eligible to choose Additional English. The course is taught for students from different streams, namely, BA, BSc, BCom, and BBA in the first year and for BA, BSc and BCom (Regular) in the second year.

The first year syllabus is an attempt by the Department of English, Christ University to recognize and bring together the polyphonic Indian and Indian sub-continental voices in English in English translation for the Additional English students of the first year. This effort aims to familiarize the students with regional literatures in translation, Indian Writing in English (IWE) and literatures from Pakistan, Nepal and Srilanka, thereby, enabling the students to learn more about Indian culture and ethos through writings from different regions of the country. We have tried to represent in some way or the other the corners of India and the

Indian sub-continent in this microcosmic world of short stories, poems and essays

There is a prescribed text bookfor the first year students, compiled by the Department of English, Christ University and intended for private circulation.

The first semester has a variety of writing from India, Pakistan and Nepal. The various essays, short stories and poems deal with various socio-economic, cultural and political issues that are relevant to modern day India and the Indian sub-continent and will enable students to comprehend issues of identity-politics, caste, religion, class, and gender. All of the selections either in the manner of their writing, the themes they deal with or the ideologies that govern them are contemporary in relevance and sensibility, whether written by contemporary writers or earlier writers. An important addition to this syllabus is the preponderance of North-Eastern writing which was hitherto not well represented. Excerpts from interviews, autobiographical writings, sports and city narratives are added to this section to introduce students to the varied genres of literature.

The objectives of this course are

to expose students to the rich literary and cultural diversity of Indian literatures
to sensitise students on the social, political, historical and cultural ethos that has shaped the nation- INDIA
to enable to grasp and appreciate the variety and abundance of Indian writing, of which this compilation is just a passing glance
to learn and appreciate India through association of ideas in the texts and the external contexts (BhashaUtsav will be an intrinsic help in this endeavour)

Learning Outcome

Learning Outcome

The students will become
sensitive to cultural, social, religious and ethnic diversities and help them engage with their peers and all around them in a more understanding and ‘educated’ manner.

it will also enable them through the activities conducted to become more proactive citizens/participants in society.

aware of the dynamics of gender, identity, communalism and politics of this vast nation through its literature.

Unit-1 **Teaching Hours:10**

Poetry

1. Keki N Daruwala "Migrations"

2. Kamala Das "Forest Fire"

3. Agha Shahid Ali "Snow on the Desert"

4. Eunice D Souza "Marriages are Made"

Unit-2 **Teaching Hours:15**

Short Stories

1. Rabindranath Tagore "Babus of Nayanjore"

2. Ruskin Bond "He said it with Arsenic"

3. Bhisham Sahni "The Boss Came to Dinner"

4. N. Kunjamohan Singh "The Taste of Hilsa"

5. Mohan Thakuri "Post Script"

Unit-3 **Teaching Hours:20**

Essays

1. Mahatma Gandhi "What is True Civilization?" (Excerpts from *Hind Swaraj)*

2. Ela Bhatt "Organising for Change"

3. Sitakant Mahapatra "Beyond the Ego: New Values for a Global Neighborhood

4. B R Ambedkar "Waiting for A Visa"

Text Books And Reference Books:

Contemporary knowledge of the soci-political situation in the sub-continent

The text book copy "Reading Diversity"

Essential Reading / Recommended Reading

On-line resources to appreciate the text through the Comprehension Questions

Evaluation Pattern

CIA 1: Classroom assignment for 20 marks keeping in mind the objectives and learning outcomes of the course.

CIA 2: Mid-semester written exam for 50 marks

CIA 3: Collage, tableaus, skits, talk shows, documentaries, Quizzes or any proactive creative assignments that might help students engage with India as a cultural space. This is to be done keeping in mind the objectives and learning outcomes of the course.

Question Paper Pattern

Mid Semester Exam: 2 hrs

Section A: 4x5= 20

Section B: 2x15=30

Total 50

End Semester Exam: 2 hrs

Section A: 4 x 5 = 20

Section B: 2 x 15= 30

Total 50

CSC131 - PROGRAMMING USING C AND DIGITAL COMPUTER FUNDAMENTALS (2020 Batch)

Total Teaching Hours for Semester:60 | **No of Lecture Hours/Week:4**

Max Marks:100 | **Credits:4**

Course Objectives/Course Description

Course Objectives

The course provides the fundamentals of C programming, number systems, Boolean algebra and logic gates. The C programming helps the students to solve problems through logical thinking and digital logic helps the students to understand the concepts of constructing combinational and sequentialcircuits.

Learning Outcome

CO1: Understand the fundamentals of structured programming, number systems, Boolean algebra and logic gates
CO2: Learn to implement the concepts of arrays, functions, pointers, structures and to analyse logical expressions.
CO3: To create programs with ethical coding standards. CO4: To design combinational and sequential circuits.

Unit-1 **Teaching Hours:6**

Introduction

Algorithms - flowcharts- The C Character Set - Constants, Variables and Keywords - Types of C Constants - Types of C Variables - Variable Names - C Instructions – data Type Declaration I/O instructions - Arithmetic Instruction - TypeConversion.

Unit-2 **Teaching Hours:6**

Control Structure

The Decision Control Structure - The if Statement- if-else Statement- Nested if-else Use of Logical Operators - ! Operator - Decisions Using switch - The Loop Control Structure While Loop - for Loop - break Statement - continue Statement- do-while Loop.

Unit-3 **Teaching Hours:6**

Arrays

A Simple Program Using Array - Array Initialization - Two Dimensional Arrays- Initializing a 2-Dimensional Array - Memory Map of a 2-Dimensional Array – Strings - Standard Library String Functions - strlen( ) - strcpy( ) - strcat() - strcmp() - Two-Dimensional Array of Characters.

Unit-4 **Teaching Hours:6**

Functions & Pointers

Function - Passing Values between Functions - Scope Rule of Functions - Calling Convention - Return Type of Function - Call by Value and Call by Reference - An Introduction to Pointers - Pointer Notation –Recursion.

Unit-5 **Teaching Hours:6**

Macros and Structures

Introduction to macros, Structures - Declaring a Structure - Accessing Structure Elements - How Structure Elements areStored.

Unit-6 **Teaching Hours:7**

Introduction to Computers & Number systems

Different number systems and their conversions (Decimal, Binary, Octal and Hexadecimal) Binary arithmetic - Addition, subtraction, multiplication and division of binary numbers, 1's and 2's complement, Floating point numbers, Coding – BCD, Gray,ASCII

Unit-7 **Teaching Hours:6**

Boolean Algebra

Boolean operations and expressions, Laws and rules of boolean algebra, Demorgan's Theorem, Boolean expressions, Simplification of Booleanexpression.

Unit-8 **Teaching Hours:6**

Logic Gates

OR gate, NOR gate , NOT gate , AND gate, NAND gate X-OR gate , X-NOR gate, The universal property of NOR and NAND gate, Karnaugh map (SOP).

Unit-9 **Teaching Hours:5**

Combinational logic

Adders (Half and Full), Decoder, Encoder, Multiplexer, De-Multiplexer (Introductory ConceptsOnly).

Unit-10 **Teaching Hours:6**

Flip-Flops

Flip-flops- SR flip-flop, JK flip-flop, Master slave JK flip-flop, Introduction to Registers andCounters.

Text Books And Reference Books:

[1] Yashavant P. Kanetkar, *Let Us C*, 15th Edition, BPB Publications, 2012.

[2] Floyd and Thomas L, *Digital Computer Fundamentals*, 11th Edition, Pearson International, 2015.

Essential Reading / Recommended Reading

[1] Byron Gottfried and Jitender Chhabra, *Programming with C*, 3rd Ed, Tata McGrawHill, 2010.

[2] Balagurusamy E, *Programming in ANSI C,* 4th Edition, Tata-McGraw-Hill, 2007.

[3] Deitel H M and Deitel P J, C - *How to Program*, 7th Edition, Prentice-Hall, 2012.

[4] Susant K Rout, *Cimple,C,* Tata-McGraw-Hill Publishing Company Ltd., 2016.

[5] Malvino, Paul Albert, Leach, Donald P. Gautam Saha, *Digital Principles And Applications*, 7th Edition,TMH,2010.

[6] Bartee, Thomas C, *Digital Computer Fundamentals,* 6th Edition, TMH,2010

Evaluation Pattern

CIA-50%

ESE-50%

CSC131N - PROGRAMMING USING C AND DIGITAL COMPUTER FUNDAMENTALS (2020 Batch)

Total Teaching Hours for Semester:60

No of Lecture Hours/Week:4

Max Marks:100

Credits:4

Course Objectives/Course Description

Course Objectives

The course provides the fundamentals of C programming, number systems, Boolean algebra and logic gates. The C programming helps the students to solve problems through logical thinking and digital logic helps the students to understand the concepts of constructing combinational and sequentialcircuits.

Learning Outcome

CO1: Understand the fundamentals of structured programming, number systems, Boolean algebra and logic gates
CO2: Learn to implement the concepts of arrays, functions, pointers, structures and to analyse logical expressions.
CO3: To create programs with ethical coding standards. CO4: To design combinational and sequential circuits.

Unit-1 **Teaching Hours:6**

Introduction

Algorithms - flowcharts- The C Character Set - Constants, Variables and Keywords - Types of C Constants - Types of C Variables - Variable Names - C Instructions – data Type Declaration I/O instructions - Arithmetic Instruction - TypeConversion.

Unit-2 **Teaching Hours:6**

Control Structure

The Decision Control Structure - The if Statement- if-else Statement- Nested if-else Use of Logical Operators - ! Operator - Decisions Using switch - The Loop Control Structure While Loop - for Loop - break Statement - continue Statement- do-while Loop.

Unit-3 **Teaching Hours:6**

Arrays

A Simple Program Using Array - Array Initialization - Two Dimensional Arrays- Initializing a 2-Dimensional Array - Memory Map of a 2-Dimensional Array – Strings - Standard Library String Functions - strlen( ) - strcpy( ) - strcat() - strcmp() - Two-Dimensional Array of Characters.

Unit-4 **Teaching Hours:6**

Functions & Pointers

Function - Passing Values between Functions - Scope Rule of Functions - Calling Convention - Return Type of Function - Call by Value and Call by Reference - An Introduction to Pointers - Pointer Notation –Recursion.

Unit-5 **Teaching Hours:6**

Macros and Structures

Introduction to macros, Structures - Declaring a Structure - Accessing Structure Elements - How Structure Elements areStored.

Unit-6 **Teaching Hours:7**

Introduction to Computers & Number systems

Different number systems and their conversions (Decimal, Binary, Octal and Hexadecimal) Binary arithmetic - Addition, subtraction, multiplication and division of binary numbers, 1's and 2's complement, Floating point numbers, Coding – BCD, Gray,ASCII

Unit-7 **Teaching Hours:6**

Boolean Algebra

Boolean operations and expressions, Laws and rules of boolean algebra, Demorgan's Theorem, Boolean expressions, Simplification of Booleanexpression.

Unit-8 **Teaching Hours:6**

Logic Gates

OR gate, NOR gate , NOT gate , AND gate, NAND gate X-OR gate , X-NOR gate, The universal property of NOR and NAND gate, Karnaugh map (SOP).

Unit-9 **Teaching Hours:5**

Combinational logic

Adders (Half and Full), Decoder, Encoder, Multiplexer, De-Multiplexer (Introductory ConceptsOnly).

Unit-10 **Teaching Hours:6**

Flip-Flops

Flip-flops- SR flip-flop, JK flip-flop, Master slave JK flip-flop, Introduction to Registers andCounters.

Text Books And Reference Books:

[1] Yashavant P. Kanetkar, *Let Us C*, 15th Edition, BPB Publications, 2012.

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Evaluation Pattern

CIA-50%

ESE-50%

CSC151 - C PROGRAMMING LAB **(2020 Batch)**

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

The course introduces programming approach and practical implementation of theoretical concepts in C language. It provides the ability to understand, program, evaluate the given problems. The course also develops analyzing and problem solving skills based on C language.

Learning Outcome

CO1: Analyze and illustrate algorithm and flowchart for the given C program
CO2: Implement structured C programs
CO3: Trace and debug the programs written in C language

Unit-1 **Teaching Hours:30**

List of programs

1. Program to implement conditional statements.

2. Program to implement the concepts of while loop.

3. Program implementing for loop concepts.

4. Program to implement 1D array concept.

5. Program based on string concepts.

6. Program to implement string library functions.

7. Program to implement 2D array concepts.

8. Program to implement functions.

9. Program demonstrating recursion functions.

10. Program to demonstrate call by value and call by reference.

Text Books And Reference Books:

[1] Yashavant P. Kanetkar, *Let Us C*, 15th Edition, BPB Publications, 2012.

Essential Reading / Recommended Reading

[1] Byron Gottfried and Jitender Chhabra, *Programming with C*, 3rd Ed, Tata McGrawHill, 2010.

[2] Balagurusamy E, *Programming in ANSI C,* 4th Edition, Tata-McGraw-Hill, 2007.

[3] Deitel H M and Deitel P J, C - *How to Program*, 7th Edition, Prentice-Hall, 2012.

[4] Susant K Rout, *Cimple,C,* Tata-McGraw-Hill Publishing Company Ltd., 2016.

Evaluation Pattern

CIA - 50%

ESE - 50%

CSC151N - C PROGRAMMING LAB **(2020 Batch)**

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

The course introduces programming approach and practical implementation of theoretical concepts in C language. It provides the ability to understand, program, evaluate the given problems. The course also develops analyzing and problem solving skills based on C language.

Learning Outcome

CO1: Analyze and illustrate algorithm and flowchart for the given C program

CO2: Implement structured C programs

CO3: Trace and debug the programs written in C language

Unit-1 **Teaching Hours:30**

List of programs

1. Program to implement conditional statements.

2. Program to implement the concepts of while loop.

3. Program implementing for loop concepts.

4. Program to implement 1D array concept.

5. Program based on string concepts.

6. Program to implement string library functions.

7. Program to implement 2D array concepts.

8. Program to implement functions.

9. Program demonstrating recursion functions.

10. Program to demonstrate call by value and call by reference.

Text Books And Reference Books:

[1] Yashavant P. Kanetkar, *Let Us C*, 15th Edition, BPB Publications, 2012.

Essential Reading / Recommended Reading

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[2] Balagurusamy E, *Programming in ANSI C,* 4th Edition, Tata-McGraw-Hill, 2007.
[3] Deitel H M and Deitel P J, C - *How to Program*, 7th Edition, Prentice-Hall, 2012.
[4] Susant K Rout, *Cimple,C,* Tata-McGraw-Hill Publishing Company Ltd., 2016.

Evaluation Pattern

CIA - 50%

ESE - 50%

ENG121 - ENGLISH - I (2020 Batch)

Total Teaching Hours for Semester:45 No of Lecture Hours/Week:3
Max Marks:100 Credits:2

Course Objectives/Course Description

- To expose learners to a variety of texts to interact with
- To help learners classify ideologies and be able to express the same
- To expose learners to visual texts and its reading formulas
- To help learners develop a taste to appreciate works of literature through the organization of language
- To help develop critical thinking
- To help learners appreciate literature and the language nuances that enhances its literary values
- To help learners understand the relationship between the world around them and the text/literature
- To help learners negotiate with content and infer meaning contextually
- To help learners understand logical sequencing of content and process information
- To help improve their communication skills for larger academic purposes and vocational purposes
- To enable learners to learn the contextual use of words and the generic meaning
- To enable learners to listen to audio content and infer contextual meaning
- To enable learners to be able to speak for various purposes and occasions using context specific language and expressions

- To enable learners to develop the ability to write for various purposes using suitable and precise language.

Learning Outcome

- Understand how to engage with texts from various countries, historical, cultural specificities and politics
- Understand and develop the ability to reflect upon and comment on texts with various themes
- Develop an analytical and critical bent of mind to compare and analyze the various literature they read and discuss in class
- Develop the ability to communicate both orally and in writing for various purposes

Unit-1 **Teaching Hours:6**

language

Common errors- subject-verb agreement, punctuation, tense errors

Unit-1 **Teaching Hours:6**

Unit 1 1. The Happy Prince By Oscar Wilde 2. Shakespeare Sonnet 18

Unit-2 **Teaching Hours:6**

language

sentence fragments, dangling modifiers, faulty parallelism,

Unit-2 **Teaching Hours:6**

unit 2

1. Why We Travel-Pico Iyer

2. What Solo Travel Has Taught Me About the World – and Myself -ShivyaNath- Blogpost

Unit-3 **Teaching Hours:6**

unit 3

1. Thinking Like a Mountain

By Aldo Leopold

2. Short Text: On Cutting a Tree

By Gieve Patel

Unit-3 **Teaching Hours:6**

language

Note taking

Unit-4 **Teaching Hours:6**

unit 4

1. Violence in the name of God is Violence against God

By Rev Dr Tveit

2. Poem: Holy Willie's Prayer

By Robert Burns

Unit-4 **Teaching Hours:6**

language

Paragraph writing

Unit-5 **Teaching Hours:6**

unit 5

1. The Story of B24

By Sir Arthur Conan Doyle

2. Short Text: Aarushi Murder case

Unit-5 **Teaching Hours:6**

Language

Newspaper report

Unit-6 **Teaching Hours:6**

unit 6

1.Long text:My Story- Nicole DeFreece

2. short text: Why You Should Never Aim for Six Packs

Unit-6 **Teaching Hours:6**

Language

Essay writing

Unit-7 **Teaching Hours:6**

Language

Paraphrasing and interpretation skills

Unit-7 **Teaching Hours:6**

unit 7

1.Long Text: Sir Ranjth Singh- Essay by SouravGanguly

2. Short text: Casey at the Bat- Ernest Lawrence Thayer

Unit-8 **Teaching Hours:3**

visual text

Visual Text: Before the Flood

Text Books And Reference Books:

ENGlogue 1

Essential Reading / Recommended Reading

Addfitional material as per teacher manual will be provided by the teachers

Evaluation Pattern

CIA 1=20

CIA 2=50

CIA 3= 20

ESE= 50 marks online and 50 marks written exam

ENG121N - ENGLISH - I (2020 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:2**

Course Objectives/Course Description

ENGlogue is an English language course book for the students of first year of undergraduate courses studying in Christ University. The book that covers both Semesters I and II is built around fourteen contemporary themes, with each unit including two interesting and engaging reading texts. The texts are meant to trigger not just the desired language-learning behaviors but also to engage the students in thinking about various pertinent issues concerning the world around them. Each unit also includes teaching and tasks based on vocabulary, reading, writing and speaking. The overall objective of the book is to provide students with hands-on learning of language skills, equipping them not only for their immediate academic needs but also for their future professional careers.

- To help learners classify ideologies and be able to express the same
- To expose learners to visual texts and its reading formulas
- To help learners develop a taste to appreciate works of literature through the organization of language
- To help develop critical thinking

- To help learners appreciate literature and the language nuances that enhances its literary values
- To help learners understand the relationship between the world around them and the text/literature
- To help learners negotiate with content and infer meaning contextually
- To help learners understand logical sequencing of content and process information
- To help improve their communication skills for larger academic purposes and vocational purposes
- To enable learners to learn the contextual use of words and the generic meaning
- To enable learners to listen to audio content and infer contextual meaning
- To enable learners to be able to speak for various purposes and occasions using context specific language and expression.
- To enable learners to develop the ability to write for various purposes using suitable and precise language.

Learning Outcome

- Understand how to engage with texts from various countries, historical, cultural specificities and politics
- Understand and develop the ability to reflect upon and comment on texts with various themes
- Develop an analytical and critical bent of mind to compare and analyze the various literature they read and discuss in class.
- Develop the ability to communicate both orally and in writing for various purposes.

Unit-1 **Teaching Hours:6**

Language

Common errors- subject-verb agreement, punctuation, tense errors

Unit-1 **Teaching Hours:6**

Beauty

1. The Happy Prince By Oscar Wilde
2. Sonnet 18 by Shakespeare

Unit-2 **Teaching Hours:6**

Language

Sentence fragments, dangling modifiers, faulty parallelism

Unit-2 **Teaching Hours:6**

Travel

1. Why We Travel- Pico Iyer
2. What Solo Travel Has Taught Me About the World and Myself - ShivyaNath

Unit-3 **Teaching Hours:6**

Environment

1. Thinking Like a Mountain- Aldo Leopold
2. On Cutting a Tree- Gieve Patel

Unit-3 **Teaching Hours:6**

Language

Note taking

Unit-4 **Teaching Hours:6**

Language

Paragraph writing

Unit-4 **Teaching Hours:6**

Religion

1. Violence in the name of God is Violence against God - Rev Dr Tveit
2. Leave this Chanting and Singing and Telling of Beads- Rabindra Nath Tagore

Unit-5 **Teaching Hours:6**

Crime

1. The Story of B24 by Sir Arthur Conan Doyle
2. Aarushi Murder case

Unit-5 **Teaching Hours:6**

Language

Newspaper report

Unit-6 **Teaching Hours:6**

Language

Essay writing

Unit-6 **Teaching Hours:6**

Health and Fitness

1. My Story- Nicole DeFreece
2. Why You Should Never Aim for Six Packs- Kinnari Jariwala

Unit-7 **Teaching Hours:6**

Language

Paraphrasing and interpretation skills

Unit-7 **Teaching Hours:6**

Sports

1. Sir Ranjth Singh- Sourav Ganguly
2. Casey at the Bat- Ernest Lawrence Thayer

Unit-8 **Teaching Hours:3**

Visual Text

Before the Flood

Text Books And Reference Books:

ENGlogue 1

Essential Reading / Recommended Reading

Additional material as per teacher manual will be provided by the teachers.

Evaluation Pattern

CIA 1=20

CIA 2=50

CIA 3= 20

ESE= 50 marks online and 50 marks written exam

FRN121 - FRENCH (2020 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

French as second language for the UG program

Learning Outcome

Enhancement of linguistic competencies and sharpening of written and oral communicative skills.

Unit-1 **Teaching Hours:5**

Chapter 1- I Discover

Lesson 1: Good Morning, How are you?

Unit-2 **Teaching Hours:5**

Chapter 1 - I discover

Lesson 2: Hello, My name is Agnes.

Unit-3 **Teaching Hours:5**

Chapter 2- Culture : Physical and Political france

Lesson 1: Who is it?

Unit-4 **Teaching Hours:5**

Chapter 2- Culture: Physical and Political France

Lesson 2: In my bag , I have.....

Unit-5 **Teaching Hours:5**

Les Fables de la Fontaine

1. La cigale et la fourmis

Unit-6 **Teaching Hours:5**

Visual Text

A French Film

Unit-7 **Teaching Hours:5**

Chapter 3- Viideo Workshop: He is cute!

Lesson 1 : How is he?

Unit-8 **Teaching Hours:5**

Les Fables de la Fontaine

2. Le renard et le corbeau

Unit-9 **Teaching Hours:5**

Chapter 3- Video Workshop: He is cute

Lesson 2: Hello?

Text Books And Reference Books:

1. Cocton, Marie-Noelle. Génération A1. Paris : Didier, 2016
2. De Lafontaine, Jean. Les Fables de la Fontaine. Paris, 1668

Essential Reading / Recommended Reading

1. Thakker, Viral. Plaisir d'écrire. New Delhi : Langers International Pvt. Ltd., 2011
2. French websites like Bonjour de France, Fluent U French, Learn French Lab, Point du FLE etc.

Evaluation Pattern

Assessment Pattern	CIA (Weight)	ESE (Weight)
CIA 1 – Assignment & MOODLE Testing (Quiz)	10%	
CIA 2 –Mid Sem Exam	25%	
CIA 3 – Role Play / Theatre and DELF Pattern: Reading & Writing	10%	
Attendance	05%	
End Sem Exam		50%
Total	50%	50%

HIN121N - HINDI (2020 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:50 **Credits:3**

Course Objectives/Course Description

The detailed text book "Samakaleen Hindi Kavitha" edited by Dr.N Mohanan is an anthology of contemporary Hindi Poems written by representative poets of Hindi Literature. From the medieval poetry ' Kabir Ke Dohe and Sur ke pad 'is also included. The poets reflect on the social, cultural and political issues which are prevalent in our society since the medieval period. Hindusthani sangeeth-parampara eva kalakar is one of the module. Since translation is a significant area in language and literature, emphasis is being given on it in the syllabus.Bharath ki pramukh sanskruthik kalayein Yakshagana,Kathakali,Ram Leela,Krishna Leela etc. included in the syllabus to enrich cultural values among students.

Course Objectves:

- to impart the knowledge of poetics
- to acquire translation skills
- to expose students to veriety of texts to interact with them
- to help students develop a taste to appreciate works of literature through the organisation of language
- to help students understand the relationship between the world around them and the text
- to improve their oral and written skills
- to expose them to the world of music

Learning Outcome

Students will be exposed to the world of poetry and Music. Through translation and cultural studies, students can understand different languages, literature and culture. Grammar portions will help the students to develop their language proficiency.

Unit-1 **Teaching Hours:20**

Samakaleen Hindi Kavitha (Collection of contemporary Hindi Poems),Kabir Ke Dohe and Sur Ke Pad.

' Samakaleen Hindi Kavitha (Collection ofcontemporary Poems) Edited By: Mahendra Kulashreshta Rajpal and Son's, New Delhi

Level of knowledge: Analytical

Unit-2 **Teaching Hours:10**

Translation-Theory and Practice

Translation-Practice English to Hindi and vice- versa.

Unit-3 **Teaching Hours:10**

Bharath ki pramukh sanskruthic kalayen-

Ramleela,Krishnaleela,Yakshagaana,kathakali.

Unit-4 **Teaching Hours:5**

Hindusthani Sangeeth-parampara evam pramukh kalakar

Utbhav,Vikas aur paramparaein

Pramukh Sangeethkar-1.Bhimsen Joshi 2.Gulam Ali 3.Pandit Ravishankar 4. Bismillah Khan.

Text Books And Reference Books:

1. 'Samakaleen Hindi Kavitha' (Collection of Poems) Edited By: Dr.N Mohanan, Rajpal and Son's,New Delhi.

Essential Reading / Recommended Reading

1. A Hand Book of Translation Studies By: Das Bijay Kumar.

2. Saral Subodh Hindi Vyakaran, By: Motilal Chaturvedi. Vinod pustak mandir, Agra-2

3. Anuvad Evam Sanchar – Dr Pooranchand Tantan, Rajpal and Son's, Kashmiri

4. Anuvad Vignan By: Bholanath Tiwar

5. Anuvad Kala By: N.E Vishwanath Iyer.

Evaluation Pattern

CIA-1(Digital learning-Editing of Hindi article in Hindi Wikipedia)-20 marks

CIA-2(Mid semester examination)-50 marks

CIA-3(Digital learning-article creation in Hindi Wikipedia)-20 marks

End sem examination-50 marks

MAT131 - DIFFERENTIAL CALCULUS (2020 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

Course Description: This course aims at enabling the students to know various concepts and principles of differential calculus and its applications. Sound knowledge of calculus is essential for the students of mathematics for the better perceptions of the subject and its development.

Course objectives: This course will help the learner to

COBJ1. Gain familiarity with the concepts of limit, continuity and differentiability.

COBJ2. Understand the relationship between the concepts of differentiability and continuity.

COBJ3. Analyse and interpret the different versions of mean value theorems.

COBJ4. Learn successive differentiation and n^{th} derivative of product of two functions.

COBJ5. Find derivative of functions of more than one variable.

COBJ6. Be familiar with curve tracing.

Learning Outcome

On successful completion of the course, the students should be able to

CO1. Compute limits, derivatives and examine the continuity, differentiability of a function at a point.

CO2. Understand the properties of continuous functions and prove that differentiability implies continuity

CO3. Prove Mean value theorems and analyse its geometric interpretation.

CO4. Compute derivatives of any order and apply Leibniz' theorem to find n^{th} derivative of product of two functions.

CO5. Master the fundamental concepts of partial differentiation and apply Euler's theorem for homogeneous functions.

CO6. Gain knowledge on the concepts such as asymptotes, concavity/convexity and singular points and apply the same for curve tracing.

Unit-1 **Teaching Hours:20**

Limits, Continuity, Differentiability and Mean Value Theorems

Definition of the limit of a function (ε-δ) form – Continuity, Uniform Continuity – Types of discontinuities – Properties of continuous functions on a closed interval - Boundedness theorem and extreme value theorem – Differentiability – Mean Value Theorems: Rolle's theorem – Lagrange's and Cauchy's First Mean Value Theorems – Taylor's theorem (Lagrange's

form and Cauchy's forms of remainder) – Maclaurin's theorem and expansions -Indeterminate forms. .

Unit-2 **Teaching Hours:20**

Successive and Partial Differentiation

Successive differentiation – nth derivatives of functions – Leibnitz theorem and its applications – Partial differentiation – First and higher order derivatives – Differentiation of homogeneous functions – Euler's theorem – Taylor's theorem for two variables (only statements and problems)- Maxima and Minima of functions of two variables.

Unit-3 **Teaching Hours:20**

Curve Tracing

Tangents and Normals, Concavity and convexity, Curvature, Asymptotes, Singular points, Tracing of curves (Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates)..

Text Books And Reference Books:

G.B. Thomas, M.D.Weir and J. Hass, *ThomasCalculus*, 12th ed., Pearson Education India, 2015.

Essential Reading / Recommended Reading

1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons Inc., 2002.
2. F. Ayres and E. Mendelson, *Schaum's Outline of Calculus*, 6th ed. USA: Mc. Graw Hill., 2013.
3. J. Stewart, *Single Variable Essential Calculus: Early Transcendentals*, 2nd ed.: Belmont, USA: Brooks/Cole Cengage Learning., 2013.
4. S. Narayanan & T. K. M. Pillay, *Calculus*, Reprint, India: S. Viswanathan Pvt. Ltd., 2009. (vol. I & II.)
5. M. Spivak, *Calculus*, 3rd ed., Cambridge University Press, 2006.
6. T.M. Apostol, *Calculus, Vol-II*, Wiley India Pvt. Ltd., 2011.
7. J. Edwards, *An elementary treatise on the differential calculus: with applications and numerous examples*, Reprint, Charleston, USA: BiblioBazaar, 2010.
8. N. P. Bali, Differential Calculus, New ed. New Delhi, India: Laxmi Publications (P) Ltd., 2012.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ, Written Assignment, Reference work, etc.,	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment, Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and	50

		analytical knowledge of the subject	
		Total	100

MAT131N - DIFFERENTIAL CALCULUS (2020 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

This course aims at enabling the students to know various concepts and principles of differential calculus and its applications. Sound knowledge of calculus is essential for the students of mathematics for the better perceptions of the subject and its development.

Learning Outcome

CO1. Compute limits, derivatives and examine the continuity, differentiability of a function at a point.

CO2. Understand the properties of continuous functions and prove that differentiability implies continuity

CO3. Prove Mean value theorems and analyse its geometric interpretation.

CO4. Compute derivatives of any order and apply Leibniz' theorem to find nth derivative of product of two functions.

CO5. Master the fundamental concepts of partial differentiation and apply Euler's theorem for homogeneous functions.

CO6. Gain knowledge on the concepts such as asymptotes, concavity/convexity and singular points and apply the same for curve tracing.

Unit-1 **Teaching Hours:20**

Limits, Continuity, Differentiability and Mean Value Theorems

Definition of the limit of a function (ε-δ) form – Continuity, Uniform Continuity – Types of discontinuities – Properties of continuous functions on a closed interval – Differentiability – Mean Value Theorems: Rolle's theorem – Lagrange's and Cauchy's First Mean Value Theorems – Taylor's theorem (Lagrange's form and Cauchy's forms of remainder) – Maclaurin's theorem and expansions -Indeterminate forms. - Maxima and Minima.

Unit-2 **Teaching Hours:20**

Successive and Partial Differentiation

Successive differentiation – nth derivatives of functions – Leibnitz theorem and its applications – Partial differentiation – First and higher order derivatives – Differentiation of homogeneous functions – Euler's theorem – Taylor's theorem for two variables (only statements and problems)- Maxima and Minima of functions of two variables.

Unit-3 **Teaching Hours:20**

Curve Tracing

Tangents and Normals, Curvature, Asymptotes, Singular points, Tracing of curves (Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates).

Text Books And Reference Books:

G.B. Thomas, M.D.Weir and J. Hass, ThomasCalculus, 12th ed., Pearson Education India, 2015.

Essential Reading / Recommended Reading

H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons Inc., 2002.

F. Ayres and E. Mendelson, Schaum's Outline of Calculus, 6th ed. USA: Mc. Graw Hill., 2013.

J. Stewart, Single Variable Essential Calculus: Early Transcendentals, 2nd ed.: Belmont, USA: Brooks/Cole Cengage Learning., 2013.

S. Narayanan & T. K. M. Pillay, Calculus, Reprint, India: S. Viswanathan Pvt. Ltd., 2009. (vol. I & II.)

M. Spivak, Calculus, 3rd ed., Cambridge University Press, 2006.

T.M. Apostol, Calculus, Vol-II, Wiley India Pvt. Ltd., 2011.

J. Edwards, An elementary treatise on the differential calculus: with applications and numerous examples, Reprint, Charleston, USA: BiblioBazaar, 2010.

N. P. Bali, Differential Calculus, New ed. New Delhi, India: Laxmi Publications (P) Ltd., 2012.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ, Written Assignment, Reference work, etc.,	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment, Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

MAT151 - DIFFERENTIAL CALCULUS USING MAXIMA (2020 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course Description: The course *Differential Calculus Using wxMaxima* is aimed at enabling the students to appreciate and understand core concepts of Differential Calculus with the help of the free and open source mathematical software *Maxima*. It is designed to gain hands on experience in using *MAXIMA* to perform plotting of standard curves, to find limits of a function, illustrate differentiability and solve applied problems on differentiation.

Course objectives: This course will help the learner to

COBJ1. Acquire skill in solving problems on Differential Calculus using MAXIMA.
COBJ2. Gain proficiency in using MAXIMA to solve problems on Differential Calculus.

Learning Outcome

On successful completion of the course, the students should be able to

CO1. Acquire proficiency in using MAXIMA to study Differential Calculus.
CO2. Demonstrate the use of MAXIMA to understand and interpret the core concepts of various types of functions from the algebraic and graphical points of view.
CO3. Use MAXIMA to evaluate limits of functions and check for continuity graphically as well as algebraically.
CO4. Be familiar with the built-in functions to find derivatives of any order and solve application problems dealing with the concept of rate of change.
CO5. Sketch graphs of standard curves using MAXIMA to interpret tracing of curves.

Unit-1 **Teaching Hours:30**

Proposed Topics

1. Introduction to MAXIMA
2. Sketch the graph of various functions: explicit-implicit-parametric-polar.
3. Evaluation of limits using built-in function in maxima and illustration of the same graphically.
4. Demonstration of continuous functions and types of discontinuities.
5. Determination of derivatives. - graphical interpretation of derivatives.
6. Verification of mean value theorems.
7. Evaluation of extreme points, maxima and minima.
8. Calculation of nth derivatives of functions
9. Partial differentiation of functions of two variables.
10. Tracing of curves.

11. Applications of differentiation

Text Books And Reference Books:

1. Zachary Hannan, wxMaxima for Calculus I (Creative Commons Attribution-Non-Commercial-Share Alike 4.0 International), Solano Community College, Edition 1.0 Publisher, Published June 17, 2015.
2. Zachary Hannan, wxMaxima for Calculus II (Creative Commons Attribution-Non-Commercial-Share Alike 4.0 International), Solano Community College, Edition 1.0 Publisher, Published June 17, 2015.

Essential Reading / Recommended Reading

Sandeep Koranne, *Handbook of Open Source Tools*, Springer Science & Business Media, 2010.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT151N - DIFFERENTIAL CALCULUS USING MAXIMA (2020 Batch)

Total Teaching Hours for Semester:30 — **No of Lecture Hours/Week:2**

Max Marks:50 — **Credits:2**

Course Objectives/Course Description

The course Differential Calculus Using Maxima is aimed at enabling the students to appreciate and understand core concepts of Differential Calculus with the help of the free and open source mathematical software Maxima. It is designed to gain hands on experience in using MAXIMA to perform plotting of standard curves, to find limits of a function, illustrate differentiability and solve applied problems on differentiation.

Learning Outcome

CO1. Acquire proficiency in using MAXIMA to study Differential Calculus.

CO2. Demonstrate the use of MAXIMA to understand and interpret the core concepts various types of functions from the algebraic and graphical points of view.

CO3. Use MAXIMA to evaluate limits of functions and check for continuity graphically as well as algebraically.

CO4. Be familiar with the built-in functions to find derivatives of any order and solve application problems dealing with the concept of rate of change.

CO5. Sketch graphs of standard curves using MAXIMA to interpret tracing of curves.

Unit-1 **Teaching Hours:30**

Proposed Topics

1. Introduction to MAXIMA
2. Sketch the graph of various functions: explicit-implicit-parametric-polar.
3. Evaluation of limits using built-in function in maxima and illustration of the same graphically.
4. Demonstration of continuous functions and types of discontinuities.
5. Determination of derivatives. - graphical interpretation of derivatives.
6. Verification of mean value theorems.
7. Evaluation of extreme points, maxima and minima.
8. Calculation of nth derivatives of functions
9. Partial differentiation of functions of two variables.
10. Tracing of curves.
11. Applications of differentiation

Text Books And Reference Books:

Zachary Hannan, wxMaxima for Calculus I (Creative Commons Attribution-Non-Commercial-Share Alike 4.0 International), Solano Community College, Edition 1.0 Publisher, Published June 17, 2015.

Zachary Hannan, wxMaxima for Calculus II (Creative Commons Attribution-Non-Commercial-Share Alike 4.0 International), Solano Community College, Edition 1.0 Publisher, Published June 17, 2015.

Essential Reading / Recommended Reading

Sandeep Koranne, Handbook of Open Source Tools, Springer Science & Business Media, 2010.

Evaluation Pattern

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	10
Total			**50**

STA131 - DESCRIPTIVE STATISTICS AND PROBABILITY THEORY **(2020 Batch)**

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

This course is designed to introduce the historical development of statistics, presentation of data, descriptive measures and fitting mathematical curves for the data.

This course also introduces measurement of relationship of quantitative and qualitative data and the concept of probability.

Learning Outcome

CO1:Demonstrate the history of statistics and present the data in various forms.

CO2:Infer the concept of correlation and regression for relating two or more related variables.

CO3:Demonstrate the probabilities for various events.

Unit-1 **Teaching Hours:10**

Organization and presentation of data

Origin and development of Statistics, Scope, limitation and misuse of statistics. Types of data:
primary, secondary, quantitative and qualitative data. Types of Measurements: nominal, ordinal,
discrete and continuous data. Presentation of data by tables: construction of frequency
distributions for discrete and continuous data, graphical representation of a frequency
distribution by histogram and frequency polygon, cumulative frequency distributions (inclusive
and exclusive methods).

Unit-2 **Teaching Hours:15**

Descriptive Statistics

Measures of location or central tendency: Arthimetic mean, Median, Mode, Geometric mean,
Harmonic mean. Partition values: Quartiles, Deciles and percentiles. Measures of dispersion:
Mean deviation, Quartile deviation, Standard deviation, Coefficient of variation. Moments:
measures of skewness, Kurtosis.

Unit-3 **Teaching Hours:10**

Correlation

Correlation: Scatter plot, Karl Pearson coefficient of correlation, Spearman's rank correlation coefficient, multiple and partial correlations (for 3 variates only). Regression: Concept of errors, Principles of Least Square, Simple linear regression and its properties.

Unit-4 **Teaching Hours:15**

Basics of probability

Random experiment, sample point and sample space, event, algebra of events. Definition of Probability: classical, empirical and axiomatic approaches to probability, properties of probability. Theorems on probability, conditional probability and independent events, Laws of total probability, Baye's theorem and its applications.

Unit-5 **Teaching Hours:10**

Association of attributes

Relation between class frequencies, consistency of data, independence of attributes, criterion of independence, association of attributes: Yule's coefficient of association, Yule'coefficient of colligation.

Text Books And Reference Books:

1. Rohatgi V.K and Saleh E, An Introduction to Probability and Statistics, 3 rd edition, John
Wiley & Sons Inc., New Jersey, 2015.
2. Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, 11 th edition, Sultan
Chand & Sons, New Delhi, 2014.

Essential Reading / Recommended Reading

1. Mukhopadhyay P, Mathematical Statistics, Books and Allied (P) Ltd, Kolkata, 2015.
2. Walpole R.E, Myers R.H, and Myers S.L, Probability and Statistics for Engineers and
Scientists, Pearson, New Delhi, 2017.
3. Montgomery D.C and Runger G.C, Applied Statistics and Probability for Engineers,
Wiley India, New Delhi, 2013.
4. Agarwal B.L, *Basic Statistics,* 6th Edition, New Age International Publication, 2015.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA131N - DESCRIPTIVE STATISTICS AND PROBABILITY (2020 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

This course is designed to introduce the historical development of statistics, presentation of data, descriptive measures and fitting mathematical curves for the data. This course also introduces measurement of relationship of quantitative and qualitative data and the concept of probability.

Learning Outcome

CO1:To enable the students understand and apply the descriptive measures and probability for data analysis.

CO2: Implement theoritical concepts of descriptive measures and probability

Unit-1 **Teaching Hours:10**

Organization and presentation of data

Origin and development of Statistics, Scope, limitation and misuse of statistics. Types of data:

primary, secondary, quantitative and qualitative data. Types of Measurements: nominal, ordinal,

discrete and continuous data. Presentation of data by tables: construction of frequency

distributions for discrete and continuous data, graphical representation of a frequency

distribution by histogram and frequency polygon, cumulative frequency distributions (inclusive

and exclusive methods).

Unit-2 **Teaching Hours:15**

Descriptive Statistics

Measures of location or central tendency: Arthimetic mean, Median, Mode, Geometric mean,

Harmonic mean. Partition values: Quartiles, Deciles and percentiles. Measures of dispersion:

Mean deviation, Quartile deviation, Standard deviation, Coefficient of variation. Moments:

measures of skewness, Kurtosis

Unit-3 **Teaching Hours:10**

Correlation

Correlation: Scatter plot, Karl Pearson coefficient of correlation, Spearman's rank correlation coefficient, multiple and partial correlations (for 3 variates only).

Unit-4 **Teaching Hours:15**

Basics of probability

Random experiment, sample point and sample space, event, algebra of events. Definition of Probability: classical, empirical and axiomatic approaches to probability, properties of probability. Theorems on probability, conditional probability and independent events, Laws of total probability, Baye’s theorem and its applications.

Unit-5 **Teaching Hours:10**

Association of attributes

Relation between class frequencies, consistency of data, independence of attributes, criterion of independence, association of attributes: Yule’s coefficient of association, Yule’coefficient of colligation.

Text Books And Reference Books:

1. Rohatgi V.K and Saleh E, An Introduction to Probability and Statistics, 3 rd edition, John

Wiley & Sons Inc., New Jersey, 2015.

2. Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, 11 th edition, Sultan

Chand & Sons, New Delhi, 2014.

Essential Reading / Recommended Reading

1. Mukhopadhyay P, Mathematical Statistics, Books and Allied (P) Ltd, Kolkata, 2015.

2. Walpole R.E, Myers R.H, and Myers S.L, Probability and Statistics for Engineers and

Scientists, Pearson, New Delhi, 2017.

3. Montgomery D.C and Runger G.C, Applied Statistics and Probability for Engineers,

Wiley India, New Delhi, 2013.

4. Mood A.M, Graybill F.A and Boes D.C, Introduction to the Theory of Statistics, McGraw

Hill, New Delhi, 2008.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA151 - DESCRIPTIVE STATISTICS AND PROBABILITY PRACTICAL (2020 Batch)

Total Teaching Hours for Semester:30 — **No of Lecture Hours/Week:2**

Max Marks:50 — **Credits:2**

Course Objectives/Course Description

The course is designed to provide a practical exposure to the students in Basic concepts of Excel and different way of representation of data.

Learning Outcome

CO1:Understand data and analysis

CO2: Implement EXCEL in given data set

CO3: Create a research statement and collect data related to the statement along with the representation of data and practical exposure on DAP.

Unit-1 **Teaching Hours:30**

List of practical assignments

1. 1. Questionnaire preparation, data collection and data base creation using Excel sheet

2. Basic data manipulation techniques: sorting, filtering, conditional formatting
3. Pivot Table construction
4. Diagrammatic representation
5. Graphical representation
6. Descriptive statistics using statistical functions
7. Data Analysis Pack (DAP)
8. Correlation and Correlation matrix
9. Exercise on partial and multiple correlation coefficient.
10. Regression analysis and their significance
11. Linear Curve estimation
12. Second order Polynomial Curve estimation

Text Books And Reference Books:

1. Rohatgi V.K and Saleh E, *An Introduction to Probability and Statistics*, 3rd edition, John Wiley & Sons Inc., New Jersey, 2015.

2. Gupta S.C and Kapoor V.K, *Fundamentals of Mathematical Statistics*, 11th edition, Sultan Chand & Sons, New Delhi, 2014.

Essential Reading / Recommended Reading

1. Mukhopadhyay P, *Mathematical Statistics*, Books and Allied (P) Ltd, Kolkata, 2015.

2. Walpole R.E, Myers R.H, and Myers S.L, *Probability and Statistics for Engineers and Scientists*, Pearson, New Delhi, 2017.

3. Montgomery D.C and Runger G.C, Applied Statistics and Probability for Engineers, Wiley India, New Delhi, 2013.

4. Mood A.M, Graybill F.A and Boes D.C, *Introduction to the Theory of Statistics*, McGraw Hill, New Delhi, 2008.

Evaluation Pattern

Section	Parameters	Marks
A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		10

STA151N - DESCRIPTIVE STATISTICS AND PROBABILITY PRACTICAL (2020 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

The course is designed to provide a practical exposure to the students in Basic concepts of Excel and different way of representation of data.

Learning Outcome

CO1:Understand data and analysis

CO2: Implement EXCEL in given data set

CO3: Create a research statement and collect data related to the statement along with the representation of data and practical exposure on DAP.

Unit-1 **Teaching Hours:30**

List of practical assignments

1. Questionnaire preparation, data collection and data base creation using Excel sheet

2. Basic data manipulation techniques: sorting, filtering, conditional formatting

3. Pivot Table construction

4. Diagrammatic representation

5. Graphical representation

6. Descriptive statistics using statistical functions and Data Analysis Pack (DAP)

7. Exercise on correlation and Correlation matrix

8. Exercise on partial and multiple correlation coefficients.

Text Books And Reference Books:

1. Rohatgi V.K and Saleh E, An Introduction to Probability and Statistics, 3rd edition, John Wiley & Sons Inc., New Jersey, 2015.

2. Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand & Sons, New Delhi, 2014.

Essential Reading / Recommended Reading

1. Mukhopadhyay P, Mathematical Statistics, Books and Allied (P) Ltd, Kolkata, 2015.

2. Walpole R.E, Myers R.H, and Myers S.L, Probability and Statistics for Engineers and Scientists, Pearson, New Delhi, 2017.

3. Montgomery D.C and Runger G.C, Applied Statistics and Probability for Engineers, Wiley India, New Delhi, 2013.

4. Mood A.M, Graybill F.A and Boes D.C, Introduction to the Theory of Statistics, McGraw Hill, New Delhi, 2008.

Evaluation Pattern

Section	Parameters	Marks
A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		10

CSC231 - DATA STRUCTURES AND OPERATING SYSTEMS (2020 Batch)

Total Teaching Hours for Semester:60 | **No of Lecture Hours/Week:4**

Max Marks:100 | **Credits:4**

Course Objectives/Course Description

The course provides knowledge on the data storage techniques, accessing techniques, the various operations applied on the data and fundamental knowledge of operating system architecture and the various operations performed by the Operating system. This course helps the students to attain comprehensive understanding of programming and to acquire the knowledge on the different tasks like job scheduling, memory management, file handling done by operatingsystems.

Learning Outcome

CO1: Understand the different Data Structures using C and the fundamental principles of operating system and system structure.
CO2: To implement the different operations on the data structures and to evaluate the process scheduling, deadlock system and effective memory management
CO3: To analyse the applications of data structures in real time applications CO4: To analyse the file structure, directory structure and allocation methods.

Unit-1 **Teaching Hours:6**

Arrays

Introduction to data structures- Arrays- Introduction, Array Operations, linear search – Binary search – insertion in an array– deletion in an array – sort – Bubble Sort - Insertion Sort - SelectionSort.

Unit-2 **Teaching Hours:6**

Linked List

Introduction –Insertion – Deletion – Search - Double Linked List Representations.

Unit-3 **Teaching Hours:6**

Stack & Queue

Introduction - Stack Operations using arrays and linked lists - Infix to Prefix - Queue Operations using array and linkedlist.

Unit-4 **Teaching Hours:6**

Binary Trees

Introduction - Binary Trees- Properties of Binary Trees - Binary Tree Representations - Binary TreeTraversals.

Unit-5 **Teaching Hours:6**

Graphs

Introduction – Definitions and terminology – graph representations – Depth first search – Breadth first search

Unit-6 **Teaching Hours:6**

Introduction and System Structures

Operating system definition, computer system organization, architecture, structure and operations, process, memory and storage management.

Unit-7 **Teaching Hours:6**

Process Management

Process concepts, scheduling, operations on processes. Process Scheduling: Basic concepts, scheduling criteria, scheduling algorithms, Synchronization: Background, critical section problems.

Unit-8 **Teaching Hours:6**

Deadlock

Deadlock System model, deadlock characterization, methods for handling deadlock, deadlock prevention, avoidance and detection.

Unit-9 **Teaching Hours:6**

Memory Management

Memory Management Strategies: Background, swapping, Memory allocation, Paging, Structure of the pagetable.

Unit-10 **Teaching Hours:6**

File system

File system structure, directory structure, allocation methods and free-space management.

Self Learning : Segmentation, File system structure.

Text Books And Reference Books:

[1] Silberschatz, P.B. Galvin and G. Gagne, *Operating System Concepts*, 9th Edition, New Delhi, Wiley India,2012.

Essential Reading / Recommended Reading

[1] William Stallings, *Operating system Internals and Design Principles*, 7th Edition, Prentice Hall,2017.

[2] Andrew S. Tanenbaum and Herbert Bos, *Modern Operating Systems*, 4th Edition, Pearson,2014.

[3] H.M. Deitel, P. J. Deitel, D. R. Choffnes, *Operating Systems,* 3rd Edition, Pearson, 2007.

Evaluation Pattern

50% ESE + 50% CIA

CSC251 - DATA STRUCTURES LAB (2020 Batch)

Total Teaching Hours for Semester:60 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

The course introduces programming approach and practical implementation of data structure concepts. The course aims to familiarize with practical and real time application of linear and Non-linear data structure. It provides the ability to identify, apply and evaluate relevant data structure concept for the given problems.

Learning Outcome

Upon completion of the course students will be able to:

CO1: Understand the need for Data Structures when building application

CO2: To write diversified solutions for given problem

CO3: Improve logical, analytical, problem solving skill using Cprogramming

Unit-1 **Teaching Hours:30**

List of lab Programs

1. Inserting an element into one dimensionalarray
2. Deletion of an element from one dimensionalarray
3. Implementation of insertionsort.
4. Implementation of selectionsort.
5. Implementation of BinarySearch.
6. Implementation of Linear Search in a linkedlist
7. Creation of a linked list and inserting nodes intoit.
8. Deletion from a linkedlist.
9. Implementation of different operations on astack.
10. Implementationofdifferentoperationsonaqueue

Text Books And Reference Books:

[1] Silberschatz, P.B. Galvin and G. Gagne, *Operating System Concepts*, 9th Edition, New Delhi, Wiley India,2012.

Essential Reading / Recommended Reading

[1] William Stallings, *Operating system Internals and Design Principles*, 7th Edition, Prentice Hall,2017.

[2] Andrew S. Tanenbaum and Herbert Bos, *Modern Operating Systems*, 4th Edition, Pearson,2014.

[3] H.M. Deitel, P. J. Deitel, D. R. Choffnes, *Operating Systems,* 3rd Edition, Pearson, 2007.

Evaluation Pattern

50% CIA + 50% Three Tests

ENG221 - ENGLISH - II (2020 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:2**

Course Objectives/Course Description

- To expose learners to a variety of texts to interact with
- To help learners classify ideologies and be able to express the same
- To expose learners to visual texts and its reading formulas
- To help learners develop a taste to appreciate works of literature through the organization of language
- To help develop critical thinking
- To help learners appreciate literature and the language nuances that enhances its literary values
- To help learners understand the relationship between the world around them and the text/literature
- To help learners negotiate with content and infer meaning contextually
- To help learners understand logical sequencing of content and process information
- To help improve their communication skills for larger academic purposes and vocational purposes
- To enable learners to learn the contextual use of words and the generic meaning
- To enable learners to listen to audio content and infer contextual meaning
- To enable learners to be able to speak for various purposes and occasions using context specific language and expressions
- To enable learners to develop the ability to write for various purposes using suitable and precise language.

Learning Outcome

- Understand how to engage with texts from various countries, historical, cultural specificities and politics
- Understand and develop the ability to reflect upon and comment on texts with various themes
- Develop an analytical and critical bent of mind to compare and analyze the various literature they read and discuss in class
- Develop the ability to communicate both orally and in writing for various purposes

Unit-1 **Teaching Hours:6**

food

1. Long text: Witches' Loaves
O Henry
2. Short text: Portion size is the trick!!!
By Ranjani Raman

Unit-1 **Teaching Hours:6**

language

Presentation skills

Unit-2 **Teaching Hours:6**

Fashion

1.Long text: In the Height of Fashion-Henry Lawson

2. short text: Crazy for Fashion- BabatundeAremu

Unit-2 **Teaching Hours:6**

Language

Report writing

Unit-3 **Teaching Hours:6**

Language

Group Discussion

Unit-3 **Teaching Hours:6**

Architecture

1. long text: Bharat Bhavan
By Charles Correa
2. Short text: The Plain Sense of Things
By Wallace Stevens

Unit-4 **Teaching Hours:6**

Management

1.Long Text: The Amazing Dabbawalas of Mumbai-ShivaniPandita

2. Short Text:
If
By Rudyard Kupling

Unit-4 **Teaching Hours:6**

Language

Interview skills and CV writing

Unit-5 **Teaching Hours:6**

History

1. Long tet: Whose Ambedkar is he anyway?
By KanchaIlaiah

2. Short text: Dhauli

By JayantaMahapatra

Unit-5 **Teaching Hours:6**

language

Developing arguments- debating

Unit-6 **Teaching Hours:6**

language

Letter writing and email writing

Unit-6 **Teaching Hours:6**

War

1. Long text: An Occurrence at Owl Creek Bridge
By Ambrose Bierce
2. Short text: Strange meeting
By Wilfred Owen

Unit-7 **Teaching Hours:6**

language

Ethics of writing on social media platforms

Unit-7 **Teaching Hours:6**

Social Media

1.Long text: Facebook and the Epiphanator: An End to Endings?
By Paul Ford

2. Short text: 'Truth in the time of Social Media' by Girish Balachandran

Unit-8 **Teaching Hours:3**

visual text

BBC Documentary- Dabbawalas

Text Books And Reference Books:

ENGlogue 1

Essential Reading / Recommended Reading

teacher manual and worksheets that teachers would provide. Listening skills worksheets.

Evaluation Pattern

CIA1- 20

MSE-50

CIA3- 20

ESE- 50 online and 50 written

FRN221 - FRENCH (2020 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

French as second language for the UG program

Learning Outcome

Enhancement of linguistic competencies and sharpening of written and oral communicative skills.

Unit-1 **Teaching Hours:5**

Chapter 4- Culture: A country of Vacations

Lesson 1: Hobbies

Unit-2 **Teaching Hours:5**

Chapter 4- Culture: A country of Vacations

Lesson 2: The routine

Unit-3 **Teaching Hours:5**

Poem

1. Demain dès l'aube - Victor Hugo

Unit-4 **Teaching Hours:5**

Chapter 5 - I discover

Lesson 1 : Where to shop?

Unit-5 **Teaching Hours:5**

Chapter 5: I discover

Lesson 2: Discover and Taste

Unit-6 **Teaching Hours:5**

Visual Text

A French Film

Unit-7 **Teaching Hours:5**

Chapter 6- Culture: Gourmet Countries

Lesson 1: Everyone is having fun

Unit-8 **Teaching Hours:5**

Poem

2. Le Lac - Alphonse de Lamartine

Unit-9 **Teaching Hours:5**

Chapter 6- Culture: Gourmet countries

Lesson 2: Daily routine of Teenagers

Text Books And Reference Books:

1. Cocton, Marie-Noelle. Génération A1. Paris : Didier, 2016
2. Poèmes : Demain dès l'aube par Victor Hugo & Le Lac par Alphonse de Lamartine (contenu rédigé sur ligne)

Essential Reading / Recommended Reading

1. Thakker, Viral. Plaisir d'écrire. New Delhi : Langers International Pvt. Ltd., 2011
2. French websites like Bonjour de France, Fluent U French, Learn French Lab, Point du FLE etc.

Evaluation Pattern

Assessment Pattern	CIA (Weight)	ESE (Weight)
CIA 1 – Assignment & MOODLE Testing (Quiz)	10%	
CIA 2 –Mid Sem Exam	25%	
CIA 3 –DELF Pattern: Listening and Speaking /Role Play / Theatre	10%	
Attendance	05%	
End Sem Exam		50%
Total	50%	50%

MAT231 - DIFFERENTIAL EQUATIONS (2020 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

Course Description: This course aims at introducing the students to the theory of ordinary and partial differential equations through various methods of solutions.

Course objectives: This course will help the learner to
COBJ1. Solve first order ODE.
COBJ1. Solve higher order ODE with constant coefficients.
COBJ1. Solve second order linear differential equations with variable coefficients.
COBJ1. Form PDE and solve linear and non linear PDE's of first order.

Learning Outcome

On successful completion of the course, the students should be able to
CO1. Understand the concepts of order, degree and linearity of ODE and recognize ODEs and PDEs.

CO2. Apply multiple approaches/appropriate techniques to solve first order ODEs.
CO3. Solve second order linear differential equations by finding Complementary function and particular integrals.
CO4. Solve second order linear differential equations with variable coefficients by different methods such as if part of the integral is known, exactness and method of variation of parameter.
CO5. Formulation of PDE by eliminating arbitrary constants and functions, solve linear PDEs using Lagrange's auxiliary equation and solve nonlinear PDE's of first order by Charpit's method.

Unit-1 **Teaching Hours:20**

First Order ODE's

Solution of ordinary differential equations of first order and first degree – Variable separable and reducible to variable separable forms – Homogeneous and reducible to homogeneous forms – linear differential equations and reducible to linear differential equations – First order exact differential equations Integrating factors, rules to find an integrating factor – Clairauts equation – Orthogonal trajectory.

Unit-2 **Teaching Hours:20**

Explicit methods of solving higher order linear differential equations

Linear homogeneous equations with constant coefficients, Linear non-homogenous equations, The Cauchy-Euler equation, Simultaneous differential equations with constant coefficients. Second order linear differential equations with variable coefficients by the following methods: (i) when a part of complementary functions is given, (ii) reducing to normal form, (iii) change of independent variable (iv) variation of parameters and (v) by finding the first integral (exact equation), equations of the form (dx/P)=(dy/Q)=(dz/R).

Unit-3 **Teaching Hours:20**

Partial differential equations

Order and degree of partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method. Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Text Books And Reference Books:

1. G. F. Simmons, Differential Equations with Applications and Historical Notes, 2nd ed., New York McGraw Hill, 2006.
2. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, Reprint, Courier Corporation, 2013.

Essential Reading / Recommended Reading

1. *M. D. Raisinghania, Ordinary and Partial Differential Equation, Chand (S.) & Co. Ltd., India: March 17, 2005.*

2. D. G. Zill, W. S. Wright, Advanced Engineering Mathematics, 4th ed., Jones and Bartlett Publishers, 2010.
3. S. L. Ross, Differential Equations, 3rd ed. (Reprint), John Wiley and Sons, 2007.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ, Written Assignment, Reference work, etc.,	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment, Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

MAT251 - DIFFERENTIAL EQUATIONS USING MAXIMA **(2020 Batch)**

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course Description: This course aims at introducing the students to an open source software MAXIMA and make students proficient in using Maxima for solving first and second order ODEs, study the nature of solution by plotting the general/particular solutions.

Course objectives: This course will help the learner to
COBJ1. Acquire skill in solving problems on Differential Equations using MAXIMA.
COBJ2. Gain proficiency in using MAXIMA to solve problems on Differential Equations and its applications.

Learning Outcome

On successful completion of the course, the students should be able to
CO1. Acquire proficiency in using Maxima to study Differential Equations.
CO2. Demonstrate the use of Maxima to understand and interpret the core concepts in Differential Equations.
CO3. Find general and particular solutions of first and second order Differential Equations and to sketch the graph for solutions.
CO4. Apply MAXIMA to learn applications of Differential Equations in real world such as population, radioactive decay and Newton's law of cooling.

Unit-1 **Teaching Hours:30**

Proposed Topics

1. Construction of slope fields of an ordinary differential equation of the form.
2. Sketch the slope fields for the given differential equations using wxMaxima.
3. Sketch the slope fields for the given differential equations by highlighting three/four solution Curves.
4. General solution of a first order differential equation and plotting families of curves representing them.
5. To verify whether the given curves are solutions to the differential equations. Also sketch the graph of any 5 solution curves.
6. To solve the initial value problems and sketch the solution curve.
7. To solve a differential equation and sketch singular solution curve.
8. Applications of First Order Differential Equations – a. Population Growth (Exponential/Logistic Model) and Radioactive decay (Four Case studies b. Mixture Problems and Newton's law of Cooling (Two case studies)
9. Sketch Orthogonal Trajectories.
10. General solution of a second order differential equation and plotting families of curves representing them.

Text Books And Reference Books:

1. *Zachary Hannan, wxMaxima for Calculus I (Creative Commons Attribution Non-Commercial-Share Alike 4.0 International, Solano Community College, Edition 1.0 Publisher, Published June 17, 2015.*
2. Zachary Hannan, wxMaxima for Calculus II (Creative Commons Attribution-Non Commercial-Share Alike 4.0 International), Solano Community College, Edition 1.0 Publisher, Published June 17, 2015.

Essential Reading / Recommended Reading

1. *Sandeep Koranne, Handbook of Open Source Tools, Springer Science & Business Media, 2010.*
2. *Velten, Mathematical Modeling and Simulation: Introduction for Scientists and Engineers, John Wiley and Sons, 2009.*

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab	e-Record work	**07**

	sessions.		
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

STA231 - STATISTICAL METHODS (2020 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

This course is designed to teach the basic concepts of random variables and its generation functions. It also gives a brief idea about standard probability distributions and how they are applied in real time situations.

Learning Outcome

1. :1. Demonstrate the random variables and its functions
   2. Infer the expectations for random variable functions and generating functions.
   3. Demonstrate various discrete and continuous distributions and their usage

Unit-1 **Teaching Hours:10**

Random Variables

Definition, Discrete and continuous random variables, Probability Mass function and Probability density function, Distribution function and its properties. Two dimension random variables: Discrete and continuous type, Joint Density function, Marginal and conditional Probability Mass function and Probability Density function, independence of variables with illustration.

Unit-2 **Teaching Hours:10**

Mathematical Expectation and Generating functions

Expectation of single and bivariate random variables and its properties. Moments and Cumulants, moment generating function, cumulant generating function and characteristic function. Uniqueness and inversion theorems (without proof) along with applications, Conditional expectations.

Unit-3 **Teaching Hours:15**

Discrete Probability distributions

Discrete distributions: Binomial, Poisson, geometric, negative binomial, Hypergeometric distributions along with their properties, limiting/approximation cases and applications.

Unit-4 **Teaching Hours:15**

Continuous Probability distributions

Continuous distributions: Uniform, normal, exponential, Cauchy, beta and gamma distributions along with their properties, limiting/approximation cases and applications.

Unit-5 **Teaching Hours:10**

Limiting Theorems

Chebyshev's inequality, Week Law of Large numbers, Strong Law of Large numbers and their applications, Central Limit Theorem for i.i.d variates and its application, De-Moivre Laplace theorem.

Text Books And Reference Books:

1. 1. Sheldon Ross, *A First Course in Probability,* 9th edition, Pearson Education, US, 2019.
   2. Gupta S.C and Kapoor V.K, *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi, 2014.

Essential Reading / Recommended Reading

1. Mukhopadhyay P, *Mathematical Statistics*, Books and Allied (P) Ltd, Kolkata, 2015.
2. Walpole R.E, Myers R.H, and Myers S.L, *Probability and Statistics for Engineers and Scientists*, Pearson, New Delhi, 2017.
3. Montgomery D.C and Runger G.C, Applied Statistics and Probability for Engineers, Wiley India, New Delhi, 2013.
4. Mood A.M, Graybill F.A and Boes D.C, *Introduction to the Theory of Statistics*, McGraw Hill, New Delhi, 2008.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10

Attendance	05
End Semester Exam	50
Total	100

STA232 - R PROGRAMMING (2020 Batch)

Total Teaching Hours for Semester:60

No of Lecture Hours/Week:4

Max Marks:100

Credits:4

Course Objectives/Course Description

This course is used to provide an introduction to R, statistical language and environment that provides more flexible graph capabilities than other popular statistical packages. The course also covers the basics of R for statistical computation, exploratory analysis, and modeling.

Learning Outcome

CO1: Handle data using statistical tool

CO2: Perform graphical representation of data using R

CO3: Use R for an introductory statistics.

Unit-1 **Teaching Hours:12**

Introduction

Introduction and preliminaries-The R environment, R and statistics, R commands, Data permanency and removing objects, Simple manipulations, Numbers and Vectors, Objects- modes and attributes, Ordered and unordered Factors, Arrays and Matrices

Unit-2 **Teaching Hours:12**

Lists and Data Frames

Constructing and modifying lists, Making Data frames, attach( ) and detach( ), Working with data frame, Reading data from files using read.table( ), scan( ), Grouping, Conditional execution: if statements, Repetitive execution: for loops, repeat and while loops, Functions.

Unit-3 **Teaching Hours:12**

Data Exploration for Univariate and Bivariate Data

Univariate Data - Handling categorical data and numerical data using R, Bivariate Data -Handling bivariate categorical data using R, Categorical vs. Numerical, Numerical vs. Numerical

Unit-4 **Teaching Hours:12**

Data Exploration for Multivariate Data

Multivariate Data -Storing multivariate data in R data frames, Accessing and manipulating data in R data frames, view multivariate data, apply( ) family functions - apply( ), sapply( ), lapply( ), tapply( ), *dplyr* package- select( ), filter( ), arrange( ), rename( ), mutate( ), group_by( ), %>%, summarize( ).

Unit-5 **Teaching Hours:12**

Correlation

Pearson correlation, Spearman rank correlation

Unit-5 **Teaching Hours:12**

Data Visualization

lattice package in R - 1D, 2D, 3D plots using lattice

ggplot2 package in R- 1D, 2D, 3D plots using ggplot2

Text Books And Reference Books:

1. W. N. Venables, D. M. Smith, *An Introduction to R*, R Core Team, 2018.
2. John Verzani, *simpleR – Using R for Introductory Statistics*, CRC Press, Taylor & Francis Group, 2005.

Essential Reading / Recommended Reading

1. Seema Acharya, *Data Analytics Using R*, CRC Press, Taylor & Francis Group, 2018.
2. Michael Lavine, *Introduction To Statistical Thought*, Orange Grove Books, 2009.
3. Paul Teetor, *R Cookbook,* O'Reilly, 2011

Evaluation Pattern

Semester	CIA1	CIA2	C I A – 3	CIA 4	Attendance (Max. Marks)	Total Marks
II	Regular Lab Exercises Evaluation (35 Marks)	Assignment (20 Marks)	Data Analysis (20 Marks)	Case Study Report (20 Marks)	05	100

STA251 - STATISTICAL METHODS PRACTICAL (2020 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

The course is designed to provide a practical exposure to the students in advanced Excel.

Learning Outcome

After completion of this course the students will acquire the knowledge to work with Pivot tables and also the advance analysis of data using few discrete and continuous data.

Unit-1 **Teaching Hours:30**

Practical Assignments using Excel:

1.Create a Pivot table and Pivot charts

2. Manipulate Pivot table by changing calculated value fields and applying Pivot table styles.

3. Setting Pivot table options

4. Draw a scatter plot and fit trend line for a bivariate data set.

5. Calculate correlation and cross-order correlations.

6. Generate random numbers using Binomial, Poisson and geometric distributions

7. Generate random numbers using normal distribution

8. Fit a binomial distribution for given n and p.

9. Fit a Poisson distribution for given value of λ.

10. Fit a normal distribution when parameters are given.

Text Books And Reference Books:

1. Mukhopadhyay P, *Mathematical Statistics*, Books and Allied (P) Ltd, Kolkata, 2015.

2. Walpole R.E, Myers R.H, and Myers S.L, *Probability and Statistics for Engineers and Scientists*, Pearson, New Delhi, 2017.

3. Montgomery D.C and Runger G.C, Applied Statistics and Probability for Engineers, Wiley India, New Delhi, 2013.

4. Mood A.M, Graybill F.A and Boes D.C, *Introduction to the Theory of Statistics*, McGraw Hill, New Delhi, 2008.

Essential Reading / Recommended Reading

1. Rohatgi V.K and Saleh E, *An Introduction to Probability and Statistics*, 3rd edition, John Wiley & Sons Inc., New Jersey, 2015.

2. Gupta S.C and Kapoor V.K, *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi, 2014.

Evaluation Pattern

Parameters	Marks
CIA (8 * 10)	80
Mid-Sem Exam	25
ESE	35
Viva-Voce Exam	10
Total	150

AEN321 - ADDITIONAL ENGLISH (2019 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

Course Description

This course is taught in the second year for students from different streams, namely BA, BSc

and BCom. If the first year syllabus is an attempt by the Department of English, Christ

University to recognize and bring together the polyphonic Indian voices in English and Indian

regional literatures in translation for the Additional English students of the first year, the

second year syllabus intends to take that project a little further and open up the engagement

of the students to texts from across the world. The syllabus - selection of texts will

concentrate on readings from South Asian, Latin American, Australian, Canadian, and Afro-

American. It will voice subaltern concerns of identity, gender, race, ethnicity and problems of

belongingness experienced by humanity all over the globe.

The syllabus will extend the concerns of nation and nationality and marginalization,

discussed within the Indian context to a more inclusive and wider global platform. We have

consciously kept out ‘mainstream’ writers and concentrated on the voices of the subalterns

from across the world. There is an implicit recognition in this project that though the aspects

of marginalization and the problems facing subalterns are present across cultures and

nations, the experiences, expressions and reflections are specific to each race and culture.

The course will address these nuances and specificities and enable our students to become

more aware and sensitive to life and reality around them. This will equip the students, who

are global citizens, to understand not just the Indian scenario, but also situate themselves

within the wider global contexts and understand the spaces they will move into and negotiate

in their future.

There is a prescribed text book Blends: Voices from Margins for the second year students,

compiled by the Department of English, Christ University and intended for private circulation.

Course Objectives

The course objectives are

 to enable students to look at different cultures through Literature

 to help students develop an understanding of subaltern realities and identity politics

 to inculcate literary sensibility/taste among students across disciplines

 to improve language skills –speaking, reading, writing and listening

 to equip the students with tools for developing lateral thinking

 to equip students with critical reading and thinking habits

 to reiterate the study skills and communication skills they developed in the previous

year and extend it.

Learning Outcome

The students will become

 more culturally, ethically, socially and politically aware citizens of the world..

 it will enable students to become aware of the nuances of cultures, ethnicities and

other diversity around them and become sensitive towards them.

Unit-1 **Teaching Hours:12**

Children?s Novel

TetsukoKuroyanagi: Tottochan: The Little Girl at the Window12

Unit-2 **Teaching Hours:12**

Short Story

Liliana Heker : “The Stolen Party

 Higuchi Ichiyo: “Separate Ways”

 Harukki Murakami "Birthday Girl"

 Luisa Valenzuela: “I’m your Horse in the Night”

Unit-3 **Teaching Hours:12**

Poetry

Poetry 12 Hrs

 Silvio Curbelo: “Summer Storm”

 Nancy Morejon: “Black Woman”

 Ruben Dario: “To Roosevelt”

 Mina Asadi: “A Ring to me is a Bondage”

Unit-4 **Teaching Hours:9**

Essay

Essay 9Hrs

 Amy Tan: “Mother Tongue

 Linda Hogan: “Waking Up the Rake”

 Isabelle Allande: “Open Veins of Latin America”

Text Books And Reference Books:

Blends Book II

Essential Reading / Recommended Reading

Oxford Encyclopeadia on Latin American History

Diary of Anne Frank

Elie Wiesel "Night"

Evaluation Pattern

Evaluation Pattern

CIA 1: A written test for 20 marks. It can be an Open Book test, a classroom assignment, an

objective or descriptive test pertaining to the texts and ideas discussed in class.

CIA2: Mid-semester written exam for 50 works

CIA 3: This is to be a creative test/ project in small groups by students. They may do

Collages, tableaus, skits, talk shows, documentaries, Quizzes, presentations, debates,

charts or any other creative test for 20 marks. This test should allow the students to explore

their creativity and engage with the real world around them and marks can be allotted to

students depending on how much they are able to link the ideas and discussions in the texts

to the world around them.

Question Paper Pattern

Mid Semester Exam: 2 hrs

Section A: 4x5= 20

Section B: 2x15=30

Total 50

End Semester Exam: 3 hrs

Section A: 4 x 5 = 20

Section B: 2 x 15= 30

Total 50

CSC331 - DATABASE MANAGEMENT SYSTEM AND JAVA PROGRAMMING (2019 Batch)

Total Teaching Hours for Semester:60 | **No of Lecture Hours/Week:4**

Max Marks:100 | **Credits:4**

Course Objectives/Course Description

To enable the students to apply the concepts of database management system and object oriented programming to develop real world applications.

Learning Outcome

Upon completion of the course students will be able to;

CO1: Understand the basic concepts of relational database model and object oriented programming.

CO2: Demonstrate database operations using Relational Calculus and Algebra.

CO3: Design normalized database applications.

CO4: Create small to medium sized application programs that demonstrate professionally acceptable coding.

Unit-1 **Teaching Hours:5**

Databases and Database Users

Data- Database- Database management system- Characteristics of the database approach- Role of Database administrators- Role of Database Designers- End Users- Advantages of Using a DBMS and When not to use a DBMS-Database System Concepts and Architecture- Data Models- Categories of data models- Schemas- Instances- and Database states- The Three schema architecture- Data independence- DBMS Languages and Interfaces- Classification of Database Management Systems.

Unit-2 **Teaching Hours:8**

Basic SQL

SQL data definition and data types- specifying constraints in SQL- SQL functions- Basic queries-Filtering data using where- Group by statements- DDL- DML- Retrieving data from multiple tables- Sub queries- Concept of a view in SQL.

Unit-3 **Teaching Hours:5**

The Relational Algebra and Relational Calculus

Relational Algebra: Unary relational operations; Binary relational operations ; Examples of queries in relational algebra, Relational calculus: The Tuple relational calculus; The Domain relational calculus.

Unit-4 **Teaching Hours:5**

Data Modeling using Entity-Relationship Model

Using High Level Conceptual Data Models for Database Design- Example Database applications-Entity types- Entity Sets-Attributes and Keys- Relationships- Relationship types- Roles and Structural constraints- Weak Entity Types- Drawing E-R Diagrams.

Unit-5 **Teaching Hours:7**

Database Design

Functional dependencies and Normalization for Relational Databases- Normalization concepts- Normal forms-1NF- 2NF-3NF- BCNF- 4NF.

Unit-6 **Teaching Hours:8**

Introduction to OOPs & Java

OOPs - Problems in Procedure Oriented Approach, Features of Object Oriented Programming System, OOPs Concepts-Class/Object, Encapsulation, Abstraction, Inheritance, Polymorphism, History and Evolution of Java, Overview of Java Data types, Variables, Arrays, Operators and Control structures.

Unit-7 **Teaching Hours:6**

Classes and Inheritance

Class fundamentals, objects, methods, constructors, overloading methods and constructors. Access control-static, Command line arguments, Inheritance & its types, super& this keyword, Abstract class.

Self-Study: String class, Garbage Collection & finalize.

Unit-8 **Teaching Hours:6**

Packages and Interfaces

Defining packages, access protection, importing packages, defining, implementing interfaces. Nested interfaces. Inheritance and interfaces. Use of static in interfaces.

Unit-9 **Teaching Hours:5**

Exceptional Handling and introduction to multithreading

Fundamentals of exceptional handling, types of exceptions, uncaught exceptions, using try, catch, multiple catch clauses, nested try, throw, throws, finally, creating user defined exceptions, Chained exceptions, Introduction to multithreading.

Self study: Enumerators, Type Wrappers.

Unit-10 **Teaching Hours:5**

Input/Output and Applets

I/O - classes, interfaces, files and directories, Byte stream and character streams , Applet class, architecture, applet display

methods.

Text Books And Reference Books:

[1]Fundamentals of Database Systems, Shamkanth B Navathe, Ramez Elmasri, Pearson Education,7th Edition, 2017.

[2]Herbert Schildt, Java: The Complete Reference,Oracle Press,Ninth Edition,2017 .

Essential Reading / Recommended Reading

[1] Database System Concepts, Abraham Silberschatz, Henry F Korth, S Sudarshan, McGraw Hill Education, 6th edition, 2017.

[2] Core Java Volume-1 Fundamentals,Cay S. Horstmann,Pearson Education, Tenth edition ,2016.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination CIA II	25
CIA III	10
Attendance	5
End Semester Exam	50
Total	100

CSC351 - JAVA PROGRAMMING LAB (2019 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

To enable the students to gain hands on experience in object-oriented programming using Java

Learning Outcome

Upon completion of the course students will be able to

CO1: Understand the basic concepts of Java Programming with emphasis on ethics and principles of professional coding.

CO2: Implement the concepts of code reusability and debugging

CO3: Develop applications using java and applets

Unit-1 **Teaching Hours:30**

List of Programs

Implement the concept of arrays

2. Implement the concept of class

3. Implement concept of inheritance

4. Implement Abstract class.

5. Implement the concept of interfaces

6. Implement the concept of packages

7. Creation of a simple applet.

8. Demonstrate usage of File Input Stream and File Output stream.

Text Books And Reference Books:

[1] Herbert Schildt, Java: The Complete Reference, Ninth Edition, 2017 Oracle Press

Essential Reading / Recommended Reading

[1] Cay S. Horstmann, Core Java Volume-1 Fundamentals, Tenth edition, 2016, Pearson Education

Evaluation Pattern

CIA 50%

ESE 50%

ENG321 - ENGLISH-III (2019 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

- T English is offered as a course for all the students in BA, BSc and BCom, classes in the third and fourth semesters. The aim is to strengthen the communication skills, and particularly study skills of the learners further, through adequate practice and exposure to good examples of writing, thought, ideas and human values. In addition, they will be trained in study skills through tasks in academic genres such as message, letter, essay, data interpretation etc. It aims to not only equip learners with skills but also sensitize them towards issues that concern human life in today's globalised

context. The course content is selected to meet the requirements of the departmental goal of “empowering the individual to read oneself, the social context and the imagined”; institutional goal of ensuring “holistic development”; and the national goal of creating competent and valuable citizens. The primary objective of this course is to help learners develop appropriate employability skills and demonstrate suitable conduct with regards to communication skills. The units are organised in order to help the learners understand the academic and workplace demands and learn by practice.

- To enable learners to develop reading comprehension for various purposes
- T To enable learners to develop writing skills for academic and professional needs
- T To enable learners to develop the ability to think critically and express logically
- To enable learner to communicate in a socially and ethically acceptable manner
- T To enable learners, to read, write and speak with clarity, precision and accuracy

Learning Outcome

- Identify deviant use of English both in written and spoken forms
- Recognise the errors of usage and correct them
- Recognise their own ability to improve their own competence in using the language
- Understand and appreciate English spoken by people from different regions
- Use language for speaking with confidence in an intelligible and acceptable manner
- Understand the importance of reading for life
- Develop an interest in reading

- Read independently unfamiliar texts with comprehension
- Read longer texts, compare and evaluate them
- Summarise texts and present orally or in writing
- Understand the importance of writing in academic life
- Write simple sentences without committing errors of spelling and grammar
- Plan a piece of writing using drafting techniques
- Ability to communicate effectively in speech and in writing
- Ability to use better vocabulary to communicate effectively
- Lead and participate in seminars and group discussions more effectively and with increased confidence
- Communicate more fluently and accurately in academic discussion
- Manage (determine the meaning of and record for personal use) unknown general academic and subject specific vocabulary

Unit-1 **Teaching Hours:10**

Introduction to university grammar

Subject verb agreement
Tenses
Preposition
Voices

Clauses

Unit-2 **Teaching Hours:10**

Strategies for Reading

Skimming and scanning
Strategies of reading
Reading and understanding reports
Reading content/ texts of various kinds
Inferencing skills

Academic vocab
Academic phrases
Professional expression

Study skills- library and referencing skills (organising reading, making notes, managing time, prioritising)

Unit-3 **Teaching Hours:10**

Strategic writing for academic purpose

Mind mapping
Organising ideas
Accurate usage of vocabulary
Paragraph strategy
Cohesion and sequencing (jumbled sentences to paragraph)
Extended writing
Formal and informal writing
Reports (all types including illustration to report and report to illustration and/or graphs, charts, tables and other statistical data)
Proposal writing (for projects, for research)
Academic essays/ articles
Persuasive writing, extrapolative writings
Case study writing
Executive summaries
Editing, proofreading skills

Resume vs CV

Unit-4 **Teaching Hours:10**

Listening and Oral communication

Self-introduction
Body language
Talks, speeches and presentations
Conversation
Telephone conversation
Meetings
Group discussion

Seminar / conference presentation

Unit-5 **Teaching Hours:5**

Business communication

Principles of communication
Process of communication
Types of communication

Barriers in communication

Text Books And Reference Books:

ENGlogue -2

Essential Reading / Recommended Reading

NIL

Evaluation Pattern

Proposed and pending for approval

Evaluation Pattern

CIA 1: Classroom assignment/test/ written or oral tasks for 20 marks keeping in tune with the course objectives and learning outcomes.
CIA 2: Mid-semester portfolio submission for 50 marks.
CIA 3: Collage, tableaus, skits, talk shows, documentaries, Quizzes or any creative assignments.

Question Paper Pattern

Mid Semester: Portfolio submission – 50 marks

Mid semester evaluation- portfolio submission (portfolios of classes will be exchanged and evaluated)
End- semester 50 marks exam / portfolio

End Semester Exam: 2 hrs

5x10=50

Total 50

FRN321 - FRENCH (2019 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

French as second language for the Arts, Science and Commerce UG program

Learning Outcome

Enhancement of linguistic competencies and sharpening of written and oral communicative skills

Unit-1 **Teaching Hours:9**

Dossier 1

To perform a tribute: artist, work, you are going to…..

Unit-2 **Teaching Hours:9**

Dossier 2

Towards a working life

Unit-3 **Teaching Hours:9**

Dossier 3

France Seen by...

Unit-4 **Teaching Hours:9**

Dossier 4

Mediamania

Unit-5 **Teaching Hours:9**

Le Bourgeois Gentilhomme

Act 1, 2 & 3

Text Books And Reference Books:

1. Berthet, Annie, Catherine Hugot et al. Alter Ego + A2. Paris : Hachette, 2012
2. Gonnet, Georges. Molière- Le Bourgeois Gentilhomme .Paris : Hachette, 1971

Essential Reading / Recommended Reading

1. Lichet, Raymond., Puig Rosado. Ecrire à tout le monde. Paris : Hachette, 1980
2. French websites like Bonjour de France, FluentU French, Learn French Lab, Point du FLE etc.

Evaluation Pattern

Assessment Pattern	CIA (Weight)	ESE (Weight)
CIA 1 – Assignments / Letter writing / Film review	10%	
CIA 2 –Mid Sem Exam	25%	
CIA 3 – Quiz / Role Play / Theatre / Creative projects	10%	
Attendance	05%	
End Sem Exam		50%
Total	50%	50%

HIN321 - HINDI (2019 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

The detailed text book “Shambook” is a Khanda Kavya written by Jagdeesh Gupta. To improve the creative writing skills,

Nibandh, Kahani and Kavitha lekhan are included.Bharathiya chitrakala is also a part of the syllabus to improve the knowledge aboutIndian paintings.

Learning Outcome

Students will be expose to different forms of poetry especially, Khanda Kaviya and make them understand the contemporary socio-political issues. By learning about the India painting and legendary artists of Indian painting, students come across the richness of theIndian painting.Creative writing module will help the students to improve their analitical and writing skills.

Unit-1 **Teaching Hours:25**

Shambooh

Khanda Kavya "Shambook" [Poetry] By:Jagdeesh Gupta. Pub: Raj Pal & Sons

Level of knowledge:Analitical

Unit-2 **Teaching Hours:10**

Creative writing

Nibandh lekhan, Katha lekhan, Kavitha lekhan.

Level of knowledge:Conceptual

Unit-3 **Teaching Hours:10**

Bharathiya chithrakala -parampara evam pramukh kalakar

Utbhav, vikas aur pramukh shailiyam

pramukh kalakar-1.M F Hussain 2.Ravindranath Tagore 3.Raja Ravi Varma 4.Jamini Roy.

Level of knowledge: Conceptual

Text Books And Reference Books:

1. Khanda Kavya"Shambook[Poetry] ByJagdeesh Gupta.Pub: Raj Pal & Sons

Essential Reading / Recommended Reading

1. Sugam Hindi Vyakaran – Prof Vamsidhar and Dharampal Shastry, Siksha Bharathi, New Delhi
2. Essentials of Screen writing: The art, craft and business of film and television writing By: Walter Richard.
3. Writing and Script: A very short introduction By: Robinson, Andrew.

Evaluation Pattern

CIA-1(Digital learning-wikipedia)

CIA-2(Mid sem examination)

CIA-3(wikipedia article creation)

End semester examination

KAN321 - KANNADA (2019 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:03**

Course Objectives/Course Description

Course Description: Language Kannada is offered to students of third Semester BA/B.Sc as Second language for fifty marks. The students who choose Kannada as second language are generally studied language Kannada at Pre University level. Samples of all genres of Kannada literature, are equally distributed to all four semesters. Students of this semester will study an anthology of Modern Kannada Poetry and an Autobiography of Laxman Gaikwad. This course prepares the students to understand the new era. At the dawn of the twentieth century, B.M. Srikantiah, regarded as the "Father of modern Kannada Literature", called for a new era of writing original works in modern Kannada while moving away from archaic Kannada forms. Students will study modern Kannada poetry from B.M.Sri to Dalit poet Dr. Siddalingiah. An anthology of modern poetry is selected to understand the beauty of modern Kannada poets through their writings. Uchalya is an autobiographical novel that carries the memories of Laxman Gaikwad right from his childhood till he became an adult. Laxman Gaikwad took birth in a criminal tribe of India belonging to Orissa/ Maharastra. The original text is translated to Kannada by Chandrakantha Pokale.

Course Objectives:

The objective is to understand and appreciate poetry as a literary art form. Students will also analyse the various elements of Poetry, such as diction, tone, form, genre, imagery, symbolism, theme, etc. In the text *Uchalya* students will learn the elements of autobiography**.**

Learning Outcome

Course Outcome:

- Strengthen the aesthetic sense in poetry
- Boost up critical thinking and writing
- Ignite critical thinking and judge a text
- Recognise the rhythms, metrics and other musical aspects of poetry

Unit-1 **Teaching Hours:25**

Modern Kannada Poetry

1. *Kariheggadeya Magalu- B.M.Sri*

2. Hunnime Ratri- Kuvempu

3. Anna Yagna-Bendre

4.Mankuthimmana Kagga-D.V.G

5.Ikkala- K.S. Narasimha Swamy

6. Kannad padgol- G.P.Rajarathnam

7.Hanathe hachchuttene- G.S.S

8.Adugemane Hudugi-Vaidehi

9. Nehru Nivruttaraguvudilla- Adgaru

10. Nanna Janagalu.-Siddalingaiah

Unit-2 **Teaching Hours:20**

Autobiography- Uchalya- Lakshman Gayekwad (Marathi)

Text: Uchalya

Author:Lakshman Gayekwad

Translation: Chandrakantha Pokle

Text Books And Reference Books:

1. English Geethegalu- Sri, Publishers: B.M.Sri Smarka Prathistana, Bangalore-19 (2013)

2. Kannada Sahitya Charithre- Volumes 1-4, Editor: G. S. Shivarudrappa, Prasaranga, Bangalore Univeristy.

3. Hosagannada Kavitheya Mele English Kavyada Prabhava- S. Ananthanarayana

4. Hosagannadada Arunodaya- Srinivasa Havanuru

Essential Reading / Recommended Reading

1. Hosagannda Sahitya- L.S. Sheshagiri Rao

2. Kannada Sahitya Sameekshe- G. S. Shivarudrappa

3. Bhavageethe- Dr. S. Prabhushankara

4. My Experiments with Truth- M.K. Gandhi

5. Ouru Keri- Siddalingaiah

Evaluation Pattern

Evaluation Pattern

CIA-1 Written Assignments- 20 Marks

CIA-2 Mid Semsester Examination- 50 Marks

CIA-3 Translation Assignment- English to Kannada -20 Marks

Attendance -05 Marks

End Semester Examination- 50 Marks

MAT331 - REAL ANALYSIS (2019 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

Course description : This course enables the students to understand the basic techniques and theories of real Analysis

Course objectives : This course will help the learner to
COBJ1. Apply and understand limit of a sequence.
COBJ2. Demonstrate the convergence or divergence of sequences and standard series.
COBJ3. Prove the tests for convergence: Comparison Test, Ratio Test, Cauchy's Root test, Raabe's Test, Alternating Series Test etc.
COBJ4. Understand the differences between convergence and absolute convergence
COBJ5. Understand the concept of pointwise and uniform convergence,integrability and differentiability of functions.

Learning Outcome

Course outcomes : On successful completion of the course, the students should be able to
CO1. Quote and understand the definition of a limit of a sequence or a function in its various forms
CO2. Demonstrate the convergence or divergence of the geometric and harmonic series and other standard series
CO3. Apply the basic tests for convergence of infinite series
CO4. Prove the tests for convergence: Comparison Test, Ratio Test, Cauchy's Root test, Raabe's Test, Alternating Series Test etc.
CO5. Understand the differences between convergence and absolute convergence
CO6. Understand and solve binomial , logarithmic and exponential series

Unit-1 **Teaching Hours:20**

Sets and Sequences

Open sets, Closed sets, closure of a set, countable and uncountable sets, topology of real line. Sequences: Definition of Sequences, limit of a sequence, algebra of limits of a sequence, convergent, divergent and oscillatory sequences, problems thereon. Bounded sequences, Monotonic sequences and their properties, Cauchy sequence.

Unit-2 **Teaching Hours:20**

Infinite Series

Infinite series, Cauchy convergence criterion for series, geometric series, comparison test, convergence of p-series, D'Alembert's Ratio test, Raabe's test, Cauchy's Root test, alternating series, Leibnitz's test . Definition and examples of absolute and conditional convergence.

Unit-3 **Teaching Hours:20**

Sequence and Series of functions

Sequences and series of functions, Pointwise and uniform convergence. M_n - test, M-test, Statements of the results about uniform convergence. Power series and radius of convergence.

Text Books And Reference Books:

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. S.C.Malik and Savita Arora, *Mathematical Analysis* , Second Edition, New Delhi, India: New Age international (P) Ltd., 2005.

Essential Reading / Recommended Reading

1. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis* , John Wiley and Sons (Asia) P. Ltd., 2000.
2. E. Fischer *, Intermediate Real Analysis* ,1 st ed.(Reprint), Springer Verlag, 2012.
3. K.A. Ross, Elementary *Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics* , Springer Verlag, 2003.
4. S Narayana and M.D. Raisinghania, *Elements of Real Analysis* , Revised ed., S. Chand & Company Ltd, 2011.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ, Written Assignment, Reference work, etc.,	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment, Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

MAT351 - INTRODUCTION TO PYTHON PROGRAMMING FOR MATHEMATICS (2019 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

Course description: The course *Introduction to Python Programming for Mathematics* is aimed at enabling the students to appreciate and understand core concepts of Mathematics with the help of Python programming language. It is designed with a learner-centric approach wherein the students will acquire mastery in the subject by using Python Programing language as tool.

Course objectives: This course will help the learner to gain a familiarity with
COBJ1. Python language using jupyter interface
COBJ2. Solving basic arithmetic problems using built-in commands
COBJ3. Solving problems using control structures
COBJ4. Data analysis using lists, tuples and dictionaries in Mathematics and depicting it graphically

Learning Outcome

On successful completion of the course, the students should be able to
CO1. Acquire proficiency in using Python
CO2. Demonstrate the use of Python to understand and interpret the concepts in Mathematics

Unit-1 | **Teaching Hours:30**

Proposed Topics

1. Working with Numbers in Python
2. Working with List or tuple in Python
3. Creating graphs with Matplotlib
4. Exploring Quadratic Function Visually
5. Exploring the Relationship between the Fibonacci Sequence and Golden Ratio
6. Summing a Series
7. Using Venn Diagrams to Visualize Relationships Between Sets
8. Verification of Continuity at a point
9. Area between two curves
10. Finding the length of the curve

Text Books And Reference Books:

Amit Saha, *Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus, and More!*, no starch press:San Fransisco, 2015.

Essential Reading / Recommended Reading

1. B E Shapiro, *Scientific Computation: Python Hacking for Math Junkies*, Sherwood Forest Books, 2015.
2. C Hill, *Learning Scientific Programming with Python*, Cambridge Univesity Press, 2016.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

STA331 - STATISTICAL INFERENCE (2019 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

Course Description: This course is designed to introduce the concepts of theory of estimation and testing of hypothesis. This paper also deals with the concept of parametric tests for large and small samples. It also provides knowledge about non-parametric tests and its applications.

Course Objective: To enable the students to give inference about the population based on sample statistic.

Learning Outcome

CO1: Demonstrate the concepts of point and interval estimation of unknown parameters and their significance using large and small samples.

CO2: Apply the idea of sampling distributions of difference statistics in testing of hypotheses.

CO3: Infer the concept of nonparametric tests for single sample and two samples.1.

Unit-1 **Teaching Hours:10**

Introduction

Concept of Population, Sample, Sample Space, Parameter and Statistic, Parameter Space, Sampling distribution of a statistic, Standard error. Derivation of Standard Error of sample mean, variance, proportion and difference between variances. Concept of Order Statistics.

Unit-2 **Teaching Hours:15**

Theory of Estimation

Point Estimation: Concept of Estimator and Estimate, properties of Point estimator – Unbiasedness, Consistency, efficiency, relative efficiency, Minimum variance unbiased estimators, sufficiency, Crammer Rao Inequality (Statement only), Rao Blackwell Theorem (Statement only), Neyman Factorization Theorem (Statement only). Methods of Estimation: Maximum likelihood, least squares and minimum variance. Concept of Interval Estimation.

Unit-3 **Teaching Hours:10**

Tests of Significance I

Concept of Statistical hypotheses, Type I and Type II error, Critical Region and power of the test. Neyman-Pearson lemma (Statement only). Large sample tests: Tests for single mean, equality of two means, single variance and equality of two variance for normal population, Tests of proportions.

Unit-4 **Teaching Hours:15**

Tests of Significance II

Sampling distributions of Chi-square, t and F statistics: derivation of Mean, variance, M.G.F and properties. Small sample tests: Tests for single mean, equality of two means, single variance and equality of two variance, Tests of proportions based on t and F statistics. Chi-square tests for independence of attributes and goodness of fit.

Unit-5 **Teaching Hours:10**

Nonparametric Tests

Concept of Nonparametric tests, Run test for randomness, Sign test and Wilcoxon Signed Rank Test for one and paired samples. Run test, Median test and Mann-Whitney-Wilcoxon tests for two samples.

Text Books And Reference Books:

1. Rohatgi V.K an Saleh E, *An Introduction to Probability and Statistics*, 3rd edition, John Wiley & Sons Inc, New Jersey, 2015.

2. Gupta S.C and Kapoor V.K, *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi, 2014.

Essential Reading / Recommended Reading

1.

1. Walpole R.E, Myers R.H and Myers S.L, *Probability and Statistics for Engineers and Scientists*, 9th edition, Pearson, New Delhi, 2017.
2. John V, *Using R for Introductory Statistics*, 2nd edition, CRC Press, Boca Raton, 2014.
3. Rajagopalan M and Dhanavanthan P, *Statistical Inference*, PHI Learning (P) Ltd, New Delhi, 2012.

4. Rohatgi V.K an Saleh E, *An Introduction to Probability and Statistics*, 3rd edition, John Wiley & Sons Inc, New Jersey, 2015.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA332 - APPLIED EXCEL (2019 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

This course is designed to build the logical thinking ability and to provide hands-on experience in solving statistical models using MS Excel with Problem based learning. To explore and visualize data using excel formulas and filters.

To enable the students to work with different kinds of data into excel.

Learning Outcome

CO1:Demonstrate the logics of using excel features.

CO2: Analyze the given problem and solve using Excel.

CO3: Infer the building blocks of excel, excel shortcuts, sample data creation and analyzing data.

Unit-1 **Teaching Hours:10**

Basics

Introduction: File types, Spreadsheet structure, Menu bar, Quick access toolbar, Mini toolbar, Excel options. Formatting: Format painter, Font, Alignment, Number, Styles, Cells, Clear, Page layout, Symbols, Equation, Editing, Link, Filter, Charts, Formula Auditing. Overview of Excel tables and properties, Collecting sample data and arranging in definite format in excel tables.

Unit-2 **Teaching Hours:15**

File exchange and Data cleaning

Importing data from different sources - text file, web page and XML file, Exporting data in different formats - text, csv, image, pdf etc. Creating database with the imported data. Data tools: text to column, identifying and removing duplicates, using format cell options, Application of functions - Concatenate, Upper, Lower, Trim, Repeat, Proper, Clean, Substitute, Convert, Left, Right, Mid, Len, Find, Exact, Replace, Textjoin, Value, Fixed, etc.

Unit-3 **Teaching Hours:10**

Handling missing data and Excel functions

Data manipulation in table using shortcuts, using formulas and function, Missing value handling in graph using example of scatter graph with connecting line. Logical functions: AND, OR XOR, NOT, Conditional functions: IF, IFERROR, IFS, SWITCH. Date and Time: Date, Time, Now, Today, Year, Eomonth, Edate, Workdays, Workdays.Intl, Yearfrac. Lookup and Reference Functions: LOOKUP, VLOOKUP, HLOOKUP, INDEX, MATCH.CHOOSE, OFFSET, HYPERLINK. Mathematical Operations: SUM, PRODUCT, AGGREGATE, SUBTOTAL. Statistical Functions: Count, Frequency, Percentiles, Quartiles, Rank, Deviation, Variance, Averages etc..

Unit-4 **Teaching Hours:10**

Data analysis

Data analysis tool pack: measures of central tendency, dispersion, skewness, kurtosis, partition values, graphical and diagrammatic representation of data: histogram, bar diagram, charts, line graphs, ogive, covariance, correlation, linear regression.

Unit-5 **Teaching Hours:15**

Macros and Security

Introduction to macros, using macros for data entry, importing files, Data cleaning and managing using macro, Different types of security available in Excel to protect the contents. Construction of dashboard.

Text Books And Reference Books:

1.

    1. Walkenbach J, *Microsoft Excel 2013 Bible: The Comprehensive Tutorial Resource*, Wiley India Pvt Ltd, New Delhi, 2016.
    2. Alexander M, *Excel 2016 formulas*, Wiley India Pvt Ltd, New Delhi, 2016.

Essential Reading / Recommended Reading

1. Olafusi M, *Microsoft Excel and Business Data Analysis for the Busy Professional*, Create Space Independent Publishing Platform, 2016.

2. Alexander M, *Excel 2016 formulas*, Wiley India Pvt Ltd, New Delhi, 2016.

3. McFedries P, *Excel Data Analysis Visual Blueprint*, 4th Edition, Wiley India Pvt Ltd, New Delhi, 2013.

4. www.excelfunctions.net

5. www.excel-easy.com

Evaluation Pattern

Semester	CIA1	CIA2	C I A – 3	ESE	Attendance (Max. Marks)	Total Marks
III	Regular Lab Exercises Evaluation (35 Marks)	Assignment (20 Marks)	Data Analysis (20 Marks)	(20 Marks)	05	100

STA351 - STATISTICAL INFERENCE PRACTICAL (2019 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course Description: This course is designed to give a practical exposure for testing of hypothesis by analyzing various data sets using R programming.

Course Outcomes: After the completion of this course, students will be able to perform the parametric and nonparametric tests for small and large samples using R programming.

Learning Outcome

1. CO1: Demonstrate the usage of R proramming in Testing of Hypothesis.

2. CO2: Perform the parametic tests using R progrmming and infer the results.

3. CO3 Infer the concept of nonparametric tests for single sample and two samples.

Unit-1 **Teaching Hours:30**

Practical Assignments using R programming

1.

1. Test for mean and equality of two means when variance is known under normality conditions.

2. Test for single mean when variance is unknown under normality conditions.
3. Test for equality of two means when variance is unknown under normality conditions.
4. Test for single proportion
5. Test for equality of two proportions.
6. Test for variance and equality of variances under normality conditions.
7. Test for independence of attributes using Chi-Square test.
8. Test for goodness fit using Chi-Square test.
9. Test for one sample using Run test and sign test.
10. Test for paired samples using Wilcoxon Signed Rank test
11. Test for two samples using Run test and Median test
12. Test for two samples using Mann-Whitney-Wilcoxon test.

Text Books And Reference Books:

Micheal J. Crawley, The R Book, 2nd Edition, Wiley International, 2017

Essential Reading / Recommended Reading

John Maindonald, W. John Braun, Data Analysis and Graphics Using R: An Example-Based Approach, Cambridge University Press, 2010.

Evaluation Pattern

Component	Points
CIA of experiments	80
Test 1	25
Test 2	35
Viva-Voce Exam	10
Total	150

AEN421 - ADDITIONAL ENGLISH (2019 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

This course is taught in the second year for students from different streams, namely BA, BSc and B Com. If the first year syllabus is an attempt by the Department of English, Christ University to recognize and bring together the

polyphonic Indian voices in English and Indian regional literatures in translation for the Additional English students of the first year, the second year syllabus intends to take that project a little further and open up the engagement of the students to texts from across the world. The syllabus - selection of texts will concentrate on readings from South Asian, Latin American, Australian, Canadian, and Afro-American. It will voice subaltern concerns of identity, gender, race, ethnicity and problems of belongingness experienced by humanity all over the globe.

The syllabus will extend the concerns of nation and nationality and marginalization, discussed within the Indian context to a more inclusive and wider global platform. We have consciously kept out 'mainstream' writers and concentrated on the voices of the subalterns from across the world. There is an implicit recognition in this project that though the aspects of marginalization and the problems facing subalterns are present across cultures and nations, the experiences, expressions and reflections are specific to each race and culture. The course will address these nuances and specificities and enable our students to become more aware and sensitive to life and reality around them. This will equip the students, who are global citizens, to understand not just the Indian scenario, but also situate themselves within the wider global contexts and understand the spaces they will move into and negotiate in their future.

There is a prescribed text book *Blends: Voices from Margins* for the second year students, compiled by the Department of English, Christ University and intended for private circulation.

The course objectives are

- to introduce the students to look at different cultures through Literature
- to help students develop an understanding of subaltern realities and identity politics
- to inculcate literary sensibility/taste among students across disciplines
- to improve language skills –speaking, reading, writing and listening

- to equip the students with tools for developing lateral thinking

- to equip students with critical reading and thinking habits

- to enable them to grasp and appreciate the variety and abundance of subaltern writing, of which this compilation is just a glimpse

- to actively engage with the world as a cultural and social space (to be facilitated through proactive CIAs which help students to interact and engage with the realities they face everyday and have come across in these texts)

- to learn and appreciate India and its place in the world through association of ideas in the texts and the external contexts

- to reiterate the study skills and communication skills they developed in the previous year and extend it.

Learning Outcome

Learning Outcome

- The course will equip students to be more proactive 'global citizens' keeping with the orientation they receive in all the four semesters.

Unit-1 **Teaching Hours:12**

Novella

Unit 1: Novella

- Viktor Frankl: "Man's Search for Meaning"(Excerpts)

Unit-2 **Teaching Hours:12**

Short Stories

Short Story

- Anton Chekov: "The Avenger"

- Chinua Achebe: "Marriage is a Private Affair"

- Nadine Gordimer: “Train from Rhodesia”

- Wakako Yamuchai: “And the Soul Shall Dance”

Unit-3 **Teaching Hours:12**

Poetry

Poetry

12 hrs

- Octavio Paz: “As One Listens to the Rain”

- Jamaica Kincaid: “Girl”

- Derek Walcott: “A Far Cry from Africa”

- Joseph Brodsky: “Freedom”

Unit-4 **Teaching Hours:9**

Essays

- Alice Walker: Excerpts from “In Search of My Mother’s Gardens”

- Hannah Arendt: “Men in Dark Times”

Dalai Lama Nobel Acceptance Speech

Text Books And Reference Books:

Blends Book II

Viktor Frankl's "Man's Search for Meaning"

Essential Reading / Recommended Reading

Elie Wiesel "Night"

Diary of Anne Frank

Famous Nobel Lectures

Evaluation Pattern

CIA 1: A written test for 20 marks. It can be an Open Book test, a classroom assignment, an objective or descriptive test pertaining to the texts and ideas discussed in class.

CIA2: Mid-semester written exam for 50 works

CIA 3: This is to be a creative test/ project in small groups by students. They may do Collages, tableaus, skits, talk shows, documentaries, Quizzes, presentations, debates, charts or any other creative test for 20 marks. This test should allow the students to explore their creativity and engage with the real world around them and marks can be allotted to students depending on how much they are able to link the ideas and discussions in the texts to the world around them.

CSC431 - SOFTWARE ENGINEERING AND COMPUTER NETWORKS (2019 Batch)

Total Teaching Hours for Semester:60 | **No of Lecture Hours/Week:4**

Max Marks:100 | **Credits:4**

Course Objectives/Course Description

This course makes the students to focus on the important steps in designing the software project and also helps them in identifying various components in a data communication system and understands state-of-the-art network protocols, architectures and its applications. This course helps the students to attain comprehensive understanding of software engineering principles and the concepts of computer networks, network models and their involvement in each stage of networkcommunication.

Learning Outcome

On completion of the course the student shall

CO1: Understand the principles and concepts of software engineering and computer networks

CO2: Find the practical solutions to the problem applying software process and network technologies

CO3: Analyze and practices software engineering principles and design the network structure for the real time applications

Unit-1 **Teaching Hours:5**

Software and Software Engineering:

Nature of software - Defining software, Software Application Domains, Legacy Software - Software Engineering, The software process, Software Engineering practice - The essence of Practice, General Principles - Software Crisis andMyths.

Unit-2 **Teaching Hours:6**

Process Models:

A generic process model – Defining a framework activity, identifying a Task Set, Process Patterns - Process Assessment and improvement, Prescriptive Process Models – The waterfall Model, Incremental Model, Evolutionary Process Model, Concurrent Models - A Final Word on EvolutionaryProcesses.

Unit-3 **Teaching Hours:6**

Understanding Requirements:

Requirements Engineering, Establishing the groundwork – Identifying Stakeholders, Recognizing multiple viewpoints, Working toward Collaboration, Asking the first questions - Eliciting requirements - Collaborative requirement gathering, Quality function Deployment, Usage Scenario Elicitation Work Products - Developing use cases, building the requirements model – Elements of the requirements Model, Analysis pattern - Negotiating requirements, validating requirements.

Unit-4 **Teaching Hours:6**

Design Concepts:

The design within the context of Software Engineering, The design process – Software quality guidelines and attributes, The evolution of software design - Design concepts – Abstraction, Architecture, Patterns, Separation of concerns, Modularity, information hiding, Functional Independence, refinement, Aspects, Refactoring, Object Oriented design concepts Design classes. The design Model – Data Design elements, Architectural Design elements, Interface Design Elements, Component - Level Design elements, Deployment level Design elements.

Unit-5 **Teaching Hours:7**

Software Testing:

A Strategic approach to testing- Verification and Validation, Organizing for software testing, software testing strategy, Criteria for completion of testing-Test strategies for conventional software - Unit testing, Integration testing- Test

strategies for Object Oriented software-Unit testing in the OO Context, Integration testing in the OO Context - Validation testing, White- box testing, Basic path testing- Flow Graph Notation, Independent program paths, Deriving test cases, Graph matrices- control structure testing – Condition testing, Data flow testing, loop testing- Black-box testing-Graph-based testing methods, Equivalence partitioning, boundary valueanalysis.

Unit-6 **Teaching Hours:6**

Introduction and Network Models

Data communications: components – Network criteria – physical structures – network models

– categories of networks –interconnection of networks - Inter network Protocols and standards: protocols-standards-standards organizations- internet standards Network models: Layeredtasks–OSImodel–layersintheOSImodel-TCP/IPprotocolsuite

Unit-7 **Teaching Hours:7**

Physical Layer:

Data and Signals: Analog and Digital: Analog and Digital Data – Analog and Digital signals, periodic and non periodic signals - Transmission Impairment: Attenuation – Distortion – Digital Transmission: Digital to digital conversion: Line coding – line coding schemes – PCM – serial transmission – parallel transmission. Transmission Media Guided media: Twisted pair cable – coaxial cable – fiber optic cable - Unguided media: radio waves - micro waves –infrared.

Unit-8 **Teaching Hours:6**

Data Link Layer

Error correction and detection: Introduction – checksum; Multiple Access: Random access – Aloha Controlled Access: reservation – polling – token passing. Channelization: FDMA - TDMA Wireless Lans IEEE 802.11 - architecture - MAC sub layer Addressing mechanism. Connecting Devices – hubs – repeaters – bridges – switches – routers – gateway.

Unit-9 **Teaching Hours:6**

Network Layer:

Network Layer: Addressing IPV4 addresses - IPV6 Addresses - Internet Protocol: IPv4 – IPv6Address. mapping protocols: ARP – RARP Routing protocols: Unicast routing protocols: distance vector routing, Link State routing, Multicast Routingprotocols

Unit-10 **Teaching Hours:5**

Transport Layer and Application Layer:

Transport Layer: Process to process delivery – UDP – TCP. DNS: Name space – domain name space – distribution of name space Electronic mail Architecture – FILE transfer: FTP. WWW and HTTP: Architecture – web documents –HTTP.

Text Books And Reference Books:

[1] Pressman S Roger, *Software Engineering A Practitioner's Approach*, McGraw Hill International Editions, 7th edition,2010.

[2] Behrouz A Forouzan, *Data communication and networking*,5 Publications, 2017.

Essential Reading / Recommended Reading

[1] Sommerville, Ian, *Software Engineering,* Addison Wesley, 9th Edition,2010.

[2] Pankaj Jalote, *Software Engineering: A Precise Approach,* Wiley India,2010.

[3] Stephen R. Schach, *Software Engineering,* Tata McGraw-Hill Publishing Company Limited,2007.

[4] William Stallings, *Data and Computer Communications*, Tenth Edition, Pearson Publications,2014.

[5] Andrew S Tanenbaum, Computer Networks, 5th Edition, PHI publication,2012.

[6] Larry L. Peterson and Bruce S Davie, Morgan Kaufmann, Computer Networks: A system approach,2010

Evaluation Pattern

CIA - 50%

ESE - 50%

CSC451 - WEB TECHNOLOGY LAB **(2019 Batch)**

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

The Web Technology Lab provides a great opening for those who want to pursue a career in the web development. Student will learn the core concepts of web site design including the wire framing, planning and hosting. This course will help them to create a interactive website with great look andfunctionality.

Learning Outcome

- CO1:Gains knowledge about the World Wide Web associated technologies
- CO2:Apply web development techniques and skills for website design
- CO3:Design an interactive website

Unit-1 **Teaching Hours:4**

Web programming Introduction

Week 1

Web programming Introduction

Web technology terminology-Structure of web page- webpage-website-web server-work flow model. HTML5- History-Tags-Attributes-element-Basic tags –Formatting tags- Color coding

Program 1

Design/Develop a website that consists of minimum 3 pages (Landing page, Content page and Contact us page) with all the possible tags and information

Unit-2 **Teaching Hours:4**

HTML FORMS

Week 2

HTML FORMS

List – Images- Hyperlink-Table-Header-Introduction to advanced tags-input tags-forms-style-buttons-image-video

Program 2

Design/Develop an interactive website which resembles the login page of any social media login page.

Unit-3 **Teaching Hours:4**

CSS - Introduction

Week 3

CSS – Introduction

Cascading style sheet –Benefits –CSS version history-Syntax-External-internal-inline-single style-multiple style-value lengths and percentage-ID selector –Class Selector-group Selector – universal selector

Program 3

Create a website with three different CSS files/ include all type of selector and all 3 types of style sheet

Unit-4 **Teaching Hours:4**

CSS - Advanced

Week 4

CSS – Advanced

Color-background-cursor-list-Box model-display positioning-floats

Program 4

Design a website that has 2 different CSS files which includes all the advanced options of the CSS positioning and formatting.

Unit-5 **Teaching Hours:4**

JavaScript - Fundamentals

Week 5

JavaScript – Fundamentals

Introduction to JavaScript-Client side-Server side-Advantages-limitations-Syntax-whitespace-line breaks-case sensitivity-comments-enabling in web browsers-placement-variables-executing first program-Data types –variables-scope-operators-if –else-switch-loops-function-events.

Program 5

Use user defined function to get array of values and sort them in ascending order

Unit-6 **Teaching Hours:4**

JavaScript -Advanced

Week 6

JavaScript – Advanced

Event Handling-onclick-onsubmit-onmouseover-onmouseout-HTML 5 standard events-cookies-how it works-storing cookies-page redirect-page printing-JS objects-Boolean-string

Program 6

Event Handling • Validation of registration form • Open a Window from the current window • Change color of background at each click of button or refresh of a page • Display calendar for the month and year selected from combo box • OnMouseover event

Unit-7 **Teaching Hours:4**

Instant Design

Week 7

Instant Design

Create website using Instant Design tools

Create website using WIX/Webflow/Google Site…etc

Creating responsive web pages

Program 7

Design a complete interactive website for portfolio management

Unit-8 **Teaching Hours:2**

Testing and hosting

Week 8 Testing and hosting

Sandboxing-Testing the website-cross platform browser compatibility check up. Templates usage (case study)

Program 8

Host the website you have created and share the live website link

Text Books And Reference Books:

[1] Rachel Andrew, Jeremy Keith, “HTML5 for Web Designers”, Second Edition, 2nd Edition, 2016, ISBN: 9781492017899, Publisher - A Book Apart

[2] “CSS3 in easy steps”, Mike McGrath, publisher: In Easy Steps, ISBN: 9781840785418, 1840785411

[3] Jeremy McPeak and Paul Wilton, “Beginning JavaScript”, Wrox publication,

Essential Reading / Recommended Reading

[1]. Faithe Wempen, Microsoft,” Start Here! Learn HTML5" , 2012

[2] David McFarland, O’REILLY , “CSS 3 Missing Manual”, 2nd edition , 2014

Evaluation Pattern

Weightage

-CIA-50%

-ESE-50%

ENG421 - ENGLISH-IV (2019 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

To enable learners to develop reading comprehension for various purposes

 To enable learners to develop writing skills for academic and professional needs

 To enable learners to develop the ability to think critically and express logically

 To enable learner to communicate in a socially and ethically acceptable manner

 To enable learners, to read, write and speak with clarity, precision and accuracy

Learning Outcome

Learning Outcome:

 Identify deviant use of English both in written and spoken forms

 Recognise the errors of usage and correct them

 Recognise their own ability to improve their own competence in using the language

 Understand and appreciate English spoken by people from different regions

 Use language for speaking with confidence in an intelligible and acceptable manner

 Understand the importance of reading for life

 Read independently unfamiliar texts with comprehension

 Read longer texts, compare and evaluate them

 Summarise texts and present orally or in writing

 Understand the importance of writing in academic life

 Write simple sentences without committing errors of spelling and grammar

 Plan a piece of writing using drafting techniques

 Ability to communicate effectively in speech and in writing

 Ability to use better vocabulary to communicate effectively

 Lead and participate in seminars and group discussions more effectively and with increased

confidence

 Communicate more fluently and accurately in academic discussion

 Manage (determine the meaning of and record for personal use) unknown general academic

and subject specific vocabulary

Unit-1 **Teaching Hours:10**

Emotional Intelligence

Self-awareness

Stress management

Assertive skills

Critical thinking

Creative problem solving and decision making

Appreciative inquiry

Conflict resolution

Unit-2 **Teaching Hours:10**

Professional skills

Professional ethics and etiquette (cell phone etiquette)

Organisation skills

Research and information management

Teamwork

Leadership skills

Workplace ethics- culture, values and gender (netiquette)job search skill, mindfulness, goal

setting, self-awareness

Unit-3 **Teaching Hours:10**

Workplace skills

Interview skills

Professional etiquette

Elevator pitch

Teleconference

Video conference

Conference calls

Negotiation

Networking

Unit-4 **Teaching Hours:15**

Professional writing

Feature writing

Writing for advertisement

Developing web content

Infographics

Emails

Making notes in meetings

Minutes

Newspaper writing

Press release

Blog writing

Tender

Memo

Brochure

User manual

Text Books And Reference Books:

ENGlogue-2

Essential Reading / Recommended Reading

NIL

Evaluation Pattern

Pending COE approval

Evaluation Pattern

CIA 1: Classroom assignment/test/ written or oral tasks for 20 marks keeping in tune with the

course objectives and learning outcomes.

CIA 2: Mid-semester portfolio submission for 50 marks.

CIA 3: Collage, tableaus, skits, talk shows, documentaries, Quizzes or any creative

assignments.

Question Paper Pattern

Mid Semester: Portfolio submission – 50 marks

Mid semester evaluation- portfolio submission

End- semester 50 marks exam / portfolio (portfolios of classes will be exchanged and

evaluated)

FRN421 - FRENCH (2019 Batch)

Total Teaching Hours for Semester:45	**No of Lecture Hours/Week:3**
Max Marks:100	**Credits:3**

Course Objectives/Course Description

French as second language for the Arts, Science and Commerce UG program

Learning Outcome

Enhancement of linguistic competencies and sharpening of written and oral communicative skills

Unit-1	**Teaching Hours:9**

Dossier 5

Leisure Time

Unit-2 **Teaching Hours:9**

Dossier 6

The world is ours

Unit-3 **Teaching Hours:9**

Dossier 7

News

Unit-4 **Teaching Hours:9**

Dossier 8

Educ- actions

Unit-5 **Teaching Hours:9**

Le Bourgeois Gentilhomme

Act 4 & 5

Text Books And Reference Books:

1. Berthet, Annie, Catherine Hugot et al. Alter Ego + A2. Paris : Hachette, 2012
2. Gonnet, Georges. Molière- Le Bourgeois Gentilhomme .Paris : Hachette, 1971

Essential Reading / Recommended Reading

1. Lichet, Raymond., Puig Rosado. Ecrire à tout le monde. Paris : Hachette, 1980
2. French websites like Bonjour de France, FluentU French, Learn French Lab, Point du FLE etc

Evaluation Pattern

Assessment Pattern	CIA (Weight)	ESE (Weight)
CIA 1 – Assignments / Letter writing / Film review	10%	
CIA 2 –Mid Sem Exam	25%	
CIA 3 – Quiz / Role Play / Theatre / Creative projects	10%	
Attendance	05%	
End Sem Exam		50%
Total	50%	50%

HIN421 - HINDI (2019 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

The detailed text-book "Ashad ka ek din" is a drama by Mohan Rakeshi, one of the eminent writers of modern Hindi Literature. Hindi journalismis is one of the major unit of this semester. Phrases, idioms, technical and scientific terminology are included in this semester to improve the literary skills.

Learning Outcome

Through the prescribed play and the theatre performance, students can go through the process of experiential learning. Study of Mass media enables them to get practical training.Technical terminology will improve the literary skills.

Unit-1 **Teaching Hours:30**

Natak- Ashad Ka Ek Din (Play) by Mohan Rakesh

Madhavi (Play) ByBhishma Sahni. Rajpal and Sons, New Delhi - 110006

Level of knowledge: Analitical

Unit-2 **Teaching Hours:20**

SancharMadhyam

- Report writing,
- Media Interview
- Hindi Journalism
- Electronic media and Hindi,
- Print media

Level of knowledge: Conceptual

Unit-3 **Teaching Hours:10**

Phrases, Idioms. and Scientific and Technical Terminology

1. 50 Nos. Phrases and Idioms for writing the meaning and sentence formation.

2. 100 Nos. (Hindi equivalent)

Level of knowledge: Basic

Text Books And Reference Books:

1. "Ashad ka ek din ” is a drama by Bhisma Sahni. Rajpal and Sons, New Delhi - 110006

Essential Reading / Recommended Reading

1. News reporting and writing: By Mencher, Melvin..
2. Hindi patrakarita ka Ithihas: By Jagadeesh Prasad Chaturvedi
3. Hindi patrakarita swaroop evam sandarbh: By Vinod Godare
4. Media Interview: By Philip Bell, Theovanleeuwen.

Evaluation Pattern

CIA-1(Digital learning)

CIA-2(Mid sem exam)

CIA-3((Wikipedia-Article creation)

End sem exam

KAN421 - KANNADA (2019 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:03**

Course Objectives/Course Description

This course explores the short story and play as meaningful literary forms, with emphasis on structure and technique. The course is designed to learn more about language, literature and culture of the Medieval Kannada literary period. A Play and a few selected short stories are prescribed to understand the literary trends of the time.

Text-1 ***Kalagnani Kanaka***, a play written by well-known critic and thinker Prof. K.R. Nagaraj. Kanakadasa was a poet-saint of the Haridasa Bhakthi tradition of the mid-16th century. Though of 'low' birth- Kanakadasa was a chieftain of the shepherd community- he became one the most celebrated Bhakthi poets of his time, forcing recognition from the Brahmin-dominated religious establishment for the literary and philosophical merit of his writings. His poetry- written in simple and spoken Kannada – reflects his belief that devotion to Gd lies beyond the artificial hierarchies imposed by caste, and orthodoxy. "Kanaka's writings touch on all aspects of truth and social reality".

Text-2 **Kannadada Moovathu Kahegalu- (Ed). Phakeer Mohamad Katpadi & Krishnamurthy Hanur .**

In the above selected short stories the students will learn the essential elements of short story writing such as plot and structure, dialogue, characterisation, setting, tense, viewpoint, and much more.

Learning Outcome

Students will:

- Attend class regularly and on time
- Participate in class activities and discussion
- Complete all individual and class projects
- Read all assigned material

Unit-1 **Teaching Hours:25**

Play

Text: 1 Kalagnani Kanaka

By

K.R. NagaraJ

Publishers: Anktha Book House

Gandhi Bazar, Bengaluru

Unit-2 **Teaching Hours:20**

Text-2 Kannadada Moovathu Kahegalu- (Ed). Phakeer Mohamad Katpadi & Krishnamurthy Hanur

1. Dhaniyara Sathyanarayana-Koradkal Sreenivasa Rao

2. Thabarana Kahte- K. P. Poornachandra Tejaswi

3. Gowthami Helida Kathe- Masti Venkatesha Iyengar

4. Raja mattu Hakki- G. P. Basavaraj

Text Books And Reference Books:

1. Adhunika Kannada Nataka- K. Marulasiddappa

2. Yugadharma hagu sahitya darshana- Keerthinatha kurthukoti

3. kannada sahitya charithre- R. S. Mugali

4. Kannada Rangabhoomi- K.V. Akshara

Essential Reading / Recommended Reading

1. Kanakadasa: Basrur Subba Rao

2. The servant of Lord Hari- Basavaraj Naikar

3. Kannada Sanna Kathegala Olavu- Giradddi Govindaraj

Evaluation Pattern

CIA-1 Written Assignment

CIA-2 Mid Semsester Examination

CIA-3 Book Review

End Semester Examination

MAT431 - ALGEBRA (2019 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

Course description : This course aims at developing the ability to write the mathematical proofs. It helps the students to understand and

appreciate the beauty of the abstract nature of mathematics and also to develop a solid foundation of theoretical mathematics.

Course objectives : This course will help the learner to
COBJ1. Understand the fundamentals of Groups and its theories.
COBJ2. Relate abstract algebraic constructs to more familiar sets and operators
COBJ3. Know about the Subgroups and Group Homomorphisms
COBJ4. Get familiar with the theories on Rings, Integral Domains and Fields.

Learning Outcome

Course outcomes : On successful completion of the course, the students should be able to
CO1. Describe and generate groups, rings and fields
CO2. Identify and differentiate different structures and understand how changing properties give rise to new structures
CO3. Demonstrate some simple applications related to group of symmetries
CO4. Understand concepts of commutative rings, integral domains, ring homomorphism and factorization theorem of commutative rings

Unit-1 **Teaching Hours:15**

Groups

Definition and examples of groups, examples of abelian and non-abelian groups, the group Znof integers under addition modulo n and the group U(n) of units under multiplication modulo n, complex roots of unity, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square.

Unit-2 **Teaching Hours:25**

Subgroups and Group Homomorphism's

Subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. order of an element, cyclic subgroups, Cosets, Index of subgroup, Lagrange's theorem, consequences of Lagrange's theorem, Normal subgroups: their definition, examples, and characterizations, Quotient groups, Cauchys theorem for finite abelian groups, permutation groups and Symmetric groups – Homomorphism of groups – Kernel of group homomorphisms and theorems thereon – Fundamental theorem of homomorphism of group.

Unit-3 **Teaching Hours:20**

Rings, Integral Domain and Fields

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Z_p, Q, R, and C. Field of rational functions.

Text Books And Reference Books:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

2. I N Herstein , *Topics in Algebra*, Second Edition. Wiley India (P) Ltd.New Delhi, India: Vikas Publishing House Pvt. Ltd, 2006.
3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 2000.

Essential Reading / Recommended Reading

1. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
2. S.R. Nagpaul and S.K.Jain, Topics in Applied Abstract Algebra, Universities Press, 2010.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ, Written Assignment, Reference work, etc.,	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment, Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

MAT451 - INTRODUCTION TO MATHEMATICAL MODELLING USING PYTHON (2019 Batch)

Total Teaching Hours for Semester:30 — **No of Lecture Hours/Week:2**

Max Marks:50 — **Credits:2**

Course Objectives/Course Description

Course description: The course *Introduction to Mathematical Modelling using Python* is aimed at enabling the students study the implementation of Python Programming for solving some problems on Mathematics and study some Mathematical Models. It is designed with a learner-centric approach wherein the students will acquire mastery in the subject by using Python Programing language as tool.

Course objectives: This course will help the learner to gain a familiarity with
COBJ1. Python language using jupyter interface
COBJ2. The built in functions required to deal with complex numbers and matrices
COBJ3. The skills to solve various Mathematical models- Exponential growth, Logistic growth, Simple pendulum and Spreading of disease

Learning Outcome

On successful completion of the course, the students should be able to
CO1. Acquire proficiency in using Python
CO2. Demonstrate the use of Python to understand and interpret the concepts in Mathematics.

Unit-1 **Teaching Hours:30**

Proposed Topics

1. Complex Arithmetic, functions in Python
2. Inverse, Determinant and Eigenvalues in Python
3. Transpose and Upper/Lower Triangular parts in Python
4. Solving Linear Systems in Python
5. Plotting of Scalar and Vector fields
6. Mathematical Model: Interest Rates
7. Mathematical Model: Growth of a population – Exponential Model
8. Mathematical Model: Logistic Growth
9. Mathematical Model: A Simple Pendulum
10. Mathematical Model: Spreading of a Disease

Text Books And Reference Books:

H P Langtangen, *A Primer on Scientific Programming with Python,* 2nd ed., *Springer*, 2016.

Essential Reading / Recommended Reading

1. B E Shapiro, *Scientific Computation: Python Hacking for Math Junkies*, Sherwood Forest Books, 2015.
2. C Hill, *Learning Scientific Programming with Python*, Cambridge University Press, 2016.
3. Amit Saha, Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus, and More!, no starch press:San Fransisco, 2015.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2

			85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

STA431 - SAMPLING TECHNIQUES (2019 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

Course Description: This course designed to introduce students about official statistical system in India and to understand basic concepts of Sampling and surveys.

Course Objective: To enable the students to understand various sampling techniques and their application in various research studies.

Learning Outcome

CO1. Demonstrate the official Statistical System in India.

CO2. Demonstrate various sampling techniques and their application

CO3. Infer various sampling error and non sampling error.

Unit-1 **Teaching Hours:10**

Introduction to Sampling Theory

Concepts of population and sample. Complete enumeration vs. sampling. Planning of Sampling Survey. Types of sampling: non-probability and probability sampling, basic principle of sample survey, population mean, total and proportion, variances of these estimates and sample size determination, Sampling and non-sampling errors, determination of sample size.

Unit-2 **Teaching Hours:10**

Simple Random Sampling

Simple Random Sampling: Probability of selecting any specified unit in the sample, selection of simple random sample, simple random sample from population with given frequency distribution, SRS of attribute, size of simple random sample for specified precision. Concept of SRSWOR and SRSWR.

Unit-3 **Teaching Hours:15**

Stratified Random Sampling and Systematic Sampling

Stratified random sampling: Technique, estimates of population mean and total, variances of these estimates. Systematic Sampling: Technique, estimates of

population mean and total, variances of these estimates (N=nxk).Comparison of systematic sampling with SRS and stratified sampling.

Unit-4 **Teaching Hours:15**

Cluster Sampling

Cluster Sampling: Cluster sampling estimation of population mean and its variance. Relative efficiency of cluster sampling with SRS in terms of intra class correlation, comparison with SRS, stratified sampling method and their applications. Some Scaling Procedures.

Unit-5 **Teaching Hours:10**

Official Statistical System

Present Official Statistical System in India relating to census of population, agriculture, industrial production, and prices; methods of collection of official statistics, their reliability and limitation and the principal publications containing such statistics. Also the various agencies responsible for the data collection- C.S.O., N.S.S.O., Office of Registrar General, their historical development, main functions and important publications.

Text Books And Reference Books:

1. Cochran W.G, *Sampling Techniques*, 3rd Edition, John Wiley and Sons, New York, 2008.
2. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th Edition, Sultan Chand and Sons, India 2009.

Essential Reading / Recommended Reading

1. Mukhopadhyay P, *Theory and Methods of Survey Sampling*, 2nd Revised edition, PHI Learning New Delhi, 2008.
2. Arnab R, *Survey Sampling Theory and Applications*, Academic Press, UK, 2017.
3. Goon A.M, Gupta M.K and Dasgupta B, *Fundamentals of Statistics* (Vol.2), World Press 2005.
4. Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA451 - SAMPLING TECHNIQUES PRACTICAL (2019 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course Description: The course is designed to provide a practical exposure to the students in application of different sampling techniques.

Course Learning Outcome: After completion of this course the students will acquire the knowledge on different sampling techniques and able to decide the application of different sampling techniques under different situation.

Learning Outcome

CO1: After completion of this course the students will acquire the knowledge on different sampling techniques

CO2: After completion of this course the students will able to decide the application of different sampling techniques under different situation.

CO3: After completion of this course the students will be able to design sampling procedures for various situations

Unit-1 **Teaching Hours:30**

Practical Assignments using EXCEL/R:

1. Random sampling using Random number tables.
2. Concepts of unbiasedness, Variance, Mean square error etc.
3. Exercise on Simple Random Sampling with Replacement.
4. Exercise on Simple Random Sampling without Replacement.
5. Concepts of Simple Random Sampling for Attributes.
6. Exercise on Stratified Sampling.
7. Efficiency of stratified sampling over SRSWR and SRSWOR
8. Estimation of gain in precision due to stratification.
9. Exercise on Systematic sampling.
10. Efficiency of Systematic sampling over SRSWR and SRSWOR
11. Exercise on Scaling Procedures.
12. Exercise on Cluster sampling.

Text Books And Reference Books:

1. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th Edition, Sultan Chand and Sons, India 2009.

Essential Reading / Recommended Reading

1. Arnab R, *Survey Sampling Theory and Applications*, Academic Press, UK, 2017.

Evaluation Pattern

Section	Parameters	Marks
A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		10

CSC541A - DATA ANALYTICS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

This course is to help students learn, understand, and practice data analytics from the chosen domain. The better understanding of Data, Relations, Preprocessing, Visualization, Correlation, Regression and Clustering plays an important role to find a formidable answer for any kind of applications.

Learning Outcome

Upon successful completion of the course the student will be able to:

CO1: Demonstrate the fundamental principles of data analytics

CO2: Apply appropriate preprocessing and visualization techniques on the data set

CO3: Design data analytic models for effective decision-making

Unit-1 **Teaching Hours:9**

Introduction

Data Analysis, Data Mining and Knowledge Discovery.

Unit-1 **Teaching Hours:9**

Data and Relations

The Iris Data Set - Data Scales - Set and Matrix representations - Relations - Dissmilarity measures - Similarity measures - Sequence Relations - Sampling and Quantization.

Unit-2 **Teaching Hours:9**

Data Preprocessing

Error types - Error Handling - Filtering - Data Transformation - Data Integration.

Unit-2 **Teaching Hours:9**

Data Visualization

Diagrams - Principal Component Analysis - Multidimensional Scaling - Associator - Histograms.

Unit-3 **Teaching Hours:9**

Correlation

Linear Correlation - Correlation and Causality - Chi-square Test for Independence.

Unit-3 **Teaching Hours:9**

Regression

Linear Regression - Linear Regression with Nonlinear Substitution - Robust Regression - Neural Networks - Radial Basis Function Networks - Cross-Validation - Feature Selection.

Unit-4 **Teaching Hours:9**

Forecasting

Finite State Machines - Recurrent Models - Autoregressive Models.

Unit-4 **Teaching Hours:9**

Classification

Classification criteria - Naive Bayes Classifier - Linear Discriminant Analysis - Support Vector Machine - Nearest Neighbor Classifier - Decision Trees.

Unit-5 **Teaching Hours:9**

Clustering

Cluster Partitions - K-Means Clustering - Hierarchy Clustering - Prototype-Based Clustering - Fuzzy Clustering - Relational Clustering - Cluster Tendency Assessment - Cluster Validity - Self-Organizing Map.

Unit-5 **Teaching Hours:9**

Optimization Methods

Optimization with Derivatives - Gradient Descent.

Text Books And Reference Books:

1. Runkler, Thomas. A, "Data Analytics: Models and Algorithms for Intelligent Data Analysis", Springer, 2012.
2. Anil Maheswari, "Data Analytics", McGraw-Hill Education, First Edition, 2017.

Essential Reading / Recommended Reading

1. Soraya Sedkaoui, "Data Analytics and Big Data", John Wileys & Sons, 2018.
2. Robert Keane, "Data Analytics: Master the Techniques for Data Science, Big Data and Data Analytics", CreateSpace Independent Publishing Platform, 2017.
3. Herbert Jones, "Data Analytics": An Essential Beginners Guide to Data Mining, Data Collection, Big Data Analytics for Business, and Business Intelligence Concepts", CreateSpace Independent Publishing Platform, 2018.

Evaluation Pattern

CIA - 50%

ESE - 50%

CSC541B - INTERNET OF THINGS (2018 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

To explore students to the world of interconnected devices, communication among these connected devices, transfer of data and further analysis of this data to make appropriate decisions

Learning Outcome

CO1: Analyze the functional blocks involved in Internet of Things.

CO2: Understand the architecture of Internet of Things.

CO3: Infer the process of analysing data in Internet of Things.

CO4: Demonstrate the application of IoT in real world.

Unit-1 **Teaching Hours:9**

Introduction to Internet of Things

Introduction, Definition and Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communications APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems.

Unit-2 **Teaching Hours:9**

IoT Physical Devices and EndPoints

What is an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python. Other IoT Devices – pcDuino, BeagleBone Black, Cubieboard.

Unit-3 **Teaching Hours:9**

Domain Specific IoTs and M2M

Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle.

IoT and M2M – Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT.

Unit-4 **Teaching Hours:9**

Arduino Programming

The Arduino Ecosystem, Installing the software, Connecting the Arduino, Opening a sketch, Sketching in code, The Structure of Arduino C, Verifying and Uploading, Working with variables, Making Decisions, Digital Ins and Outs, Analog In, Analog Out.

Unit-5 **Teaching Hours:9**

Infrastructure and Service Discovery Protocols for the IoT Ecosystem

Infrastructure Protocols: Routing Protocol, IEEE 802.15.4, Bluetooth Low Energy, Z-Wave, ZigBee. Protocols for IoT Service Discovery: multicast Domain Name System (mDNS), DNS Service Discovery, Universal Plug and Play. Prominent IoT Service Discovery Products available in the market.

Text Books And Reference Books:

[1] Arshdeep Bahga and Vijay Madisetti , "Internet of Things: A Hands-on Approach", Universities Press, 2015

[2] Pethuru Raj and Anupama C. Raman , “The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

[3] Brian Evans, Beginning Arduino Programming, Apress, 2011

Essential Reading / Recommended Reading

[1] March Schwartz, “Internet of Things with Arduino Cookbook”, Packt Publishing, 2016

[2] Olivier Hersent , David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

[3]Peter Waher, “Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3”, Packt Publishing, 2018

Evaluation Pattern

CIA 50%

ESE 50%

CSC541C - DIGITAL IMAGE PROCESSING (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

To provide basic foundation on concepts and algorithms widely used in Digital image processing. It also focuses on compression and restoration of images using various techniques.

Learning Outcome

CO1:Comprehend the knowledge of image processing techniques.
CO2:Analyze image processing techniques in spatial domain.
CO3: Design algorithms to solve classification and compression techniques.

Unit-1 **Teaching Hours:9**

Introduction and Digital Image Fundamentals

The origins of Digital Image Processing, Fundamental Steps in Image Processing, Elements of Digital Image Processing System, Image Sampling and Quantization, Basic relationships: NeighborsConnectivity.

Unit-2 **Teaching Hours:9**

Image Enhancement Techniques

Gray Level Transformations, Histogram Processing, Histogram equalization, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters.

Unit-3 **Teaching Hours:9**

Image Compression and Image restoration techniques

Huffman coding, Run length coding, LZW coding. Image restoration using spatial filters.

Unit-4 **Teaching Hours:9**

Image Segmentation

Region Based Segmentation – Region Growing and Region Splitting and Merging. Representation – Chain codes. Point, Line and Edge detection. Thresholding – Global thresholding.

Unit-5 **Teaching Hours:9**

Description and Object Recognition

Boundary descriptors –Regional and Topological descriptors – Introduction to Patterns and Pattern Classes. Minimum distance classifier, K-NN classifier and Bayes.

Text Books And Reference Books:

[1] R. C. Gonzalez & R. E. Woods, "*Digital Image Processing*", 3rd Edition. Pearson Education,2018.

[2] A.K. Jain, "*Fundamental of Digital Image Processing"*, 4th Edition. PHI,2011.

Essential Reading / Recommended Reading

[1] M. A. Joshi, *"Digital Image Processing: An algorithmic approach*", 2nd Edition. PHI 2009.

[2] B.Chanda, D. DuttaMajumdar, "*Digital Image Processing and analysis*", 1st Edition, PHI,2011.

Evaluation Pattern

CIA weightage 50%

ESE weightage 50%

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Effective implementation of a Business Intelligence (BI) results in better business decisions and increased success in achieving goals. Business intelligence is the process of collecting and turning the resource into business value. This course will provide an understanding of business intelligence, knowledge delivery and examine the BI processes and techniques used in transforming data to knowledge and value.

Learning Outcome

CO1: Understand the fundamentals of business intelligence.

CO2: Apply various modeling techniques and business intelligence methods to various situations using data mining principles.

CO3: Demonstrate the impact of business reporting, information visualization, and dashboards.

Unit-1 **Teaching Hours:9**

Introduction to Business Intelligence

Introduction to OLTP and OLAP, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities.

Unit-2 **Teaching Hours:10**

Basics of Data Integration ETL

Concepts of data integration need and advantages of using data integration, introduction to common data integration approaches, introduction to ETL, Introduction to data quality, data profiling concepts and applications.

Unit-3 **Teaching Hours:9**

Introduction to Multi-Dimensional Data Modeling

Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi-dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema.

Unit-4 **Teaching Hours:9**

Basics of Enterprise Reporting

Introduction to enterprise reporting, concepts of dashboards, balanced scorecards, and overall architecture.

Unit-5 **Teaching Hours:8**

Data Mining Functionalities

Association rules mining, Mining Association rules from single level, multilevel transaction databases, Classification and prediction, Decision tree induction, Bayesian Classification, knearest neighbour classification.

Text Books And Reference Books:

CindiHowson ,Successful Business Intelligence, Unlock the Value of BI & Big Data Hardcover –Second Edition: Import, 1 Nov 2013.

Essential Reading / Recommended Reading

Gert H.N. Laursen, JesperThorlund , Business Analytics for Managers: Taking Business Intelligence beyond Reporting Paperback , 26 Sep 2013

Evaluation Pattern

CIA	50%
ESE	50%

CSC542A - UNIX OPERATING SYSTEM (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

UNIX is a multi user and multi-tasking operating system. After learning the concepts of an operating system, it is appropriate to learn how UNIX implements these concepts. The subject is introduced with the features and architecture of UNIX. The file system, Process management and Memory management are discussed to make the students understand the internals of UNIX. Various commands used by UNIX shell is also discussed which makes the users of UNIX comfortable to interact with each other. Bourne shell programming is dealt in depth which can be used to develop applications in UNIX.

Learning Outcome

CO1: Describe the architecture and features of UNIX Operating System and distinguish it from other Operating System.

CO2: Apply and change the ownership and file permissions using advance Unix commands.

CO3: Build Regular expression to perform pattern matching using utilities like grep, sed and awk.

CO4: Implement shell scripts for real time applications.

Unit-1 **Teaching Hours:8**

Introduction to UNIX

Evolution of UNIX – UNIX System Structure – Features of Unix - Operating System Services - Unix Kernel - Locating Commands, Internal and External Commands, Flexibility of Command Usage, man: Browsing and Manual Pages On-line, Understanding the man Documentation.

General Purpose Utilities: cal, date, echo, printf, echo, bc, script, passwd, who, uname, tty, stty.

Unit-2 **Teaching Hours:9**

The UNIX file system

The File, I-nodes – Structure of a regular file. The HOME Variable: The Home Directory, Directory related commands: pwd, mkdir, cd, rmdir. Absolute and relative path names. The UNIX File System. File manipulation commands: cat, cp, rm, mv, more, The lp Subsystem: Printing a File, file, wc, Words and Characters, od, The spell and ispell, cmp, comm, diff. File compression commands: gzip, gunzip, tar, zip, unzip. Basic file attributes: The –d Option: Listing Directory Attributes, File Ownership, File Permissions, chmod: Changing File Permissions, Directory Permissions, Changing File Ownership. Hard links, Symbolic Links, ln, umask, and find.

Unit-3 **Teaching Hours:9**

UNIX process management

Process Basics, Process States and Transitions, ps: Process Status, System Processes (-e or –a), Internal and External Commands, Running Jobs in Background, nice: Job Execution With Low Priority, Killing Processes with Signals, Job Control, at and batch: Execute Later, cron: Running Jobs Periodically, time: Timing Processes. PID and PPID.

Unit-4 **Teaching Hours:9**

Filters and communication simple filters

The Sample Database, pr: Paginating Files, head: Displaying the Beginning of a File, tail: Displaying the End of a File, cut: Slitting a File Vertically, paste: Pasting Files, sort: Ordering a File, uniq: Locate Repeated and Non repeated Lines, tr: Translating Characters, An Example: Displaying a Word-count List. Filters using regular expressions: grep: Searching for a Pattern, and egrep. Communication: Communicating with Other Users: Who, Mail, Wall, Send, Mesg, Ftp.

Unit-5 **Teaching Hours:10**

UNIX shell environment

The Wild-cards, Escaping and Quoting, Redirection; Review of vi Operations – Different Modes – Saving and Exiting - Accessing Multiple Files - Interacting with Unix - Miscellaneous Commands - Alphabetical List of Keys. Shell variables - Shell Keywords - Positional parameters - Passing command line arguments. Arithmetic in shell scripts - Read and Echo - Control Structures - if-then-fi - if-then-else-fi - Nested if - Case control structure – Loops - while-until –for - break and continue. Shell meta characters - Exporting variables - User defined Functions.

Text Books And Reference Books:

[1] Sumitabha Das. *UNIX Concepts and Applications*. 5th Edition, New Delhi: Tata McGraw Hill, 2013.

[2] Yashavant P Kanetkar. *Unix Shell Programming*. New Delhi: BPB Publications, 2012.

Essential Reading / Recommended Reading

[1] Maurice J Bach. *The Design of Unix Operating System.* NewDelhi: Prentice Hall of India Pvt. Ltd, 2012.

[2] Paul Love, Joe Merlino, Craig Zimmerman, Jeremy C. Reed, and Paul Weinstein. *Beginning UNIX*. New Delhi: Wiley Publishing, Inc, (Wrox Publishing) 2007

Evaluation Pattern

CIA (Weightage) - 50%

ESE (Weightage) - 50%

CSC542B - PYTHON PROGRAMMING (2018 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

This course covers the programming paradigms associated with python. It explores the object-oriented programming, Graphical programming aspects of python with help of built in modules.

Learning Outcome

CO1: Understand the use of built-in objects of Python

CO2: Demonstrate significant experience with python program development environment

CO3: Develop GUI programming concepts.

Unit-1 **Teaching Hours:6**

Introduction to Python Data Structures

Underlying mechanism of Module Execution- Sequences, Mapping and Sets- Dictionaries- Functions - Lists and Mutability- Problem Solving Using Lists andFunctions

Unit-2 **Teaching Hours:10**

Object oriented programming using python and regular expressions

Classes: Classes and Instances-Inheritance—Polymorphism-Abstract classes-Exceptional Handling- Regular Expressions using “re” module.

Unit-3 **Teaching Hours:10**

GUI Programming

Introduction-Tkiner module-Root window-Widgets-Button-Label-Message-Text-Menu- Listboxes-Spinbox-Creatingtables

Unit-4 **Teaching Hours:10**

Introduction to web framework-Django

Introduction-Web framework-creating model to add database service-python application shell-Django administration application-input-forms and models

Unit-5 **Teaching Hours:9**

Using Numpy and Pandas

Computation on NumPy-Aggregations-Computation on Arrays-Comparisons, Masks and Boolean Arrays-Fancy Indexing-Sorting Arrays-Structured Data: NumPy's Structured Array. Introduction to Pandas Objects-Data indexing and Selection-Operating on Data in Pandas- Handling Missing Data-Hierarchical Indexing

Text Books And Reference Books:

[1] Wesely J.Chun,*Core Python Application Programming* ,Prentice Hall,third edition 2015.

[2]T.R.Padmanabhan, *Programming with Python*,Springer Publications,2016.

Essential Reading / Recommended Reading

[1]Zhang.Y ,*An Introduction to Python and Computer Programming,* Springer Publications, 2016.

Evaluation Pattern

CIA : 50%

ESE : 50%

CSC542D - GRAPHICS AND ANIMATION (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

To acquire knowledge in three-dimensional modelling and animation using 3DS Max software and to render the animated scene effectively using light and material design.

Learning Outcome

Upon completion of the course students will be able to:

CO1: Understand the concept of 2D and 3D.

CO2: Construct graphic models in 2D and 3D with lighting effects.

CO3: Apply animation on 3D models.

Unit-1 **Teaching Hours:9**

Autodesk 3ds Max

Introduction, Working, touring the interface, working with objects, and viewing.

Unit-1 **Teaching Hours:9**

Introducing Objects

Standard primitives, modelling with modifiers, making clones, working with groups.

Unit-2 **Teaching Hours:9**

Creating Shapes with Splines

Drawing with splines, modifying a shape, outlining and extruding splines, combining and extruding primitive splines, creating a solid form with splines.

Unit-2 **Teaching Hours:9**

Editing Meshes and Creating and Organizing and Editing Objects

Creating shapes with Boolean objects, tracing a sketch, editing meshes, create symmetric forms, smoothing meshes. Naming and renaming objects, organizing objects by layer, lofting an object.

Unit-3 **Teaching Hours:9**

Light and Shadow

Lighting the model, rendering a view, ambient light, adding shadow effects, playing in the shadows, using the light listener, using scene states.

Unit-3 **Teaching Hours:9**

Enhancing Models with Materials

Texture maps, adding materials to object, editing materials, using the standard material, assigning materials to parts of an object.

Unit-4 **Teaching Hours:9**

Using the Camera

Basics of 3ds max camera, setting up an interior view, creating an environment, using immersive environment for animation, using render type and elements, matching your scene to background image.

Unit-4 **Teaching Hours:9**

Organizing Objects and Scene Management

Gaining access, arranging furniture, replacing objects, using the rendered framework window.

Unit-5 **Teaching Hours:9**

Animation

The world of video, Time, creating a quick study animation, key frames, increasing and editing key frames, adding more frames, moving the camera target over time, controlling lights over time.

Text Books And Reference Books:

[1] J. Harper, Mastering Autodesk 3ds Max 2013. Sybex, 2012.

Essential Reading / Recommended Reading

[1] R. L. Derakhshani and D. Derakhshani, Autodesk 3ds Max Essential. Sybex, 2011.

[2] K. L. Murdock, 3ds Max 2012 Bible. Wiley, 2011.

[3] T. Mullen, Introducing Character Animation with Blender. Sybex, 2007.

Evaluation Pattern

CIA: 50%

ESE: 50%

CSC542E - .NET TECHNOLOGY (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

The course gives introduction to the .Net framework. It also enable the studentst to learn and develop console, windows and web based application in the .NET framework using C# programming.

Learning Outcome

CO1: Understand the buliding blocks of .Net framework.
CO2: Experiment with C# programming language in .Net framework.
CO3: Design and develop window based applications.
CO4: Develop web based applications for real world problems.

Unit-1 **Teaching Hours:10**

Introduction

Vision and goals of .NET, Building blocks of .Net, Overview of .Net applications, .Net evolution, The .Net Framework Architecture, Intermediate Language(IL), Common Language Runtime (CLR), JIT Compilation, Common Type System(CTS), Common Language System (CLS), Assemblies, IL Disassembler (ILdasm.exe), Namespaces.

C# features

Working with methods- understanding method structure, calling a method, understanding parameter types, overloading methods, virtual methods, overriding methods.

Unit-2 **Teaching Hours:10**

C# classes

Constants, fields, methods, properties, events, indexers, operators, constructors, destructors, static modifiers. Compiling with multiple classes, virtual and override methods, abstract methods, sealed classes, Boxing and Unboxing,Working with namespaces, Understanding interfaces, handling exceptions.

Self Learning: Class
Inheritance

Unit-3 **Teaching Hours:9**

Windows Applications

Understanding Windows Forms Architecture, Windows controls: Common, Containers, Menus and Tool strips, Data, Reporting. Adding and using windows controls to the form.

Unit-4 **Teaching Hours:8**

Database programming with ADO.NET

Understanding the Dataset classes and their relatives, Understanding OLEDB and SQL Server Support, Understanding common database operations using ADO.NET–Operations that don't return rows, Data operations that return single row entities, data operations that affect single-row entities, data operations returning sets of rows, data operations affecting sets of rows, operations that return hierarchical data.

Unit-5 **Teaching Hours:8**

ASP.NET

Creating web applications with webforms [ASP.NET], Difference between ASP and ASP.NET, Defining a web application, ASP.NET architecture, ASP.NET webforms, Code behind model, Validation controls in ASP.NET, Server controls and data binding, Grid view, data repeater, data list, Data binding in ASP.NET, Data source controls-sql data source, Data controls–gridview and details view, Login controls.

Text Books And Reference Books:

[1] JeffFerguson, BrianPatterson, Jason Beres ,*C# Programming Bible* ,Wiley Publishing Inc., Reprint 2006.

Essential Reading / Recommended Reading

[1] JeffProsise, *Programming .Net,* 2nd Edition, WP Publishers & Distributors Pvt.Ltd, 2009.

[2] Kevin Hoffman & Jeff Gabriel, *Professional .Net Framework*, 1st Edition, Wrox PressPublishers,2006.

Evaluation Pattern

CIA (Weightage) - 50%
ESE (Weightage) - 50%

CSC551A - DATA ANALYTICS LAB (2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

This course is to help students to do hands-on lab experience by practicing data analytics to get the insights from the chosen area/domain based on the given topics.

Learning Outcome

CO1: Demonstrate the Correlation and Regression methods.

CO2: Design different forecasting models.

CO3: Analyse data classification and clustering based on different methods.

Unit-1 **Teaching Hours:30**

List of programs

1. Open/ Create a dataset and write all its characteristics. E.g. variable/ attribute, discrete/continuous, scales of measurement, frequency distribution, cumulative distribution, sorting.
2. Data Preprocessing - Filtering, Data Transformation, Data Integration.
3. Data Visualization - Graphs and charts.
4. Data Visualization - Principal Component Analysis, Multi-dimensional Scaling.
5. Correlation - Linear Correlation, Chi-Square Test.
6. Regression - Feature Selection.
7. Forecasting - Finite State Machines, Recurrent Models.
8. Classification - Any one of the method.
9. Clustering - Any one of the method.

Text Books And Reference Books:

1. Thomas A. Runkler, "Data Analystics - Models and Algorithms for Intelligent Data Analysis", Springer Vieweg, 2nd Edition, 2016.
2. Anil Maheswari, "Data Analytics", McGraw-Hill Education, First Edition, 2017.

Essential Reading / Recommended Reading

1. Soraya Sedkaoui, "Data Analytics and Big Data", John Wiley & Sons, 2018.
2. Robert Keane, "Data Analytics: Master the Techniques for Data Science, Big Data and Data Analytics", CreateSpace Independent Publishing Platform, 2017.
3. Herbert Jones, "Data Analytics: An Essential Beginners Guide to Data Mining, Data Collection, Big Data Analytics for Business, and Business Intelligence Concepts", CreateSpace Independent Publishing Platform, 2018.

Evaluation Pattern

CIA - 50%

ESE - 50%

CSC551B - INTERNET OF THINGS LAB (2018 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

To enable the students to design and develop IoT applications aimed at improving quality of life and applications that benefit society.

Learning Outcome

CO1: Learn the basics of Arduino programming frameworks.

CO2: Understand IoT principles, design and abstraction of developing IoT applications.

CO3: Integrate a variety of IoT devices, sensors and services to build real life applications.

Unit-1 **Teaching Hours:30**

List of programs

1. Design a circuit to blink an LED.

2. Design a circuit to capture the temperature value from the environment and display it in the serial monitor. Read the datasheet corresponding to the respective sensor and verify the program by checking for hold time violation.

3. Design a circuit to capture temperature and humidity from the environment and display both the values parallel in the serial monitor. Read the datasheet corresponding to the respective sensor and verify the program by checking for hold time violation

4. Design a program that helps in analyzing pressure variation through a graph in an application. (Example: Thingspeak). Read the datasheet corresponding to the respective sensor and verify the program by checking for hold time violation

5. Design a program to detect the movement of a person within the sensor range using PIR sensor and send an email if detected. Read the datasheet corresponding to the respective sensor and verify the program by checking for hold time violation

6. Design a program to detect air quality in a room and send a message to a mobile device is detected. Read the datasheet corresponding to the respective sensor and verify the program by checking for hold time violation.

7. Design a circuit to collect pressure and temperature data. Analyze the data to send an alarming message to the user if the value is below a threshold.

8. Write a program to control an LED using smartphone.

9. Design an application to analyze the light in the environment and control its intensity by using a smartphone.

10. Design a circuit to play .wav files through an interface that is designed. Trigger the speaker when each key is pressed.

Text Books And Reference Books:

[1] Brian Evans, Beginning Arduino Programming, Apress, 2011

Essential Reading / Recommended Reading

[1] March Schwartz, "Internet of Things with Arduino Cookbook", Packt Publishing, 2016

Evaluation Pattern

CIA 50%

ESE 50%

CSC551C - DIGITAL IMAGE PROCESSING LAB (2018 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

This course helps student to understand image enhancement techniques in spatial domain.This also focuses on classification of images using Matlab

Learning Outcome

CO1: Understand the enhancement techniques of images.

CO2:Analyse different filtering methods in Spatial domain.

Unit-1 **Teaching Hours:30**

List of programs

1. Write a program to display frequency of each pixel occurring in a row of an image.

2. Write a program to convert color images to Gray scaleImages.

3. Write a program to perform Rotation of images using differentmethods.

4. Write a program to perform resizing of images using differentmethods.

5. Write a program to implement Contraststretching

6. Write a program to demonstrate smoothening of animage

7. Write a program to perform non-linear filtering of animage(Median)

8. Write a program to implement of Edgedetection

9. Write a program to extract the three color components in theimages

10. Write a program to perform bit planeslicing.

Text Books And Reference Books:

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Essential Reading / Recommended Reading

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Evaluation Pattern

CIA weightage 50%

ESE weightage 50%

CSC551D - BUSINESS INTELLIGENCE LAB

(2018 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

This course is designed to introduce a concept of Business Intelligence for better business decision. Also gives practical knowledge on implementation of Business Intelligence concepts.

Learning Outcome

CO1: Explore various modeling techniques and business intelligence methods to various situations using data mining tools.

CO2: Demonstrate the impact of business reporting, information visualization, and dashboards using BI tools.

Unit-1 **Teaching Hours:30**

Programs

1. Practice various data access methods. Representation formats: CSV, FLV, ARFF, XML.

2. Implement data conversion. eg. CSV2ARFF file format conversion in Java.

3. Configuring and testing the ETL tools.

4. Implement pipeline, sampling.

5. Implement surrogate keys and change in dimensions.

6. Practice data source views, dimensions, hierarchies.

7. Implement OLAP explorative data analysis with Pivot Tables.

8. Implement the metrics.

9. Implement Parent-child hierarchies. ROLAP and MOLAP.

10. Implement SQL reporting services.

Text Books And Reference Books:

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Essential Reading / Recommended Reading

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Evaluation Pattern

CIA - 50%

ESE- 50%

CSC552A - UNIX OPERATING SYSTEM LAB

(2018 Batch)

Total Teaching Hours for Semester:30	**No of Lecture Hours/Week:2**
Max Marks:50	**Credits:2**

Course Objectives/Course Description

This course focuses on acquiring skills needed to develop UNIX programs, making use of wide range of UNIX programming standard commands.

Learning Outcome

CO1: Develop text data processing applications using Unix commands and filters

CO2: Build Regular expression to perform pattern matching using utilities like grep, sed and awk

CO3: Implement shell scripts for real time applications

Unit-1 **Teaching Hours:30**

List of programs

1. Write a shell program using command line arguments.
2. Write a shell program for string manipulation.
3. Write a shell program to demonstrate manipulation of file contents.
    a. Comparing file contents
    b. Conversion of case of characters in a file using command line arguments

4. Write a Shell Script to demonstrate directory related commands.
5. Write a Shell Script to demonstrate various compression commands.
6. Write Shell Scripts to demonstrate recursive functions.
7. Write a shell program to demonstrate process related commands.
8. Write a Shell Script to demonstrate communication and date related commands.
9. File handling system:

a. create a file
b. copy the file
c. move the file
d. delete the file
e. exit

10. Write a menu-based program to permit or remove read/write/execute permission of a file.

Text Books And Reference Books:

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Essential Reading / Recommended Reading

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Evaluation Pattern

CIA (Weightage) - 50%

ESE (Weightage) - 50%

CSC552B - PYTHON PROGRAMMING LAB

(2018 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

This course covers the programming paradigms associated with python. It explores the object oriented programming, Graphical programming aspects of python with help of built in modules.

Learning Outcome

CO1: Design the use of built-in objects of Python
CO2: Demonstrate significant experience with python program development environment
CO3: Implement GUI programming concepts.

Unit-1 **Teaching Hours:30**

List of programs

1. Demonstrate use of lists,tuples.

2. Demonstrate use of strings, dictionaries,sets.
3. Demonstrate use of object- oriented programmingconcepts
4. Demonstrate use of "re"module
5. Demonstrate use of tkintermodule
6. Create a GUI application using various pythonmodules.
7. Create a web application using Djangoframework.
8. Demonstrate Indexing andSorting
9. Demonstrate handling of missingdata

Text Books And Reference Books:

[1] Wesely J.Chun,*Core Python Application Programming* ,Prentice Hall,third edition 2015.

[2]T.R.Padmanabhan, *Programming with Python*,Springer Publications,2016.

Essential Reading / Recommended Reading

[1] Zhang.Y ,*An Introduction to Python and Computer Programming,* Springer Publications, 2016.

Evaluation Pattern

CIA : 50%

ESE : 50%

CSC552D - GRAPHICS AND ANIMATION LAB

(2018 Batch)

Total Teaching Hours for Semester:30 — **No of Lecture Hours/Week:2**

Max Marks:50 — **Credits:2**

Course Objectives/Course Description

To acquire knowledge in three dimensional modelling and animation using 3DS Max software and to render the animated scene effectively using light and material design.

Learning Outcome

Upon successful completion of the course, the students would be able to

CO1: Design real-time 3D objects using 3DS Max

CO2: Apply effects to objects using light and material.

CO3: Create animated frames on built models.

Unit-1 **Teaching Hours:30**

List of programs

1. Modelling basic objects using standard primitives.
2. Editing shapes with meshes.
3. Transformations and filling of images.
4. Working with color palette and layers.
5. Enhancing objects with lights and shadow.
6. Enhancing models with materials.
7. Creation of images with special effects.
8. Rendering a Scene with layers in the time line.
9. Keyframe animation.
10. Rendering the animation.

Text Books And Reference Books:

[1] J. Harper, Mastering Autodesk 3ds Max 2013. Sybex, 2012.

Essential Reading / Recommended Reading

[1] R. L. Derakhshani and D. Derakhshani, Autodesk 3ds Max Essential. Sybex, 2011.

[2] K. L. Murdock, 3ds Max 2012 Bible. Wiley, 2011.

[3] T. Mullen, Introducing Character Animation with Blender. Sybex, 2007.

Evaluation Pattern

CIA: 50%

ESE: 50%

CSC552E - .NET TECHNOLOGY LAB (2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Apply the knowledge acquired on object oriented programming concepts to develop console, window and web based applications.

Learning Outcome

CO1: Design and develop an application using fundamentals of object-oriented programming concepts.
CO2: Demonstrate the skills in designing an interactive Graphical User Interface using windows-based application.

Unit-1 **Teaching Hours:30**

List of programs

1. To implement output parameter and reference parameter
2. To implement the concept of indexers
3. To implement the concept of sealed class
4. To implement the concept of namespace
5. To implement the concept of interfaces
6. To implement the concept of events
7. To implement exception handling
8. To designa calculator in windows form
9. To implement data controls in windows form
10. To implement validation controls in web form
11. To implement Data controls in web form
12. To implement SqlDataReader in ADO.NET
13. To implement Dataset object in ADO.NET

Text Books And Reference Books:

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Essential Reading / Recommended Reading

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Evaluation Pattern

CIA (Weightage): 50%
ESE (Weightage): 50%

MAT531 - LINEAR ALGEBRA (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course description : Linear algebra is one of the basic core disciplines in mathematics, and is central to many subjects in pure and applied mathematics. It also has direct applications in diverse areas in science and engineering including optimization, mathematical modelling, probability and statistics.

Course objectives : This course will help the learner to
COBJ1. Understand the algebra of matrices, concepts in vector spaces and Linear Transformations
COBJ2. Gain problems solving skills in solving systems of equations using matrices, finding eigenvalues and eigenvectors, vector spaces and linear transformations.

Learning Outcome

On successful completion of the course, the students should be able to
CO1. Solve systems of equations through various techniques.
CO2. Use properties of matrices, especially invertibility, and matrix algebra.
CO3. Explore eigenvectors and eigenvalues
CO4. Understand concepts of vector space, subspace of a vector space, linear span, linear dependence, linear independence, dimension, basis and formally prove standard results related to these concepts.
CO5. Be familiar with Linear transformations and their corresponding matrices and understand the Rank and nullity concepts

Unit-1 **Teaching Hours:15**

Matrices and System of linear equations

Elementary row operations - Rank - Gaussian elimination, elementary matrices – Inversion of a matrix using row operations - Echelon Forms - Normal Forms - System of Homogeneous and non-homogeneous equations - Cayley Hamilton Theorem - Eigenvalues - Eigenvectors - and diagonalization.

Unit-2 **Teaching Hours:15**

Vector Spaces

Vector space-Examples and Properties, Subspaces-criterion for a subset to be a subspace, linear span of a set, linear combination, linear independent and dependent subsets, Basis and dimensions, Standard properties, Examples illustrating concepts and results.

Unit-3 **Teaching Hours:15**

Linear Transformations

Linear transformations, properties, matrix of a linear transformation, change of basis, range and kernel, rank and nullity, Rank, Nullity theorem

Text Books And Reference Books:

1. S. Narayan and P.K. Mittal, Text book of Matrices, 10th ed., New Delhi: S Chand and Co. Ltd, 2004.
2. V. Krishnamurthy, V. P. Mainra, and J. L. Arora, *An introduction to linear algebra*. New Delhi, India: Affiliated East East-West Press Pvt Ltd., 2003.

Essential Reading / Recommended Reading

1. David C. Lay, *Linear Algebra and its Applications*, 3rd ed.-Indian Reprint, Pearson Education Asia, 2007.
2. S. Lang, *Introduction to Linear Algebra*, 2nd ed., New York: Springer-Verlag, 2005.
3. S. H. Friedberg, A. Insel, and L. Spence, *Linear algebra*, 4th ed., Pearson, 2015.
4. Gilbert Strang, Linear Algebra and its Applications, 4th ed., Thomson Brooks/Cole, 2007.
5. K. Hoffmann and R. A. Kunze, Linear algebra, 2nd ed., PHI Learning, 2014.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment, Reference work	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Assignment Project	Mastery of the core concepts Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

MAT541A - INTEGRAL TRANSFORMS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course description: This course aims at providing a solid foundation upon the fundamental theories on Fourier Transforms and Laplace Transforms.

Course objectives: This course will help the learner to

COBJ1. Gain familiarity in fundamental theories on Fourier Series, Fourier Transforms and Laplace Transforms.

COBJ2. Acquire problem solving skills on Fourier Series, Fourier Transforms and Laplace Transforms.

Learning Outcome

Course outcomes: On successful completion of the course, the students should be able to

CO1. Evaluate some standard integrals by using Fourier Integrals.

CO2. Understand different types of Fourier integrals.

CO3. Solve problems on Fourier integrals (sine and cosine).

CO4. Derive Fourier sine and cosine transform.

CO5. Derive Laplace transforms of different types of functions.

CO6. Use the properties of Laplace Transforms.

CO7. Apply Laplace transforms in solving ordinary differential equations.

Unit-1 **Teaching Hours:15**

Fourier Series and Fourier Transform

Fourier Series and Fourier transform of some common functions, the Fourier Integral, Complex Fourier Transforms-Basic Properties, Transform of the derivative, Convolution theorem, Parseval's Identity. Applications of Fourier Transforms to Ordinary Differential Equations.

Unit-2 **Teaching Hours:15**

Fourier sine and cosine transforms

Fourier Cosine and Sine Transforms with examples, Properties of Fourier Cosine and Sine Transforms, Applications of Fourier Cosine and Sine Transforms with Examples.

Unit-3 **Teaching Hours:15**

Laplace Transform

Laplace Transform of standard functions, Laplace transform of periodic functions, Inverse Laplace transform, Solution of ordinary differential equation with constant coefficient using Laplace transform, Solution of simultaneous Ordinary differential equations.

Text Books And Reference Books:

B. Davis, Integral transforms and their Applications, 2nd ed., Springer Science and Business Media, 2013.

Essential Reading / Recommended Reading

1. E Kreyszig, *Advanced Engineering Mathematics*, Eighth Edition New Delhi, India: Wiley India Pvt. Ltd., 2010.
2. Dr. B. S. Grewal, *Higher Engineering Mathematics*, Thirty ninth Edition, Khanna Publishers, July 2005.
3. P. Dyke, An introduction to Laplace Transforms and Fourier Series, 2nd ed., Springer Science and Business Media, 2014,

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment Reference work	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment / Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

Course description: This course is concerned with the fundamentals of mathematical modeling. It deals with finding a solution to real-world problems by transforming into mathematical models using differential equations. The coverage includes mathematical modeling through first order, second order and system of ordinary differential equations.

Course objectives:

COBJ1. This course will help the learner to interpret the real-world problems in the form of first and second order differential equations

COBJ2. They shall be made familiar with some classical linear and nonlinear models

COBJ3. They shall also be analyzing the solutions of the system of differential equations by phase portrait method

Learning Outcome

By the end of the course the learner will be able to:

CO1. Demonstrate a working knowledge of differential equations in other branches of sciences, commerce, medicine, etc.,

CO2. Become familiar with some of the classical mathematical models

CO3. Validate the results of the calculations

CO4. Demonstrate competence with a wide variety of mathematical tools and techniques

CO5. Take an analytical approach to problems in their future endeavors

Unit-1 **Teaching Hours:15**

Mathematical Modeling through First Ordinary Differential Equations:

Population Dynamics, Carbon dating, Newton's law of cooling, Epidemics, Economics, Medicine, mixture problem, electric circuit problem, Chemical reactions, Terminal velocity, Continuously compounding of interest.

Unit-2 **Teaching Hours:15**

Mathematical Modeling through Second Ordinary Differential Equations:

The vibrations of a mass on a spring, free damped motion, forced motion, resonance phenomena, electric circuit problem, Nonlinear Pendulum

Unit-3 **Teaching Hours:15**

Mathematical Modeling through system of linear Differential Equations:

Phase plane analysis , Predator prey model, Combat model, Epidemics, Economics- SIR model, mixture Problems.

Text Books And Reference Books:

1. D. G. Zill, W. S. Wright, *Advanced Engineering Mathematics*, 4th ed., Jones and Bartlett Publishers, 2010.

2. J. R. Brannan and W. E. Boyce, Differential equations with boundary value problems: modern methods and applications. Wiley, 2011.

Essential Reading / Recommended Reading

1. C. H. Edwards, D. E. Penney, and D. Calvis, *Differential equations and boundary value problems: computing and modeling*. 3rd ed., Pearson Education Limited, 2010.
2. D. G. Zill, *Differential Equations with Boundary-Value Problems, I 7th ed.,* Cengage Learning, 2008.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment, Reference work	Mastery of the core concepts Problem-solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Assignment Project	Mastery of the core concepts Problem-solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

MAT541C - GRAPH THEORY (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course Description: This course is an introductory course to the basic concepts of Graph Theory. This includes definition of graphs, types of graphs, paths and circuits, trees, shortest paths and algorithms to find shortest paths.

Course objectives: This course will help the learner to gain a familiarity with
COBJ1. fundamental concepts of graphs, graph classes and graph operations and related results.
COBJ2. the concepts and results on Eulerian graphs and Hamiltonian graphs.
COBJ3. the concepts and results on trees, binary trees and spanning tree algorithms
COBJ4. the concepts and results on planar graphs and their properties.
COBJ5. proof writing techniques used in graph theory.

Learning Outcome

On successful completion of the course, the students should be able to

CO1. Be familiar with the history and development of graph theory

CO2. Write precise and accurate mathematical definitions of basics concepts in graph theory

CO3. Provide appropriate examples and counter-examples to illustrate the basic concepts

CO4. Understand and apply various proof techniques in proving theorems in graph theory.

CO5. Learn different algorithms in graphs.

Unit-1 **Teaching Hours:15**

Introduction to Graphs

Graphs – introduction – graphs as models – connected graphs - classes of graphs - complete graphs, bipartite graphs, multigraphs and digraphs, vertex degrees - regular graphs- degree sequences - isomorphism of graphs - isomorphism as a relation – cutsets and cutnodes - different matrix representation of graphs - adjacency matrix, incidence matrix, distance matrix, cut-set matrix and cycle matrix – directed graphs.

Unit-2 **Teaching Hours:15**

Connectivity and Traversability in Graphs

Connectivity of graphs - separable graphs - Eulerian graphs, Fleury's algorithm, Hamiltonian graph, Dirac's theorem - weighted graphs, Chinese postman problem - travelling salesman problem –Traversability in digraphs and networks.

Unit-3 **Teaching Hours:15**

Trees and Planarity in Graphs

Trees - Fundamental results - rooted and binary trees - spanning trees - minimum spanning tree algorithms - Prim's and Kruskal's algorithms for minimal spanning trees - Cayley's theorem on number of spanning trees - planar graphs- Euler formula, geometric dual of graphs.

Text Books And Reference Books:

1. N Deo, *Graph Theory with applications to engineering and computer science,* Delhi: Prentice Hall of India, 1979.
2. G. Chartrand and P.Chang, *Introduction to Graph Theory,* New Delhi: Tata McGraw-Hill, 2006.

Essential Reading / Recommended Reading

1. F. Harary, *Graph Theory,* New Delhi: Narosa, 2001.
2. D.B. West, *Introduction to Graph Theory,* New Delhi: Prentice-Hall of India, 2011.
3. S.A. Choudum, *A first Course in Graph Theory*, MacMillan Publishers India Ltd, 2013.
4. J. A. Bondy and U.S.R. Murty, *Graph Theory with applications,* Elsevier Science, 1976.
5. R.J. Wilson, *Introduction to graph theory,* Prentice Hall, 1998.
6. J. Clark and D.A. Holton, *A First Look at Graph Theory,* Singapore: World Scientific, 2005.

7. R. Balakrishnan and K Ranganathan, *A Textbook of Graph Theory,* New Delhi: Springer, 2008.
8. R. Diestel, Graph Theory, New Delhi: Springer, 2006.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment Reference work	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment / Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

MAT541D - CALCULUS OF SEVERAL VARIABLES **(2018 Batch)**

Total Teaching Hours for Semester:45 — **No of Lecture Hours/Week:3**

Max Marks:100 — **Credits:3**

Course Objectives/Course Description

Course Description: This course aims to enlighten students with the fundamental concepts of vectors, geometry of space, partial differentiation and vector analysis such as gradient, divergence, curl, and the evaluation of line, surface and volume integrals. The three classical theorems, viz., Green's theorem, Gauss divergence theorem and the Stoke's theorem are also covered.

Course objectives: This course will help the learner to
COBJ1. Gain familiarity with the fundamental concepts of vectors geometry of space.
COBJ2. Understand differential and integral calculus of vector fields.
COBJ3. Demonstrate an understanding of and be able to use Green's Theorem for the plane, Stokes Theorem, and Gauss' divergence Theorem to simplify and solve appropriate integrals.

Learning Outcome

On successful completion of the course, the students should be able to
CO1. Solve problems involving vector operations
CO2. Understand the TNB frame work and derive Serret-Frenet formula.
CO3. Apply the vector differential operator
CO4. Compute double integrals and be familiar with change of order of integration

CO5. Understand the concept of line integrals for vector valued functions
CO6. Apply Green's Theorem, Divergence Theorem and Stoke's Theorem.

Unit-1 **Teaching Hours:15**

Vectors and Geometry of Space

Fundamentals: Three-dimensional coordination systems, Vectors and vector operations, Line and planes in space, Curves in space and their tangents, Integrals of vector functions, Arc length in space, Curvature and normal vectors of a space, TNB frame, Directional derivatives and gradient vectors, Divergence and curl of vector valued functions.

Unit-2 **Teaching Hours:15**

Multiple Integrals

Double Integrals- Areas, Moments, and Centres of Mass – Double Integrals in Polar Form – Triple Integrals in Rectangular Coordinates, Masses and Moments in Three Dimensions, Triple Integrals in Cylindrical and Spherical Coordinates, Substitutions in Multiple Integrals.

Unit-3 **Teaching Hours:15**

Integration in Vector Fields

Line Integrals, Vector Fields, Work, Circulation and Flux, Path Independence, Potential Functions, and Conservative Fields, Green's Theorem in the Plane, Surface Area and Surface Integrals, Parametrized Surfaces, Stokes' Theorem, The Divergence Theorem.

Text Books And Reference Books:

M. D. Weir, J. Hass and F. R. Giordano, *Thomas' Calculus*, 11th ed., USA: Pearson, 2012.

Essential Reading / Recommended Reading

1. J. Stewart, Multivatialble calculus, 7th ed.: Belmont, USA: Brooks/Cole Cengage Learning., 2013.
2. M. Spivak, *Calculus*, 3rd ed., Cambridge University Press, 2006.
3. T.M. Apostol, *Mathematical Analysis,* 2nd ed., Wiley India Pvt. Ltd., 2011.
4. Serge Lang, *Calculus of several variables,* 3rd ed., Springer, 2012.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment Reference work	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Assignment/problem solving	Problem solving skills	10

Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	**100**

MAT541E - OPERATIONS RESEARCH (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course description: Operations research deals with the problems on optimization or decision making that are affected by certain constraints / restrictions in the environment. This course aims at teaching solution techniques of solving linear programming models, simple queuing model, two-person zero sum games and Network models.

Course objectives: This course will help the learner to

COBJ1. gain an insight executing the algorithms for solving linear programming problems including transportation and assignment problems.

COBJ2. learn about the techniques involved in solving the two person zero sum game.

COBJ3. calculate the estimates that characteristics the queues and perform desired analysis on a network.

Learning Outcome

On successful completion of the course, the students should be able to:

CO1. solve Linear Programming Problems using Simplex Algorithm, Transportation and Assignment Problems.

CO2. find the estimates that characterizes different types of Queuing Models

CO3. obtain the solution of two person zero sum games using Linear Programming

CO4. formulate Maximal Flow Model using Linear Programming.

CO5. perform computations using PERT and CPM.

Unit-1 **Teaching Hours:15**

Introduction to Linear Programming Problems

Introduction to simplex algorithm –Special cases in the Simplex Method – Definition of the Dual Problem – Primal Dual relationships – Dual simplex methods. Transportation Models: Determination of the starting solution – iterative computations of the transportation algorithm. Assignment Model: The Hungarian Method.

Unit-2 **Teaching Hours:15**

Queuing Theory and Game Theory

Elements of a queuing Model – Pure Birth Model – Pure Death Model – Specialized Poisson Queues – Steady state Models: (M/M/1):(GD/∞/∞) –

(M/M/1):(FCFS/∞/∞) - (M/M/1):(GD/N/∞) – (M/M/c):(GD/∞/∞) – (M/M/∞):(GD/∞/∞).

Game Theory: Optimal solution of two person zero-sum games – Solution of Mixed strategy Games (only Linear programming solution).

Unit-3 **Teaching Hours:15**

Network Models

Linear programming formulation of the shortest-route Problem. Maximal Flow model:- Enumeration of cuts – Maximal Flow Algorithm – Linear Programming Formulation of Maximal Flow Model. CPM and PERT:- Network Representation – Critical path computations – Construction of the Time Schedule – Linear Programming formulation of CPM – PERT calculations.

Text Books And Reference Books:

A.H. Taha, *Operations research*, 9th ed., Pearson Education, 2014.

Essential Reading / Recommended Reading

1. F.S. Hillier and G.J. Lieberman, *Introduction to operations research*, 9th Edition, McGraw-Hill, 2009.
2. Chandrasekhara Rao & Shanthi Lata Mishra, Operations research, Alpha Science International, 2005

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment Reference work	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment, Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

MAT551 - LINEAR ALGEBRA USING PYTHON (2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course description: This course aims at providing hands on experience in using Python functions to illustrate the notions vector space, linear independence, linear dependence, linear transformation and rank.

Course objectives: This course will help the learner to gain a familiarity with
COBJ1. The built in functions required to deal with vectors and Linear Transformations.
COBJ2. Python skills to handle vectors using the properties of vector spaces and linear transformations

Learning Outcome

On successful completion of the course, the students should be able to
CO1. demonstrate sufficient skills in using Pythonfunctions in the applying of the notions of Vector space and Linear transformations

Unit-1 **Teaching Hours:30**

Proposed Topics:

1. Operations on Matrices
2. Echelon form
3. Inverse of a matrix by Gauss Elimination method
4. Solving system of Equations using various method
5. Eigenvalues and Eigenvectors
6. Expressing a vector as a linear combination of given set of vectors
7. Linear Span, Linear Independence and Linear dependence
8. Linear Transformations and Rank
9. Plotting of Linear transformations

Text Books And Reference Books:

1. Amit Saha, *Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus, and More!*, no starch press:San Fransisco, 2015.
2. H P Langtangen, *A Primer on Scientific Programming with Python,* 2nd ed., *Springer*, 2016.

Essential Reading / Recommended Reading

1. B E Shapiro, *Scientific Computation: Python Hacking for Math Junkies*, Sherwood Forest Books, 2015.
2. C Hill, Learning Scientific Programming with Python, Cambridge University Press, 2016.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**

Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT551A - INTEGRAL TRANSFORMS USING PYTHON (2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course description: This course will help students to gain skills in using Python to illustrate Fourier Transforms, Laplace Transforms for some standard functions and implementing Laplace Transforms in solving Ordinary Differential Equations of first and second order with constant coefficient.

Course objectives: This course will help the learner to gain a familiarity with
COBJ1. Python language using jupyter interface.
COBJ2. The built in functions required to deal with Fourier Transforms and Laplace Transforms.
COBJ3. Inverse Laplace Transforms and the inverse Fourier transforms of standard functions using sympy.integrals.

Learning Outcome

On successful completion of the course, the students should be able to
CO1. Acquire proficiency in using Python.
CO2. Have proficiency in using Python to illustrate Fourier Series, Fourier Transforms and Laplace Transforms.
CO3. Be competent in using Python for solving ODE's by using Laplace Transforms.

Unit-1 **Teaching Hours:30**

Proposed Topics:

1. Fourier Series using the classes sympy and numpy
2. Practical Harmonic Analysis using the classes math, sympy and numpy
3. Fourier cosine and Fourier sine transforms using sympy and math
4. DFT using python

5. Laplace Transforms using the classes sympy, sympy.integrals and sympy.abc
6. Inverse Laplace Transforms using the above classes
7. Inverse Fourier Transforms using the above classes

Text Books And Reference Books:

J. Nunez-Iglesias, S. van der Walt, and H. Dashnow, Elegant SciPy: The art of scientific Python, O'Reilly Media, 2017.

Essential Reading / Recommended Reading

1. J. Unpingco, Python for signal processing . Springer International Pu, 2016.
2. B. Downey, Think DSP: digital signal processing in Python . O'Reilly, 2016.
3. M. A. Wood, Python and Matplotlib Essentials for Scientists and Engineers. IOP Publishing Limited, 2015.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT551B - MATHEMATICAL MODELLING USING PYTHON (2018 Batch)

Total Teaching Hours for Semester:30 — **No of Lecture Hours/Week:2**

Max Marks:50 — **Credits:2**

Course Objectives/Course Description

Course description: This course provides students with an understanding of the practical and theoretical aspects of mathematical models involving ordinary differential equations (ODEs) using Python programming.

Course objectives:

COBJ1. The course exposes students to various models spanning disciplines such as physics, biology, engineering, and finance.

COBJ2. They will be able to develop a basic understanding of differential equations and skills to implement numerical algorithms to solve mathematical problems using Python.

Learning Outcome

On successful completion of the course, the students should be able to

CO1. acquire proficiency in using Python

CO2. demonstrates the use of Python to understand and interpret applications of differential equations

CO3. apply the theoretical and practical knowledge to real-life situations

Unit-1 **Teaching Hours:30**

Propopsed Topics

1. Growth of a population – Linear growth, Exponential growth, Logistic growth
2. Decay Model - Radioactive Decay
3. Numerical Methods
4. A Simple Pendulum
5. Spreading of a Disease
6. Mixture problems
7. Trajectory of a ball
8. Spring mass system
9. Electrical Circuits

Text Books And Reference Books:

1. H P Langtangen, *A Primer on Scientific Programming with Python,* 2nd ed., *Springer*, 2016.
2. Hans Fangohr, Introduction to Python for Computational Science and Engineering (A beginner's guide), University of Southampton, 2015.

Essential Reading / Recommended Reading

1. B E Shapiro, *Scientific Computation: Python Hacking for Math Junkies*, Sherwood Forest Books, 2015.
2. C Hill, *Learning Scientific Programming with Python*, Cambridge Univesity Press, 2016.
3. Amit Saha, *Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus, and More!*, no starch press: San Fransisco, 2015.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT551C - GRAPH THEORY USING PYTHON

(2018 Batch)

Total Teaching Hours for Semester:30 — **No of Lecture Hours/Week:2**

Max Marks:50 — **Credits:2**

Course Objectives/Course Description

Course description: The course *Graph Theory using Python* is aimed at enabling the students to appreciate and understand core concepts of Graph Theory with the help of technological tools. It is designed with a learner-centric approach wherein the students will understand the concepts of Graph Theory using programming tools and develop computational skills.

Course objectives: This course will help the learner to gain a familiarity with

COBJ1. Python language using jupyter interface and NetworkX package

COBJ2. Construction of graphs and analyze their structural properties.

COBJ3. The implementation of algorithms for shortest paths, minimal spanning trees and graph searching.

Learning Outcome

On successful completion of the course, the students should be able to use Python

CO1. construct graphs using related matrices

CO2. compute the graph parameters such as degree, distance

CO3. gain mastery to deal with optimization problems related to network

CO4. gain an algorithmic approach to graph theory problems

Unit-1 **Teaching Hours:30**

Proposed Topics:

1. Introduction to NetworkX package
2. Construction of graphs
3. Matrices associated with graphs
4. Degree related parameters
5. Graph connectivity
6. Spanning tree algorithms
7. Shortest path algorithms
8. Graph operations
9. Graph coloring
10. Graph as models.

Text Books And Reference Books:

Mohammed Zuhair, Kadry, Seifedine, Al-Taie, Python for Graph and Network Analysis. Springer, 2017.

Essential Reading / Recommended Reading

1. B. N. Miller and D. L. Ranum, *Python programming in context*. Jones and Bartlett, 2014.
2. David Joyner, Minh Van Nguyen, David Phillips. *Algorithmic Graph Theory and Sage,* Free software foundation,2008.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

Course description: The course Calculus of Several Variables using Python is aimed at enabling the students to explore and study the Calculus with Several variables in a detailed manner with the help of the mathematical packages available in Python. This course is designed with a learner-centric approach wherein the students will acquire mastery in understanding Multivariate Calculus using Python Modules.

Course objectives: This course will help the learner to gain a familiarity with

COBJ1. Skills to implement Python language in calculus of several variables

COBJ2. The built in functions available in library to deal with problems in multivariate calculus

Learning Outcome

Course outcomes: This course aims at providing hands on experience in using Python modules to solve problems of Multivariate Calculus. The objective is to familiarize students in using Python for

CO1. Plotting lines in two and three dimensional space

CO2. Finding the tangent vector and the gradient vector field

CO3. Evaluation of Line integral

CO4. Applications of Line integrals

CO5. Evaluation of double integral

CO6. Applications of double integrals

Unit-1 | **Teaching Hours:30**

Proposed Topics

1. Introduction to Basic commands and plotting of graph using matplotlib.
2. Vectors-dot and cross products, Plotting lines in two and three dimensional space, Planes and Surfaces.
3. Arc length, Curvature and Normal Vectors.
4. Curves in sphere: Tangent vectors and velocity- Circular helix with velocity vectors.
5. Functions of two and three variables: Graphing numerical functions of two Variables
6. Graphing numerical functions in polar coordinates. Partial derivatives and the directional derivative.
7. The gradient vector and level curves- The tangent plane -The gradient vector field.
8. Vector fields: Normalized vector fields- Two dimensional plot of the vector field.
9. Double Integrals - User defined function for calculating double integrals - Area properties with double integrals.
10. Line Integrals – Curl and Green’s theorem- Divergence theorem.

Text Books And Reference Books:

H P Langtangen, A Primer on Scientific Programming with Python, 2nd ed., Springer, 2016

Essential Reading / Recommended Reading

1. B E Shapiro, *Scientific Computation: Python Hacking for Math Junkies*, Sherwood Forest Books, 2015.
2. C Hill, *Learning Scientific Programming with Python*, Cambridge Univesity Press, 2016.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

STA531 - LINEAR REGRESSION MODELS (2018 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

Course Description: This course deals with simple and multiple linear regression models with their assumptions, estimation and their significance of regression coefficients. Model and variable selection techniques and variable transformation techniques are discussed.

Course Objectives: To enable the students establish and verify the relationship between the related variables.

Learning Outcome

CO1. Demonstrate simple and multiple regression analysis with one dependent and one or more independent variables.

CO2. Infer about R^2, adjusted R^2 for model selection.

CO3. Apply the concepts of forward, backward and stepwise methods for selecting the independent variables.

CO4. Demonstrate the concepts of heteroscedasticity, multicollinearity, autocorrelation and residual plots.

Unit-1 **Teaching Hours:15**

Simple Linear Regression

Introduction to regression analysis: Modelling a response, overview and applications of regression analysis, major steps in regression analysis. Simple linear regression (Two variables): assumptions, estimation and properties of regression coefficients, significance of regression coefficients.

Unit-2 **Teaching Hours:10**

Multiple Linear Regression

Multiple linear regression model: assumptions, ordinary least square estimation of regression coefficients, interpretation and properties of regression coefficients, significance of regression coefficients.

Unit-3 **Teaching Hours:10**

Criteria for Model Selection and Residual Analysis

Mean Square error criteria, R^2 and adjusted-R^2 criteria for model selection, Forward, Backward and Stepwise procedures, Statistical analysis of residuals: various types of residuals, residual plots, Need of the transformation of variables; Box-Cox transformation.

Unit-4 **Teaching Hours:10**

Tests of assumptions in MLR

Concept of heteroscedasticity, multicollinearity and autocorrelation and their practical consequences; detection and remedial measures.

Text Books And Reference Books:

1. Montgomery D.C, Peck E.A and Vining G.G, *Introduction to Linear Regression Analysis*, John Wiley and Sons Inc,. New York, 2012.

2. Chatterjee S and Hadi A, *Regression Analysis by Example*, 4th edition, John Wiley and Sons Inc, New York, 2015

Essential Reading / Recommended Reading

1. 1. George A.F.S and Lee A.J, *Linear Regression Analysis*, John Wiley and Sons, Inc, 2012.

2. Pardoe I, *Applied Regression Modeling*, John Wiley and Sons Inc, New York, 2012

3. Wasserman L, *All of Statistics*, Springer Series in Statistics, 2010.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA541A - STATISTICAL QUALITY CONTROL (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course Description: This course is designed to introduce the application of statistical tools on industrial environment to study, analyze and control the quality of products.

Course Objectives: To enable the students to enrich the concepts of process and product control along with the concepts of Reliability.

Learning Outcome

CO1. Demonstrate the concepts control charts and sampling plans to improve the quality standards of the products.

CO2. Apply the idea of Reliability theory to control the quality of industrial outputs.

Unit-1 **Teaching Hours:15**

Introduction to SQC

Quality: Definition, dimensions of quality, historical perspective of quality control, historical perspective of Quality Gurus and Quality Hall of Fame. Quality system and standards: Introduction to ISO quality standards, Quality registration. Statistical Process Control - Seven tools of SPC, chance and assignable Causes, Statistical Control Charts - Construction and Statistical basis of 3-σ Control charts, Rational Sub-grouping.

Unit-2 **Teaching Hours:10**

Statistical Process Control

Control charts for variables: X-bar & R-chart, X-bar & s-chart. Control charts for attributes: np-chart, p-chart, c-chart and u-chart. Comparison between control charts for variables and control charts for attributes. Analysis of patterns on control chart, estimation of process capability.

Unit-3 **Teaching Hours:10**

Statistical Product Control

Acceptance sampling plan: Principle of acceptance sampling plans, Single and Double sampling plan - OC, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation, use and interpretation of Dodge and Romig's sampling inspection plan tables.

Unit-4 **Teaching Hours:10**

Reliability

Reliability concepts. Reliability of components and systems. Life distributions, reliability functions, hazard rate, common life distributions- Exponential, Gamma and Weibull. System reliability, Series, parallel, stand by systems, r/n systems. Complex systems. Fault tree and event tree analysis, link between quality and reliability.

Text Books And Reference Books:

1. Montgomery D.C, *Introduction to Statistical Quality Control*, 7th edition, Wiley India (P) Ltd, 2012.
2. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th edition (Reprint), Sultan Chand and Sons, India, 2019.

Essential Reading / Recommended Reading

1. Mukhopadhyay P, *Applied Statistics*, 2nd edition revised reprint, Books and Allied(P) Ltd, 2011.
2. Renyan J, *Introduction to Quality and Reliability Engineering*, 1st Edition, Springer, 2015.
3. Schilling E.G and Neubaer D.V, *Acceptance sampling plan Quality Control*, 2nd edition, CRC Press, Boca Raton, 2009.

Evaluation Pattern

Component	Marks

CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA541B - DESIGN OF EXPERIMENTS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course Description: This course introduces various experimental designs, selection of appropriate designs in planning a scientific experimentation.

Course Objective: To enable the students to understand the principles of experimentation and employ suitable designs in experiments.

Learning Outcome

CO1:Demonstrate the concepts of Analysis of Variance with comparison of more than two treatments.

CO2:Demonstrate the efficiency of CRD, RBD and LSD.

CO3:Demonstrate the applications of factorial experiments with confounding.

Unit-1 **Teaching Hours:10**

Analysis of variance

Meaning and assumptions. Fixed, random and mixed effect models. Analysis of variance of one-way and two-way classified data with and without interaction effects. Multiple comparison tests: Tukey's method, critical difference.

Unit-2 **Teaching Hours:10**

Experimental designs

Principles of design of experiments. Completely randomized, randomized block, and Latin square designs (CRD, RBD, and LSD) -layout formation and the analysis using fixed effect models.

Unit-3 **Teaching Hours:10**

Efficiency of a design and missing plot technique

Comparison of efficiencies of CRD, RBD, and LSD. Estimation of single missing observation in RBD and LSD and analysis.

Unit-4 **Teaching Hours:15**

Factorial experiment

Factorial experiment: Basic concepts, main effects, interactions, and orthogonal contrasts in 2^2 and 2^3 factorial experiments. Yates' method of computing factorial effects total. Analysis and testing the significance of effects in 2^2 and 2^3 factorial experiments in RBD**.** Need for confounding. Complete and partial confounding in a 2^3 factorial experiment in RBD - layout and its analysis.

Text Books And Reference Books:

1. Montgomery D.C, *Design and Analysis of Experiments*, John Wiley and Sons Inc,. New York, 2014.

2. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th edition (Reprint), Sultan Chand and Sons, India, 2019.

Essential Reading / Recommended Reading

1. Mukhopadhyay P, *Mathematical Statistics*, 2nd edition revised reprint, Books and Allied(P) Ltd, 2015.

2. Lawson J, *Design and Analysis of Experiments with R*, CRC Press, 2015.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA541C - ACTUARIAL STATISTICS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course Description: This course is designed to introduce the application of statistical methods in framing the insurance policies.

Course Objective: To enable the students to gain knowledge in premium calculations for life insurance.

Learning Outcome

CO1: Demonstrate the principle terms used and major life insurance covered by Indian life insurance.

CO2:Infer the calculation of premium for various life insurance policies.

Unit-1 **Teaching Hours:10**

Introductory Statistics and Insurance Applications

Discrete, continuous and mixed probability distributions. Insurance applications, sum of random variables. Utility theory: Utility functions, expected utility criterion, types of utility function, insurance and utility theory.

Unit-2 **Teaching Hours:10**

Principles of Premium Calculation

Properties of premium principles, examples of premium principles. Individual risk models: models for individual claims, the sum of independent claims, approximations and their applications.

Unit-3 **Teaching Hours:10**

Survival Distribution and Life Tables

Uncertainty of age at death, survival function, time until death for a person, curate future lifetime, force of mortality, life tables with examples, deterministic survivorship group, life table characteristics, assumptions for fractional age, some analytical laws of mortality.

Unit-4 **Teaching Hours:15**

Life Insurance

Models for insurance payable at the moment of death, insurance payable at the end of the year of death and their relationships. Life annuities: continuous life annuities, discrete life annuities, life annuities with periodic payments. Premiums: continuous and discrete premiums.

Text Books And Reference Books:

1. Corazza M, Legros F, Perna C and Sibillo M, *Mathematical and Statistical Method for Actuarial Science and Finance*, Springer, 2017.

2. Dickson C.M.D, Insurance Risk and Ruin, *International Series on Actuarial Science*, Cambridge University Press, 2005.

Essential Reading / Recommended Reading

1. CT-5 *General Insurance, Life and health contingencies*, Institute of Actuaries of India.

2. Mishra M.N and Mishra S.B, *Insurance: Principles and Practice*, 22nd edition, S. Chand Publications, 2016.

3. IC-02 (Revised), *Practice of Life assurance*, Insurance Institute of India.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA541D - INTRODUCTION TO SPATIAL STATISTICS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course Description: This course designed as an application of statistics in geographical data analysis

Course Objective: To enable the students to understand basic concepts of Spatial Statistics.

Learning Outcome

After completion of this course students are able to understand the following topics,

1. Demonstrate the basic biological concepts in genetics
2. Infer the bioassays and their types
3. Demonstrate the Feller's theorem and dose response estimation using regression models and dose allocation schemes.

Unit-1 **Teaching Hours:15**

Introduction

Spatial Statistics, Geostatistics, Spatial Autocorrelation, Important properties of MC, Relationships between MC and GR, join count statistics, Graphic portrayals: the Moran scatterplot and the semi-variogram plot, Impacts of spatial autocorrelation, Testing for spatial autocorrelation in regression residuals.

Unit-2 **Teaching Hours:10**

Spatial Sampling

Puerto Rico DEM data, Properties of the selected sampling design, Sampling simulation experiments on a unit square landscape, sampling simulation experiments on a hexagonal landscape structure, Spatial autocorrelation and effective sample size.

Unit-3 **Teaching Hours:10**

Spatial Composition and Configuration

Spatial heterogeneity, ANOVA, Testing for heterogeneity over a plan, regional supra-partitionings, direction supra-partitionings, Spatial weight metrics, Spatial heterogeneity.

Unit-4 **Teaching Hours:10**

Spatial Regression

Linear regression, non-linear regression, Binomial/logistic regression, Poisson/negative binomial regression, simple kriging, universal kriging, simulated experiments.

Text Books And Reference Books:

1. Yongan C, Griffith D.A, *Spatial Statistics & Geostatistics: Theory and Applications for Geographic Information Science & Technology*, Sage Publication, 2013.
2. Carlo G, Xavier G, *Spatial Statistics and Modeling*, Springer, 2010.

Essential Reading / Recommended Reading

1. Van Lieshout M.N.M, *Theory of Spatial Statistics: A Concise Introduction*, CRC Press, 2019.

2. Kalkhan M.A, *Spatial Statistics: GeoSpatial Information Modeling and Thematic Mapping*, CRC Press, 2011.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA551 - LINEAR REGRESSION MODELS PRACTICAL

(2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course Description

The course is designed to provide a practical exposure to the students in Simple and Multiple linear Regression Analysis.

Learning Outcome

Course Learning Outcome

After completion of this course, the students are able to develop a deeper understanding of the linear regression model by visualizing and fitting models with minimum error using R programming.

Unit-1 **Teaching Hours:30**

Practical assignments using R programming

1. Scatter Plots diagnosis.
2. Estimation of simple regression model.
3. Significance of simple linear regression.
4. Confidence Interval Estimation of simple linear regression.
5. Estimation of Multiple regression model.
6. Variable selection in multiple regression
7. Significance of multiple linear Regression.
8. Confidence interval for multiple linear Regression.
9. Residuals Plots, detection of outliers and their interpretation in simple and multiple linear regression.
10. Checking for Normality of Residuals.
11. Checking for Multicollinearity in simple and multiple linear regression.
12. Checking for Heteroscedasticity and auto-correlation in simple and multiple linear regression.

Text Books And Reference Books:

1. Seema Acharya, *Data Analytics Using R*, CRC Press, Taylor & Francis Group, 2018.

Essential Reading / Recommended Reading

1. Pardoe I, *Applied Regression Modeling*, John Wiley and Sons Inc, New York, 2012

Evaluation Pattern

Component	Points
CIA of experiments	80

Test 1	25
Test 2	35
Viva-Voce Exam	10
Total	150

STA552A - STATISTICAL QUALITY CONTROL PRACTICAL (2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course Description

The course is designed to provide a practical exposure to the students for the various statistical quality control tools.

Learning Outcome

Course Learning Outcome

After completion of this course, the students are able to construct the variable and attribute control charts and develop sampling plans using R programming/EXCEL.

Unit-1 **Teaching Hours:30**

Practical assignments using R programming/EXCEL

1. and R charts (Standard values known and unknown)
2. and s charts (Standard values known and unknown)
3. np and p charts (Standard values known and unknown)
4. c and u charts (standard values known and unknown)
5. Pareto charts
6. Fish Bone diagram using EXCEL
7. Construction of OC, AOQ, ASN and ATI curves for single sampling plan under the conditions of binomial distribution.
8. Construction of OC, AOQ, ASN and ATI curves for single sampling plan under the conditions of binomial distribution.
9. Calculating sample size and acceptance number for single sampling plan using unity value approach.
10. Construction of OC, AOQ, ASN and ATI curves for double sampling plan under the conditions of binomial

distribution.

11. Reliability and hazard functions
12. Fault tree analysis using EXCEL and R

Text Books And Reference Books:

1. Seema Acharya, *Data Analytics Using R*, CRC Press, Taylor & Francis Group, 2018.

Essential Reading / Recommended Reading

1. Renyan J, *Introduction to Quality and Reliability Engineering*, 1st Edition, Springer, 2015.

Evaluation Pattern

Component	Points
CIA of experiments	80
Test 1	25
Test 2	35
Viva-Voce Exam	10
Total	150

STA552B - DESIGN OF EXPERIMENTS PRACTICAL (2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

The course is designed to provide a practical exposure to the students for the various experimental designs.

Learning Outcome

After completion of this course, the students are able to construct and analyse basic experimental designs using R programming.

Unit-1 **Teaching Hours:30**

Practical assignments using R programming

1. Construction of ANOVA for one way classification
2. Construction of ANOVA for two way classification
3. Analysis of CRD
4. Analysis of RBD
5. Efficiency of RBD over CRD
6. Analysis of LSD
7. Efficiency of LSD over RBD

8. Efficiency of LSD over CRD
9. Analysis of 2^2 factorial experimental using RBD layout
10. Analysis of 2^3 factorial experimental using RBD layout
11. Analysis of 2^3 factorial experimental using RBD layout (Complete confounding)
12. Analysis of 2^3 factorial experimental using RBD layout (Partial confounding)

Text Books And Reference Books:

1. Seema Acharya, *Data Analytics Using R*, CRC Press, Taylor & Francis Group, 2018.

Essential Reading / Recommended Reading

1. Lawson J, *Design and Analysis of Experiments with R*, CRC Press, 2015.

Evaluation Pattern

Component	Points
CIA of experiments	80
Test 1	25
Test 2	35
Viva-Voce Exam	10
Total	150

STA552C - ACTUARIAL STATISTICS PRACTICAL (2018 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

The course is designed to provide a practical exposure to the students in Actuarial Modeling.

Learning Outcome

CO1: To develop a deeper understanding of the premium and risk calculations of life insurance policies.

CO2: To implement actuarial statistics in real life

CO3: To construct new models using real-life concepts

Unit-1 **Teaching Hours:30**

List of practicals

Practical assignments using EXCEL:

1. Premium calculation

2. Risk computation for different utility models

3. Discrete and continuous risk calculations

4. Calculation of aggregate claims for collective risks

5. Calculation of aggregate claim for individual risks

6. Computing Ruin probabilities and aggregate losses

7. Annuity and present value of the contract

8. Computing premium for different insurance schemes

9. Practical based on life models and tables

Text Books And Reference Books:

1. Corazza M, Legros F, Perna C and Sibillo M, *Mathematical and Statistical Method for Actuarial Science and Finance*, Springer, 2017.

2. Dickson C.M.D, Insurance Risk and Ruin, *International Series on Actuarial Science*, 2nd edition, Cambridge University Press, 2016.

Essential Reading / Recommended Reading

1. CT-5 *General Insurance, Life and health contingencies*, Institute of Actuaries of India.

2. Mishra M.N and Mishra S.B, *Insurance: Principles and Practice*, 22nd edition, S. Chand Publications, 2016.

3. IC-02 (Revised), *Practice of Life assurance*, Insurance Institute of India.

Evaluation Pattern

Section	Parameters	Marks
A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		**10**

STA552D - SPATIAL STATISTICS PRACTICAL

(2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

This course is designed to teach practical Spatial problems using statistical software.

Learning Outcome

CO1: To practically evaluate Spatial Statistical models using R programming.

CO2: To apply spatial statistics in real-life problems

CO3: To construct spatial regression models

Unit-1 **Teaching Hours:30**

List of practicals

Practical assignments using R programming:

1. Moran scatter plot
2. Semi-variogram plot
3. Estimation of Spatial Autocorrelation
4. Testing for spatial autocorrelation in regression residuals
5. Sampling simulation experiments on a unit square landscape
6. Sampling simulation experiments on a hexagonal landscape structure
7. Calculation of effective sample size
8. Spatial heterogeneity
9. Testing for heterogeneity over a plan: regional supra-partitionings
10. Testing for heterogeneity over a plan, direction supra-partitionings
11. Spatial Linear regression
12. Spatial Non-linear regression

Text Books And Reference Books:

1. Yongan C, Griffith D.A, *Spatial Statistics & Geostatistics: Theory and Applications for Geographic Information Science & Technology*, Sage Publication, 2013.
2. Carlo G, Xavier G, *Spatial Statistics and Modelling*, Springer, 2010.

Essential Reading / Recommended Reading

1. Van Lieshout M.N.M, *Theory of Spatial Statistics: A Concise Introduction*, CRC Press, 2019.
2. Kalkhan M.A, *Spatial Statistics: GeoSpatial Information Modeling and Thematic Mapping*, CRC Press, 2011.

Evaluation Pattern

Section	Parameters	Marks
A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		**10**

CSC631 - DESIGN AND ANALYSIS OF ALGORITHMS (2018 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

Course Objectives

To understand the ways to analyze and evaluate the performance of an algorithm.

To understand different design techniques of algorithms to solve problems.

Learning Outcome

Course Outcomes

CO1:Demonstrate their ability to apply appropriate Data Structures.

CO2: Design and develop algorithms using relevant data structure operations.

CO3: Evaluate the Algorithms for its efficiency.

Unit-1 **Teaching Hours:7**

Introduction

Algorithm-definition, Specification- pseudo code conventions, recursive algorithms, Performance analysis – space complexity, time complexity, asymptotic notation, practical complexities, performance measurement, Randomized algorithms- basics of probability theory, identifying the repeated element, primality testing, advantages and disadvantages.

Unit-2 **Teaching Hours:8**

Elementary Data Structures

Stacks and queues, Trees- terminology, binary trees, Dictionaries- binary search trees, cost amortization, Priority queues- heaps, heap sort, Sets and disjoint Set Union-union and find operations, Graphs-definitions, representations.

Unit-3 **Teaching Hours:8**

Divide and Conquer

General method, Binary search, Finding the maximum and minimum, Merge sort, quick sort-performance measurement

Unit-4 **Teaching Hours:12**

Greedy Method & Dynamic Programming

The general method, Knapsack problem, Minimum cost spanning trees- Prim's algorithm, Kruskal's algorithm, Single-source shortest paths, Dynamic Programming: The general method, Multistage graphs, All pairs shortest paths, - -optimal binary search trees - The traveling salesperson problem.

Unit-5 **Teaching Hours:10**

Backtracking & Branch And Bound

Backtracking- The general method, The 8-queens problem, sum of subsets, graph coloring Hamiltonian cycles. , Branch and Bound: Least cost search, Bounding, FIFO Branch and bound, LC branch and bound, Knapsack problem, Traveling salesperson problem.

Text Books And Reference Books:

[1] Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, *Fundamentals of computer algorithms*, Galgotia Publications, 2007.

Essential Reading / Recommended Reading

[1] Sara Baase and Allen VanGelder, *Computer Algorithms Introduction to design and Analysis,* Third edition, Pearson education, 2004.

Evaluation Pattern

CIA - 50%

End Semester Exam - 50%

CSC641A - INTRODUCTION TO SOFT COMPUTING **(2018 Batch)**

Total Teaching Hours for **No of Lecture**

Semester:45 **Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

The main objective of this course is to provide fundamental knowledge of soft computing techniques.On successful completion of the course,students will acquire fundamental knowledge of artificial neural network, fuzzy Logic and genetic algorithms.

Learning Outcome

CO1:Describe the structure of artificial neural network and Biological neural network.

CO2:Demonstrate various artificial neural network models,supervised,unsupervised and reinforcement learning methods.

CO3:Apply Perceptron (Single and Multiple output classes) and Back propagation algorithm in real time applications.

Unit-1 **Teaching Hours:9**

Introduction to Soft Computing

Neural Networks-Application Scope of Neural Networks-Fuzzy Logic-Genetic Algorithm-Soft Computing.

Introduction to Artificial Neural Networks

Fundamental Concept of ANN: The Artificial Neural Network-Biological Neural Network-Comparison between Biological Neuron and Artificial Neuron-Evolution of Neural Network.

Unit-2 **Teaching Hours:9**

Basic Models of ANN

Connections-Learning-Supervised Learning-Unsupervised Learning-Reinforcement Learning-Activation Functions

Important Terminologies of ANN- Weights, Bias, Threshold, Learning Rate, Momentum Factor, Vigilance Parameter, Notations.

Unit-3 **Teaching Hours:9**

Supervised Learning Network

Perceptron Networks-Theory-Perceptron Learning Rule-Architecture-Flowchart for training Process-Perceptron Training Algorithm for Single and Multiple Output Classes.

Back Propagation Network- Theory-Architecture-Flowchart for training process-Training Algorithm-Learning Factors for Back-Propagation Network.

Radial Basis Function Network RBFN: Theory, Architecture, Flowchart and Algorithm.

Unit-4 **Teaching Hours:9**

Introduction to Fuzzy Logic and Sets

Introduction to Fuzzy Logic - Fuzzy Sets – Fuzzy set operations-properties of Fuzzy sets.

Fuzzy Relations: cardinality-operations and properties of fuzzy relations-fuzzy composition.

Fuzzy membership functions -Features of membership functions-Fuzzification- Methods of Membership value assignments.

Unit-5 **Teaching Hours:9**

Genetic Algorithm

Introduction to Genetic Algorithm-Biological Background-Genetic Algorithm and Search Space-Genetic Algorithm vs Traditional Algorithms-Basic Terminologies in Genetic Algorithm-Simple GA-General Genetic Algorithm

Text Books And Reference Books:

[1] S.N.Sivanandam, S. N. Deepa, *Principles of Soft Computing,* Wiley-India, 3rd Edition, 2018.

[2]S.N.Sivanandam,S. Sumathi, S.N.Deepa, *Introduction to Neural Networks using MATLAB 6.0,*Tata McGraw-Hill, New Delhi, 2010.

Essential Reading / Recommended Reading

[1] Satish Kumar, *Neural Networks – A Classroom approach*, Tata McGraw-Hill, New Delhi,2007.

[2] Martin T. Hagan, Howard B. Demuth, Mark Beale, *Neural Network Design*, Thomson Learning, India, 2002.

[3] Simon Haykin, *Neural Networks,* PHI,2nd Edition,2005.

[4] Ethem Alpaydin, *Introduction To Machine Learning,* PHI, 2005.

[5] J.S.R. Jang, C.T.Sun, E.Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 2012.

Evaluation Pattern

CIA – 50 %

ESE - 50 %

CSC641B - CLOUD COMPUTING (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

This course covers a series of current cloud computing technologies, including technologies for Infrastructure as a Service, Platform as a Service, Software as a Service, and Physical Systems as a Service. For different layers of the cloud

technologies, practical solutions such as Google, Amazon, Microsoft,SalesForce.com.

Learning Outcome

CO1: Demonstrate the fundamental principles of distributed computing.
CO2: Apply distributed computing in Cloud Computing.
CO3: Evaluate the business models that underlie Cloud Computing.

Unit-1 **Teaching Hours:8**

Introduction

The vision of cloud computing - Characteristics and benefits - Challenges ahead - Historical developments - Distributed systems - Virtualization - Building cloud computing environments - Application development - Infrastructure and system development - Computing platforms andtechnologies.

Unit-2 **Teaching Hours:9**

Principles of Parallel computing and Virtualization

Principles of Parallel Computing – Parallel vs. distributed computing - Elements of parallel computing - Hardware architectures for parallel processing Approaches to parallel programming - Laws of caution.

Introduction to virtualization - Characteristics of virtualized environments - Taxonomy of virtualization techniques – Hardware Virtualization - Virtualization and cloud computing - Pros and cons of virtualization.

Unit-3 **Teaching Hours:9**

Cloud Computing Architecture

The Cloud reference model – Architecture – Types of Cloud – Public Cloud – Private Cloud – Hybrid Cloud – Community Cloud – Economies of the cloud.

Unit-4 **Teaching Hours:10**

Cloud Platforms in Industry

Amazon web services: Compute services - Storage services - Communication services - Additional services. Google AppEngine: Architecture and core concepts - Application life cycle - Cost model – Observations. Microsoft azure: Azure core concepts - SQL azure - Windows azure platform appliance.

Unit-5 **Teaching Hours:9**

Data in the cloud and Cloud Applications

Data in the cloud: Relational databases - Cloud file systems: GFS and HDFS - BigTable, HBase - Cloud data stores: Datastore and SimpleDB

Cloud Application: Healthcare: ECG analysis in the cloud - Biology: protein structure prediction - Biology: gene expression

data analysis for cancer diagnosis - Geoscience: satellite image processing.

Text Books And Reference Books:

[1] RajkumarBuyya, Christian Vecchiola and S. ThamaraiSelvi ―Mastering Cloud Computing" - Foundations and Applications Programming , MK publications, 2013.

Essential Reading / Recommended Reading

[1] Michael J.Kavis, "Architecting the Cloud: Design Decisions for Cloud Computing Service Models SaaS, PaaS, and IaaS‖, John Wiley & Sons Inc., Jan 2014.

Evaluation Pattern

50% CIA + 50% ESE

CSC641C - COMPUTER ARCHITECTURE (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

This course deals with concepts and models of computer peripherals. It explains a set of disciplines that describes a computer system by specifying its parts and their relations. The course provides insights into the basic design of an ALU, the memory design, the various operations performed.

Learning Outcome

At the end of the course students will be able to
CO1: Understand the evolution of computer hardware to meet the needs of multi-processing systems.
CO2: Demonstrate the basic computer organization & design and state the significant components in CPU.
CO3: Implement computer arithmetic algorithms and explain the input output organization.

Unit-1 **Teaching Hours:7**

Introduction

Basic Model of a Computer, Computer Components, Register transfer and Micro operations: Register Transfer Language ,Register Transfer , Bus and Memory Transfers, Arithmetic Micro operations , Logic Micro operations , Shift Micro operations, Arithmetic Logic and ShiftUnit.

Unit-2 **Teaching Hours:9**

Basic Computer organization and design

Instruction codes, Computer registers, Computer Instruction, Timing and control, Instruction cycle, Memory reference instructions, Input output and Interrupt, Design of basic computer, Design of Accumulator logic.

Unit-3 **Teaching Hours:9**

Central Processing Unit

Introduction, General Register Organization, Stacks organizations-Register stack, Memory stack, Instruction formats- Three address instruction, two address instruction, one address instruction, zero address instruction , Addressing modes, Data transfer and manipulation- Data transfer instructions, Data manipulationinstructions.

Unit-4 **Teaching Hours:10**

Computer Arithmetic

Introduction ,Addition and Subtraction – Addition and subtraction with signed magnitude data, addition and subtraction with signed 2's complement data ,Multiplication Algorithms- Signed magnitude ,Booth multiplication algorithm, array multiplier ,Division Algorithms- signed magnitudealgorithm.

Unit-5 **Teaching Hours:10**

Input Output Organization

Peripheral Device, Input Output Interface – I/O bus and interface modules, I/O versus memory bus, Asynchronous data transfer, Modes of transfer – programmed I/O , Interrupt initiated I/O, , Direct Memory Access – DMA controller and DMAtransfer.

Text Books And Reference Books:

[1] Mano M Morris, *Computer System Architecture*, PHI, 3rd Edition,2008.

Essential Reading / Recommended Reading

[1] Stalling, Williams. *Computer Organization and Architecture*, 7th Edition, 2010.

[2] Hayes, John. P, *Computer Architecture and Organization*, 3rd Edition, McGraw-Hill, 2008.

Evaluation Pattern

CIA-50%

ESE-50%

CSC641D - OOAD USING UML (2018 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

This course provides instruction and practical experience on the effective use of object-oriented technologies and the judicious use of software modelling as applied to a software development process.

Learning Outcome

The successful completion of this course will enable the students

CO1: Understand the life cycle of object oriented model.

CO2: Identify the objects and their relationships,services through UML.

CO3: Apply object oriented design process to any real time applications using UML.

Unit-1 **Teaching Hours:9**

Complexity and Object Model

The inherent complexity of software, The evolution of object model, Elements of object model, applying the object model, Foundations of the object model.

Unit-2 **Teaching Hours:9**

Classes and Objects,Classification

The nature of an object, Relationship among objects, the nature of a class, Relationship among classes, The interplay of classes and objects, The importance of proper classification, Identifying classes and objects.

Unit-3 **Teaching Hours:9**

Notation

Basic Behavioural Modelling, Basic elements, class diagram, object, state Transition diagram, Interactions, Use Case Diagrams, Activity, module and process diagrams.

Unit-4 **Teaching Hours:9**

Process

Principles, Micro and macro development process, Pragmatics-Management and planning, staffing, Release management, Reuse, Quality Assurance Metrics, Documentation, Tools

Unit-5 **Teaching Hours:9**

Architectural Modelling

Components, Deployment, Collaborations, Pattern and Frameworks, Component Diagram, Deployment Diagrams, Systems and Models.

Text Books And Reference Books:

[1] Grady Booch, *Object-Oriented Analysis And Design With Applications*, Pearson Education, 3rd Edition, 2009.

Essential Reading / Recommended Reading

[1] Mahesh P Matha, *Object Oriented Analysis and Design using UML*, PHI, 3rd reprint, 2012

[2] Grady Booch, James Rumbaugh and Ivar Jacobson, *The Unified Modeling Languages User Guide*, Addison Wesley, 4th Edition, Reprint 2000.

[3] Mike O'Docherty, *Object Oriented Analysis and Design Understanding system development with UML2.0*, John Wiley and Sons, 1st Edition, 2005.

Evaluation Pattern

CIA : 50%

End Semester Exam : 50%

CSC641E - USER EXPERIENCE DESIGN(UX)

(2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

The UI/UX course provides a great entry point for those who want to pursue a career in the user interface design and development. Student will learn the core principles of visual design, including building storyboards, choosing color schemes and visualizing the ideal user interface to improve the user experience. This course will help to create intuitive and great- looking software products that users will love, and boost company's ability to persuade audiences into becomingbuyers.

Learning Outcome

CO1: Describe design principles.

CO2: Demonstrate impactful visual design and color concepts. CO3: Apply design principles and skills for design prototype. CO4: Design an intuitive design for software products.

Unit-1 **Teaching Hours:9**

Introduction

HCI-Human computer Interaction-Fundamentals of Design-people and design-Visual Design-overview -difference between visual & UI/UX, UI design trends, Roles of a UI designer, UI UX process-UX- UX terminologies-elements-layers-roles-user centered vs. value-centered design-usertypes.

Unit-2 **Teaching Hours:9**

Principles

Visual Communication-Design principles-Design elements-Color theory-Typography

Unit-3 **Teaching Hours:9**

User Experience (UX)

What makes an experience-the cost of overlooking your users-a balanced approach to solving problems-involving users to perfect your product-good and bad user experiences-Understand the business problem- understand the user context- making sense of what you have found- prototype the solution –test learn tweak.Iterate.

Unit-4 **Teaching Hours:9**

Designing for Voice User Interfaces

Introduction-History-what is VUI designer?-chat bots-Basic Voice user interface design principles-designing for mobile devices verses IVR systems-conventional design-error handling-personas, avtars, actor and video games-Speech Recognition Technology-Advanced Voice User Interface Design-User testing. Hands on reference Amazon Alexa, Google Dialogflow

Unit-5 **Teaching Hours:9**

Case Study / Tools / Design Lab

Case study based on domain-web-mobile-product interaction-software tools-mockups- interactive design. Learn through cheat-sheets- Invision-AdobeXD-Sketch-UXPin-FluidUI- Portfolio creation through behance.net

Text Books And Reference Books:

[1] DonalsChesnut,KevinPNichols,*"UXforDummies"*,JohnwileyandSons,2014

[2] Jodie Moule, *"KILLER UX Design"*, Site point , Shroff Publishers, 2015 ISBN: 978:93:5213:175-4

[3] CathyPearl, "*Designing Voice User Interfaces*", O'Reilly Media Inc, 2017, ISBN : 978- 93-5213-526-4

Essential Reading / Recommended Reading

[1] DonaldA.Norman,BasicBooks,"*TheDesignofEverydayThings*",Inc.NewYork,NY, USA ©2002 ISBN: 9780465067107

[2] Krug, Steve, **"***Don't Make Me Think, Revisited : a Common Sense Approach to Web Usability*", [Berkeley, Calif.] : New Riders, 2014.Print

[3] William lidwell, Kritina Holden,Jill Butler, "*Universal Principles of Design*", Rockport Publishers, 2010, ISBN-13: 978-1-592453-587-3,ISBN-10:1-59253-

587-9.

Evaluation Pattern

CIA : 50

ESE : 50

CSC681 - MAIN PROJECT (2018 Batch)

Total Teaching Hours for Semester:60 **No of Lecture Hours/Week:4**

Max Marks:100 **Credits:04**

Course Objectives/Course Description

The main aim of this course is to develop practical knowledge of the students on building a project using any of their interested concepts. Students identifies real world problem, design and develop the project.

Learning Outcome

The following outcomes are expected from the students:

CO1: Identify the problem and understand the practical concepts to develop project.

CO2: Analyse the problem to find the solutions as per the requirement.

CO3: Create a working project that satisfies the need of the end user.

Unit-1 **Teaching Hours:60**

MAIN PROJECT

This main project helps the student to apply the concepts which they have learnt in the previous semesters. Students can use any modern technology or tool for their project. Student has to identify and understand the real world problems in consultation with the guide to select the project. Students will be divided into batches, each batch containing not more than 3 students.

Text Books And Reference Books:

-

Essential Reading / Recommended Reading

-

Evaluation Pattern

CIA:50%

ESE:50%

MAT631 - COMPLEX ANALYSIS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course description: This course enables the students to understand the basic theory and principles of complex analysis.

Course objectives: This course will help the learner to gain a familiarity with

COBJ1. the geometry and theory of complex analysis,

COBJ2. Problem solving skills on problems based on analytic functions, Cauchy's integral theorem, Cauchy's integral formula, complex contour integrals, bilinear transformations, sequences of complex valued functions etc.,

Learning Outcome

Course outcomes: On successful completion of the course, the students should be able to

CO1. State and prove the necessary and sufficient conditions for a function to be analytic

CO2. Prove certain fundamental theorems about analytic functions viz. Cauchy's Integral Theorem, Cauchy's Integral Formula etc..

CO3. Compute complex contour integrals in several ways

CO4. Familiarity with bilinear transformations and their properties

CO5. Examine the nature of a sequence

Unit-1 **Teaching Hours:15**

Analytic Functions

Properties of complex numbers, regions in the complex plane, functions of complex variable, Limits, Limits involving the point at infinity, continuity. Analytic functions, Necessary and sufficient conditions for a function to be analytic

Unit-2 **Teaching Hours:15**

Complex Integration and Conformal Mapping

Definite integrals of functions, Contour integrals and its examples, Cauchy's integral theorem, Cauchy integral formula, Liouville's theorem and the fundamental theorem of algebra, Conformal mappings Bilinear Transformations, Mapping by elementary transformations.

Unit-3 **Teaching Hours:15**

Power Series and Singularities

Convergence of sequences and series, Taylor series and its examples, Laurent series and its examples, absolute and uniform convergence of power series. Zeros and poles.

Text Books And Reference Books:

Dennis G. Zill and Patrick D. Shanahan, A first course in Complex Analysis with Applications, 2nd Ed, Jones & Barlett Publishers, 2011.

Essential Reading / Recommended Reading

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications,* 8th ed., McGraw – Hill International Edition, 2009.

2. Joseph Bak and Donald J. Newman, *Complex analysis,* 2nd ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 2000.
3. Alan Jeffrey, Complex Analysis and Applications, 2nd ed., CRC Press, Boca Raton 2013.
4. L. V. Ahlfors, *Complex Analysis*, 3rd ed., McGraw-Hill Education, 2017.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment Reference work	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

MAT641B - NUMERICAL METHODS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course description: To explore the complex world problems physicists, engineers, financiers and mathematicians require certain methods. These practical problems can rarely be solved analytically. Their solutions can only be approximated through numerical methods. This course deals with the theory and application of numerical approximation techniques.

Course objectives: This course will help the learner
COBJ1. to learn about error analysis, solution of nonlinear equations, finite differences, interpolation, numerical integration and differentiation, numerical solution of differential equations, and matrix computation.
COBJ2. It also emphasis the development of numerical algorithms to provide solutions to common problems formulated in science and engineering.

Learning Outcome

By the end of the course the learner will be able to:

CO1. Understand floating point numbers and the role of errors and its analysis in numerical methods.

CO2. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.

CO3. Apply numerical methods to obtain approximate solutions to mathematical problems.

CO4. Understand accuracy, consistency, stability and convergence of numerical methods.

Unit-1 **Teaching Hours:20**

Mathematical Preliminaries, Error analysis and Solution of Non-linear equations

Errors and their analysis – Floating point representation of numbers – Solution of Algebraic and Transcendental Equations: Bisection method, fixed point Iteration method, the method of False Position, Newton Raphson method and Mullers method. Solution of linear systems – Matrix inversion method – Gauss Elimination method – Gauss-Seidel and Gauss-Jacobi Iterative methods - Modification of the Gauss method to compute the inverse – LU Decomposition method .

Unit-2 **Teaching Hours:15**

Finite Differences and Interpolation

Finite differences: Forward difference, Backward difference and Shift Operators – Separation of symbols – Newton's Formulae for interpolation – Lagrange's interpolation formulae - Numerical differentiation – Numerical integration: Trapezoidal rule, Simpson's one-third rule and Simpson's three-eighth rule.

Unit-3 **Teaching Hours:10**

Numerical Solution of Differential Equations

Numerical solution of ordinary differential equations – Taylor's series – Picard's method – Euler's method – Modified Euler's method – Runge Kutta methods - second order (with proof) and fourth order (without proof).

Text Books And Reference Books:

1. C. F. Gerald and P. O. Wheatly, *Applied Numerical Analysis*, 7th ed., Wesley.
2. M. K. Jain, Iyengar, S. R. K. and R. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, New Age Pvt. Pub, New Delhi.
3. R. L. Burden and J. D. Faires, Numerical analysis, Belmont, CA: Thomson Brooks/Cole, 2005.

Essential Reading / Recommended Reading

1. S. D. Conte and C. De Boor, *Elementary Numerical Analysis*, Mc Graw Hill publication.

2. E. V. Krishnamurthy and S. K. Sen, *Applied Numerical Analysis*, East West publication.
3. Francis Scheid, *Schaum's Outline of Numerical Analysis*, 2nd ed., Mc.Graw Hill, 2006.
4. Allaire Grégoire, *Numerical analysis and optimization: an introduction to mathematical modelling and numerical simulation*, Oxford: Oxford University Press, 2007.
5. K. E. Atkinson and W. Han, Elementary numerical analysis. Hoboken, NJ: Wiley, 2004

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment Reference work	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Assignment/problem solving	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	**100**

MAT641C - DISCRETE MATHEMATICS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

Course description: It is a fundamental course in computational algebra and combinatorics involving Set theory, Permutations and Combinations, Lattices and Generating functions

Course objectives: This course will help the learner to

COBJ 1. gain a familiarity with fundamental concepts of Combinatorial Mathematics
COBJ 2. understand and apply knowledge to analyze and solve problems using models of Discrete Mathematics

Learning Outcome

CO1. Enhance research, inquiry and analytical thinking abilities.

CO2. Apply the basics of combinatorics in solving practical problems

Unit-1 **Teaching Hours:15**

Combinatorics

Permutations and Combinations, Laws of set theory, Venn diagrams, Relations and functions, Stirling numbers of the second kind, Pigeon hole principle

Unit-2 **Teaching Hours:15**

Enumeration

Principle of Inclusion and Exclusion, Generating Functions, partitions of integers and Recurrence Relations

Unit-3 **Teaching Hours:15**

Lattice Theory

Partially ordered set, Lattices and their properties, Duality Principle, Lattice Homomorphisms, Product Lattices, Modular and Distributive Lattices, Boolean Lattices.

Text Books And Reference Books:

1. Ralph P. Grimaldi, *Discrete and Combinatorial Mathematics – An applied introduction*, Pearson Addison Wesley, 5th Edition, 2004.
2. Jongsma Calvin, *Discrete Mathematics: Chapter 0, Table of Contents and Preface*,. Faculty Work: Comprehensive List. Paper 426, 2016

Essential Reading / Recommended Reading

1. R. A. Brualdi, *Introductory Combinatorics*, 5th ed., China Machine Press, 2009.
2. J. P. Tremblay and R. Manohar, *Discrete mathematical structures with applications to computer science,* Tata McGraw-Hill Education, 2001.
3. E.A.Bender and S. G. Williamson, *Foundations of combinatorics with applications,*Dover Publ., 2007.
4. George Grätzer, Lattice Theory: Foundation. 10.1007/978-3-0348-0018-1,2011.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment Reference work	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Written Assignment, Project	Problem solving skills	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and	50

		analytical knowledge of the subject	
		Total	100

MAT641D - NUMBER THEORY (2018 Batch)

Total Teaching Hours for Semester:45 — **No of Lecture Hours/Week:3**

Max Marks:100 — **Credits:3**

Course Objectives/Course Description

Course description : This course is concerned with the basics of Analytical Number Theory. Topics such as divisibility and congruences are covered in this course. Some of the applications of the said concepts are also included.

Course objectives : This course will help the learner to gain a familiarity with

1. concepts of divisibility, congruence, greatest common divisor and prime factorization.
2. the concept of congruence and use various results related to congruences.
3. certain number theoretic functions and their properties.
4. proof writing techniques used in number theory.

Learning Outcome

On successful completion of the course, the learner will be able to

1. define, interpret and apply the concepts and principles of number theory to perform numerical and symbolic computations.
2. apply different types of proof writing techniques in number theory to related situations.
3. develop an in-depth understanding of the principles of number theory.
4. communicate the number theory concepts, techniques and principles effectively in both written and oral form.

Unit-1 — **Teaching Hours:15**

Divisibility of Primes

The Division Algorithm, The Greatest Common Divisor, The Euclidean Algorithm, The Linear Diophantine Equation, The Fundamental Theorem of Arithmetic.

Unit-2 — **Teaching Hours:15**

The Theory of Congruences

Basic Properties of Congruences, Binary and Decimal Representations of Integers, Linear Congruences and Chinese Remainder Theorem, Fermat's Little Theorem and Pseudoprimes, Wilson's Theorem.

Unit-3 — **Teaching Hours:15**

Euler's Generalization of Fermat?s Theorem

The Greatest Integer Function, Euler's Phi-Function, Euler's theorem, Some Properties of Phi-function.

Text Books And Reference Books:

D.M. Burton, Elementary Number Theory, 6th ed.,, New Delhi: Tata McGraw-Hill, 2012.

Essential Reading / Recommended Reading

1. Niven, H.S. Zuckerman and H.L. Montgomery, *An Introduction to The Theory of Numbers*, 5t ed., New Delhi: John Wiley & Sons, Inc., 2012.
2. K. Ireland and M. Rosen, *A Classical Introduction to Modern Number Theory*, 2nd ed., New York: Springer-Verlag, 2010.
3. G. A. Jones And J. Mary Jones, *Elementary Number Theory*, Springer(India) Pvt. Ltd., 1999.
4. J. H. Silverman, A Friendly Introduction To Number Theory, Pearson Prentice Hall, 2006.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment Reference work	Mastery of the core concepts Problem solving skills	**13**
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	**05**
CIA III	Written Assignment / Project	Written assignment based on Binary and Decimal representation of integers.	**05**
Attendance	Attendance	Regularity and Punctuality	**02**
ESE		Basic, conceptual and analytical knowledge of the subject	**25**
		Total	**50**

MAT641E - FINANCIAL MATHEMATICS (2018 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

Course description: Financial Mathematics deals with the solving of financial problems by using Mathematical methods. This course aims at introducing the basic ideas of deterministic mathematics of finance. The course focuses on imparting sound knowledge on elementary notions like simple interest, complex interest (annual and non-annual), annuities (varying and non-varying), loans and bonds.

Course objectives: This course will help the learner to

1. gain familiarity in solving problems on Interest rates and Level Annuities..
2. derive formulae for different types of varying annuities and solve its associated problems
3. gain in depth knowledge on Loans and Bonds and hence create schedules for Loan Repayment and Bond Amortization Schedules.

Learning Outcome

Course outcomes: On successful completion of the course, the students should be able to:

1. deal with the elementary notions like simple interest, compound interest and Annuities.
2. solve simple problems on Interest Rates, Annuities, Varying Annuities, Non-Annual interest Rates, Loans and Bonds
3. apply the formulae appropriately in solving problems that mimics real life scenario.

Unit-1 **Teaching Hours:15**

Interest Rates, Factors and Level Annuities

Interest Rates, Rate of discount, Nominal rates of interest and discount, Constant force of interest, Force of interest, Inflation, Equations of Value and Yield Rates, Annuity-Immediate, Annuity-Due, Perpetuities, Deferred Annuities and values on any date, Outstanding Loan Balances (OLB)

Unit-2 **Teaching Hours:15**

Varying Annuities

Non-level Annuities, Annuities with payments in Geometric Progression, Annuities with payment in Arithmetic Progression, Annuity symbols for non-integral terms, Annuities with payments less/more frequent than each interest period and payments in Arithmetic Progression, Continuously Payable Annuities.

Unit-3 **Teaching Hours:15**

Loans Repayment and Bonds

Amortized loans and Amortization Schedules, The sinking fund method, Loans with other repayment patterns, Yield rate examples and other repayment patterns, Bond symbols and basic price formula, Other pricing formula for bonds, Bond Amortization Schedules, Valuing a bond after its date of issue.

Text Books And Reference Books:

L. J. F. Vaaler and J. W. Daniel, Mathematical interest theory. Mathematical Association of America, 2009.

Essential Reading / Recommended Reading

S. J. Garrett and J. J. McCutcheon, *An introduction to the mathematics of finance: a deterministic approach*. Amsterdam: Elsevier/Butterworth-Heinemann, 2013.

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ Written Assignment Reference work	Mastery of the core concepts Problem solving skills	**10**
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	**25**
CIA III	Assignment	Problem solving skills	**10**
Attendance	Attendance	Regularity and Punctuality	**05**
ESE		Basic, conceptual and analytical knowledge of the subject	**50**
		Total	**100**

MAT651 - COMPLEX ANALYSIS USING PYTHON (2018 Batch)

Total Teaching Hours for Semester:30 — **No of Lecture Hours/Week:2**

Max Marks:50 — **Credits:2**

Course Objectives/Course Description

Course description: This course will enable students to have hands on experience in constructing analytic functions, verifying harmonic functions, illustrating Cauchy's integral theorem and bilinear transformations and in illustrating different types of sequences and series using PYTHON.

Course objectives: This course will help the learner to gain a familiarity with

COBJ1. Python language using jupyter interface.

COBJ2. Solving basic arithmetic problems using cmath built-in commands.

COBJ3. Solving problems using cmath.

Learning Outcome

On successful completion of the course, the students should be able to

CO1. Acquire proficiency in using Pyt Proficiency in using cmath functions for processing Complex Numbers.

CO2. Skillful in using Python modules to implement Milne-Thompson Method.

CO3. Expertise in illustrating harmonic functions and demonstrating Cauchy's integral theorem

CO4. Representation of conformal mappings using Matplotlib

Unit-1 — **Teaching Hours:30**

Proposed Topics:

1. Cmath functions for Complex numbers
2. Graphical Illustration of the Limit of a Complex Sequence.
3. Convergence/divergence of Complex Series.

4. Implementation of Milne-Thomson method of constructing analytic functions (simpleexamples).
5. Verifying real and imaginary parts of an analytic function being harmonic.
6. Examples connected with Cauchy's integral theorem.
7. Illustration of conformal mapping.

Text Books And Reference Books:

H P Langtangen, A Primer on Scientific Programming with Python, 2nd ed., Springer, 2016

Essential Reading / Recommended Reading

1. B E Shapiro, Scientific Computation: Python Hacking for Math Junkies, Sherwood Forest Books, 2015.
2. C Hill, *Learning Scientific Programming with Python*, Cambridge Univesity Press, 2016.
3. Amit Saha, Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus, and More!, no starch press:San Fransisco, 2015.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT651A - MECHANICS USING PYTHON (2018 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course description: This course aims at enabling the students to explore and study the statics and dynamics of particles in a detailed manner using the mathematical software *Python*. This course is designed with a learner-centric approach wherein the students will acquire mastery in understanding mechanics using Python.

Course objectives: This course will help the learner to

COBJ1. Acquire skill in usage of suitable functions/packages of Python.

COBJ2. Gain proficiency in using Python to solve problems on Mechanics.

Learning Outcome

By the end of the course the learner will be able to:

CO1. Acquire proficiency in using different functions of Python to study Differential Calculus.Mechanics.

CO2. Demonstrate the use of Python to understand and interpret the dynamical aspects of Python.

CO3. Use Python to evaluate the resultant of forces and check for equilibrium state of the forces.

CO4. Be familiar with the built-in functions to find moment and couple.

Unit-1 **Teaching Hours:30**

Proposed Topics

1. Introduction to Python
    - Some useful shortcuts; Variables; Input/Output; Relational operators;
    - Logical operators; conditional statements; Lists and Matrices.
2. Resultant of a Number of Forces
    - Resultant of two Forces in same plane.
    - Resultant of any number of forces.
3. Condition for Equilibrium for a given number of forces.
4. Components of a given force
    - Components of a force in Horizontal and Vertical Directions
    - Components of a force in any two given directions
5. Resultant force of Parallel Forces
    - Resultant force of two parallel like forces
    - Resultant force of two parallel alike forces
6. Introduction to Moments and Torques
    - Moment from magnitude and perpendicular distance 16
    - Equilibrium of two moments
7. Projectiles
8. Simple Harmonic motion

Text Books And Reference Books:

1. B E Shapiro, Scientific Computation: Python Hacking for Math Junkies, Sherwood Forest Books, 2015.

2. C Hill, Learning Scientific Programming with Python, Cambridge University Press, 2016.

Essential Reading / Recommended Reading

Amit Saha, *Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus, and More!*, no starch press:San Fransisco, 2015.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT651B - NUMERICAL METHODS USING PYTHON (2018 Batch)

Total Teaching Hours for Semester:30 — **No of Lecture Hours/Week:2**

Max Marks:50 — **Credits:2**

Course Objectives/Course Description

Course description: This course will help the students to have an in depth knowledge of various numerical methods required in Scientific and Technological Applications. Students will gain hands on experience in using Python for illustrating various numeric techniques.

Course objectives: This course will help the learner to

COBJ1. develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems using Python.

COBJ2. to develop the basic understanding of the applicability and limitations of the techniques.

Learning Outcome

Course outcomes: By the end of the course the learner will be able to:
CO1. Implement a numerical solution method in a well-designed, well-documented Python program code
CO2. Interpret the numerical solutions that were obtained in regards to their accuracy and suitability for applications
CO3. Present and interpret numerical results in an informative way

Unit-1 **Teaching Hours:30**

Proposed topics

1. Some basic operations in Python for scientific computing
2. Solution of Algebraic and Transcendental Equations
    - Bisection method
    - Fixed point Iteration method
    - The method of False Position
    - Newton-Raphson method
3. Solution of linear systems
    - Gauss Elimination method
    - Gauss-Seidel Iterative method
    - Gauss-Jacobi Iterative method
    - LU Decomposition method
4. Numerical Differentiation and Integration
5. Solution of Differential Equations
    - Euler's method
    - Runge Kutta method

Text Books And Reference Books:

Jaan Kiusalaas, *Numerical methods in engineering with Python 3*, Cambridge University press, 2013.

Essential Reading / Recommended Reading

Hans Fangohr, Introduction to Python for Computational Science and Engineering (A beginner's guide), University of Southampton, 2015. (https://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf)

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and	Lab	**03**

	Punctuality	attendance	95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT651C - DISCRETE MATHEMATICS USING PYTHON (2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course description: This course aims at providing hands on experience in using Python functions to illustrate the notions of combinatorics, set theory and relations.

Course objectives: This course will help the learner to
COBJ1. gain a familiarity with programs on fundamental concepts of Combinatorial Mathematics
COBJ2. understand and apply knowledge to solve combinatorial problems using Python

Learning Outcome

By the end of the course the learner will be able to:
CO1. attain sufficient skills in using Python functions
CO2. demonstrate the programming skills in solving problems related to applications of Computational Mathematics.

Unit-1 **Teaching Hours:30**

Proposed Topics

1. Permutations
2. Combinations
3. Set Construction and Set Operations
4. Using Venn diagram to visualize relationship between sets
5. Recurrence Relations
6. Partially ordered set

Text Books And Reference Books:

1. Amit Saha, *Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus, and More!*, no starch press:San Fransisco, 2015.
2. H P Langtangen, *A Primer on Scientific Programming with Python,* 2nd ed., *Springer*, 2016.

Essential Reading / Recommended Reading

1. B E Shapiro, *Scientific Computation: Python Hacking for Math Junkies*, Sherwood Forest Books, 2015.
2. C Hill, Learning Scientific Programming with Python, Cambridge Univesity Press, 2016.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT651D - NUMBER THEORY USING PYTHON (2018 Batch)

Total Teaching Hours for Semester:30 — **No of Lecture Hours/Week:2**

Max Marks:50 — **Credits:2**

Course Objectives/Course Description

Course description: This course will help the students to have an in-depth knowledge of various concepts of number theory. Students will gain hands-on experience in using Python for illustrating various number theory concepts, such as the division algorithm, the Euclidean algorithm, the fundamental theorem of Arithmetic, Congruences, solutions of a linear system of congruences, binary and decimal representations of integers, Pseudoprimes and etc.

Course objectives: This course will help the learner to gain a familiarity with

COBJ1. Python language using jupyter interface

COBJ2. The built in functions required to deal with Division Algorithm , Euclidean Algorithm and Chinese Remainder.

COBJ3. The skills to solve various number theoretic concepts.

Learning Outcome

Course outcomes: On successful completion of the course, the students should be able to use Python

CO1. To solve a system of linear congruences.
CO2. To represent an integer in the binary and decimal form.
CO3. Demonstrate the understanding of number theory concepts .
CO4. Demonstrate the Division Algorithm, the Euclidean algorithm and Chinese remainder theorem.

Unit-1 **Teaching Hours:30**

Proposed Topics:

1. Introduction to packages and libraries in Python.
2. Division Algorithm.
3. Hexadecimal, octal and binary representation of the integers.
4. Basic arithmetic operations (addition, subtraction, division and mod) of integers in binary.
5. Euclid algorithm.
6. Prime factorisation of integers.
7. The inverse of congruences and solutions of a system of linear congruences.
8. Illustration of Chinese Remainder theorem.
9. Pseudoprimes.
10. Euler's phi function.

Text Books And Reference Books:

J.C. Bautista, Mathematics with Python Programming, Lulu.com, 2014.

Essential Reading / Recommended Reading

1. Maria Litvin and Gary Litvin, Mathematics for the Digital Age and Programming in Python, Skylight Publishing, 2010.
2. Johansson Robert, Numerical Python, Apress, 2015.
3. S.A. Kulkarni, Problem solving and Python programming, Yesdee Publications, 2018.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03**

			95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT651E - FINANCIAL MATHEMATICS USING PYTHON **(2018 Batch)**

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course description: Financial Mathematics deals with the solving financial problems by using Mathematical methods. The course aims at providing hands on experience in using Python programming to illustrate the computation of constant/varying force of interest, continuously payable varying/non-varying annuities, increasing/decreasing annuity immediate/due, loans and bonds.

Course objectives: This course will help the learner to

COBJ1. Acquire skill in solving problems on Financial Mathematics using Python.

COBJ2. Gain proficiency in using the Python programming skills to solve problems on Financial Mathematics.

Learning Outcome

Course outcomes: On successful completion of the course, the students should be able to:

CO1. demonstrate sufficient skills in using Python programming language for solving problems on Financial Mathematics.

CO2. apply the notions on various types of interests, annuities, loans and bonds, by solving problems using Python.

Unit-1 **Teaching Hours:30**

Proposed Topics

1. *Force of interest*
2. Level Annuities
3. Outstanding Loan balances
4. Annuities with payments in Geometric Progression
5. Annuities with payments in Arithmetic Progression
6. Continuously Payable annuities
7. Amortization Loans and Amortization Schedules
8. Bond Amortization Schedules

Text Books And Reference Books:

1. Y. Yan, *Python for finance: financial modeling and quantitative analysis explained*. Packt Publishing, 2017.
2. L. J. F. Vaaler and J. W. Daniel, *Mathematical interest theory*. Mathematical Association of America, 2009.

Essential Reading / Recommended Reading

1. J. M. Weiming, *Mastering python for finance understand, design, and implement state-of-the-art mathematical and statistical applications used in finance with Python*. Packt Publishing, 2015.
2. M. Humber, *Personal finance with Python: using pandas, requests, and recurrent*. Apress, 2018.
3. S. Fletcher and C. Gardner, *Financial modeling in Python*. Wiley, 2009.

Evaluation Pattern

The course is evaluated based on continuous internal assessments (CIA) and the lab e-record. The parameters for evaluation under each component and the mode of assessment are given below.

Component	Parameter	Mode of Assessment	Maximum Points
CIA I	Mastery of the concepts	Lab Assignments	**20**
CIA II	Conceptual clarity and analytical skills	Lab Exam - I	**10**
Lab Record	Systematic documentation of the lab sessions.	e-Record work	**07**
Attendance	Regularity and Punctuality	Lab attendance	**03** 95-100% : 3 90-94% : 2 85-89% : 1
CIA III	Proficiency in executing the commands appropriately,.	Lab Exam - II	**10**
Total			**50**

MAT681 - PROJECT ON MATHEMATICAL MODELS **(2018 Batch)**

Total Teaching Hours for Semester:75 **No of Lecture Hours/Week:5**

Max Marks:150 **Credits:5**

Course Objectives/Course Description

Course description: The course aims at providing hands on experience in analyzing practical problems by formulating the corresponding mathematical models.

Course objectives: This course will help the learner to

COBJ1. develop positive attitude, knowledge and competence for research in Mathematics

Learning Outcome

On successful completion of the course, the students should be able to

CO1. Demonstrate analytical skills

CO2. Apply computational skills in Mathematics

Unit-1 **Teaching Hours:75**

PROJECT

Students are given a choice of topics in Mathematical modelling at the undergraduate level with the approval of HOD. Each candidate will work under the supervision of the faculty. Project Coordinator will allot the supervisor for each candidate in consultation with the HOD at the end of the fifth semester.

Project need not be based on original research work. Project could be based on the review of research papers that are at the undergraduate level.

Each candidate has to submit a dissertation on the project topic followed by viva voce examination. The viva voce will be conducted by the committee constituted by the head of the department which will have an external and an internal examiner. The student must secure 50% of the marks to pass the examination. The candidates who fail must redo the project as per the university regulations.

Proposed Topics for Project:

1. Mathematical Modeling using Graphs/Networks
2. Mathematical Modeling using Optimization Techniques
3. Mathematical Modeling using Linear Algebra
4. Mathematical Modeling using Differential Equations
5. Mathematical Modeling using Calculus of Several Variables. (Proficiency in solving PDE may be required)
6. Developing a new Mathematics library for FOSS tools

Text Books And Reference Books:

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Essential Reading / Recommended Reading

*

Evaluation Pattern

*

STA631 - TIME SERIES ANALYSIS AND FORECASTING TECHNIQUES (2018 Batch)

Total Teaching Hours for Semester:45 | **No of Lecture Hours/Week:3**

Max Marks:100 | **Credits:3**

Course Objectives/Course Description

Course Description: This course covers applied statistical methods pertaining to time series and forecasting techniques. Moving average models like simple, weighted and exponential are dealt with. Stationary time series models and non-stationary time series models like AR, MA, ARMA and ARIMA are introduced to analyse time-series data.

Course Objective: To enable the students to establish and verify the relationship between the related variables over a period of time.

Learning Outcome

A student graduating this course will gain knowledge in the following topics:

CO1: Demonstrate the approach and analyze univariate time-series

CO2: Infer the difference between various time series models like AR, MA, ARMA and ARIMA models

CO3: Demonstrate the difference between stationary and non-stationary time series models

CO4: Demonstrate how to forecast future observations of the time series

Unit-1 **Teaching Hours:15**

Introduction to Time Series and Stochastic Process

Introduction to time series and stochastic process, graphical representation, components and classical decomposition of time series data.Auto-covariance and auto-correlation functions, Exploratory time series analysis, Test for trend and seasonality, Smoothing techniques such as Exponential and moving average smoothing, Holt- Winter smoothing, Forecasting based on smoothing.

Unit-2 **Teaching Hours:10**

Stationary Time Series Models

Wold representation of linear stationary processes, Study of linear time series models: Autoregressive, Moving Average and Autoregressive Moving average models and their statistical properties like ACF and PACF function.

Unit-3 **Teaching Hours:10**

Estimation of ARMA Models

Estimation of ARMAmodels: Yule- Walker estimation of AR Processes, Maximum likelihood and least squares estimation for ARMA Processes, Residual analysis and diagnostic checking.

Unit-4 **Teaching Hours:10**

Nonstationary Time Series Models

Concept of non-stationarity, general unit root tests for testing non-stationarity; basic formulation of the ARIMA Model and their statistical properties-ACF and PACF; forecasting using ARIMA models

Text Books And Reference Books:

1. George E. P. Box, G.M. Jenkins, G.C. Reinsel and G. M. Ljung, *Time Series analysis Forecasting and Control*, 5th Edition, John Wiley & Sons, Inc., New Jersey, 2016.

2. Montgomery D.C, Jennigs C. L and Kulachi M, *Introduction to Time Series analysis and Forecasting*, 2nd Edition,John Wiley & Sons, Inc., New Jersey, 2016.

Essential Reading / Recommended Reading

1. Anderson T.W, *Statistical Analysis of Time Series*, John Wiley& Sons, Inc., New Jersey, 1971.
2. Shumway R.H and Stoffer D.S, *Time Series Analysis and its Applications with R Examples*, Springer, 2011.
3. Brockwell P.J and Davis R.A, *Times series: Theory and Methods*, 2nd Edition, Springer-Verlag, 2009.
4. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th Edition (Reprint), Sultan Chand and Sons, 2018.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA641A - APPLIED STATISTICS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

This course is designed to teach demographic methods, mortality and fertility rates, concept of index numbers and their usages are explained. Demand analysis helps

students to understand the various statistical tools used in demand and supply sector. Educational and psychological statistics are used to emphasize the usage of statistics in real life.

To enable the students understand index numbers and other statistical tools applied to demographic and chorological data.

Learning Outcome

After completion of this course students are able to

1. Demonstrate the demographic profiles, mortality and fertility rates.
2. Infer the concepts of Demand and supply and their importance
3. Demonstrate the importance of index numbers and their usage.

Unit-1 **Teaching Hours:15**

Demographic Methods

Sources of demographic data-census, register, ad-hoc surveys, hospital records, demographic profiles of Indian census, questionnaire, errors in these data and their adjustment. Measurements of Mortality-CDR, SDR (w.r.t. age and sex), IMR, standardized death rate, complete life table, its main features and uses. Measurements of fertility and reproduction-CBR, General, Age-specific and total fertility rates, GRR, NRR.

Unit-2 **Teaching Hours:10**

Index Numbers

Introduction, different types of index numbers, criteria for index numbers; construction of index numbers of prices and quantities; cost of living index numbers, uses and limitations of index numbers.

Unit-3 **Teaching Hours:10**

Demand Analysis

Demand and Supply, Price elasticity of demand, Partial and Cross elasticities of demand, Types of data required for estimating elasticities, Pareto's Law of income distribution, Unity function.

Unit-4 **Teaching Hours:10**

Psychological and Educational statistics

Scaling of Mental tests and Psychological data, Scaling of scores on a test – Z-score ,and scaling, standardized scores, normalized scores, computation of T-scores for a given frequency distribution, comparison of T- scores and standardized scores, percentile scores, scaling of rankings and ratings in terms of normal curves Intelligent tests- intelligent quotient and educational quotient.

Text Books And Reference Books:

1. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th Edition (Reprint), Sultan Chand and Sons, New Delhi, 2018.

2. Ken Black, *Applied Business Statistics: Making Better Business Decisions*, 7th Edition, Wiley International, US, 2012.

Essential Reading / Recommended Reading

1. Mukhopadhyay P, *Mathematical Statistics*, 2nd Edition, Books and Allied (P) Ltd., Kolkata, 2000.
2. BorowiakD.S and Shapiro A.F, *Financial and Actuarial Statistics: An Introduction*, 2nd Edition, CRC Press, Boca Raton, 2013.
3. Goon A.M, Gupta M.K and Dasgupta B, *An Outline of Statistical Theory* (Vol. I), 4th Edition, World Press, Kolkata, 2003.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA641B - ELEMENTS OF STOCHASTIC PROCESS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

This course designed to introduce the concepts, models and problem solving techniques of stochastic process.

To enable the students to understand basic concepts of various stochastic process techniques.

Learning Outcome

After completion of this course students are able to,

1. Solve the problems related to business or industry which are stochastic in nature.
2. Demonstrate the different queuing systems and methods to solve the queuing problems.

Unit-1 **Teaching Hours:10**

Introduction

Probability Distributions: Generating functions, Bivariate probability generating function. Stochastic Process: Introduction, Stationary Process.

Unit-2 **Teaching Hours:15**

Markov Chains

Definition of Markov Chain, transition probability matrix, order of Markov chain, Markov chain as graphs, higher transition probabilities. Generalization of independent Bernoulli trials, classification of states and chains, stability of Markov system, graph theoretic approach.

Unit-3 **Teaching Hours:10**

Poisson Process

Postulates of Poisson process, properties of Poisson process, inter-arrival time, pure birth process, Yule Furry process, birth and death process, pure death process.

Unit-4 **Teaching Hours:10**

Queuing System

General concept, steady state distribution, queuing model, M/M/1 with finite and infinite system capacity, waiting time distribution (without proof). Gambler's Ruin Problem: Classical ruin problem, expected duration of the game.

Text Books And Reference Books:

1. Yates R.D and Goodman D.J, *Probability and Stochastic Process*, 3rd edition, John Wiley & Sons, 2014.
2. Taha H.A, *Operations Research: An Introduction*, 10th edition, Pearson's publications, 2017.

Essential Reading / Recommended Reading

1. Medhi J, *Stochastic Process*, New Age International Publishers, 2009.
2. Basu A.K, *Introduction to Stochastic Process*, Narosa Publications, 2005.
3. Bhat B.R, *Stochastic Models: Analysis and Applications*, New Age International Publishers, 2004.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA641C - BIOSTATISTICS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

This course designed as an application of statistics in medical sciences. The concepts of bioassays, quantitative epidemiology and survival analysis are

introduced. R programming is used to analyze the bio-statistical data.

To enable the students to understand basic concepts of biostatistics and survival analysis.

Learning Outcome

After completion of this course students are able to understand the following topics,

1. Demonstrate the basic biological concepts in genetics
2. Infer the bioassays and their types
3. Demonstrate the Feller's theorem and dose response estimation using regression models and dose allocation schemes.

Unit-1 **Teaching Hours:15**

Introduction to Statistical Genetics

Basic biological concepts in genetics, Mendel's law, Hardy Weinberg equilibrium, estimation of allele frequency, approach to equilibrium for X-linked gene. The law of natural selection, mutation, genetic drift.

Unit-2 **Teaching Hours:10**

Bioassays

The purpose and structure of biological assay; types of biological assays, direct assays, ration estimates, asymptotic distributions: Feller's theorem. Regression approach to estimating dose response, relationships, Logit and Probit approaches when dose-response curve for standard preparation is unknown, quantal responses, methods of estimation of parameters, estimation of extreme quantiles, dose allocation schemes.

Unit-3 **Teaching Hours:10**

Quantitative Epidemiology

Introduction to modern epidemiology, principles of epidemiological investigation, erveillance and disease monitoring in populations. Epidemiologic measures: Organizing and presenting epidemiologic data, measure of disease frequency, measures of effect and association, causation and casual inference. Design and analysis of epidemiologic studies. Types of studies, case-control studies, cohort studies, cross over design, regression models for the estimation of relative risk.

Unit-4 **Teaching Hours:10**

Survival Analysis

Introduction to survival analysis, examples and its characteristics, types of survival analysis, survival functions and hazard function, life distributions – Exponential, Gamma, Weibull, Lognormal, Pareto, Linear failure rate, Life tables, KM survival curves and log-rank test, comparison of survival curves, Cox-PH model and its characteristics, stratified Cox-regression model, Cox-regression with time dependent covariates.

Text Books And Reference Books:

1. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th Edition, Sultan Chand and Sons, 2014.
2. Lange K, *Mathematical and Statistical Methods for Genetic Analysis*, Springer, 2008.

Essential Reading / Recommended Reading

1. Danial W.W, Cross C.L, *Biostatistics: Basic concepts and Methodology for the Health Sciences*, 10th Edition, John Wiley, 2014.
2. Indranil S, Bobby P, *Essential of Biostatistics*, 2nd Edition, Academic Publishers, 2016.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA641D - STATISTICAL GENETICS (2018 Batch)

Total Teaching Hours for Semester:45 **No of Lecture Hours/Week:3**

Max Marks:100 **Credits:3**

Course Objectives/Course Description

This course is designed to introduce the basic concepts of genetics, estimation of linkage, Application and extension of the equilibrium law under different situation. This course also introduces the concept of inbreeding, Heritability, Repeatability and Genetic correlation in large populations.

To enable the students understand and apply different concepts of statistical genetics in large populations with selection, mutation and migration.

Learning Outcome

After completion of this course the students will be able to

1. Demonstrate the basic concepts of genetics and their applications.
2. Demonstrate Fisher's fundamental theorem of natural selection with different forces.
3. Demonstrate methods of estimation of Heritability, Repeatability and Genetic correlation.

Unit-1 **Teaching Hours:15**

Segregation and Linkage

Physical basis of inheritance. Analysis of segregation, detection and estimation of linkage for qualitative characters. Amount of information about linkage, combined estimation, disturbed segregation.

Unit-2 **Teaching Hours:10**

Equilibrium law and sex-linked genes

Gene and genotypic frequencies, Random mating and Hardy -Weinberg law, Application and extension of the equilibrium law, Fisher's fundamental theorem of natural selection. Disequilibrium due to linkage for two pairs of genes, sex-linked genes, Theory of path coefficients.

Unit-3 **Teaching Hours:10**

Inbreeding and Systematic forces

Concepts of inbreeding, regular system of inbreeding. Forces affecting gene frequency - selection, mutation and migration, equilibrium between forces in large populations, Random genetic drift, Effect of finite population size

Unit-4 **Teaching Hours:10**

Association and selection index

Correlations between relatives, Heritability, Repeatability and Genetic correlation. Response due to selection, Selection index and its applications in plants and animals improvement programmes, Correlated response to selection.

Text Books And Reference Books:

1. Laird N.M and Christoph L, *The Fundamental of Modern Statistical Genetics*, Springer, 2011.
2. Balding DJ, Bishop M & Cannings C, *Hand Book of Statistical Genetics*, John Wiley, 2001.

Essential Reading / Recommended Reading

1. Benjanmin M.N, Manuel A.R.F, Sarah E.M, Danielle P, *Statistical Genetics*, CRC Press, 2008.
2. Shizhong Xu, *Principles of Statistical Genomics*, Springer, 2013.

Evaluation Pattern

Component	Marks
CIA I	10
Mid Semester Examination (CIA II)	25
CIA III	10
Attendance	05
End Semester Exam	50
Total	100

STA651 - TIME SERIES ANALYSIS AND FORECASTING TECHNIQUES PRACTICAL (2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

The course is designed to provide a practical exposure to the students in Time Series analysis

Learning Outcome

After completion of this course the students will acquire the knowledge to analyse a univariate time series and also to forecast the future values of a given univariate time series.

Unit-1 **Teaching Hours:30**

Assignments

1. Time series plots, Decomposition of time series.
2. ACF, PACF plots and their interpretation
3. Smoothing techniques – Simple, Moving average methods, Differenced series.
4. Fitting Autoregressive
5. Fitting of Moving average models.
6. Model identification using ACF and PACF.
7. Residual analysis and diagnostic checking of AR models
8. Residual analysis and diagnostic checking of MA models
9. Testing for stationarity.
10. Fitting ARMA, ARIMA models.
11. Residual analysis and diagnostic checking of ARMA , ARIMA models
12. Forecasting using ARIMA models.

Text Books And Reference Books:

1. George E. P. Box, G.M. Jenkins, G.C. Reinsel and G. M. Ljung, *Time Series analysis Forecasting and Control*, 5th Edition, John Wiley & Sons, Inc., New Jersey, 2016.
2. Montgomery D.C, Jennigs C. L and Kulachi M,*Introduction to Time Series analysis and Forecasting*, 2nd Edition,John Wiley & Sons, Inc., New Jersey, 2016.

Essential Reading / Recommended Reading

1. Anderson T.W,*Statistical Analysis of Time Series*, John Wiley& Sons, Inc., New Jersey, 1971.
2. Shumway R.H and Stoffer D.S, *Time Series Analysis and its Applications with R Examples*, Springer, 2011.
3. Brockwell P.J and Davis R.A, *Times series: Theory and Methods*, 2nd Edition, Springer-Verlag, 2009.
4. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th Edition (Reprint), Sultan Chand and Sons, 2018.

Evaluation Pattern

Section	Parameters	Marks
A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		10

(2018 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

This course is designed to teach practical problems in demographic methods, Demand analysis, index numbers and educational statistics.

Learning Outcome

After completion of this course students are able to practically evaluate demographic profiles, calculate various index numbers and apply concepts of Psychological and educational statistics in real life .

Unit-1 **Teaching Hours:30**

Assignments

1. Measures of Mortality and IMR
2. Measures of fertility
3. Construction of life tables.
4. Construction of weighted and unweighted Index numbers
5. Construction of Price and Quantity index numbers
6. Tests for index numbers
7. Construction of Cost of living index numbers
8. Computation of T-scores for a given frequency distribution
9. Psychological and educational statistics-1 (Computation of various scores)
10. Psychological and educational statistics-2 (Scaling of ranking & ratings)

Text Books And Reference Books:

1. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th Edition (Reprint), Sultan Chand and Sons, New Delhi, 2018.
2. Ken Black, *Applied Business Statistics: Making Better Business Decisions*, 7th Edition, Wiley International, US, 2012.

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1. Mukhopadhyay P, *Mathematical Statistics*, 2nd Edition, Books and Allied (P) Ltd., Kolkata, 2000.
2. BorowiakD.S and Shapiro A.F, *Financial and Actuarial Statistics: An Introduction*, 2nd Edition, CRC Press, Boca Raton, 2013.
3. Goon A.M, Gupta M.K and Dasgupta B, *An Outline of Statistical Theory* (Vol. I), 4th Edition, World Press, Kolkata, 2003.

Evaluation Pattern

Section	Parameters	Marks
A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		10

STA652B - ELEMENTS OF STOCHASTIC PROCESS PRACTICAL (2018 Batch)

Total Teaching Hours for Semester:30 **No of Lecture Hours/Week:2**

Max Marks:50 **Credits:2**

Course Objectives/Course Description

Course Description: This course is designed to teach practical Stochastic process problems using statistical softwares.

Course Objectives: The objective of this course is train the students to be able to practically evaluate stochastic models using R.

Learning Outcome

Course outcomes: After completion of this course students are able to apply stochastic models to real life problems.

Unit-1 **Teaching Hours:30**

Practical Assignments:

Practical assignments using EXCEL:

1. Calculation of transition probability matrix
2. Calculation of conditional and joint probabilities
3. Identification of Ergodic transition probability matrix
4. Stationarity of Markov chain and graphical representation of Markov chain
5. Simulating Markov chain
6. Computation of probabilities in case of generalizations of independent Bernoulli trials
7. Calculation of probabilities for given birth and death rates and vice versa
8. Calculation of probabilities for Birth and Death Process
9. Computation of inter-arrival time for a Poisson process.
10. Calculation of Probability and parameters for (M/M/1) model and change in behavior of queue as N tends to infinity.

Text Books And Reference Books:

1. Yates R.D and Goodman D.J, *Probability and Stochastic Process*, 3rd edition, John Wiley & Sons, 2014.
2. Taha H.A, *Operations Research: An Introduction*, 10th edition, Pearson's publications, 2017.

Essential Reading / Recommended Reading

1. Medhi J, *Stochastic Process*, New Age International Publishers, 2009.
2. Basu A.K, *Introduction to Stochastic Process*, Narosa Publications, 2005.
3. Bhat B.R, *Stochastic Models: Analysis and Applications*, New Age International Publishers, 2004.

Evaluation Pattern

1. The evaluation pattern is as follows:

Section	Parameters	Marks
A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		10

STA652C - BIOSTATISTICS PRACTICAL (2018 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

Course Description: This course is designed to teach practical bio statistical problems using statistical softwares.

Course Objectives: The objective of this course is to train the students to be able to practically evaluate bio statistical models and apply them to the biological/genetical problems for analysis.

Learning Outcome

Course outcomes: After completion of this course students are able to practically evaluate bio statistical models using R programming.

Teaching Hours:30

Unit-1

Practical Assignments using R programming:

1. Regression approach of estimating the dose response
2. Logit and Probit approaches for dose response
3. Estimation of Logit and Probit models
4. Calculation of Survival and Hazard functions using Exponential distribution
5. Calculation of Survival and Hazard functions using gamma distribution
6. Calculation of Survival and Hazard functions using Weibull distribution
7. Parato charts and Life tables
8. Kaplan-Meier curves
9. Fitting of Cox-regression models
10. Fitting of Cox regression with time dependent covariates

Text Books And Reference Books:

1. Gupta S.C and Kapoor V.K, *Fundamentals of Applied Statistics*, 4th Edition, Sultan Chand and Sons, 2014.
2. Lange K, *Mathematical and Statistical Methods for Genetic Analysis*, Springer, 2008.

Essential Reading / Recommended Reading

1. Danial W.W, Cross C.L, *Biostatistics: Basic concepts and Methodology for the Health Sciences*, 10th Edition, John Wiley, 2014.
2. Indranil S, Bobby P, *Essential of Biostatistics*, 2nd Edition, Academic Publishers, 2016.

Evaluation Pattern

1. The evaluation pattern is as follows:

Section	Parameters	Marks
A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		10

STA652D - STATISTICAL GENETICS PRACTICAL (2018 Batch)

Total Teaching Hours for Semester:30 | **No of Lecture Hours/Week:2**

Max Marks:50 | **Credits:2**

Course Objectives/Course Description

Course Description: This course is designed to teach practical biological problems using statistical softwares.

Course Objectives : The objective of the course is to train the students so as to handle the biological/genetical/pharmacetical problems by applying bio statistical models to analyse.

Learning Outcome

Course outcomes: After completion of this course students are able to practically evaluate bio statistical models using R programming.

Unit-1 **Teaching Hours:30**

Practical Assignments using R programming:

1. Analysis of segregation, detection and estimation of linkage
2. Estimation of Amount of information about linkage
3. Calculation of combined estimationof linkage
4. Estimation of disequilibrium due to linkage for two pairs of genes
5. Estimation of path coefficients
6. Estimation of equilibrium between forces in large populations
7. Correlations between relatives and Heritability
8. Correlations between Repeatability and Genetic correlation

Text Books And Reference Books:

1. Laird N.M and Christoph L, *The Fundamental of Modern Statistical Genetics*, Springer, 2011.
2. Balding DJ, Bishop M & Cannings C, *Hand Book of Statistical Genetics*, John Wiley, 2001.

Essential Reading / Recommended Reading

1. Benjanmin M.N, Manuel A.R.F, Sarah E.M, Danielle P, *Statistical Genetics*, CRC Press, 2008.
2. Shizhong Xu, *Principles of Statistical Genomics*, Springer, 2013.

Evaluation Pattern

1. The evaluation pattern is as follows:

Section	Parameters	Marks

A	Objective/Aim	2
B	Analysis	3
C	Interpretation	3
D	Timely submission	2
Total		10