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

School of Sciences
Delhi NCR Campus

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

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

1 Semester - 2020 - Batch				
Paper Code	Paper	Hours Per Week	Credits	Marks
ECO131	PRINCIPLES OF MICROECONOMICS	5	4	100
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	Paper	Hours	Credits	Marks

Code		Per Week		
ECO231	PRINCIPLES OF MACROECONOMICS	5	4	100
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
ECO331	FUNDAMENTALS OF ECONOMIC GROWTH AND DEVELOPMENT	5	4	100
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
ECO401	ADVANCED MICRO AND MACROECONOMICS	2	2	50
ECO431	INTERNATIONAL ECONOMICS	5	4	100
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	2	2	50

	USING PYTHON			
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
ECO501	RESEARCH METHODOLOGY FOR ECONOMICS	2	2	50
ECO541A	PUBLIC FINANCE	4	4	100
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
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
ECO631	INTRODUCTION TO ECONOMETRICS	4	4	100
ECO641A	ENVIRONMENTAL ECONOMICS	4	4	100

ECO641B	**FINANCIAL ECONOMICS**	**4**	**3**	**100**
ECO681	**DISSERTATION**	**0**	**4**	**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

For Mathematics Practical Courses:

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**

Exam Pattern for Statistics practicals

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

Total Marks : 50

Examination And Assesments

EXAMINATION AND ASSESSMENT S

For Theory Courses:

Continuous Internal assessment (CIA) forms 50% and the end semester examination forms the other 50% of the marks in theory. CIA marks are awarded based on the their performance in assignments, MSE and class assignments (Quiz, presentations, Moodle based tests, problem solving, minor projects, MOOC etc.). The MSE & ESE for each theory paper is of two & three hours respectively.

CIA I and CIA III are conducted by respective faculty in the form of different types of assignments.

MSE will be held for odd semesters in the month of August and even semesters in the month of January.

ESE:The theory as well as practical courses are held at the end of the semesters.

Department Overview:

Established in 1969, the Department of Economics is one of the strongest and vibrant departments in South India. Currently, the department, offers a wide array of undergraduate courses and a postgraduate programme with multiple specializations. To promote the holistic development of the students and to sustain the academic creativity and inventiveness of the faculty the department engages in numerous workshops, seminars, industrial interfaces, faculty development programmes and many such endeavors. 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 stu

Mission Statement:

Vision: Excellence and Service Mission : Department of Economics Preparing students to understand and resolve the multitude of challenges in the economy through relevant research based education. We aim to educate our students to become successful professionals and socially responsible citizens who contribute positively to the socio-economic well-being. Department of Mathematics To organize, connect, create and communicate mathematical ideas effectively, through 4D's; Dedication, Disc

Introduction to Program:

The course is designed to develop students with respectable intellectual levels. It seeks to expose the students to various concepts in Economics, Mathematics and Statistics and encourage them to uphold scientific integrity and objectivity in professional endeavors. Economics : The undergraduate courses in economics are structured to contribute to the student?s liberal education with a multiplicity of combinations. The programmes impart analytical skills and intellectual maturity to comprehend the complexities in the working of the economy. The course provides a sound theoretical basis in economic theory supplemented by practical applications of theories. The first four semesters are

devoted to give a firm background in microeconomics, macroeconomics, development economics & international economics. In the fifth and sixth semesters, the students take two compulsory courses namely Indian Economy since Independence & Financial Economics. They have elective courses in the final year encompassing two options each semester. The elective courses offered by the department are mathematical methods for economics or health economics in the fifth semester and statistical methods for economics or environmental economics in the sixth semester. 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

Program Objective:

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 On successful completions of the BSc EMS Programme students will be able to PSO1.Demonstrate the problem solving skills in mathematical sciences. PSO2. Use effectively the mathematical and statistical tools in the analysis of economic and social problems. PSO3. Address current economic issues and trends. PSO4. Acquire a strong foundation in Statistical analytics PSO5. Express proficiency in oral and written communications to appreciate innovation in research. PSO6. Develop industry-focused skills to lead a successful career.

Assesment Pattern

- Internal assessment 50%
    - CIA1- written assignment, group work, presentations
    - CIA2 - midterm examination
    - CIA3 - written assignment, group work, presentations
- End Semester Examination 50%

The assessment strategy involves specific rubric for evaluation of each component.

Examination And Assesments

The evaluation is divided in to two components: Continuous Internal Assessment (CIA) including Mid Semester Examination (MSE), and the End Semester Examination (ESE).

Department Overview:

The Department of Economics, CHRIST (Deemed to be University) Delhi NCR Campus, formed in 2019 consists of a faculty pool with rich experience in teaching, research and consultancy. The Department has five full-time

faculty members with specialisation in Development Economics, Rural and Health Economics, Quantitative Economics, Agricultural Economics, Resource Economics, involving in advanced research.

Mission Statement:

Vision Establish an identity as a department of high standard in teaching and research in Economics. Mission Equip students with advanced knowledge and skill sets to address real world economic problems and undertake cutting edge research on contemporary economic issues.

Introduction to Program:

The course is designed to develop students with respectable intellectual levels. It seeks to expose the students to various concepts in Economics, Mathematics and Statistics and encourage them to uphold scientific integrity and objectivity in professional endeavours.

Program Objective:

The undergraduate economics courses provide a sound theoretical basis in economic theory supplemented by practical applications of theories. The first four semesters are devoted to give a firm background in microeconomics, macroeconomics, development economics and international economics. In the fifth and sixth semester the students take one compulsory course and one elective.

Assesment Pattern

CIA: 50%

ESE: 50%

Examination And Assesments

CIA: 50%

ESE: 50%

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 the 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.

Mission Statement:

Vision The Department of Computer Science endeavors to imbibe the vision of the University ?Excellence and Service?. The department is committed to this philosophy which pervades every aspect and functioning of the department. Mission ?To develop IT professionals with ethical and human values?. To accomplish our mission, the department encourages students to apply their

acquired knowledge and skills towards professional achievements in their careers. The department also moulds the stude

Introduction to Program:

Bachelor of Computer Applications is a 3-year undergraduate programme spread over six semesters. The course is designed to bridge the gap between IT industries and academic institutes by incorporating the latest developments into the curriculum and to give students a complete understanding within a structured framework. The curriculum supports students to gain adequate programming practices along with theoretical foundation and also includes interdisciplinary courses and electives for widening the domain expertise. State-of-the-art infrastructure provides an excellent learning environment to hone the knowledge of each student.

Program Objective:

? Provide strong foundations in fundamentals of computer science and applications for employability and/or further graduation. ? Empower students with competencies in creative thinking and problem solving, inter- personal communication and managerial skills. ? Facilitate overall understanding of the technological development with legal and ethical issues. ? Equip the students in providing professional solutions to real-time problems. Programme Outcomes (PO) ? PO1: Acquire and Apply Knowledge: Ability to understand and apply the fundamental principles, concepts and methods in key areas of Computer Applications and multidisciplinary fields. PO2: Problem Analysis: Ability to analyze real-time problems using various tools and techniques. PO3: Design and Development: Ability to design and develop solutions to meet the desired needs. PO4: State-of-art Technologies: Ability to adapt and apply emerging tools and technologies. PO5: Entrepreneurship and Innovation: Ability to provide sustainable and innovative solutions for real-time problems. PO6: Lifelong Learning: Ability to engage in continuous reflective learning in the context of technological advancement. PO7: Communication and Team Building: Ability to demonstrate effective communication and interpersonal skills. PO8: Ethics and Social Responsibility: Ability to integrate ethical and human values to become a socially responsible citizen.

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

BCA112N - OFFICE AUTOMATION TOOLS LAB (2020 Batch)

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

Max Marks:50 | **Credits:1**

Course Objectives/Course Description

MS-WORD

The purpose of this course is to teach students to identify word processing terminology and concepts, Create technical documents, Animation and Design document, format and edit documents, use simple tools and utilities, Mail merge concepts and Mathematical expressions.

MS-EXCEL

This course will teach you the skills you'll need to successfully use Excel. This course will start with basic skills, and then move forward to more advanced features and techniques.

Learning Outcome

CO1: Ability to Animate and Design the document.
CO2: Simplification of Mathematical expressions.
CO3: Create Format cells, rows, columns, and entire worksheets.
CO4: Create charts and diagrams for data.
CO5: Create data lists and forms.
CO6: Create and use pivot tables and pivot charts.
CO7: Work with VBA concept.

Unit-1 **Teaching Hours:30**

List of Programs

MS-WORD

1. Create and Design Admission/Enquiry Forms in Microsoft Word.
2. Create a mail to ‘n’ number of contacts from label and send mail to ‘n’ number of contacts selected from label using mail merge.
3. Prepare a document about any topic in mathematics which uses mathematical symbols.
   At least 5 mathematical symbols should be used.
   Assign a password for the document to protect it from unauthorized access.
   Demonstrate the use of Hyperlink Option.
   Write a macro that sets margins to your document, a font of size and double spaced document.

4. Create and Design Seminar/Conference/Workshop brochure.

MS-EXCEL

1. Enter the order id, product name, unit price, quantity and discount. Perform the following operation using MS – Excel.

a. Calculate the revenue and tax on the revenue for each product
b. Calculate the net come of each product
c. Calculate the total revenue of all products
d. Calculate the total net income of all products
e. Count the number of products in the list above
f. Count the number of products of Order ID <<X>>
g. Calculate the total net income of products of Order <<X>>

2. Enter the following details of 20 students data’s in column wise, s.no, roll no, name, test – 1, test – 2 and test – 3 marks, total, mention and grade from

Cell A to h and do the following operations in excel

a. Calculate the total score of each student

b. Display the word "Fail" if the student failed and "Pass" if the student passed in Mention column.
c. Students are considered failed if their total is less than 30. Otherwise, they pass.

d. Count the number of students who failed in subject wise

e. Count the number of students who passed in a subject in the column "# of passed students.

f. Calculate the percentage of students who failed in all subjects and write "% of failed students"

g. Calculate the percentage of students who passed in all subjects write "% of passed students"
Format the cell in percentage <="80--"> <="75--"> <="70--"> <="65--"> <="55--"> <="50--"> <="45--"> <="40--">

h. Display grade letter of each student in Grade column, based on the following conditions:

75 <total Score <=80 à A

70 <total Score <=85 à B+

65 <total Score <=70 à B

55 <total Score <=65 à C+

50 <total Score <=55 à C

45 <total Score <=50 à D+

40 <total Score <=45 à D

35 <total Score <=40 à E+

30 <total Score <=35 à E

Total Score < 30 à F

3. Create a basic calculator with VBA in Excel.

4. Write some code in VBA (Visual Basic for Application) to manipulate records in Excel spreadsheet and work with VBA user form to build graphic user interface application.
In case that you have a lot of records in your data sheets, manipulating records--add new, update, save, delete, move, and find record is hard. With VBA, you can solve this problem.

5. Write some code in VBA (Visual Basic for Application) to manipulate records in Excel spreadsheet and work with VBA user form to build graphic user interface application.
In case that you have a lot of records in your data sheets, manipulating records--add new, update, save, delete, move, and find record is hard. With VBA, you can solve this problem.

6. Prepare a pay-bill using a worksheet. The work sheet should contain

Employee Id, Name, Designation, Experience and Basic Salary and Job ID.

If Job Id is 1 then DA is 45% of the basic salary. HRA is Rs. 5500.

If Job Id is 2 then DA is 40% of the basic salary. HRA is Rs. 4500. For all

the other Job ids DA is 35% of the basic salary and HRA is Rs. 3500. For all

the above Job ids PF to be deducted is 4%. For the job ids 1&2 Rs. 100 to be

deducted as Professional Tax.

a. Find the net pay.
b. Use filter to display the details of employees whose salary is greater than 10,000.
c. Sort the employees on the basis of their net pay.
Use advance filter to display the details of employees whose designation is Programmer and Net Pay is greater than 20,000 with experience greater than 2 yrs.

7. Using Excel project the Product sales for any five products for five years.

a. Compute the total sales of each product in the five years.
b. Compute the total sales of all the products in five year.
c. Compute the total sales of all products for each year.
d. Represent annual sale of all the products using Pie-Chart
e. Represent annual sales of all products using Bar Chart.
f. Represent sale of a product for five years using Pie-Chart.
g. Label and format the graphs.

Text Books And Reference Books:

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Essential Reading / Recommended Reading

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Evaluation Pattern

CIA - 50%

ESE - 50%

BCA121N - PROFESSIONAL ENGLISH (2020 Batch)

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

Course Objectives/Course Description

This course focuses on preparing students to communicate verbally and non-verbally in an effective manner. The aim is to introduce students to communicate in a professional environment. It is instrumental in learners comprehending the role of technical English in communication.

Objectives:

1. Introduce learners to language skills in their area of specialisation.

2. Enable them to enhance career prospects and employability through English language skills

3. Help students gain an understanding of language at the workplace

4. To develop verbal and non-verbal skills in English communication

Learning Outcome

1. comprehension and demonstration of language in the field of technology

2. Prepare individuals as Independent communicators

3. Illustrate professional requirements through language proficiency

Unit-1 **Teaching Hours:8**

Reviewing grammar

This unit undertakes to revise the foundation of language; the grammar section of language learning. Students will be reviewed the grammar aspects mentioned through task-based activities

- Concept of time in language – reflective learning will be used to help students detect their grammatical errors in tenses and rectify.
- Degrees of comparison – using technical literature students can be engaged in apprehending degrees of comparison.
- Direct and reported speech – to enable learners to carry on a comprehensible conversation either spoken or written, in a business context.
- Subject-verb agreement – through worksheets and task-based learning students will be familiarized to construct error-free sentences

Unit-2 **Teaching Hours:6**

Technical vocabulary

Learners will be acquainted with the basic of English language learning. They will be taught to identifying technical vocabulary from the general. Technical magazines prescribed by the institution that are subject-specific can be used as teaching tools.

- Introduction to the technical lexicon – help students identify jargon and technical terminologies. Assist them to comprehend the significance of implementation with moderation through their subject literature.
- Internet lexis and contextualisation – provide meanings accurately to ensure the right exercise of terms in a professional scenario through hands-on experience.
- Circumstantial usage of diction – aid the comprehension of word usage as verbs and nouns based on the requirement. Differentiating the meanings of synonyms and their orientation in a text.
- Integrating technical vocabulary in describing process and procedure – through prescribed texts students can be made to enhance their language by right integration of diction.
- Mind mapping of textual diction and allied words – diagrammatically mapping of words based on their meaning, context and usage will re-emphasise the words in the minds of the learners.

Unit-3 **Teaching Hours:8**

Rereading texts

Having gained familiarity with technical and subject-specific vocabulary, students will be introduced to the types of reading. The basic receptive skill will help students prioritise and eliminate content.

- Reading strategies – acquaint the learners with the functions and benefits of reading strategy in the academic and professional set-up.
- Reading: skimming, scanning – introduce learners to the types of reading. The integral aspects of each method will be familiarized to the students. They can be given practice sessions through subject material provided.
- Intensive and extensive reading – benefits and features of the two types of reading can be elaborated. To emphasise on the learner the difference, practice sessions with subject material can be carried out.
- Summarising – consolidation of key ideas can be carried out in the spoken and written format. Technical literature can be provided for the purpose.

Unit-4 **Teaching Hours:5**

Non - verbal communication

The ancillaries of speaking skill are in focus here. Prior to delving into the productive skill, the nitty-gritty that enhances its effectiveness is made familiar to the learner. Classroom activities and vicarious learning through case studies and video clippings can be screened.

- Competence in non-verbal communication- create an awareness of the role of non-verbal communication in a professional set-up.
- Functions of non-verbal communication – the various utilities of nonverbal communication can be elaborated to students with case

studies.

- Benefits of non-verbal communication – elucidate the advantages of non-verbal communication with reference to cultural distinctions.
- Proxemics, Chronemics, Kinesics, Haptics, Gestures, Paralanguage - vicarious learning of these aspects of non-verbal communication can be carried out through video clippings of suitable material and print media

Unit-5 **Teaching Hours:4**

Communication strategies

The productive skills are finessed through identification and refining of the elements mentioned in this unit. They contribute to the holistic presentation. Task-based activities must be used to practise. Business Communication texts and worksheets will provide ample support.

Nuances of communication – communication in the workplace requires knowing the dos and don'ts of professional communication. An introduction to listening, speaking, reading and writing with reference to professional communication can be provided.

- Opening techniques
- Speech markers
- Fillers
- Turn-taking
- Backchannelling
- Dealing with interruptions

Every element mentioned can be elaborated. Ample examples can be provided through audiovisual media, it can be provided to them through demonstrations and verbal reinforcement language checklists can be provided to aid students understand the implementation of the elements. A follow up through mock sessions must be carried out in groups

Unit-6 **Teaching Hours:6**

Writing skill

Having dealt with speaking skill in the previous unit, the other productive skill; writing is taken into consideration here. The various forms of writing in an official context will be taught in form and content.

- Report writing – a corporate requirement is the ability to report on meetings and conferences. The format and requirements of a report writing can be taught to the students through samples and later they can be made to draft reports of their own and peer evaluated
- Note-taking – corporate atmosphere calls for not taking at every step. Students need to be taught the framework of note-taking. They can be given samples as reference. Later they can be made to listen to technical audio clips and provide the note-taking carried out at an individual level.
- Minutes – corporate life calls for being in attendance of numerous meetings. Taking down the minutes is a skill that is assumed to be possessed by one. The essentials of maintaining the minutes must

be made conversant through illustrations. This can be emphasised by classroom activities of the same.

Unit-7 **Teaching Hours:8**

Professional communication

Lastly, students will be introduced to typical work scenarios through hands-on sessions.

- Small talk – the purpose and role of small talk must be taught to the students. They can be screened video clippings of the same. Mock sessions can be performed in the class. The key phrases and language used can be imparted through the provision of language worksheets and skills checklists.
- Meeting- types of meetings, the hierarchy of most often featuring members, etiquette to be held at the meeting and the duties to be performed can be taught implicitly. Chairing, setting the agenda, controlling the smooth functioning, participating, deliberating and diplomacy must be made clear. The key phrases and language used can be taught through language worksheets and skills checklists.
- Group discussion – group discussions are carried out at every level. Students must be familiarized with the basics of group discussions. Agreeing, disagreeing, and being diplomatic are essentials to be imparted. The soft skills and language essentials most commonly noted can be made comprehensible to the students. Vicarious learning and language charts can be used as learning tools.

Text Books And Reference Books:

Booher, Dianna. E- Writing: 21st Century Tools for Effective Communication. Macmillan, 2008.

Knapp .M. Essentials of Non-Verbal Communication Theory Rea. FL: Harcourt, 1995.

Essential Reading / Recommended Reading

[1] Driscoll, Liz. Common Mistakes at Intermediate and How to Avoid Them. CUP, 2008.

[2] Carter, Ronald and Michael McCarthy. Cambridge Grammar of English. CUP, 2006.

[3] Leech, Geoffrey, Jan Svartvik. A Communicative Grammar of English. Third Edition. New Delhi: Pearson Education, 2009.

Evaluation Pattern

CIA I- 20

MID SEMESTER EXAM - 50

CIA II -20

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 introducing the students into the world of Discrete Mathematics. It includes the topic like Mathematical Logic, Method of proofs, Mathematical induction, Permutations and combinations and Binomial coefficients. Also, this course emphasizes general techniques of problem solving and explores the creation of mathematical patterns.

Course Objective: This course will help the learner to

COBJ1. understand and use the notions of Mathematical Logic.

COBJ2. give proofs for Mathematical problems by using different methods of proofs

COBJ3. prove the mathematical problems/statements by using Mathematical Induction

COBJ4. use the permutations,combinations,binomial coefficients for solving problems appropriate problems

Learning Outcome

Course Outcomes: On successful completion of this course, student will be able to

CO1. Formulate and interpret statements presented and determine their validity by applying the rules and methods of propositional logic.

CO2. Reformulate statements from common language to formal logic using the rules of propositional and predicate calculus, and assess the validity of arguments.

CO3. Apply the logical structure of proofs and work symbolically with connectives and quantifiers to produce logically valid, correct and clear arguments

CO4. Construct elementary proofs using ordinary and strong induction in the context of studying the properties of recursion

CO5. Apply basic counting principles including the pigeonhole principle and rules for counting permutations and combinations.

Unit-1 **Teaching Hours:15**

Logic

Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers.

Unit-2 **Teaching Hours:15**

Methods of Proof

Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.

Unit-3 **Teaching Hours:15**

Counting

Mathematical Induction (Pg.311-333), The Basics of Counting, The PigeonholePrinciple, Permutations and Combinations, Binomial Coefficients and Identities

Text Books And Reference Books:

K. H. Rosen, *Discrete Mathematics and its Applications*, 7th ed., McGraw – Hill, 2012.

Essential Reading / Recommended Reading

1. R.P. Grimaldi and B.V. Ramana, *Discrete and Combinatorial Mathematics, An applied introduction*, 5th ed., Pearson Education, 2007.
2. D. S. Chandrasekharaiah, *Discrete Mathematical Structures,* 4th ed., India: PRISM Book Pvt. Ltd., 2012
3. J. P. Tremblay and R. Manohar, *Discrete Mathematical Structures with Application to Computer Science,* Reprint, India: Tata McGraw Hill Education, 2008.

Evaluation Pattern

ESE - Question Paper Pattern

Part	Unit and No. of subdivisions to be set in the unit		No. of subdivisions to be answered	Marks for each subdivision	Max. marks for the part
A	UNIT I	4	10	3	30
	UNIT II	4			
	UNIT III	4			
B	UNIT II	4	3	7	21
C	UNIT I	5	4	7	28
D	UNIT III	4	3	7	21
				Total	100

BCA132N - STATISTICS I FOR BCA (2020 Batch)

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

Max Marks:100 **Credits:3**

Course Objectives/Course Description

To acquaint students with various statistical methods.
To cultivate statistical thinking among students.
To prepare students for future courses having quantitative components.

Learning Outcome

CO1: Understand and appreciate descriptive statistics.

CO2: Understand the concepts of probability and random variables.

CO3: Understand the different index numbers.

Unit-1 **Teaching Hours:10**

Introduction

Importance of Statistics, Primary and secondary data, data collection methods. Presentation of numerical and categorical data.

Unit-2 **Teaching Hours:12**

Concepts of central tendency and dispersion

Mean, median, mode and partition values-quartiles for grouped and ungrouped data. Range, quartile deviation, standard deviation and coefficient of variation for grouped data

Unit-3 **Teaching Hours:12**

Probability

Random Experiment- Sample space and events. Probability. rules. Conditional probability and Bayes theorm.

Unit-4 **Teaching Hours:6**

Random variable

Definition, types of random variables, probability functions, expectations and variance.

Unit-5 **Teaching Hours:5**

Index Number

Laspeyres', Paasches', Fishers price and quantity index numbers. Time reversal and factor reversal tests.

Text Books And Reference Books:

1. Berenson and Levine, *Basic Business Statistics*, New Jersey, 6th edition, Prentice- Hall India, 1996.

Essential Reading / Recommended Reading

1. D.C. Montogomery and G.C.Runger, *Applied Statistics and Probability for engineers*, New Jersey, John Wiley and Sons, 3rd edition, 2003.

Evaluation Pattern

Evaluation Pattern:

Component	Marks
Continuous Internal Assessment-I	10
Continuous Internal Assessment-II	25
Continuous Internal Assessment-III	10
Attendance	5
End Semester Exam(Written Test)	50

Total	**100**

End Semester Exam Pattern:

Section	Total number of questions	No. of questions to be answered	Max. Marks for each question	Total Marks
A	12	10	2	20
B	6	5	6	30
C	6	5	10	50
Total	24	19		100

BCA133N - 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

This is an introductory course that provides the required knowledge about the digital fundamentals of computers. The course covers a few topics like number systems, logic gates, and flips flops. The course starts with an introduction to number systems and its applications in computers. The discussion about the working of devices like encoders and decoders, multiplexers, and demultiplexers are dealt with.

Learning Outcome

CO1: Ability to use math and Boolean algebra in performing computations in various number systems.

CO2: Simplification of Boolean algebraic expressions.

CO3: Ability to design efficient combinational and sequential logic circuit

implementations from a functional description of digital systems.

Unit-1 **Teaching Hours:12**

Introduction to Number System and Codes

Number systems: Decimal numbers, Binary numbers: Counting in binary, The weighted structure of binary numbers, Octal numbers, hexadecimal numbers, and their mutual conversions, Binary arithmetic: Addition, subtraction, multiplication, and division of binary numbers, 1‘s and 2‘s complement, signed numbers, arithmetic operations: addition, subtraction with signed numbers, 9‘s and 10‘s complement, BCD numbers, BCD addition, BCD subtraction, Gray code: Binary to Gray code conversion, Gray to Binary conversion, Weighted code: 8421 code and non-weighted codes: ASCII and EBCDIC.

Unit-2 **Teaching Hours:8**

Boolean Algebra

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

Unit-3 **Teaching Hours:10**

Logic Gates

AND gate, OR gate, NOT gate, NAND gate, NOR gate, X-OR gate, X-NOR gate, The universal property of NAND gate and NOR gate, Realization of basic gates. The boolean expression for logic circuits, Karnaugh map SOP with examples.

Unit-4 **Teaching Hours:10**

Combinational Logic

Basic Adders: Half adder, Full adder, 4-bit Parallel adders, Subtractor: Half subtractor, Full subtractor Implementation using logic gates, Decoders: 4-bit decoder, BCD to decimal decoder, Encoder: Decimal to BCD encoder, Multiplexer: 4 to 1 multiplexer, Demultiplexer: 1 to 4 demultiplexer.

Unit-5 **Teaching Hours:10**

Flip-flops

Latches: SR latch, Clocked flip-flops: SR flip-flop, D flip-flop, JK flip-flop, Positive edge-triggered flip flops, Timing diagrams, Master-slave JK flip-flop.

Unit-6 **Teaching Hours:10**

Registers and Counters

Modes of operation of registers: SISO, SIPO, PISO, and PIPO, Asynchronous counters: Four-bit ripple counter, Decade counter, Synchronous counters: Four bit synchronous counter, Decade counter

Self-Learning

Introduction to RAM, SRAM, DRAM, ROM, PROM, EPROM, EEPROM

Text Books And Reference Books:

Floyd, Thomas L: Digital Computer Fundamentals, 11th Edition, Pearson International, 2015.

Essential Reading / Recommended Reading

Malvino, Paul Albert, Leach, Donald P,GautamSaha: Digital Principles And Applications, TMH ,8th Edition, 2015.

Bartee, Thomas C: Digital Computer Fundamentals, 6 Edition,TMH, 2010.

Evaluation Pattern

CIA - 50%

ESE - 50%

BCA134N - INTRODUCTION TO PROGRAMMING USING C (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 students with a comprehensive study of C programming language. The course lectures stress the strengths of C, which provides the outcome of writing efficient, maintainable and portable code. Course includes few lab exercises to make sure the student has not only gained the knowledge but can also apply and execute it. Objectives of the course are,

- To study about algorithms, flowcharts and programs.
- To solve problems through logical thinking.

Learning Outcome

CO1: To clearly understand the logic of the problem.

CO2: To analyze the given problem and write the algorithm, flowchart.

CO3: To write structured C programs, this is the foundation of any programming language.

Unit-1 **Teaching Hours:8**

Introduction to computers and programming

Evolution of Computers, Generation of Computers, Classification of Computers.Characteristics of Computers. Advantages of Computers. Block Diagram of a Digital Computer. Types of Programming Languages.Structured Programming.Algorithms and Flowcharts with Examples.Programming Logic.

Unit-2 **Teaching Hours:10**

Introduction to C programming

History of C- Character set - Structure of a C program - constants, variables and keywords. Expressions – Statements – Operators – Arithmetic, Unary, Relational and logical, Assignment, Conditional. Library functions. Data Input and output – Single character input, getchar, getch, getc – Single character output putchar, putc, Formatted I/O scanf, printf, gets, puts.

Unit-3 **Teaching Hours:11**

Control structures and arrays

Branching: condition: if, if..else, switch. Looping: while, do..while, for, nested control structures, break, continue statement, goto statement. Arrays: definition, processing, types - One and Two dimensional arrays. String, string operations, arrays of strings.

Unit-4 **Teaching Hours:11**

Functions and Pointers

Functions: Definition, Accessing and prototyping, types of functions, passing arguments to functions, recursion, passing arrays to functions. Pointers: Definition, notation, applications, call by reference.

Unit-5 **Teaching Hours:11**

Structures, Unions and Files

Structures: Definition, Processing, user defined data type typedef - Unions – definition, declaration and accessing union elements. Enumerated Data type.Files: File opening in different modes, closing, reading and writing. fopen, fclose, fprintf, fscanf, getw, putw.

Unit-6 **Teaching Hours:9**

Low level programming and C preprocessor

Storage Structures: extern, register, static, auto. Bitwise Operations: AND, OR, exclusive OR, complement, right shift and left shift operators. Preprocessor: Types of C preprocessor directives. Macros- comparison with functions. File Inclusion. Command line Arguments.

Text Books And Reference Books:

[1] Byron Gottfried, JitenderChhabra ,*Programming with C, 3rd* Edition. Tata McGraw-Hill, 2010

Essential Reading / Recommended Reading

[1] Balagurusamy E., *Programming in ANSI C,* 6th Edition,TataMcGraw-Hill,2012.

[2] Deitel H M and Deitel P J, *C- How to Program*, 5th Edition, Prentice-Hall, 2006.

[3] SmarajitGhosh, *All of 'C',2nd Edition,2009.*

[4] M. T. Somashekara, *Problem Solving with C,* PHI,2009

Evaluation Pattern

CIA - 50%

ESE - 50%

BCA151N - DIGITAL COMPUTER FUNDAMENTALS LAB (2020 Batch)

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

Max Marks:100 **Credits:2**

Course Objectives/Course Description

This course offers an experimental view of hardware components, digital circuits and logic gates of a computer. Objective of the course is to understand the working principle and logic design of digital circuits.

Learning Outcome

CO1: Students will demonstrate an ability to identify the basic components to build digital circuits.

CO2: Students will be able to design efficient Combinational and Sequential logic circuits.

Unit-1 **Teaching Hours:60**

List of programs

1. Demonstration of the components of (i) Kindle (ii) iPad (iii) Smart Phone (iv) Laptops

2. Demonstration of the installation and discussion of the features of different Operating

Systems. Eg: Mac, Unix, Ubuntu, Windows etc.

3. Verification of the truth tables of AND, OR & NOT gates.

4. Verification of the truth tables of NAND & NOR gates.

5. Verification of the truth table of XOR using NAND gates.

6. Verification of the truth table of Half Adder circuits using NAND gates.

7. Verification of the truth table of Full Adder circuits using NAND gates.

8. Verification of the truth table of D flip flop.

9. Verification of the truth table of JK flip flop.

10. Verification of the truth table of RS flip flop.

11. Binary To Gray Code and Gray Code to Binary Converter

12. Verification of the Function table of Binary Ripple Counter using JK FF.

13. Verification of the Function table of Decade Counter.

14. Verification of the Function table of Serial In Serial Out Shift Register using D FF.

Text Books And Reference Books:

Floyd, Thomas L: Digital Computer Fundamentals, 11th Edition, Pearson International, 2015.

Essential Reading / Recommended Reading

Malvino, Paul Albert, Leach, Donald P,GautamSaha: Digital Principles And Applications, TMH ,8th Edition, 2015.

Bartee, Thomas C: Digital Computer Fundamentals, 6 Edition,TMH, 2010.

Evaluation Pattern

CIA - 50%

ESE - 50%

BCA152N - C PROGRAMMING LAB (2020 Batch)

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

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

Course Objectives/Course Description

To learn problem solving through procedural language programming technique and Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.

Learning Outcome

CO1: Read, understand and trace the execution of programs written in C language. CO2: Write the C code for a given algorithm.

CO3: Implement Programs with pointers and arrays, perform pointer arithmetic, and use the pre-processor.

Unit-1 **Teaching Hours:60**

List of Programs

1. To demonstrate the usage of operators and data types in C

a. Write a program to print the size of all the data types with its modifiers supported by C and its range.

b. Write a program to convert Fahrenheit to Celsius.

2. To demonstrate the usage of if, if-else

a. Write a program to check whether the given number is a Prime number or not.

b. Write a program to accept three numbers and find the largest and second largest among them.

3. To demonstrate the concept of while, do-while, for loops, break and continue

a. Write a program to print all prime numbers between any 2 given limits.

b. Write a program to print all the Armstrong numbers between any 2 given limits.

4. To demonstrate the concept of arrays and strings

a. Write a program to check whether a string is a Palindrome.

b. Write a program to check whether a given matrix is an Identity matrix or not.

c. Write a program to perform matrix multiplication.

5. To demonstrate the concept of switch-case

a. Write a program to count the different vowels in a line of text.

b. Write a program to accept two numbers and perform various arithmetic operations (+, -, *, /) based on the symbol entered.

6. To demonstrate the usage of functions and recursion

a. Write a program to find the roots of a quadratic equation

b. Write a recursive program to find the factorial of a number.

7. To demonstrate the concept of structures and unions

a. Create an employee structure and display the same.

b. Create a student database storing the roll no, name, class etc. Implement modify and search operations.

8. To demonstrate the concept of

a. Write a function to swap two numbers using pointers

b. Write a program to access an array of integers using pointers

9. To demonstrate the concept of File

a. Create a file and store some records in it. Display the contents of the same. Implement search, modify, and delete operations.

10. To demonstrate the concept of Bitwise operators and preprocessors

a. Perform the different bitwise operations (menu driven program) .The i/p and the o/p should be displayed in Binary form.

b. Write a program to include your own header file.

Text Books And Reference Books:

Text Books and Reference Books

[1] Byron Gottfried, JitenderChhabra ,*Programming with C, 3rd* Edition. Tata McGraw-Hill, 2010

Essential Reading / Recommended Reading

[1] Balagurusamy E., *Programming in ANSI C,* 6th Edition,Tata McGraw-Hill,2012.

[2] Deitel H M and Deitel P J, *C - How to Program*, 5th Edition, Prentice-Hall, 2006.

[3] SmarajitGhosh, *All of 'C',2nd Edition, 2009.*

[4] M. T. Somashekara, *Problem Solving with C,* PHI, 2009

Evaluation Pattern

CIA weightage 50%

ESE weightage 50%

Total Teaching Hours for Semester:75 | **No of Lecture Hours/Week:5**

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

Course Objectives/Course Description

Develop the conceptual foundations and analytical methods used in micro economics; Familiarize the students with the basics of consumer behaviour, behaviour of firms and market equilibrium; Analyse the market structures of perfect competition, oligopoly and monopolies; Introduce the game theory and welfare economics

Learning Outcome

- Understand that economics is about the allocation of scarce resources and how that results in trade-offs.
- Understand the role of prices in allocating scarce resources in market economies and explain the consequences of government policies in the form of price controls.
- Appreciate positive as well as normative view points on concepts of market failure and the need for government intervention.

Unit-1 **Teaching Hours:16**

Micro Economics and the Theory of Consumption

Ten principles of economics: How people make decisions, how people interact and how the economy as a whole works- Role of observations and theory in economics- Role of assumptions- Role of Economic models- Wants and resources; Problem of choice, Production Possibility Frontier; Opportunity costs.

Unit-2 **Teaching Hours:14**

Demand and supply

Law of demand, Reasons for the downward slope of the demand curve. Exceptions to the law; Changes in demand; Elasticity of Demand- Degrees of price elasticity with diagrams; Factors determining price elasticity, methods of measurement. Income elasticity demand; Cross elasticity demand; Laws of supply, Changes in supply- Consumers, Producers and the Efficiency of the Markets: Consumer‟s surplus (Marshall), Producer surplus and Market efficiency- Externalities and Market inefficiency- Public goods and common resources.

Unit-3 **Teaching Hours:16**

Theory of Production and Cost

Production function; Law of Variable proportions; Laws of returns, Economies of scale; Producer's Equilibrium with the help of iso-quants and iso-cost lines. Cost function - Important cost

concepts. Short run and long run cost analysis (traditional theory) Modern theory of cost- Long run and short run - Revenue analysis - AR and MR.

Unit-4 **Teaching Hours:19**

Product Pricing and Factor Pricing

Market structure. Perfect competition, Price and output determination. Role of time element in market price determination. Monopoly- Price output determination, Price discrimination Monopolistic Competition. Price and Output determination. Selling costs. Product differentiation. Wastes in monopolistic competition. Oligopoly Price determination (collusive pricing, price leadership), Features of Duopoly and Monopsony

Unit-5 **Teaching Hours:10**

Theory of Consumer Choice and New Frontiers in Microeconomics

Cardinal utility analysis; Law of diminishing marginal utility; Consumer's surplus (Marshall), Ordinal utility analysis. Indifference curves- Properties, consumer's equilibrium, Price effect, Income Effect and substitution effect. New Frontiers in Microeconomics: Introduction to concepts of Asymmetric Information, Political economy, Behavioral Economics.

Text Books And Reference Books:

1. N. Gregory Mankiw (2012). *Principles of Microeconomics*, 4th Edition, Cengage Learning India.

2. Lipsey, R.G. and K.A. Chrystal (1999), *Principles of Economics* (IX Ed.), Oxford University Press, Oxford.

Essential Reading / Recommended Reading

1. Ramsfield, E. (1997), *Micro Economics* (IX edition), W.W Norton and company, New York.

2. Pindyck and Rubinfield (2009), *Micro Economics* (VII edition), Pearson Education.

3. Ray,N.C.(1975), *An Introduction to Micro economics*, Macmillan company of India Ltd, New Delhi.

4. Samuelson, P.A. and W.D. Hague (1972), *A textbook of Economic Theory*, ELBS Longman group, London.

5. H.L. Ahuja, *Principles ofMicroeconomics*, S.Chand, New Delhi.

Evaluation Pattern

CIA - 1: 20 marks.

CIA - 2: Mid Semester Examination - 50 marks; 2 hours.

CIA - 3: 20 marks.

ECO131N - PRINCIPLES OF MICROECONOMICS (2020 Batch)

Total Teaching Hours for Semester:75 **No of Lecture Hours/Week:5**

Max Marks:100 **Credits:5**

Course Objectives/Course Description

Develop the conceptual foundations and analytical methods used in micro economics; familiarise the students with the basics of consumer behaviour, behaviour of firms and market equilibrium; Analyse the market structures of perfect competition, oligopoly and monopolies; Introduce the game theory and welfare economics.

Learning Outcome

Understand that economics is about the allocation of scarce resources and how that results in trade-offs.

Understand the role of prices in allocating scarce resources in market economies and explain the consequences of government policies in the form of price controls.

Appreciate positive as well as normative view points on concepts of market failure and the need for government intervention.

Unit-1 **Teaching Hours:16**

Microeconomics and the Theory of Consumption

Ten principles of economics: How people make decisions, how people interact and how the economy as a whole works-Role of observations and theory in economics – Role of assumptions - Role of Economic models-Wants and resources; Problem of choice, Production Possibility Frontier; Opportunity costs.

Unit-2 **Teaching Hours:14**

Demand and supply

Law of demand, Reasons for the downward slope of the demand curve. Exceptions to the law; Changes in demand; Elasticity of Demand – Degrees of price elasticity with diagrams; Factors determining price elasticity, methods of measurement. Income elasticity demand; Cross elasticity demand; Laws of supply, Changes in supply - Consumers, Producers and the Efficiency of the Markets: Consumers' surplus (Marshall), Producers' surplus and Market Efficiency -Externalities and Market inefficiency-Public goods and common resources.

Unit-3 **Teaching Hours:16**

Theory of Production and Cost

Production function; Law of Variable proportions; Laws of returns, Economies of scale; Producer's Equilibrium with the help of iso-quants and iso-cost lines

Cost function-Important cost concepts. Short run and long run cost analysis (traditional theory) Modern theory of cost-Long run and short run-Revenue analysis-AR and MR.

Unit-4 **Teaching Hours:19**

Product Pricing and Factor Pricing

Market structure; Perfect competition, Price and output determination; Monopoly – Price output determination, Price discrimination-Monopolistic Competition: Price and Output determination. Selling costs. Product differentiation; Wastes in monopolistic competition; Oligopoly Price determination (collusive pricing and price leadership), Features of Duopoly and Monopsony

Unit-5 **Teaching Hours:10**

Theory of Consumer Choice and New Frontiers in Microeconomics

Ordinal utility analysis;Indifferencecurves - Properties, consumers' equilibrium, Price effect, Income Effect and substitution effect. New Frontiers in Microeconomics: Introduction to concepts of Asymmetric Information, Political Economy and Behavioral Economics.

Text Books And Reference Books:

1. N. Gregory Mankiw (2012). *Principles of Microeconomics,* 4th Edition, Cengage Learning India.

2. Lipsey, R.G. and K.A. Chrystal (1999), *Principles of Economics* (IX Ed.), Oxford University Press, Oxford.

3. Ramsfield, E. (1997*), Microeconomics* (IX edition), W.W Norton and company, New York.

4. Ray, N.C. (1975), *An introduction to Microeconomics*, Macmillan company of India Ltd, New Delhi.

Essential Reading / Recommended Reading

1. Samuelson, P A and W D Hague (1972), A textbook of Economic Theory, ELBS Longman group, London.

2. Pindyk and Rubinfeld - Micro Economics (Pearson Education).

3. HL Ahuja, Principles of Microeconomics, S Chand, New Delhi

Evaluation Pattern

Evaluation Pattern	CIA1	MSE* (CIA2)	CIA3	ESE**	Attendance
Weightage	10	25	10	50	05

* Mid Semester Exam ** End Semester Exam

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

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%

HIN122N - 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" is a collection of Modern Hindi poems of leading writers of Hindi Poetry edited by Dr.N Mohanan.From the medieval poetry ' Kabir Ke Dohe and Sur ke pad 'is also included.By teaching business correspondence emphasis is being given to functional Hindi too. Hindusthani Music and TranslationPractice also have been included in this semester.

Course Objectives:

- 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, students can understand different languages, literatures and cultures. Business correspondence helps the students to understand the functional aspects of the language.

Unit-1 **Teaching Hours:20**

Kavya Sankalan - Samakaleen Hindi Kavitha. (An anthology of contemporary Hindi poems), Kabir ke Dohe and Sur Ke Pad

'Samakaleen Hindi Kavitha' (Collection of Poems) Ed by Dr N Mohanan, Rajpal and son's, New Delhi

Level of knowledge: Analytical

Unit-1 **Teaching Hours:20**

Hindustani Music

Gazal Ki Parampara and Pramukh kalakar

Unit-2 **Teaching Hours:15**

Translation- practice

Translation-Practice English to Hindi and vise- versa

Level of knowledge:Basic

Unit-3 **Teaching Hours:5**

Patra Lekhan --Vyavasaik Patra Vyavhar (Business letters)

Vyavasaik Patra Vyavhar (Business letters)

1. Mulya Suchi
2. Adesh
3. Shikayathi
4. Bhugtan

Level of knowledge: Conceptual

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. Kavya Sankalan - 'Samakaleen Hindi Kavitha' (Collection of Poems)Ed. by Dr. N Mohanan.

Essential Reading / Recommended Reading

1. Abhinav Patra-Vyavahar -Dr.Paramanand Gupta

2. Vanijya Hindi By A.R.Narti*1*.A Hand Book of Translation Studies By Das Bijay Kumar

3. Anuvad Evam Sanchar – Dr Pooranchand Tantan, Rajpal and Son's, Kashmiri Gate, New Delhi – 110006

4. Anuvad Vignan By Bholanath Tiwari

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-Creating article 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*, 12^{th} 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 analytical knowledge of the subject	50
		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

ECO231 - PRINCIPLES OF MACROECONOMICS (2020 Batch)

Total Teaching Hours for Semester:75 | **No of Lecture Hours/Week:5**

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

Course Objectives/Course Description

It aims at providing a systematic introduction to mainstream approaches to the study of macroeconomics in the current century. It has been designed in such a way that it stimulates awareness on macroeconomic challenges and policy management in progressive nations. It also aims at developing the ability for objective reasoning about macroeconomic issues.

Learning Outcome

- It provides the student a strong foundation in macroeconomics and helps in understanding the policy implications in emerging economies.
- It helps in understanding the contribution of various macroeconomic schools and in evaluating their policy prescriptions.
- It enables the student to evaluate the pros and cons of different macroeconomic policies in real situations.

Unit-1 **Teaching Hours:9**

Measuring a Nation's Income and Cost of Living

Economy's Income and Expenditure: Measurement of GDP, components of GDP, real versus nominal GDP, the GDP Deflator. The Consumer Price Index: calculation of CPI, GDP deflator versus the CPI, correcting the economic variables for the effects of inflation, real versus nominal interest rates- Production and Growth-Unemployment and its Natural Rate

Unit-2 **Teaching Hours:15**

Goods and Money Market

Saving and Investment in the National Income Accounts. The Market for Loanable Funds; Policy changes and impact on the market for loanable funds. Meaning and functions of Money. Banks and Money supply; Money creation with 100 per cent Reserve Banking and Fractional Reserve Banking. Central Bank tools of Monetary Control. Classical Theory of Inflation; Classical Dichotomy and Monetary Neutrality. Velocity and Quantity Equation; Fisher Effect. Costs of Inflation.

Unit-3 **Teaching Hours:12**

Open - Economy Macroeconomics: Basic Concepts

The International Flows of Goods and Capital – The Prices for International Transactions: Real and Nominal Exchange Rates – A first Theory of Exchange – Rate Determination: Purchasing Power Parity.

Unit-4 **Teaching Hours:18**

Aggregate Demand, Aggregate Supply & Influence of Monetary and Fiscal Policy on Aggregate Demand

Three key facts about economic fluctuations. Short run Economic Fluctuations: Aggregate Demand Curve, Aggregate Supply Curve and the two causes of economic fluctuations. Monetary Policy influence on Aggregate Demand. The Theory of Liquidity Preference. Fiscal Policy influence Aggregate Demand: The Multiplier Effect and Crowding – out Effect. Stabilisation Policy and Active versus Automatic Stabilisers.

Unit-5 **Teaching Hours:18**

Short Run Trade-Off between Inflation and Unemployment

Philips Curve and shifts in Philips Curve: The Role of Expectations, shifts in Philips Curve and the Role of Supply Shocks. The Cost of reducing Inflation. Rational Expectations and the possibility of costless disinflation.

Unit-6 **Teaching Hours:3**

Six Debates over Macroeconomic Policy

Monetary and Fiscal Policy – pros and cons. Handling Recession: higher spending versus tax cuts. Monetary Policy: rule versus discretion; Central Bank: zero inflation. Balanced Budget debate. Tax Law reformation for savings debate.

Text Books And Reference Books:

1. Mankiw, Gregory N (2012). *Principles of Macroeconomics*, 6th Edition, Cengage Learning India.

Essential Reading / Recommended Reading

1. Sloman, John, (2006). *Economics,* 6th Ed., Pearson Education.
2. Ackley, G. (1976). *Macroeconomics*, Theory and Policy, Macmillan Publishing Company, New York.
3. Day.A.C.L.(1960). *Outline of Monetary Economics*, Oxford University Press, New Delhi.
4. Heijdra,B.J. and F.V.Ploeg (2001). *Foundations of Modern Macro economics*, Oxford University Press, Oxford.
5. Lewis, M.K. and P.D. Mizan (2000). *Monetary Economics*, Oxford University Press, New Delhi.
6. Shapiro, E. (1996). *Macro economics Analysis*, Galgotia Publications, NewDelhi.

7. Dillard, D.(1960), *The Economics of John Maynard Keynes*, Crossby Lockwood and Sons, London.
8. Hanson, A.H. (1963). *A Guide to Keynes*, McGraw Hill, New York.
9. Keynes, J.M. (1936). *The General Theory of Employment, Interest and Money*, Macmillan, London.
10. Farmer, Roger.(2001). *Macro economics*, II Edition. ISBN.
11. Stanley Fischer and Rudiger Dornbusch. *Macro Economics*, London. MacGraw-Hill.

Evaluation Pattern

CIA 1 : 20 Marks

CIA II : 50 Marks (Mid Semester Examination). Time: 2 Hours

CIA III : 20 Marks

ESE : 100 Marks (End Semester Examination). Time: 3 Hours

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 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**

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

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

ECO331 - FUNDAMENTALS OF ECONOMIC GROWTH AND DEVELOPMENT (2019 Batch)

Total Teaching Hours for Semester:75 | **No of Lecture Hours/Week:5**

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

Course Objectives/Course Description

The course is intended to give an understanding of the theoretical perceptions of economic growth and development together with the forces bringing about them. It also helps to broaden the awareness of the challenges in the developmental process and thus motivate the students towards the thought process of alternative solutions.

Learning Outcome

The students will

1. Gain conceptual base in Economic Dvelopment and Growth.

2. Familiarise with key models and theories in Dvelopment and Growth.

3. Gain insight in to the key issues of economic development.

4. Get awareness of the approaches to development efforts.

Unit-1 **Teaching Hours:12**

Meaning of Development and Relevant Concepts

Distinction between Growth and Development; PQLI; Human Development Index; Gender Development Index; Sen's Capabilities Approach; Environmental Sustainability and Development; Common Characteristics of Developing Nations; Alternative Measures of Development.

Unit-2 **Teaching Hours:14**

Growth Models and Empirics

The Harrod-Domar model; the Solow model and its variants; Theories of endogenous growth with special reference to Romer's

model; the Big Push Theory and Lebenstence Theory of Critical Minimum Efforts.

Unit-3 **Teaching Hours:12**

Approaches to Development

Balanced and Unbalanced Growth; Low Income Equilibrium Trap; Dual Economy Models of Lewis

Unit-4 **Teaching Hours:12**

Poverty, Inequality and Development

Measurement of Poverty – Absolute and Relative; Head-Count Index and Poverty Gap Indices; Policy options for Alleviation of Poverty; Measurement of Income Inequality; Economic Growth and Income Inequality – Kuznet's Inverted Hypothesis, Impact of Inequality on Development.

Unit-5 **Teaching Hours:12**

Urbanization and Informal Sector

Causes and effects of urbanization; Harris-Todaro Model of Rural-Urban Migration; Migration and Development; Policies for the Urban Informal Sector; Women in the Informal Sector; the Microfinance Revolution.

Unit-6 **Teaching Hours:13**

Planning for development

Economic planning; Shadow prices, project evaluation and cost-benefit analysis; Concept of capital output ratio; Economic planning and price mechanism.

Text Books And Reference Books:

1. Todaro, Michael, P. and Stephen. C. Smith, (2015). *Economic Development*, Pearson Education, (Singapore) Pvt. Ltd., Indian Branch, Delhi.
2. Ray, Debraj (2014), *Development Economics*, Seventh impression, Oxford University Press, New Delhi.
3. Lekhi, R. K. (2016), *The Economics of Development and Planning*, Kalyani Publishers, New Delhi.

Essential Reading / Recommended Reading

1. Abhijit Banerjee, Roland Benabou and Dilip Mookerjee, *Understanding Poverty*, Oxford University Press, 2006.
2. Amartya Sen, *Development as Freedom*, Oxford University Press, 2000.
3. Basu, K. *Analytical Development Economics: The Less Developed Economy Revisited*. (Cambridge: MIT Press, 1997)
4. Daron Acemoglu and James Robinson, *Economic Origins of Dictatorship and Democracy*, Cambridge University Press, 2006.

5. Partha Dasgupta, *Economics: A Very Short Introduction*, Oxford University Press, 2007.
6. Robert Putnam, *Making Democracy Work: Civic Traditions in Modern Italy*, Princeton University Press, 1994.
7. Thirlwall, A.P. *Growth, and Development with Special Reference to Developing Economies* (Basingstoke: Palgrave Macmillan, 2006) 8th Edition.
8. Basu, K. 2012, editor, *The New Oxford Companion to Economics in India*, Oxford University Press

Evaluation Pattern

CIA 1 and 3 consists of 20 marks each. CIA 2 (Mid-semester) carries 50 marks.

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	Lab Exam - II	**10**

	appropriately,.		
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	Assignment	Data	(20	05	100

	Exercises Evaluation (35 Marks)	(20 Marks)	Analysis (20 Marks)	Marks)		

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.

ECO401 - ADVANCED MICRO AND MACROECONOMICS (2019 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 sound understanding of some of the advanced concepts in Microeconomics and Macroeconomics. The course combines mathematical approach along with the geometric approach to economic theory and includes some intermediate concepts, which aim to bridge the gap between the Principles of Microeconomics and Macroeconomics that the students have studied in the first year and the Mathematical Economics.

Learning Outcome

- Sound understanding of the concepts at the intermediate level relating to consumer behavior, production and market structure
- Students will get familiar with the mathematical approach to economic analysis

Understanding of the macroeconomic functioning of the economy

Unit-1 **Teaching Hours:6**

Preferences, utility and choice

Consumer preferences: Assumptions, indifference curves, Perfect substitutes and Perfect complements, Quasi linear preferences, Cobb Douglas preferences, Well behaved preferences, Marginal rate of substitution; Introduction to utility, monotonic transformation; Cardinal Utility; Constructing a utility function, , Marginal Utility and MRS: Optimal choice

Unit-2 **Teaching Hours:6**

Theory of production

Production function with two variable inputs: Isoquants, characteristics, Marginal Rate of Technical Substitution, Special Isoquants, Returns to scale, Cobb Douglas production function, CES production function, Elasticity of technical substitution, Total product and marginal product; Least cost factor combination: isocost lines, expansion path

Unit-3 **Teaching Hours:3**

Price and output under oligopoly

Cournot model,, Stackelberg model, Collusive oligopoly

Unit-4 **Teaching Hours:5**

The ISLM model (Closed economy)

The goods market and the IS curve, Shifts in the IS curve; The money market and the LM curve, Shifts in the LM curve; Equilibrium in the IS-

LM mode

Unit-5 **Teaching Hours:5**

Applications of the IS-LM Model (Closed Economy)

Fluctuations: Fiscal policy and monetary policy, interactions between fiscal policy and monetary policy, Shocks in the IS-LM model, Deriving aggregate demand from the IS-LM model, IS-LM in the short run and in the long run, Liquidity trap

Unit-6 **Teaching Hours:5**

The open economy

International flows of capital and goods, Saving and investment in a small open economy, Fiscal policy and trade balance, Nominal and real exchange rates, Determination of real exchange rate, Effects of policies on real exchange rates

Text Books And Reference Books:

Koutsoyiannis, A., (2008). Modern Microeconomics. London: Macmillan Press.

Varian, Hal R., (2010). Intermediate microeconomics: a modern approach. 8th Edition, New York: W.W. Norton & Company.

Pindyck, Robert & Rubinfeld, Daniel (2017), Micro Economics, 8th Edition, Pearson India

Nicholson, Walter & Snyder, Christopher (2014) Microeconomic Theory : Basic Principles and Extensions, Cengage Learning

N. Gregory Mankiw. (2012). Macroeconomics. 8th Edition, Worth Publishers.

Essential Reading / Recommended Reading

Pindyck, Robert & Rubinfeld, Daniel (2017), Micro Economics, 8th Edition, Pearson India

Nicholson, Walter & Snyder, Christopher (2014) Microeconomic Theory : Basic Principles and Extensions, Cengage Learning

N. Gregory Mankiw. (2012). Macroeconomics. 8th Edition, Worth Publishers.

Evaluation Pattern

Continuous assessment out of 50 marks.

ECO431 - INTERNATIONAL ECONOMICS (2019 Batch)

Total Teaching Hours for Semester:75 **No of Lecture Hours/Week:5**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

The aim of this paper is to provide students with strong foundation in the principles of international economics which will

help them to know the trade policies at the national and international levels and the impact of the globalization on income, employment and social standards in the current international scenario. The paper also covers the pure theory of trade and extensions thereof, customs union, and balance of payments adjustment policies under alternative exchange-rate regimes including the determination of the exchange rate.

Learning Outcome

The students will:

1. gain strong foundation in the principles of international economics

2. be able to know the trade policies at the national and international levels and the impact of the globalization on income, employment and social standards in the current international scenario

3. gain an understanding of the trade policies

Unit-1 **Teaching Hours:6**

Introduction and Essentials

The Subject Matter of International Economics; Trade Based on Absolute Advantage; Trade Based on Comparative Advantage; Comparative Advantage and Opportunity Costs; Empirical Tests of the Ricardian Model.

Unit-2 **Teaching Hours:12**

The Standard Theory of International Trade, Offer Curves and the Terms of Trade

The Basis for and the Gains from Trade with Increasing Costs; Trade Based on Differences in Tastes; The Equilibrium Relative Commodity Price with Trade – Partial Equilibrium Analysis; Offer Curves; General Equilibrium Analysis; the terms of trade.

Unit-3 **Teaching Hours:10**

The Heckscher - Ohlin Theory, Economies of Scale, Imperfect Competition and International Trade

Factor Endowments and Heckscher-Ohlin Theory; Factor-Price Equalization and Income Distribution; Empirical Tests of the Heckscher-Ohlin Model–The Leontief Paradox; Heckscher-Ohlin Model and New Trade Theories; Economies of Scale and International Trade; Imperfect Competition and International Trade.

Unit-4 **Teaching Hours:6**

Economic Growth and International Trade

The Rybczynski Theorem; Technical Progress; Growth and Trade: The Small Country Case; Growth and Trade: The Large Country Case – Immiserizing Growth.

Unit-5 **Teaching Hours:8**

Trade Restrictions: Tariffs and Nontariff Trade Barriers

Partial Equilibrium Analysis of a Tariff; General Equilibrium Analysis of a Tariff in a Small Country – The Stolper - Samuelson Theorem; Import Quotas; Other Non-tariff Barriers.

Unit-6 **Teaching Hours:10**

Economic Integration: Customs Unions and Free Trade Areas

Trade-Creating Customs Unions; Trade-Diverting Customs Unions; The Theory of the Second Best and Other Static Welfare Effects of Customs Unions; History of Attempts at Economic Integration – The European Union; Multilateralism –WTO.

Unit-7 **Teaching Hours:15**

The Balance of Payments, Foreign Markets and Exchange Rate Determination

Balance of Payments–Principles; Functions of the Foreign Exchange Markets; Foreign Exchange Rates; Purchasing Power Parity Theory; Stable and Unstable Foreign Exchange Markets.

Unit-8 **Teaching Hours:8**

The International Monetary System and Macroeconomic Policy Coordination

The Evolution of the Breton Woods System; The IMF; Policy Coordination with Floating Exchange Rates; Optimum Currency Area Theory; The Single Currency and Economic Integration; The European Monitory Union.

Text Books And Reference Books:

Dominick Salvatore (2011), *International Economics: Trade and Finance*, John Wiley International Student Edition, 10th Edition.

Essential Reading / Recommended Reading

Dominick Salvatore (2011), *International Economics: Trade and Finance*, John Wiley International Student Edition, 10th Edition.

Evaluation Pattern

CIA I : 20 marks

CIA II (Mid semester Exam) : 50 Marks

CIA III : 20 Marks

End Semester Examination : 100 Marks

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

Teaching Hours:9

Unit-2

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	Lab Exam -	**10**

	the commands appropriately,.	II	
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

ECO501 - RESEARCH METHODOLOGY FOR ECONOMICS (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 enable students to understand the importance of research in creating and extending the knowledge base in their area of research interest; To develop the ability to distinguish between the strengths and limitations of different research approaches in general and in their research area specifically; To impart skills to work independently, to plan and carryout a small-scale research project.

Learning Outcome

To enable students to understand the importance of research in creating and extending the knowledge base in their area of research interest.

To develop the ability to distinguish between the strengths and limitations of different research approaches in general and in their research area specifically.

To impart skills to work independently, to plan and carryout a small-scale research project.

Unit-1 **Teaching Hours:4**

Nature of social and business research

Meaning and definition of research–criteria for good research-Deductive and inductive methods– classification of research–case study–survey methods

Unit-2 **Teaching Hours:5**

Selection of research problem

Steps involved in selection of research problem– evaluation of the problem– literature review– sources of literatures

Unit-3 **Teaching Hours:8**

Research Design

Meaning of research design– types of research design-evaluation of research design

Unit-4 **Teaching Hours:4**

Sampling and sample design

Meaning of sampling– sampling process– essential and methods of sampling – sampling errors

Unit-5 **Teaching Hours:4**

Methods of data collection

Primary and secondary data– observation – interview-questionnaire– schedule-sources of secondary data

Unit-6 **Teaching Hours:2**

Hypothesis testing

Meaning of hypothesis-types and steps in testing of hypothesis– type I and type II error

Unit-7 **Teaching Hours:3**

Report writing

Types of report – planning of report writing– format of research report– reference styles

Text Books And Reference Books:

1. W. Lawrence Neuman, *Social Research Methods*, Library of Congress, Cataloging-in-Publication Data

2. C.R. Kothari, *Research Methodology*, New Age Publications.

3. Bell,J.(1993)*Doing your research project: A guide for first-time researchers in Education and Social Science*, Buckingham, UK: The Open University.

4. Goode and Hatt, *Methods in Social Research*, McGraw Hill Publications

5. Borg, W.R., & Gall,M.D.(1983).Educational Research: An Introduction (Fourth ed.). New York: Longman Inc.

Essential Reading / Recommended Reading

1. Brinberg, D. and McGrath, J.E. (1985) Validity and the research process, Newbury Park, CA: Sage Publications, Inc.

2. Erickson, F. (1986). Qualitative methods on research on teaching. in M.C. Wittrock (ed.),Handbook of research on teaching (3rded.,pp.119-161).New York: MacMillan.

3. Fitz-Gibbon, C.T. and L. L. Morris (1987) How to Analyse Data, Newbury Park: Sage Publications, Inc.

4. Foddy, W (1993) Constructing Questions for Interviews and Questionnaires: Theory and Practice in Social Research, Cambridge: Cambridge University Press.

5. Isaac, S, and Michael, W. B. (1981). Hand book in research and evaluation: A collectionofprinciples,methods,andstrategiesusefulintheplanning,design, and evaluation of studies in education and the behavioral sciences (2nd ed.).San Diego

6. Yin, R.K. (1994).Case Study Research (Second Edition, Vol5).Thousand Oaks, CA: Sage Publications, Inc.

Evaluation Pattern

Out of 50 marks as decided by the Department.

ECO541A - PUBLIC FINANCE (2018 Batch)

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

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

Course Objectives/Course Description

The paper deals with the nature of government intervention and its implications for allocation, distribution and stabilization. Inherently, this study involves a formal analysis of government taxation and expenditures.This paper combines a thorough understanding of fiscal institutions with a careful analysis of the issues which underline budgetary policies in general and Indian experience in particular.

Learning Outcome

- To analyse the role of government in the economy in the context of business activity, income distribution, economic growth, globalisation and market failure
- Insight into the various functions of the govt and problems in the allocation of the resources
- Theoretical and practical knowledge about the fiscal policy instruments and its relevance in the economic stabilisation
- An understanding of the Centre state relations and problems confronted in the federal finance

Unit-1 **Teaching Hours:10**

Role of Government in Organised Society

The nature, scope and significance of public economics –Public vs Private Finance- Principle of Maximum Social advantage: Approaches and Limitations- Functions of Government - Economic functions -allocation, distribution and stabilization; Regulatory functions of the Government and its economic significance

Unit-2 **Teaching Hours:14**

Public Goods and Public Sector

Concept of public goods-characteristics of public goods, national vs. local public goods; determination of provision of public good; Externality- concept of social versus private costs and benefits, merit goods, club goods; Provision versus production of public goods - Market failure and public Provision

Unit-3 **Teaching Hours:6**

Public Expenditure

Structure and growth of public expenditure; Wagner's Law of increasing state activities; Wiseman-Peacock hypothesis; Pure theory of public expenditure- Trends of Public expenditure-Subsidies in India

Unit-4 **Teaching Hours:9**

Principles of Taxation

Concept of tax, types, canons of taxation-Incidence of taxes; Taxable capacity; Approaches to the principle of Equity in taxation -Ability to Pay principle, Benefit Approach; Sources of Public Revenue; VAT, Goods and Services Tax

Unit-5 **Teaching Hours:5**

Public Debt

Different approaches to public debt; concepts of public debt; sources and effects of public debt; Methods of debt redemption-Growth of India's public debt

Unit-6 **Teaching Hours:9**

Government Budget and Policy

Government budget and its structure – Receipts and expenditure - concepts of current and capital account, balanced, surplus, and deficit budgets, concept of budget deficit vs. fiscal deficit, functional classification of budget- Budget, government policy and its impact- Budget multipliers

Unit-7 **Teaching Hours:7**

Federal Finance

Federal Finance: Different layers of the government; Inter governmental Transfer; horizontal vs. vertical equity; Principle of federal finance; Finance Commission.

Text Books And Reference Books:

1. Musgrave and Musgrave: Public Finance in Theory and Practice (Fifth Edition).

2. Dr.Tyagi B.P., Public Finance, Jai Prakash Nath Pub.Meerat (UP)

3. R.K.Lekhi, Public Finance, Kalyani Publishers.

Essential Reading / Recommended Reading

1. H.L. Bhatia. Public Finance. (Fifteenth Revised Edition).
2. Amaresh Bagchi (ed.). Readings in Public Finance. Oxford University Press
3. Buchanan J.M., The public Finances, Richard D.Irwin, Homewood.
4. Jha.R (1998), Modern Public Economics, Routledge, London.
5. Srivastave.D.K., Fiscal Federalism in India, Har Ananad Publication Ltd., New Delhi
6. Atkinson A.B and J.E.Stigliz "Lectures on Public Economics", Tata McGraw Hill, New Delhi.

Evaluation Pattern

CIA I : 20 Marks

CIA II : 50 Marks (Mid semester Examination)

CIA III : 20 Marks

ESE : 100 Marks

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

MAT541B - MATHEMATICAL MODELLING

(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 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**

MAT551D - CALCULUS OF SEVERAL VARIABLES 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 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 **No of Lecture**

Semester:45 **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

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**

ECO631 - INTRODUCTION TO ECONOMETRICS (2018 Batch)

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

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

Course Objectives/Course Description

The course is designed to impart the learning of principles of econometric methods and tools. This is expected to improve student's ability to understand of econometrics in the study of economics and finance. The learning objective of the course is to provide students to get the basic knowledge and skills of econometric analysis, so that they should be able to apply it to the investigation of economic relationships and processes, and also understand the econometric methods, approaches, ideas, results and conclusions met in the majority of economic books and articles. Introduce the students to the traditional econometric methods developed mostly for the work with cross-sections data.

Learning Outcome

The students with the skills of construction and development of simple and multiple regression models get acquainted with some advanced linear models and special methods of econometric analysis and estimation, understanding the area of their application in economics. They know how to apply regression analysis to real-world economic examples and data sets for hypothesis testing and prediction and be able to recognise and make adjustments for a number of common regression problems.

Unit-1 **Teaching Hours:8**

INTRODUCTION

Definitions and scope of econometrics; the methodology of econometric research; Specification and estimation of an econometric model; Basic concepts of estimation; Desirable properties of estimators; Unbiasedness, efficiency, consisistency and sufficiency.

Unit-2 **Teaching Hours:10**

SIMPLE REGRESSION ANALYSIS AND THEORETICAL DISTRIBUTION

Statistical vs determininistic relationships; correlation and regression; Coeffient of determination; Estimation of an equation.

Unit-3 **Teaching Hours:12**

ESTIMATION THEORY

OLS method: Assumptions, Gauss-markov Therom; Testing of regression coeffient; Test for regression as a whole: coeffient of determination, F test.

Unit-4 **Teaching Hours:15**

PROBLEMS IN OLS ESTIMATION

Problem of heteroscedasticity; Auto correlation (first order); multicollinearity; their consequences, tests and remedies.

Unit-5 **Teaching Hours:8**

LAG MODELS AND SUMMARY VARIABLES

Lags in econometric models: concepts, Koyck model; partial adjustment and adaptive expectation models; summary variables; qualitative data; seasonal analysis; use of dummy variables for pooled data.

Unit-6 **Teaching Hours:7**

APPLICATION OF ECONOMETRIC METHODS

Estimation of demand and supply functions, production cost functions and consumption function.

Text Books And Reference Books:

1. Damodar Gujarati and Dawn C Porter (2010). *Basic Econometrics,* 5th Edition, Tata McGraw-Hill Education Publishers Ltd.

Essential Reading / Recommended Reading

1. A. Koutsoyiannis (1992). *Theory of Econometrics,* 2nd Edition, Macmillan Publications Ltd.

Evaluation Pattern

Assesment pattern is varied depending on the requirements and the nature of the individual papers

ECO641A - ENVIRONMENTAL ECONOMICS

(2018 Batch)

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

Max Marks:100 **Credits:4**

Course Objectives/Course Description

To enhance the skills of the students in the application of the economic principles in solving environmental problems; to make the students understand the importance of proper policy formulations in the environmental front.

Learning Outcome

- To introduce the basic concepts and theories in environment and resource economics.
- To expose Students tp the basic economic evaluation practices.
- To make the students understand the value of Environmnet and help them understand the problems faced by environmental damage.

Unit-1 **Teaching Hours:12**

Introduction to environmental economics

Definition; Nature and scope; Ecology and resource economics; Nexus between economics and environment; Environment and economic development; Sustainable development; Private versus social costs; Externalities.

Unit-2 **Teaching Hours:12**

Management and Policy Regarding Environmental resources

Energy- renewable & non-renewable energy sources- access to Common Property Resources (CPR). Pollution; (1) Domestic-solid waste, health, sanitation and safe drinking water; (2) Industry- air pollution, water pollution, soil pollution, noise pollution; (3) Agricultural – soil erosion, deforestation and (4) auto mobile pollution. Land degradation. Pollution taxes – subsidies, carbon credits; pollution control boards – national and international environmental policies; Legislative measures of environmental protection in India; Climate change conventions

Unit-3 **Teaching Hours:10**

Environment and Development

Non marketed goods; Trade - off between environmental protection and economic growth. Environmental‟s Kuznet curve , Ecosystem services and human wellbeing.

Unit-4 **Teaching Hours:12**

Environment and soceity

Pollution and environment. Impact of population growth(trends, sex ratio, rural and urban) on environment. Poverty and environment. Urbanization and environment. People"s participa tion

and environmental moveme

Unit-5 **Teaching Hours:14**

Environmental Valuation

Concepts of environmental value; Total economic value; Market and non-market valuation; Revealed preference methods – travel cost, hedonic pricing; Stated preference methods – Contingent valuation, choice experiment.

Text Books And Reference Books:

1. Charles Kolstad, *Environmental Economics*.
2. Karpagam I.M. *Environmental Economics*, Sterling Publishers
3. Rabindra, N. Bhattacharya, *Environmental Economics*(Ed), 2001, Oxford University Press, New Delhi,
4. Baumol, W.J. and W.E. Oates, *The Theory Of Environmental Policy*, 1998, II Edition, Cambridge University Press, Ca.

Essential Reading / Recommended Reading

1. Charles Kolstad, *Environmental Economics*.
2. Karpagam I.M. *Environmental Economics*, Sterling Publishers

Evaluation Pattern

CIA1- Assignment/ test- 20 Marks.

CIA2- Mid-Sem - 50 Marks.

CIA3-Assignment/test- 20 Marks.

ECO641B - FINANCIAL ECONOMICS (2018 Batch)

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

Max Marks:100 **Credits:3**

Course Objectives/Course Description

The objectives of the course are:

1. To provide students with a conceptual and practical knowledge of financial markets, institutions and instruments in an Indian context

2. To provide understanding of the operational issues of capital and money markets

3. To provide knowledge of the regulatory framework of capital and money markets.

Learning Outcome

The students will be:

1. Ffamiliar with the financial system and its operations both in domestic and international perspective

2. Equipped with an understanding of the nature and types of various financial intruments

3. Introduced to the tradinig of finacial intruments in biotht the money and capital markets

Unit-1 **Teaching Hours:12**

Introduction to Financial Economics

Role of financial intermediation – financial markets – money vs. capital markets – primary vs. secondary markets – instruments in the money market – instruments in the capital markets – financial institutions.

Unit-2 **Teaching Hours:7**

Financial Regulations

Money market regulations and credit policy of RBI – capital market regulations of SEBI – legal norms in security trading

Unit-3 **Teaching Hours:12**

Equity Market

Private vs. Public placement- IPO and Book building process – stock quotations – stock indexes – stock market performance.

Unit-4 **Teaching Hours:12**

Stock Evaluation

Stock evaluation methods – fundamental vs. technical analysis – Efficient Market Hypothesis – Capital Asset Pricing Model – factors affecting stock prices – economic factors – market related factors – firm specific factors – indicators of future stock prices.

Unit-5 **Teaching Hours:7**

Stock Risks

Measures of risk – Beta of the stock – Risk and return framework and investment decisions – methods of determining maximum expected loss

Unit-6 **Teaching Hours:7**

Derivative Security Market

Financial future market – valuation of financial futures – option market – speculation with option market – hedging – arbitrage

and foreign exchange futures market.

Unit-7 **Teaching Hours:3**

Financial Sector Reforms

Concept of capital account convertibility – lessons from other countries – Indian preparedness to full convertibility.

Text Books And Reference Books:

1. Madura, Jeff. (2010). Financial Institutions and Markets. (1st Ed.) New Delhi: Cengage Learning India Private Limited.

Essential Reading / Recommended Reading

1. Boddie, K.M., and Ryan, 2003, Investments, McGraw-Hill.
2. Copeland,T.E. and J.F.Weston, 1988, *Financial Theory and Corporate Policy*, Addison Wesley.
3. Hull, J.M, 2003, *Futures, Options and other Derivatives*, Prentice Hall.
4. Ross,S.A., Randolph W Westerfield, Bradford D Jordan, and Gordon S Roberts,2005, *Fundamentals of Corporate Finance*, McGraw-Hill.
5. Robert C Radcliffe, *Investment Concepts, Analysis and Strategies.*
6. Machiraju H R, *Indian Financial System,* Vikas Publishing House.
7. L.M. Bhole, Financial Institutions and Markets.
8. Donald E Fisher, Roland J Jordan, *Security Analysis and Portfolio management*, Eastern Economy Edition.

Evaluation Pattern

CIA I-20 Marks

CIA II [MID SEMESTER] -50 Marks

CIA III-20 MARKS

ECO681 - DISSERTATION (2018 Batch)

Total Teaching Hours for Semester:0 **No of Lecture Hours/Week:0**

Max Marks:100 **Credits:4**

Course Objectives/Course Description

This paper is an additional elective offered to the undergraduate students of BA and BSc Programmes. The students can take up this paper based on the criteria set by the Department in terms of the selection process. Through this paper students undertake an original research work based on the area of his/her interest and academic leaning in the previous semesters. This also becomes a thorough training in the nuances of analytical and research skills. The students begin this paper at the beginning of the fifth semester and complete by the end of the sixth semester.

Learning Outcome

Inculcating in students the rigour of research work

Imbibing in students the spirit of inquiry

Encouraging students to do academic reading of journal articles

Informing about new developments in the field of economics research

Unit-1 **Teaching Hours:0**

Methodology

The dissertation work is carried out under the guidance of a faculty with scheduled meetings for discussion of the progress of the work and timely interim presentations before a panel of faculty to assess the quality of the work. The final submission of the dissertation is followed by a viva voce on the topic of the research. The paper carries 4 credits and is evaluated out of 100 marks.

Text Books And Reference Books:

Research methodology related references

Essential Reading / Recommended Reading

Research methodology related references

Evaluation Pattern

The dissertation work is carried out under the guidance of a faculty with scheduled meetings for discussion of the progress of the work and timely interim presentations before a panel of faculty to assess the quality of the work. The final submission of the dissertation is followed by a viva voce on the topic of the research. The paper carries 4 credits and is evaluated out of 100 marks. The evaluation is based on the following components:

1. Regularity of meeting with guide for discussions 20% weightage
2. The evaluation of thesis carries 40% weightage
3. Thesis defense carries 40% weightage

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 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 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

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Evaluation Pattern

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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

STA652A - APPLIED STATISTICS PRACTICAL

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.

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

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