GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(GITAM)

(Deemed to be University, Estd. u/s 3 of UGC Act 1956)

∗VISAKHAPATNAM ∗HYDERABAD ∗BENGALURU∗

Accredited by NAAC with 'A+' Grade

REGULATIONS AND SYLLABUS

of

Bachelor of Science
in
MATHEMATICAL SCIENCES

(Mathematics, Statistics, Computer Science)

(2019-20 admitted batch)

GITAM Committed to Excellence

B.Sc. MATHEMATICAL SCIENCES REGULATIONS

(2019-20 admitted batch)

1.0 ADMISSIONS

Admissions into B.Sc.Mathematical Sciences program of GITAM are governed by GITAM admission regulations.

2.0 ELIGIBILITY CRITERIA

2.1 A pass in Intermediate with Mathematics as one of the course and with a minimum aggregate of 50% marks or any other equivalent Examination approved by GITAM.

2.2 Admissions into B.Sc.Mathematical Sciences will be based on the marks obtained in intermediate or equivalent examination and the rule of reservation, wherever applicable.

3.0 CHOICE BASED CREDIT SYSTEM

Choice based credit system (CBCS) is introduced with effect from the admitted batch of 2015-16 based on UGC guidelines in order to promote:

- Student centered learning
- Cafeteria approach
- Inter-disciplinary learning.

Learning goals/objectives and outcomes are specified leading to what a student should be able to do at the end of the program.

4.0 STRUCTURE OF THE PROGRAMME

4.1 The program consists of:

(i) Ability enhancement compulsory core courses (AECC)
(ii) Core Courses (compulsory) (CC)
(iii) Discipline specific electives (DSE)
(iv) Generic electives (GE)
(v) Skill enhancement courses (SEC) are of general nature either relatled or unrelated to the discipline.
(vi) Practical Proficiency Courses(PPC): Laboratory work

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each lecture / tutorial hour.
- Two credits for three hours of practicals.

4.4 The curriculum of six semesters B.Sc. Mathematical Sciences program is designed to have a total of 122 credits for the award of B.Sc.Mathematical Sciences degree.

5.0 MEDIUM OF INSTRUCTION:

The medium of instruction (including examinations and project reports) shall be English.

6.0 REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute / University.

7.0 ATTENDANCE REQUIREMENTS

7.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He /She have to repeat the semester along with his / her juniors.

7.2 However, the Vice Chancellor on the recommendation of the Principal/ Director of the University College / Institute may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine medical grounds and on payment of prescribed fee.

8.0 EVALUATION

8.1 The assessment of the student's performance in a Theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60 marks).

8.2 A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks (i.e. 40%) in the theory component at the semester-end examination.

8.2.1 Practical/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table 1.

Table 1: Assessment Procedure

S. No.	Component of assessment	Marks allotted	Type of Assessment	Scheme of Examination
1	Theory	40	Continuous evaluation	(i) Two mid semester examinations shall be conducted for 15 marks each. (ii) 5 marks are allocated for quiz. (iii) 5marks are allocated for assignments.
		60	Semester-end examination	The semester-end examination shall be for a maximum of 60 marks.
	Total	100		
2	Practicals	40	Continuous evaluation	Forty (40) marks for continuous evaluation is distributed among the components: regularity, preparation for the practical, performance, submission of records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the Semester.
		60	Continuous evaluation	Sixty (60) marks for two tests of 30 marks each (one at the mid-term and the other towards the end of the Semester) conducted by the concerned lab Teacher and another faculty member of the department who is not connected to the lab, as appointed by the HoD.
	Total	100		

9. RETOTALING & REVALUATION

9.1 Retotaling of the theory answer script of the semester-end examination is permitted on request by the student by paying the prescribed fee within one week after the announcement of the results.

9.2 Revaluation of the theory answer scripts of the semester-end examination is permitted on request by the student by paying the prescribed fee within one week after the announcement of the result.

10. PROVISION FOR ANSWER BOOK VERIFICATION & CHALLENGE EVALUATION:

10.1 If a student is not satisfied with his/her grade after revaluation, the student can apply for, answer book verification on payment of prescribed fee for each course within one week after announcement of revaluation results.

10.2 After verification, if a student is not satisfied with revaluation marks/grade awarded, he/she can apply for challenge valuation within one week after announcement of answer book verification result/ two weeks after the announcement of revaluation results, which will be valued by the two examiners i.e., one Internal and one External examiner in the presence of the student on payment of prescribed fee. The challenge valuation fee will be returned, if the student is succeeded in the appeal with a change for a better grade.

11. SUPPLEMENTARY EXAMINATIONS & SPECIAL EXAMINATIONS:

11.1 The odd semester supplementary examinations will be conducted on daily basis after conducting regular even semester examinations in April/May.

11.2 The even semester supplementary examinations will be conducted on daily basis after conducting regular odd semester examinations during November/December

11.3 A student who has completed his/her period of study and still has "F" grade in final semester courses is eligible to appear for Special Examination normally held during summer vacation.

12. PROMOTION TO THE NEXT YEAR OF STUDY

12.1 A student shall be promoted to the next academic year only if he/she completes the academic requirements of 60% of the credits till the previous academic year.

12.2 Whenever there is a change in syllabus or curriculum he/she has to continue the course with new regulations after detention as per the equivalency established by the BoS to continue his/her further studies.

13. BETTERMENT OF GRADES

13.1 A student who has secured only a pass or second class and desires to improve his/her class can appear for betterment examinations only in 'n' (where 'n' is no.of semesters of the program) theory courses of any semester of his/her choice, conducted in summer vacation along with the Special Examinations.

13.2 Betterment of Grades is permitted 'only once', immediately after completion of the program of study.

14. REPEAT CONTINUOUS EVALUATION:

14.1 A student who has secured 'F' grade in a theory course shall have to reappear at the subsequent examination held in that course. A student who has secured 'F' grade can improve continuous evaluation marks upto a maximum of 50% by attending special instruction classes held during summer.

14.2 A student who has secured 'F' grade in a practical course shall have to attend Special Instruction classes held during summer.

14.3 A student who has secured 'F' grade in a combined (theory and practical) course shall have to reappear for theory component at the subsequent examination held in that course. A student who has secured 'F' grade can improve continuous evaluation marks upto a maximum of 50% by attending special instruction classes held during summer.

14.4 The RCE will be conducted during summer vacation for both odd and even semester students. Student can register a maximum of 4 courses. Biometric attendance of these RCE classes has to be maintained. The maximum marks in RCE be limited to 50% of Continuous Evaluation marks. The RCE marks are considered for the examination held after RCE except for final semester students.

14.5 RCE for the students who completed course work can be conducted during the academic semester. The student can register a maximum of 4 courses at a time in slot of 4 weeks. Additional 4 courses can be registered in the next slot.

14.6 A student is allowed to Special Instruction Classes (RCE) 'only once' per course.

15. GRADING SYSTEM

15.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as givenin Table 2.

Table 2: Grades & Grade Points

Sl.No.	Grade	Grade Points	Absolute Marks
1	O (outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab. (Absent)	0	-

15.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, subject to securing an average GPA (average of all GPAs in all the semesters) of 5 at the end of the Program to declare pass in the program.

Candidates who could not secure an average GPA of 5 at the end of the program

shall be permitted to reappear for a course(s) of their choice to secure the same.

16. GRADE POINT AVERAGE

16.1 A Grade Point Average (GPA) for the semester will be calculated according to the formula:

$$GPA = \frac{\Sigma [C * G]}{\Sigma C}$$

Where

C = number of credits for the course,

G = grade points obtained by the student in the course.

16.2 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student's performance in all the courses taken, in all the semesters up to the particular point of time.

16.3 CGPA required for classification of class after the successful completion of the program is shown in Table 3.

Table 3: CGPA required for award of Class

Class	CGPA Required
First Class with Distinction	≥ 8.0*
First Class	≥ 6.5
Second Class	≥ 5.5
Pass Class	≥ 5.0

* In addition to the required CGPA of 8.0 or more the student must have necessarily passed all the courses of every semester in first attempt.

17. ELIGIBILITY FOR AWARD OF THE B.Sc. DEGREE

17.1 Duration of the program: A student is ordinarily expected to complete B.Sc program in six semesters of three years. However a student may complete the program in not more than five years including study period.

17.1 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

17.2 A student shall be eligible for award of the B.Sc Degree if he / she fulfills all the following conditions.

a) Registered and successfully completed all the courses and projects.
b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.
c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and
d) No disciplinary action is pending against him / her.

17.3 The degree shall be awarded after approval by the Academic Council.

18. DISCRETIONARY POWER:

Not with standing anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

Program Objectives (PO) for B.Sc.(Mathematics,Statistics,Computer Science)

PO 1	Apply basic knowledge of mathematics ,statistics, computer Science to understand the real world problems.
PO 2	Develop complexity problem solving techniques using mathematical,statistical and computer tools.
PO 3	Establish the methodologies for mathematics and statistics problems.
PO 4	Implement computer solution methods for large systems.
PO 5	Assess the influence of global changes on organization for effective decision making business problems.
PO 6	Acquire knowledge of fast changing methodologies for solving engineering and science problems.
PO 7	Exhibit leadership capabilities
PO 8	Perform inter-disciplinary research objectives
PO 9	Communicate effectively in peer and research related conferences
PO 10	Acquire skills to become a good researcher
PO 11	Engage in life-long learning environment.
PO 12	Imbibe professional and ethical responsibility towards the society.

Programme Specific Outcomes (PSO) for B.Sc.(Mathematics,Statistics,Computer Science)

Upon successful completion of B.Sc.(Mathematics, Statistics,Computer Science) Programme, student will be able to

PSO1: Create Mathematical Models (along with solution) for various physical needs.

PSO2 : Use Mathematics, not only in the discipline of Mathematics, but also in other disciplines and in their future endeavours

PSO3: Develop the statistical and computer programming skill for solving various physical problems.

B.Sc. Mathematical Sciences

(Mathematics, Statistics, Computer Science)

(2019-20 admitted batch)

Scheme of Instruction

I Semester

Course Code	Course Title	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	P		CE	SE	Total Marks
SFC 101	English for communication - I	AECC	3	0	2	40	60	100
SPH 101	Differential Calculus	CC	4	0	4	40	60	100
SPH 121	Differential Calculus Tutorial/Lab	PPC	2	0	2	100	--	100
SAM 101	Descriptive Statistics and Probability Theory	CC	4	0	4	40	60	100
SAM 121	Descriptive Statistics and Probability Theory Lab	PPC	0	3	2	100	--	100
SPH 109	Object Oriented Programming in C++	CC	4	0	4	40	60	100
SPH 129	Object Oriented Programming in C++ Lab	PPC	0	3	2	100	--	100

II Semester

Course Code	Course Title	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	P		CE	SE	Total Marks
SFC 102	Environmental Science	AECC	3	0	2	40	60	100
SPH 102	Differential Equations	CC	4	0	4	40	60	100
SPH 120	Differential Equations Tutorial/Lab	PPC	2	0	2	100	--	100
SAM 102	Mathematical Expectation and Probability Distributions	CC	4	0	4	40	60	100
SAM 122	Probability Distributions Lab	PPC	0	3	2	100	--	100
SPH 110	Data Structures and File Processing	CC	4	0	4	40	60	100
SPH 128	Data Structures and File Processing Lab	PPC	0	3	2	100	--	100

III SEMESTER

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	P		CE	SE	Total Marks
SFC 203	English for communication - II	AECC	3	0	2	40	60	100
SPH 201	Real Analysis	CC	4	0	4	40	60	100
SPH 221	Real Analysis Tutorial /Lab	PPC	2	0	2	100	--	100
SAM 201	Statistical Methods	CC	4	0	4	40	60	100
SAM 221	Statistical Methods Lab	PPC	0	3	2	100	--	100
SPH 209	Design and Analysis of Algorithms	CC	4	0	4	40	60	100
SPH 229	Design and Analysis of Algorithms Lab	PPC	0	3	2	100	--	100
Choose any one								
SSE 275	Logic and sets	SEC	2	0	2	100	--	100
SSE 277	Computer Graphics	SEC	2	0	2	100	--	100

IV SEMESTER

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	P		CE	SE	Total Marks
SPH 202	Algebra	CC	4	0	4	40	60	100
SPH 220	Algebra Tutorial/Lab	PPC	2	0	2	100	--	100
SAM 202	Statistical Inference	CC	4	0	4	40	60	100
SAM 222	Statistical Inference Lab	PPC	2	0	2	100	--	100
SPH 210	Operating Systems	CC	4	0	4	40	60	100
SPH 228	Operating Systems Lab	PPC	0	3	2	100	--	100
Choose any one								
SSE 276	Vector calculus	SEC	2	0	2	100	--	100
SSE 278	Number theory	SEC	2	0	2	100	--	100
SSE 280	E-Commerce	SEC	2	0	2	100	--	100

V SEMESTER

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	**P**		**CE**	**SE**	**Total Marks**
Choose any one								
SPH 361*	Matrices	DSE	4	0	4	40	60	100
SPH 363**	Statics and Dynamics	DSE	4	0	4	40	60	100
SPH 365***	Linear Algebra	DSE	4	0	4	40	60	100
Choose any one (*corresponding to theory course)								
SPH 333*	Matrices Tutorial/Lab	PPC	0	3	2	100	--	100
SPH 335**	Statics and Dynamics Tutorial/Lab	PPC	0	3	2	100	--	100
SPH 337***	Linear Algebra Tutorial/Lab	PPC	0	3	2	100	--	100
Choose any one								
SAM 351@	Sampling Techniques and Design of Experiments	DSE	4	0	4	40	60	100
SAM 353@@	Statistical Quality Control and Reliability	DSE	4	0	4	40	60	100
SAM 355@@@	Stochastic Process	DSE	4	0	4	40	60	100
Choose any one (@ corresponding to theory course)								
SAM 321@	Sampling Techniques and Design of Experiments Lab	PPC	2	0	2	100	--	100
SAM 323@@	Statistical Quality Control and Reliability Lab	PPC	2	0	2	100	--	100
SMS 325@@@	Stochastic Process Lab	PPC	2	0	2	100	--	100
Choose any one								
SPH391&	Data Mining	DSE	4	0	4	40	60	100
SPH393&&	Cryptography	DSE	4	0	4	40	60	100
Choose any one (&corresponding to theory course)								
SPH343&	Data Mining Lab	PPC	0	3	2	100	--	100
SPH345&&	Cryptography Lab	PPC	0	3	2	100	--	100
Choose any one								
SSE 375	Theory of Equations	SEC	2	0	2	100	--	100
SSE 377	Probability and Statistics	SEC	2	0	2	100	--	100
SSE 379	Combinatorial Optimization	SEC	2	0	2	100	--	100

VI SEMESTER

Course Code	Subject	Category	Instruction Hours/week		Credits	Scheme of Instruction		
			L	**P**		**CE**	**SE**	**Total Marks**
Choose any one								
SPH 362*	Numerical methods	DSE	4	0	4	40	60	100
SPH 364**	Complex analysis	DSE	4	0	4	40	60	100
SPH 366***	Linear programming	DSE	4	0	4	40	60	100
Choose any one (*corresponding to theory course)								
SPH 334*	Numerical methods Tutorial	PPC	0	3	2	100	--	100
SPH 336**	Complex analysis Tutorial	PPC	0	3	2	100	--	100
SPH 338***	Linear programming Tutorial	PPC	0	3	2	100	--	100
Choose any one								
SAM 352@	Optimization Techniques	DSE	4	0	4	40	60	100
SAM 354@@	Econometrics	DSE	4	0	4	40	60	100
SAM 356@@@	Applied Statistics	DSE	4	0	4	40	60	100
Choose any one (@ corresponding to theory course)								
SAM 322@	Optimization Techniques Lab	PPC	2	0	2	100	--	100
SAM 324@@	Econometrics Lab	PPC	2	0	2	100	--	100
SAM 326@@@	Applied Statistics Lab	PPC	2	0	2	100	--	100
Choose any one								
SPH392&	Information security	DSE	4	0	4	40	60	100
SPH394&&	Database applications	DSE	4	0	4	40	60	100
SPH396&&	Computer networks							
Choose any one (& corresponding to theory course)								
SPH344&	Information security Lab	PPC	0	3	2	100	--	100
SPH346&&	Database applications Lab	PPC	0	3	2	100	--	100
SPH348&&	Computer networks Lab	PPC	0	3	2	100	--	100
Choose any one								
SSE 376	Transportation and game theory	SEC	2	0	2	100	--	100
SSE 378	Graph theory	SEC	2	0	2	100	--	100
SSE 380	Concepts of Ethical Hacking	SEC	2	0	2	100	--	100

SEMESTER -I

SFC 101: ENGLISH FOR COMMUNICATION– I

No. of hours per week: 03 **Credits: 02**

UNIT- I **The eyes are not here – Ruskin Bond**
Pronunciation: Consonants,**Grammar:** Nouns, **Vocabulary:**Roots forms of words**, Spelling:** Correcting wrong spelling,
Punctuation: Capitalisation,
Conversation and Role Play: Introducing oneself in formal or social contexts,

UNIT- II **Work Brings Solace – APJ Abdul Kalam**

Pronunciation: Monophthongs **Grammar:** Pronouns,
Vocabulary: Prefixes & Suffixes, **Spelling:** using 'un' and 'dis' to complete antonyms**, Punctuation:** Capitalisation,
Conversation and Role Play: starting a conversation/controlling a conversation**,**

UNIT –III **Bangle Sellers – Sarojini Naidu**

Pronunciation: Diphthongs **Grammar:** Helping verbs & auxiliary verbs, **Vocabulary:** Homophones, Homographs, Homonyms **Punctuation:** comma & full stop,
Conversation: Describing one's college and course of study, **Writing:** Paragraph writing/ Descriptive Writing,

UNIT -IV **The Merchant of Venice (Extract) – William Shakespeare**
Pronunciation: varied pronunciation of some letters of the alphabet**Grammar:** Main verbs & Tenses, **Vocabulary:** Collocations, **Punctuation:** Question mark and Exclamation mark,
Conversation: Leaving a message and taking an appointment

UNIT- V **Vocabulary building:** Synonyms, Antonyms, One Word Substitutes, Phrasal Verbs, Idiomatic Expressions, Foreign Phrases

Text Books:
Part – 1 (English for Enhanced Competence (by Sumit Roy, A.Karunakar, A.Aruna Priya)

Supplementary Reading:

1. Communicative skills for Technical Students, M. Faratullah. Orient Longman

2. Rizvi,MAshraf. ***Effective Technical Communication.*** McGraw - Hill.

(Mathematics, Statistics, Computer Science)

SEMESTER –I

SPH101 :Differential Calculus

No. of hrs/week: 4 **Credits: 4**

Preamble: Differential Calculus provides information about limits, continuity, differentiation and partial differentiation. The focus of the course is to study the limits and continuity, applications of partial differentiation, tracing of curves in Cartesian coordinates and Polar coordinates and mean value theorem on differentiation.

Objectives:

- To introduce Basic properties of continuity and differentiation
- Partial differentiation and application of Euler's theorem
- Tracing of curves and to find tangents and normal
- Rolle's theorem and mean value theorem
- Expansion of the function using taylor's series and Maclaurin's series

UNIT-I

Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem.

Learning Outcomes: The student will be able to:

- Define the basic properties of limits and continuity
- Explain different types of discontinuities
- Define differentiability of functions and successive differentiation

UNIT-II

Partial differentiation, Euler's theorem on homogeneous functions.

Learning Outcomes: The student will be able to:

- Define partial differentiation
- Evaluate problems on partial differentiation
- Apply Euler's theorem on homogeneous functions with the help of partial differentiation

UNIT-III

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.

Learning Outcomes: The student will be able to:

- Define tangents and normals
- Explain curvature and asymptotes
- Trace the parametric curves
- Define polar coordinates

UNIT-IV

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder

Learning Outcomes: The student will be able to:

- Explain Rolle's theorem with an application
- Explain mean value theorems with some examples

- Evaluate Taylor's theorem with Lagrange's and Cauch's forms of remainder

UNIT-V

Taylor's series, Maclaurin's series of sin x, cos x, e^x, log(l+x), $(l+x)^m$, Maxima and Minima, Indeterminate forms.

Learning Outcomes: The student will be able to:

- Explain Taylor's series
- Explain Maclaurin's series
- Evaluate Maxima and minima of a function

Books Recommended :

1. "Elements of Real Analysis" by Shanthi Narayan and Dr. M.D. Raisinghania, published by S.Chand& Company Ltd., New Delhi
2. "A Text Book of B.Sc. Mathematics Volume-II" by V.Venkateswara Rao, N Krishna Murthy, B.V.S.S. Sarma and S. AnjaneyaSastry, published by S.Chand& Company Ltd., New Delhi.
3. "Calculus Single Variable" by Howard Anton, IrlBivens and Stephen Davis, published by John Wiley and Sons, Inc., 2002.
4. "Calculus and Analytic Geometry" by George B. Thomas, Jr. and Ross L. Finney, published by Pearson Education, 2007, 9^{th} edition.

Course Outcomes:

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

- Define the basic properties of limits and continuity
- Explain different types of discontinuities
- Define partial differentiation
- Evaluate problems on partial differentiation
- Trace the parametric curves
- Define polar coordinates
- Explain mean value theorems with some examples
- Evaluate Taylor's theorem with Lagrange's and Cauch's forms of remainder
- Evaluate Maxima and minima of a function

B.Sc. Mathematical Sciences

(Mathematics,Statistics,Computer Science)
SEMESTER –I
SPH 121 Differential Calculus Tutorial/Lab

Hours per week: 2 **Credits: 2**
Continuous Evaluation: 100 Marks

1. Problems on Limits and Continuity Problems on Partial differentiation
2. Problems on Euler's theorem
3. Problems on Tangents and normal
4. Tracing of curves
5. Problems on Rolle's theorm
6. Problems on Mean value theorems
7. Problems on Taylor's theorem
8. Problems on Taylor's and Maclaurin's series
9. Problems on Maxima and Minima

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

- Evaluate limits and continuity of a function
- Solve problems on partial differentiation
- Explain applications of Rolle's theorem, Mean value theorems, Taylor's and Maclaurin's series
- Define maxima and minima of functions

(Mathematics, Statistics, Computer Science)

SEMESTER –I

SAM 101 :Descriptive Statistics and Probability Theory

No. of hrs/week: 4 **Credits: 4**

Preamble:

Probability theory is important when it comes to evaluating statistics. This course treats the most common discrete and continuous distributions, showing how they find use in decision and estimation problems, and constructs computer algorithms for generating observations from the various distributions.

Course Objectives:

- To understand the collection, analysis, interpretation, and presentation of data.
- To understand the difference between discrete and continuous random variables and probability
- To evaluate problems on discrete and continuous probability distributions
- To understand the concept of mathematical expectation
- Ability to explore certain statistical concepts in expectation and generating functions

UNIT-I

Introduction to Statistics : Concepts of Primary and Secondary data. Methods of collection and editing of primary data, Secondary data. Designing a questionnaire and a schedule. Measures of Central Tendency - Mean, Median, Mode, Geometric Mean and Harmonic Mean.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Explain the diagrammatic and graphic representation of data
- Describe the basic concepts of Measures of central tendency
- Describe the properties of mean, median and mode
- Describe the basic concepts of geometic mean and Harmonic mean

Unit-II

Measures of dispersion: Range, Quartile Deviation, Mean Deviation and Standard Deviation. Descriptive Statistics -Central and Non-Central moments and their interrelationship. Sheppard's correction for moments.Skewness and kurtosis.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Explain the concepts of measures of dispersion
- Describe the basic concepts of central and non-central moments
- Describe the difference between central and non-central moments
- Describe the basic concepts of skewness and kurtosis

Unit-III

Introduction to Probability: Basic Concepts of Probability, random experiments, trial, outcome, sample space, event, mutually exclusive and exhaustive events, equally likely and favorable outcomes. Mathematical, Statistical, axiomatic definitions of probability. Conditional Probability and independence of events.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Define probability
- Describe the basic concepts of axiomatic approach to probability
- Concept of conditional probability and problems
- Evaluate problems on independence of events

Unit-IV

Probability theorems: Addition and multiplication theorems of probability for two and for n events. Boole's inequality and Bayee's theorems and problems based on Bayee's theorem.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Describe probability theorems for two and n events
- Describe the basic concepts of axiomatic approach to probability
- Concept of conditional probability and problems
- Evaluate problems on addition theorem , multiplication theorems
- Evaluate problems on Bayee’s theorem

Unit-V

Random variable: Definition of random variable, discrete and continuous random variables, functions of random variable. Probability mass function.Probability density function, Distribution function and its properties.Bivariate random variable - meaning, joint, marginal and conditional Distributions, independence of random variables.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Define descrite and continuous random variables with examples
- Describe the basic concepts of probability mass function
- Concepts of probability density function
- Evaluate problems on condtional and marginal distributions

Text Books:

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. B.A/B.Sc I year statistics - descriptive statistics, probability distribution - Telugu Academy - DrM.JaganmohanRao,DrN.Srinivasa Rao, DrP.Tirupathi Rao, Smt.D.Vijayalakshmi
3. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI.

Reference books:

1. WillamFeller : Introduction to Probability theory and its applications. Volume –I, Wiley
2. Modern Mathematical Statistics with Applications Jay L. Devore, Kenneth N. Berk Springer Second edition.
3. Goon AM, Gupta MK,Das Gupta B : Fundamentals of Statistics , Vol-I, the World Press Pvt.Ltd., Kolakota.
4. Hoel P.G: Introduction to mathematical statistics, Asia Publishing house.
5. Sanjay Arora and BansiLal:.New Mathematical Statistics : Satya Prakashan , New Delhi.
6. Hogg.Tanis.Rao: Probability and Statistical Inference. 7th edition. Pearson.

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

- Explain the diagrammatic and graphic representation of data
- Describe the basic concepts of Measures of central tendency
- Describe the basic concepts of central and non-central moments
- Describe the difference between central and non-central moments
- Concept of conditional probability and problems
- Define descrite and continuous random variables with examples

B.Sc. Mathematical Sciences
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SEMESTER –I

SAM 121 :Descriptive Statistics and Probability Theory Lab

No. of hrs/week: 3 **Credits: 2**

1. Graphical presentation of data (Histogram, frequency polygon, Ogives).
2. Graphical presentation of data (Bar diagram, Histogram, frequency polygon, Ogives) using MS Excel
3. Diagrammatic presentation of data (Bar and Pie).
4. Diagrammatic presentation of data (Bar and Pie) using MS Excel
5. Computation of Mean, Standard deviation, Coefficient of Variation
6. Computation of Mean, Standard deviation, Coefficient of Variation using MS Excel
7. Computation of non-central and central moments – Sheppard's corrections for grouped data.
8. Computation of coefficients of Skewness (β_1) and Kurtosis (β_2) – Karl Pearson's and Bowley's s coefficient of skewnes.
9. Computation of measures of central tendency, dispersion and coefficients of Skewness, Kurtosis using MS Excel.
10. Problems on Probability theory.

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

- Explain the diagrammatic and graphic representation of data
- Evaluate Mean, standard deviation using MS Excel
- Solve problems on non-central and central moments
- Evaluate Skewness and Kurtosis

B.Sc. Mathematical Sciences
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SEMESTER –I

SPH 109: Object Oriented Programming in C++

No. of hrs/week: 4 **Credits: 4**

Preamble: C++ is a general purpose programming language and widely used now a days for competitive programming. It has imperative, object-oriented and generic programming features. C++ runs on lots of platform like Windows, Linux, Unix, Mac etc.

Objectives:

- To develop logic through algorithms and flowcharts.
- To understand the difference between procedure oriented programming and object oriented programming.
- To learn the basic concepts , applications of OOPS and practice of object oriented analysis and design in the construction of robust, maintainable programs which satisfy their requirements;
- To develop the ability to implement features of object oriented programming
- To solve real world problems using Inheritance, data abstraction, encapsulation and Polymorphism.

UNIT- I

Programming Concepts: Algorithm and its characteristics, pseudo code / flow chart Assignment statement, input/output statements, if, if then else statements.

Introduction to structured programming: Data types- simple data types, floating data types, character data types, string data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, operators, preprocessor directives, creating a C++ program.

Learning Outcomes: By the end of this Unit, the student will be able to

- Show the logic involved in solving a problem through algorithms and flowcharts.(L1)
- Describe the basic concepts of object oriented programming. (L2)
- Develop and run simple C++ programs.(L3)
- Choose appropriate data type and operators in programs. (L3)

UNIT- II

Input/output statements, Expressions, Control Structures if and if … else statement, switch and break statements. For, while and do – while, break and continue statement, nested control statements.

Learning Outcomes : By the end of this Unit, the student will be able to

- Select the right controlstructure (L1)
- Develop applications by using appropriate concepts. (L3)

UNIT -III

Local and global variables, static and automatic variables, enumeration type, Function Prototyping, Function Overloading, one dimensional array, two dimensional array,

character array.

Learning Outcomes: By the end of this Unit, the student will be able to

- What is a local variable and what is a Global variable (L1)
- Explain the need of static and Automatic variables.(L2)
- Develop the concept of overloading functions.(L2)
- Utilize the one dimensional and two dimensional arrays in programming.(L3)
-

UNIT- IV

Object Oriented Concepts: objects, classes, methods, constructors, Destructor, Abstraction, encapsulation, Overloading Unary Operators, Rules for Operator Overloading

Learning Outcomes : By the end of this Unit, the student will be able to

- Illustrate the concept of classes and objects (L3)
- Develop real world applications by using appropriate concepts. (L3)
- Use unary operators for overloading.(L3)

UNIT- V

Inheritance – Single, Multiple, Multi Level, Hierarchical, Hybrid Inheritance,static and dynamic binding, Pointers, Virtual Functions and Polymorphism.

Learning Outcomes: By the end of this Unit, the student will be able to

- Explain the need of reusability concept with inheritance.(L2)
- Summarize different types of inheritance.(L2)
- Identify the need of pointer.(L1)

Course Outcomes: Upon completion of the course, the student is able to

- emphasize the special features of C++ language.(L4)
- Examine the working of Controlstructures in C++ programs.(L4)
- develop and implement classes and objects. (L3)
- Understand various Inheritance mechanisms, operator overloading ,polymorphism and apply in applications.(L2)

Books Recommended

Object Oriented Programming with C++ by E.Balagurusamy, Tata MC GrawHill, 6th edition, 2013.

Reference Books:

1. Mastering C++ by Venugopal K R, RajkumarBuyya , Tata Mc Graw Hill, 2nd edition, 2013
2. Object Oriented Programming using C++ by B.Chandra, Narosa Publications, 2005.

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SEMESTER –I

SPH 129: Object Oriented Programming in C++ Lab

No. of hrs/week: 3 **Credits: 2**

1. Write a C++ program to demonstrate the usage of data types & operators.
2. Write a C++ program to demonstrate Class and Object.
3. Write a C++ program to demonstrate Control structures.
4. Write a C++ program to demonstrate operator overloading.
5. Write a C++ program to demonstrate function overloading using Arrays.
6. Write a C++ program to demonstrate different types of Arrays.
7. Write a C++ program to demonstrate Constructors and Constructor overloading.
8. Write a C++ program to demonstrate Copy constructor and Destructor.
9. Write a C++ program to demonstrate Single Inheritance, Multiple Inheritance.
10. Write a C++ program to demonstrate Multi level Inheritance, Hierarchal Inheritance.
11. Write a C++ program to demonstrate Pointers.
12. Write a C++ program to demonstrate Run time polymorphism and Compile time Polymorphism.

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

- Write a program on different types of arrays
- Demonstrate constructors and constructo overloading
- Demonstrate single inheritance and multiple inhetence
- Explain multi level inheritance and hierarchal inheritance
- Demonstrate pointers

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SEMESTER –II

SFC 102 : ENVIRONMENTAL SCIENCE

No. of hours per week: 03 **Credits: 02**

UNIT-I

The Multidisciplinary nature of environmental studies–Definition, Scope and Importance, Need for Public awareness. Natural Resources: Classification – Renewable and Non Renewable Resources. Renewable Resources: Forest, Water and Energy Resources Non Renewable Resources: Mineral, Food and Land resources (Uses, reasons for over-utilization and effects)

UNIT-II

Eco-system: Structure of an Ecosystem, Producers, consumers and de-composers. Structure of Terrestrial Ecosystems (Forest ecosystem, Grassland ecosystem and Desert ecosystem) and Aquatic Ecosystems (Pond ecosystem and ocean ecosystem). Function of an ecosystem -food chains, food web and ecological pyramids - energy flow in the ecosystem. Environmental Pollution: Causes, effects and control measures of Air, Water,soil pollution, Thermal pollution and nuclear hazards. Municipal solid waste management.

UNIT-III

Environmental problems: Global Environmental Problems, Green house effect, Ozone layer depletion, acid rains and Climate change. National Environmental Problems: Deforestation – Causes and Effects, Environmental Problems associated with dams. Mining and Environmental effects.

UNIT-IV

Social Issues and the Environment: Environmental ethics, Issues and possible solutions. Waste land reclamation, Consumerism and waste products. Environmental Legislation: Environment Protection Act, Air Act, Water Act, Wildlife Protection act and Forest conservation act.

UNIT-V

Human Population and the Environment: Population growth, variation among nations, Population explosion-Family welfare programme. Environment and human health. Human rights, Value education, HIV/AIDS, Women and Child welfare, Role of information technology in environment and human health.

Text Books:

1. Text Book of Environmental studies for Undergraduate courses by BharuchaErach Published by V.G.C
2. Environmental Science: A Global Concern by William P.Cunningham and Baraba Woodworth Saigo.
3. A text book of Environmental Science by P.C.Joshi
4. A text book of Environmental Science by Arvind Kumar
5. A text book of Environmental Science by S.C.Santra
6. Ecology & Environment by P.D.Sharma

B.Sc. Mathematical Sciences
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SEMESTER –II

SPH 102 :Differential Equations

No. of hrs/week: 4 **Credits: 4**

Preamble: Many physical laws and relations can be expressed mathematically in the form of differential equations. Thus it is natural that this course opens with the study of differential equations and their solutions. Indeed, many engineering problems appear as differential equations. The main objectives of this course are twofold: the study of ordinary differential equations and their most important methods for solving them and the study of modeling.

Objectives:

- To Identify the type of a given differential equation and apply the appropriate analytical technique for finding the solution of first order and higher degree ordinary differential equations.
- To Solve second order and higher order linear differential equations.
- To Solve non-homogeneous differential equations
- To Solve the Simultaneous differential equations and Total differential equations.
- To formulate first order partial differential equations
- To solve the non-linear first order Partial differential equation by Charpit's method
- To classify second order partial differential equations into elliptic, parabolic and hyperbolic
- To transform the second order partial differential equations to Normal forms

UNIT-I

First order exact differential equations. Integrating factors, rules to find an integratingfactor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations.

Learning Outcomes: By the end of this Unit, the student will be able to

- Distinguish between linear, nonlinear, partial and ordinary differential equations.
- Recognize and solve an exact differential equation.
- Recognize and solve a non-exact differential equation by finding integrating factor.
- Recognize and solve First order higher degree equations solvable for x, y, p
- Evaluate basic application problems described by first order differential equations

UNIT-II

Basic theory of linear differential equations, Wronskian, and its properties.Solving a differential equation by reducing its order. Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Learning Outcomes: By the end of this Unit, the student will be able to

- Use the existence theorem for boundary value problems to determine uniqueness of solutions.

- Use the Wronskian condition to determine if a set of functions is linearly independent.
- Determine the complete solution of a homogeneous differential equation with constant coefficients by examining the characteristic equation and its roots.
- Evaluate the complete solution of a non-homogeneous differential equation as a linear combination of the complementary function and a particular solution.
- Determine the complete solution of a non-homogeneous differential equation with constant coefficients by the method of undetermined coefficients.
- Find the complete solution of a differential equation with constant coefficients by variation of parameters and also solve Cauchy-Euler Equation Evaluate Simultaneous differential equations and total differential equation
- Evaluate basic application problems described by second order linear differential equations with constant coefficients.

UNIT-III

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations

Learning Outcomes: By the end of this Unit, the student will be able to

- Recognize the concept of linear and non-linear partial differential equations.
- Recognize the concept of order and degree of partial differential equations
- Construct a first order partial equation by elimination of arbitrary constants
- Construct a first order partial equation by elimination of arbitrary functions of specific functions
- Construct a first order partial equation by Elimination of Arbitrary Functions
- Construct a physical or biological model to a first order partial differential equations

UNIT-IV

Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Learning Outcomes: By the end of this Unit, the student will be able to

- Distinguish between general solution and complete solution
- Recognize and solve Lagrange's equation
- Find Lagrange's multipliers
- Recognize and solve first order non linear partial differential equation by Charpit's method.
- Recognize and reduce the first order partial different equation to different forms

UNIT-V

Classification of second order partial differential equations into elliptic, parabolic andhyperbolic through illustrations only.

Learning Outcomes: By the end of this Unit, the student will be able to

- Recognize the second order partial differential equations into elliptic, parabolic and hyperbolic
- Construct the different example for elliptic, parabolic and hyperbolic
- Transform the second order partial differential equations into normal form
- Solve basic application problems like one dimensional wave equation and heat equation

Books Recommended

1. N.Krishna Murthy & others " A text book of Mathematics for BA/B.Sc. Vol. 1 S.Chand& Company, New Delhi.
2. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984
3. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

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

- Recognize and solve an exact differential equation.
- Recognize and solve a non-exact differential equation by finding integrating factor.
- Recognize and solve First order higher degree equations solvable for x, y, p
- Determine the complete solution of a homogeneous differential equation with constant coefficients by examining the characteristic equation and its roots.
- Evaluate the complete solution of a non-homogeneous differential equation as a linear combination of the complementary function and a particular solution.
- Recognize the concept of order and degree of partial differential equations
- Construct a first order partial equation by elimination of arbitrary constants
- Construct a first order partial equation by elimination of arbitrary functions of specific functions
- Find Lagrange's multipliers
- Recognize and solve first order non linear partial differential equation by Charpit's method.
- Construct the different example for elliptic, parabolic and hyperbolic
- Transform the second order partial differential equations into normal form

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SEMESTER –II

SPH 120 Differential Equations Tutorial/Lab

Hours per week: 2 Credits: 2
Continuous Evaluation: 100 Marks

1. Solving first order and first degree differential equations
2. Solving first order and higher degree differential equations
3. Solving linear differential equations with constant coefficients
4. Solving differential equations with variation of parameters
5. Solving Cauchy-Euler equation
6. Solving Simultaneous differential equations
7. Solving total differential equations
8. Formation of first order partial differential equations
9. Problems using Lagrange's method
10. Problems using Charpit's method
11. Classification of second order partial differential equations

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

- Evaluate first order and first degree differential equations
- Solve problems on first order and higher degree differential equations
- Explain linear differential equations with constant coefficients
- Explain the methods to solve partial differential equations
- Classify second order partial differential equations

B.Sc. Mathematical Sciences
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SEMESTER –II

SAM 102 :Mathematical Expectation and Probability Distributions

No. of hrs/week: 4 **Credits: 4**

Preamble:

This course covers the concepts on Mathematical expectations , discrete and continuous probability distributions

Course Objectives:

- To understand mathematical expections
- To learn the basic concepts on moments
- To identify and practice the difference between discrete distribution and continuous distribution

Unit-I

Mathematical expectation : Mathematical expectation(ME) of a random variable and function of a random variable. Moments and covariance using mathematical expectation with examples. Addition and Multiplication theorems on expectation. Definitions of M.G.F, C.G.F, P.G.F, C.F its properties. Chebyshev and Cauchy - Schwartz inequalities.

Learning Outcomes: By the end of this Unit, the student will be able to

- Distinguish between mathematical expectation of a random variable and function of a random variable
- Recognize and solve problems on addition and multiplication theorems on expections
- Define moment generating function, cumulative generating function, probability generating function, cumulative function

Unit-II

Discrete Distributions : Binomial and Poisson distributions, their definitions, 1^{st} to 4^{th} central moments, M.G.F, C.F, C.G.F, P.G.F, mean, variance, additive property if exists. Poisson approximation to Binomial distribution.

Learning Outcomes: By the end of this Unit, the student will be able to

- Distinguish between binomial distribution and poission distribution
- Evaluate central moments for binomial distribution and poission distribution
- Explain poisson approximation to binomial distribution

Unit-III

Negative Binomial, geometric, hyper geometric distributions - Definitions, means, variances, M.G.F, C.F, C.G.F, P.G.F, reproductive property if exists. Binomial approximation to Hyper Geometric Distribution, Poisson approximation to Negative binomial distribution.

Learning Outcomes: By the end of this Unit, the student will be able to

- Distinguish between negative binomial distribution,geometric and hyper geometic distribution
- Evaluate mean and variance for negative binomial distribution and geometic distribution
- Explain poisson approximation to negative binomial distribution

Unit-IV

Continuous Distributions : Rectangular, Exponential, Gamma, Beta Distributions of two kinds. Other properties such as mean , variance, M.G.F, C.G.F, C.F, reproductive property.

Learning Outcomes: By the end of this Unit, the student will be able to

- Explain rectangular, exponential , gamma, beta distributions
- Evaluate mean and variance for gamma, beta distribution
- Explain moment generating function and cumulative generating function for continuous distributions

Unit - V

Normal Distribution: Definition, Importance, Properties, M.G.F, additive properties, Interrelation between Normal and Binomial, Normal &Poisson distribution. Cauchy Distribution .

Learning Outcomes: By the end of this Unit, the student will be able to

- Define normal distribution
- Discuss properties of normal distribution
- Explain interrelation between normal and binomial distributions
- Explain interrelation between normal and poission distributions

Text Books:

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. B.A/B.Sc I year statistics - descriptive statistics, probability distribution - Telugu Academy - DrM.Jaganmohan Rao ,DrN.Srinivasa Rao, DrP.Tirupathi Rao, Smt.D.Vijayalakshmi

Reference Books:

1. WillamFeller : Introduction to Probability theory and its applications. Volume –I, Wiley
2. Modern Mathematical Statistics with Applications Jay L. Devore, Kenneth N. Berk Springer Second edition.
3. Goon AM, Gupta MK,Das Gupta B : Fundamentals of Statistics , Vol-I, the World Press Pvt.Ltd., Kolakota.
4. Hoel P.G: Introduction to mathematical statistics, Asia Publishing house.
5. Sanjay Arora and BansiLal:.New Mathematical Statistics : Satya Prakashan , New Delhi.
6. Hogg.Tanis.Rao: Probability and Statistical Inference. 7th edition. Pearson.
7. K.V.S. Sarma: statistics Made Simple: do it yourself on PC. PHI

8. Gerald Keller: Applied Statistics with Microsoft excel. Duxbury, Thomson Learning.
9. Levine, Stephen, Krehbiel, Berenson: Statistics for Managers using Microsoft Excel 4th edition. Pearson Publication.

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

- Distinguish between mathematical expectation of a random variable and function of a random variable
- Recognize and solve problems on addition and multiplication theorems on expections
- Evaluate central moments for binomial distribution and poission distribution
- Explain poisson approximation to binomial distribution
- Evaluate mean and variance for negative binomial distribution and geometic distribution
- Explain poisson approximation to negative binomial distribution
- Explain moment generating function and cumulative generating function for continuous distributions
- Discuss properties of normal distribution
- Explain interrelation between normal and binomial distributions

B.Sc. Mathematical Sciences
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SEMESTER –II

SAM 122 :Probability Distributions Lab

No. of hrs/week: 3 **Credits: 2**

1. Fitting of Binomial distribution – Direct method.
2. Fitting of Binomial distribution – Direct method using MS Excel.
3. Fitting of binomial distribution – Recurrence relation Method.
4. Fitting of Poisson distribution – Direct method.
5. Fitting of Poisson distribution – Direct method using MS Excel.
6. Fitting of Poisson distribution - Recurrence relation Method.
7. Fitting of Normal distribution – Areas method.
8. Fitting of Normal distribution – Ordinates method.

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

- fit binomial distribution
- fit poission distribution
- fit normal distribution

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SEMESTER –II

SPH 110 : Data Structures and File Processing

No. of hrs/week: 4 **Credits: 4**

Preamble: In the field of Computer Science, data structures provides an efficient way to handle data efficiently. With a single variable it is an unfeasible task to store huge amount of data. Storing data in a file provides a flexible approach where data is stored in a disk.

Objectives :

- Enable the student to learn about linear and non linear data structures.
- Understand searching and sorting algorithms.
- Learn to store data in a sequential file and access the data.
- Use direct file access and Indexed sequential file organization.

UNIT-I

Fundamental Concepts: Introduction to Data Structures, Types of Data Structures.
Linear Data Structure Using Arrays: Sequential Organization, Linear Data Structure Using Sequential Organization: Arrays, Arrays as an Abstract Data Type, Memory Representation and Address Calculation, Class Array, Pros and Cons of Arrays.
Searching and Sorting: Searching, Searching Techniques: Sequential Search, Binary Search. Sorting: Types of Sorting, General Sort Concepts, Bubble Sort, Insertion Sort, Selection Sort.
Learning Outcomes: By the end of this Unit, the student will be able to

- Infer Linear and Nonlinear data structures. (L2)
- Apply sequential search and Binary search on data sets. (L2)
- Infer the general sorting methods. (L4)

UNIT-II

Stacks: Concepts of Stacks and Queues, Stacks, Stack Abstract Data Type, Representation of Stacks Using Arrays.
Queues: Concept of Queues, Queue as Abstract Data Type, Realization of Queues Using Arrays, Circular Queue, Dequeue, Priority Queue.
Learning Outcomes: By the end of this Unit, the student will be able to

- develop stack using arrays. (L3)
- interpret application of stack. (L2)
- build queue using array. (L3)
- make use of circular queue, deque, priority queue. (L3)

UNIT-III

Linked Lists: Introduction, Linked List, Realization of Linked Lists, Dynamic Memory Management, Linked list Abstract Data Type, Doubly Linked List, Circular Linked List.
Trees: Introduction, Types of Trees, Binary Tree, Binary Tree Abstract Data Type, Realization of a Binary Tree, Binary Tree Traversal.

Learning Outcomes: By the end of this Unit, the student will be able to

- utilize the concept of dynamic memory allocation.(L3)
- develop doubly linked list, circular linked list. (L3)
- Inspect Binary tree traversal algorithms. (L4)

UNIT-IV

Hashing: Introduction, Hash Functions, Collision Resolution Strategies, Extendible Hashing, Dictionary.

Indexing and Multiway Trees: Introduction, Indexing, Types of Search Trees: Multiway Search Tree, B-Tree, B+ Tree.

Learning Outcomes: By the end of this Unit, the student will be able to

- outline Hash Functions. (L2)
- develop B tree and B+ Trees. (L3)

UNIT-V

Files: Introduction, External Storage Devices, File Organization, Files Using C++, Sequential File Organization, Direct Access File Organization, Indexed Sequential File Organization.

Learning Outcomes: By the end of this Unit, the student will be able to

- experiment with sequential file organization and random file organization. (L3)
- demonstrate indexed sequential file organization. (L2)

Course Outcomes: Upon completion of the course, the student is able to

- illustrate array data structure and perform searching and sorting. (L2)
- write programs to create, insert, delete and display the elements ofstack, queue, linked list. (L2)
- develop tree and perform traversals. (L3)
- utilize sequential and direct access files. (L3)

Text Book:

Data Structures Using C++, Varsha H. Patil, Oxford University Press.

Reference Books:

1. Data Structures and Algorithms in C++, 3rd Edition, Adam Drozdek, Cengage Learning.
2. Data Structures and Algorithms in C++, Brijendra Kumar Joshi, Tata McGraw Hill,2010

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SEMESTER –II

SPH 128 : Data Structures and File Processing Lab

No. of hrs/week: 3 **Credits: 2**

1. Write a C++ program to convert a sentence from lower case to to upper case , count number of vowels and delete blank spaces.
2. Write a C++ program to implement Stack operations.
3. Write a C++ program to implement queue operations.
4. Write a C++ program to implement the operations in Linked list
5. Write a C++ program to concatenate two files and copy the contents of one file to another file.
6. Write a C++ program program for direct access of records in a file.
7. Write a C++ program to implement field organization using length indicator.
8. Write a C++ program for fixed length field organization.
9. Write a C++ program for index access of records in a file.
10. Write a C++ program for accessing records in a file using index(record organization).
11. Write a C++ program to print a line if it contains more than 80 characters.
12. Write a C++ program for reading and writing contents to a file from console.
13. Write a C++ program to reverse the contents of the given file.
14. Write a C++ program to search for a given record using sequential search
15. Write a C++ program to search for a given record using simple Hashing.
16. Write a C++ program to sort records in a file.

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

- Implement stack and queue operatons in C++
- Concatenate two files
- Implement field organization
- Index access of records in a file
- Sort records in a file

B.Sc. Mathematical Sciences
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SEMESTER -III

SFC 203: ENGLISH FOR COMMUNICATION– II

No. of hours per week: 03 **Credits: 02**

UNIT- I

The Open Window : Saki (H.H.Munro)

Pronunciation: Syllabification**, Grammar:** Non-infinite verbs, **Vocabulary:** Simile & Metaphor**, Spelling:** using 'ie' or 'ei', **Punctuation:** semi-colon, **Conversation:** Asking for advice/information,

UNIT- II

The Voice of Humanity – Rabindranath Tagore

Pronunciation: Word Stress, **Grammar:** Adjectives, **Vocabulary:** Oxymoron & Hyperbole**, Spelling:** using 'able' and 'ible', **Punctuation:** Colon & dash, **Group Discussion**

UNIT –III

If – Rudyard Kipling

Pronunciation: Sentence Stress**, Grammar:** Articles, **Vocabulary:** Portmanteau and loan words**, Spelling:** using suffixes, **Punctuation:**Hyphen & dash, **Oral Presentation**

UNIT -IV

Riders to the Sea – JM Synge

Pronunciation – Intonation**, Grammar:** Adverbs, **Vocabulary:** Palindromes**, Spelling:** completing tables with nouns, verbs, adjectives, adverbs **Punctuation:** Inverted comma, **Conversation/Role play:** Appearing for a job interview/conducting a job interview

UNIT- V Academic Writing: Letter Writing, Paragraph Writing, Essay Writing, Resume Preparation, Dialogue Writing, Precis

Text Books:
Part – 2 (English for Enhanced Competence (by Sumit Roy, A.Karunakar, A.Aruna Priya)

Supplementary Reading:

1. Communicative skills for Technical Students, M. Faratullah. Orient Longman

2. Rizvi,MAshraf. ***Effective Technical Communication.*** McGraw - Hill.

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SEMESTER –III

SPH 201 :Real Analysis

No. of hrs/week: 4 **Credits: 4**

Preamble: Real Analysis studies the behaviour of real numbers, functions, sequences, series and sets on the real line. The focus of the course is to study the properties of fields of real numbers, convergence/divergence of sequences, series of numbers and functions.

Objectives:

- To introduce basic properties of fields of real numbers
- sequences and discuss about their convergence infinite series and the tests of convergence
- Alternating series, absolute and conditional convergence of infinite series
- Point wise and uniform convergence ofsequence and series of functions

UNIT-I

Finite and infinite sets, examples of countable and uncountable sets, Real line,bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Learning Outcomes: The student will be able to:

- Define and recognize the basic properties of field of real numbers
- Find suprema and infima of sets
- Discuss the cluster points of sets

UNIT-II

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Learning Outcomes: The student will be able to:

- Define sequences and its properties
- Verify the convergence of sequence
- Prove fundamental theorems on convergence

UNIT-III

Infinite series. Cauchy convergence criterion for series, positive term series,geometric series, comparison test, convergence of p-series

Learning Outcomes: The student will be able to:

- Define Infinite series and its properties
- Discuss the convergence of Geometric series
- Verify the convergence of series

UNIT-IV

Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence

Learning Outcomes: The student will be able to:

- Define alternating series
- Explain the absolute and conditional convergence of the series
- Explain the Root, Ratio and Leibnitz's test

UNIT-V

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

Learning Outcomes: The student will be able to:

- Define sequence and series of functions
- Understand the difference between point wise and uniform convergence
- Apply M-test Course Learning

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

- Write precise proofs
- Recognize convergent, divergent, bounded, Cauchy and monotone sequences and their properties
- Calculate the infima, suprema and limit points of a set Recognize alternating, conditionally and absolutely convergent series
- Apply the ratio, root, Leibnitz's test
- Test the pointwise and uniform convergence of sequences and series of functions

Books Recommended

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P. Ltd., 2000.
3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.
4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

B.Sc. Mathematical Sciences
(Mathematics, Statistics,Computer Science)
SEMESTER –III
SPH 221: Real Analysis Tutorial

Hours Per Week :2 **Continuous Evaluation:100 Marks**
Credits :2

1. Finding supremum and infimum of a set
2. Finding limit points of a set
3. Problems on sequences
4. Problems on Cauchy convergence
5. Problems on monotonic sequence
6. Problems on infinite series
7. Convergence or divergence of Geometric series
8. Convergence or divergence using comparison test
9. Convergence or divergence of p-series
10. Problems on root test
11. Problems on Ratio test
12. Problems on alternating series

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

- Calculate the infima, suprema and limit points of a set.
- Apply tests to verify the convergence or divergence of sequences.
- Verify the convergence, divergence, absolute convergence , conditional convergence of series

B.Sc. Mathematical Sciences
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SEMESTER –III

SAM 201:Statistical Methods

No. of hrs/week: 4 **Credits: 4**

Preamble:

This course covers the concepts on Correlation and Regression Analysis, curve fitting,attributes,and exact sampling distributions.

Objectives:

- Compute correlation coefficient for ungrouped data
- Compute rank correlation coefficient
- Compute regression lines and correlation ratio
- Fitting of curves
- Obtain co-efficient of association
- Obtain properties of $\chi 2$, t, F distributions

Unit-I

Correlation: Definition, scatter diagram its coefficient and its properties. , scatter diagram, computation of correlation coefficient for ungrouped data. spearman's rank correlation coefficient, properties of spearman's correlation coefficients and problem.

Learning Outcomes: The student will be able to:

- Define correlation and scatter diagram
- Explain coefficient of correlation
- Evaluate rank correlation coefficient

Unit-II

Regression: simple linear regression, properties of regression coefficients. Regression lines, Concept of Correlation ratio, partial and multiple correlation coefficients, correlation verses regression and their problems.

Learning Outcomes: The student will be able to:

- Explain linear regression and its properties
- Explain concept of correlation ratio
- Discuss the difference between correlation and regression

Unit – III

Curve fitting: Method of least square - Fitting of linear, quadratic, Exponential and power curves and their problems.

Learning Outcomes: The student will be able to:

- Define method of least squares
- Fit linear and quadratic curves
- Fit exponential and power curves

Unit-IV

Attributes : Introduction, Nature, and consistency and mention its conditions. Independence and association of attributes, co-efficient of association, coefficients of contingency and their problems.

Learning Outcomes: The student will be able to:

- Explain nature of attributes
- Evaluate association of attributes
- Define coefficient of association
- Explain contingency of attributes

Unit –V

Exact sampling distributions: Concept of population, Parameter, random sample, statistic, sampling distribution, standard error. Statement and Properties of $\chi 2$, t, F distributions and their inter relationships.

Learning Outcomes: The student will be able to:

- Define population, sample, parameter, and statistic
- Define standard error
- Explain the properties of $\chi 2$, t, F distributions

Text books

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Cahnd& Sons, New Delhi
2.. BA/B.Sc II year statistics - statistical methods and inference - Telugu Academy by A. Mohanrao, N.Srinivasa Rao, DrR.Sudhakar Reddy, Dr T.C. Ravichandra Kum.
3. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI.

List of Reference text books

1. Goon.A.M, Gupta.M.K, Das Gupta B: Outlines of Statistics, Vol-II, the World Press Pvt.Ltd.,Kolakota
2. Hoel P.G.: Introduction to matechematical statistics, Asia Publishing house.
3. Sanjay Arora and Bansi Lai: New mathematical Statistisc Satya Prakashan, New Delhi

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

- Explain coefficient of correlation
- Evaluate rank correlation coefficient
- Explain linear regression and its properties
- Explain concept of correlation ratio
- Fit linear and quadratic curves
- Fit exponential and power curves
- Evaluate association of attributes
- Explain the properties of $\chi 2$, t, F distributions

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER –III

SAM 221:Statistical Methods Lab

No. of hrs/week: 3 **Credits: 2**

1. Fitting of straight line.
2. Fitting of exponential curves.
3. Fitting of power curve.
4. Computation of correlation coefficient & Fitting of Regression lines.
5. Rank correlation coefficient.
6. Computation of Contingency coefficients.
7. MS-Excel methods any for the Serial Numbers 1,2,4,5.

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

- Fit a straight line and parabola
- Fit exponential curves
- Fit power curves
- Compute correlation coefficient and rank correlation coefficient
- Evaluate regression lines
- Evaluate contingency tables

B.Sc. Mathematical Sciences
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SEMESTER –III

SPH 209 : Design and Analysis of Algorithms

No. of hrs/week: 4 **Credits: 4**

Preamble: Design and Analysis of Algorithm is very important for designing algorithm to solve different types of problems in the branch of computer science and information technology. This course deals the fundamental concepts of Designing Strategies, Complexity analysis of Algorithms, followed by problems on Graph Theory and Sorting methods.

Objectives:

- To rephrase algorithms. (L2)
- To demonstrate sorting techniques.(L2)
- To emphasize graph traversals. (L3)
- To illustrate challenges in numeric algorithms. (L2)

UNIT –I

Introduction: Algorithm Specification, Performance Analysis, Randomized Algorithms- Las Vegas, Monte Carlo Algorithm Definition, RQuick Sort.

Sorting Techniques: Selection Sort, Bubble Sort, Insertion Sort, Heap Sort, Shell Sort, Linear Search

Learning Outcomes: By the end of this Unit, the student will be able to

- Specify algorithms and analyze performance of algorithm. (L2)
- develop sorting techniques. (L5)

UNIT - II

Divide and Conquer: General Method, Binary Search, Finding maximum and minimum, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

Basic Graph Traversal Techniques- Breadth First Search, Depth-First Search.

Learning Outcomes: By the end of this Unit, the student will be able to

- examine divide and conquer method. (L4)
- adopt BFS and DFS algorithms. (L3)

UNIT- III

Greedy Method: General Method, Knapsack Problem, Minimum Cost Spanning Trees- Kruskal's , Prim Algorithms, Single Source Shortest Paths

Learning Outcomes: By the end of this Unit, the student will be able to

- make use of minimum cost spanning trees. (L4)
- explain Krushkl's, Prims and single source shortest path algorithm. (L2)

UNIT – IV

Dynamic Programming: General Method, All pairs Shortest Paths, Travelling Salesperson Problem.

Transform and Conquer: Multiplication of Large Integers, Horners Rule and Binary Exponentiation, Computing the least common multiple, counting paths in a graph, Reduction of Optimization Problem. (Anany Levitin chapter -6)

Learning Outcomes: By the end of this Unit, the student will be able to

- elaborate Travelling salesman problem. (L4)
- solve Horners rulw and binary exponentiation, computer LCM. (L3)

UNIT – V

Input Enhancement in String Matching: Horspools Algorithm, Boyer- Moore Algorithm.

Limitations of Algorithm Power : Lower-Bound Arguments, Trivial Lower Bounds, Information-Theoretic Arguments, Adversary Arguments, Problem Reduction

Decision Trees: Decision Trees for Sorting, Decision Trees for Searching a sorted Array

P, NP, and NP-Complete Problems : Basic Concepts, P and NP Problems, NP-Complete Problems, Challenges in Numeric Algorithms (Anany Levitin – 11th chapter)

Learning Outcomes: By the end of this Unit, the student will be able to

- model Horspools Algorithm, Boyer- Moore Algorithm. (L4)
- choose decision tree for sorting. (L3)

Course Outcomes: Upon completion of the course, the student is able to

- Learn to analyze performance of algorithm.(L2)
- solve a given problem recursively dealing with sub-problems.(L3)
- learn to solve notorious computational problems. (L4)

Text Books:

1. Fundamentals of Computer Algorithms – Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, Second Edition, 2008, University Press,
2. Introduction to the Design and Analysis of Algorithms, ,Anany Levitin, 3rd Edition 2012, Pearson (Unit- IV,V)

B.Sc. Mathematical Sciences
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SEMESTER –III

SPH 229 : Design and Analysis of Algorithms Lab

No. of hrs/week:3 **Credits: 2**

1. Write a C++ program to implement Bubble sort.
2. Write a C++ program to implement Insertion Sort.
3. Write a C++ program implement Selection Sort.
4. Write a C++ program to implement Quick Sort.
5. Write a C++ program to implement Merge Sort.
6. Write a C++ program to implement Shell Sort.
7. Write a C++ program to Find Maximum and Minimum using Divide and Conquer.
8. Write a C++ program to implement Strassen's Matrix Multiplication.
9. Write a C++ program to implement Breadth First Search, Depth First Search.
10. Write a C++ program on Knapsack Problem.
11. Write a C++ program to find Minimum Cost Spanning Tree.
12. Write a C++ program to find All pairs Shortest Path.
13. Write a C++ program to find Single Source Shortest Path.
14. Write a C++ program to evaluate an expression using Horner's Rule.
15. Write a C++ program to perform string matching – Horspools or Boyer- Moore algorithm.

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

- Implement bubble sort, insertion sort,selection sort, quick stor, merge sort, shell short using C++ program
- Find maximum and minimum using divide and conquer
- Implement BFS , DFS and minimum spanning tree algorithms
- Implement single source shortes path algorithms

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SEMESTER –III

SSE 275 : Logic and Sets

No. of hrs/week: 2 **Credits: 2**

Introduction, propositions, truth table, negation, conjunction and disjunction.Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Propositional equivalence: Logical equivalences.

Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Examples of finite and infinite sets.Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.
Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.

Relation: Product set, Composition of relations, Types of relations,Partitions, Equivalence Relations with example of congruence modulo relation.

Books Recommended

1. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
2. P.R. Halmos, *Naive Set Theory*, Springer, 1974.
3. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.

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

- Explain propositional calculus
- Evaluate problems on predicate functions
- Explain different types of sets and operations on sets
- Define relation between two sets
- Explain different types of relations

B.Sc. Mathematical Sciences
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SEMESTER –III

SSE 277 :Computer Graphics

No. of hrs/week: 2 **Credits: 2**

Preamble: Computer graphics is regarded as a branch of computer science that deals with the theory and technology for computerized image synthesis. The task of composing image on a computer is essentially a matter of setting pixel values. The field of computer graphics is characterized by rapid changes in hoe the technology is used in everyday applications and by constant evolution of graphics systems.

Course Objectives:

- To familiarize with Raster Scan and Random Scan Systems.
- To know about line drawing algorithms.
- To learn about polygon filling algorithm.
- To understand ant aliasing techniques

Development of Computer Graphics, Raster Scan and Random Scan graphics storages, display processor and character generators, color display techniques.
Cathode Ray Tube(CRT)basics, Refresh Display, Direct View Storage Tube(DVST , Interactive input/output devices)
Points, lines and curves, Scan conversion, Line-Drawing Algorithms, Circle and Ellipse Generation.
Conic-section generation, polygon filling, anti aliasing.
Two-dimensional viewing, Coordinate systems, linear transformations, line and polygon clipping algorithms.

Text Book: Computer Graphics by Amarendra N Sinha, Arun D Udai, Tata McGraw Hill, 2008.

Reference Books :

1. Computer Graphics by D. Hearn and M.P. Baker, Prentice–Hall of India, 2nd Ed., 2004.

3. Procedural Elements in Computer Graphics by D.F. Rogers, TMH, 2nd Ed., 2001.

Course Outcomes: By the end of this Unit, the student will be able to

- Show raster scan and random scan graphics storage. (L1)
- Explain display processor. (L1)
- Outline colour display techniques. (L3)
- Outline CRT display. (L2)
- Explain DVST. (L3)
- Narrate interactive input output devices. (L2)
- Know about scan conversion algorithms.(L3)
- Describe Line drawing Algorithms. (L2)
- Explain Circle generation and Ellipse generation algorithms. (L2)

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SEMESTER –IV

SPH 202 :Algebra

No. of hrs/week: 4 **Credits: 4**

Preamble: This course aims to provide basic concepts of Abstract algebra. The focus of the course is to study the fundamental properties of Groups and its kind.

Course Objectives:

- To introduce groups, subgroups, permutation and cyclic groups with examples
- To discuss the fundamental properties of Groups, sub groups etc
- To study the structure preserving mappings, homomorphism and isomorphism, its properties.
- To increase mathematical maturity, including writing their own proofs

UNIT – I

GROUPS :

Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties Finite and Infinite groups – examples – order of a group. Composition tables with examples.

Learning Outcomes: The student will be able to:

- Explain algebraic structures
- Verify group properties of a given algebraic structure
- Define order of a group and order of an element

UNIT – II

SUBGROUPS :

Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition – examples-criterion for a complex to be a subgroups.Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups.

Co-sets and Lagrange's Theorem :

Cosets Definition – properties of Cosets–Index of a subgroups of a finite groups–Lagrange's Theorem.

Learning Outcomes: The student will be able to:

- Define and explain the properties of complexes, subgroups and co-sets
- Explain the index of a subgroups with examples
- Prove Lagranges theorem

UNIT –III

NORMAL SUBGROUPS :

Definition of normal subgroup – proper and improper normal subgroup–Hamilton group – criterion for a subgroup to be a normal subgroup – intersection of two normal

subgroups – Sub group of index 2 is a normal sub group – simple group – quotient group – criteria for the existence of a quotient group.

Learning Outcomes: The student will be able to:

- Explain normal subgroups and its properties
- Define quotient groups and criteria for the existence of a quotient group

UNIT – IV

HOMOMORPHISM :

Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – aultomorphism definitions and elementary properties– kernel of a homomorphism – fundamental theorem on Homomorphism and applications.

Learning Outcomes: The student will be able to:

- Discuss the structure preserving mappings
- Prove the properties of Homomorphism and Isomporphism
- Define Kernal of Isomorphism and its properties

UNIT –V

PERMUTATIONS AND CYCLIC GROUPS :

Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.

Cyclic Groups :

Definition of cyclic group – elementary properties – classification of cyclic groups.

Learning Outcomes: The student will be able to:

- Define and give examples of permutation and cyclic groups
- Perform permutation multiplication
- Find generators of cyclic group
- Prove fundamental properties of permutation and cyclic groups

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

- Write abstract mathematical proofs in logical manner
- Verify group properties for the given algebraic structure
- Prove fundamental theorems of group theory
- Explain the use of order of an element and group in finding generators of the group
- Discuss the structure preserving mappings and its importance

Books Recommended

1.A text book of Mathematics for B.A. / B.Sc. by B.V.S.S. SARMA and others Published byS.Chand& Company New Delhi.

2 A. First course in Abstract Algebra, by J.B. Fraleigh Published by Narosa Publishing house.

3. Modern Algebra by M.L. Khanna.

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

5. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.

B.Sc. Mathematical Sciences
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SEMESTER –IV
SPH 220: Algebra Tutorial/Lab

Hours per week: 2 **Credits: 2**
Continuous Evaluation: 100 Marks

1. Problems on Groups Problems on subgroups
2. Problems on co-sets and Lagrange's theorem
3. Problems on normal subgroups
4. Problems on quotient group Problems on homomorphism of groups
5. Problems on isomorphism of groups
6. Problems on permutation multiplication
7. Problems to find inverse of a permutation
8. Problems on cyclic permutation and transposition
9. Problems on Cayley's theorem Problems on cyclic groups

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

- Verify group properties of given algebraic structure demonstrate the subgroups, normal subgroups, quotient groups with examples
- Recognize the structure preserving mappings
- Find the generators of a group Discuss about permutations and their produc

B.Sc. Mathematical Sciences
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SEMESTER –IV

SAM 202:Statistical Inference

No. of hrs/week: 4 **Credits: 4**

Preamble : Statistical inference is the process of drawing conclusions about populations or scientific truths from data. There are many modes of performing inference including statistical modeling, data oriented strategies and explicit use of designs and randomization in analyses.

Course Objectives:

- To estimate the parameter
- To estimate the population parameters using maximum likelihood method
- To learn two tailed tests
- To test the hypothesis using normal distribution
- To test the hypothesis for large sample tests
- To test the hypothesis for small sample tests
- To learn non-parameteric tests

UNIT-I

Theory of estimation: Estimation of a parameter, criteria of a good estimator – unbiasedness, consistency, efficiency, &sufficiency and. Statement of Neyman's factorization theorem. Estimation of parameters by the methods of moments and maximum likelihood (M.L), properties of MLE's. Binomial, Poisson &Normal Population parameters estimate by ML method. Confidence intervals of the parameters of normal population.

Learning Outcomes: The student will be able to:

- Estimate the population parameters
- Estimate the binomial population parameters
- Estimate poisson & normal population parameters
- Evaluate confidence intervals of the parameters

UNIT II

Concepts of Statistical hypothesis: Null and alternative hypothesis, critical region, two types of errors, level of significance, power of a test. 1 tailed, 2 tailed tests, Neyman - Pearson's lemma. Examples in of Binomial,Poisson, Normal distributions.

Learning Outcomes: The student will be able to:

- Test the hypothesis using one tailed test and two tailed test
- Evaluate Neyman-Pearson's lemma
- Testing of hypothesis using binomial, poisson, normal distributions

Unit-III

Large Sample Tests : Large sample tests for single mean, two means, Single proportion, Two proportions, Standard Deviation of single and double samples and Fisher's Z transformation .

Learning Outcomes: The student will be able to:

- Test the hypothesis for single mean, two means
- Test the hypothesis for single proportion and two proportions

- Test the hypothesis for standard diviation of single and double samples in Large samples

Unit-IV

Small sample tests: Tests of significance based on $\chi 2$, t and F. $\chi 2$-test for test for independence of attributes, t-test for single, double and paired tests, Variance Ratio Test(F-test).

Learning Outcomes: The student will be able to:

- Test the significance based on chi-square distribution, t- distribution, and F distribution
- Test for independence of attributes
- Test the hypothesis of t-test for single, double and paired

Unit-V

Non-parametric tests - Advantages and Disadvantages. Two sample run test, Two sample Median test and Two sample sign test.

Learning Outcomes: The student will be able to:

- Test non-parametes
- Explain two sample run test
- Explain two sample median test
- Explain two sample sign test

TEXT BOOKS

1. BA/BSc II year statistics - statistical methods and inference - Telugu Academy by A.Mohanrao, N.Srinivasa Rao, DrR.Sudhakar Reddy, Dr T.C. Ravichandra Kumar.
2. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI.

List of Reference Books:

1. V.K.Kapoor and S.C.Gupta : Fundamentals of Applied Statistics. Sultan Chand
2. ParimalMukhopadhyay : Applied Statistics . New Central Book agency,
3. Daroga Singh and Chowdhary: Theory and Analysis of Sample survey designs., Wiley Eastern.
4. M.R.Saluja : Indian Official Statistics. ISI publications.
5. B.L.Agarwal: Basic Statistics.New Age publications.
6. S.P.Gupta : Statistical Methods. Sultan Chand and Sons.
7. PratirupaSidhanthamulu - Telugu Academy.
8. PrayogaRachana and Visleshana - Telugu Academy.

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

- Estimate the population parameters
- Estimate the binomial population parameters
- Test the hypothesis using one tailed test and two tailed test
- Evaluate Neyman-Pearson's lemma
- Test the hypothesis for single mean, two means
- Test the hypothesis for single proportion and two proportions
- Test the significance based on chi-square distribution, t- distribution, and F distribution
- Explain two sample run test
- Explain two sample median test

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SEMESTER –IV

SAM 222:Statistical Inference Lab

No. of hrs/week: 3 **Credits: 2**

1. Large sample tests for mean(s).
2. Large sample tests for proportion(s).
3. Large sample tests for standard deviation(s).
4. Large sample tests for Fisher's Z- transformation.
5. Small sample tests for Single and Doublet-test.
6. Small sample tests for Paired t-test.
7. F-Test.
8. Chi square test for independence of attributes.
9. Non-parametric testst – run test.
10. Non-parametric tests - median test.
11. Non-parametric tests - sign tests.
12. MS-Excel methods for the above Serial Numbers 1,2,3,4.

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

- Estimate the population mean for large samples
- Estimate the population proportion for large samples
- Explain large saple tests for single and double test
- Evaluate Chi square test for independence of attributes
- Evaluate run test, median test, sign test

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SEMESTER –IV

SPH 210: Operating Systems

No. of hrs/week: 4 **Credits: 4**

Preamble: operating systems is an essential part of any computer science education. This field is undergoing rapid change, as computers are now prevalent in virtually every arena of day-to-day life—from embedded devices in automobiles through the most sophisticated planning tools for governments and multinational firms.

Objectives:

- To cover both traditional PC and server operating systems, as well as operating systems for mobile devices.
- To enlighten the concepts of distributed operating system, system calls and system programs.
- To explain process scheduling algorithms.
- To introduce memory management techniques.
- To give an over view of mass storage structure.

UNIT-I

Introduction : What Operating Systems do. Computer-System Architecture, Operating-System Structure, Operating-System Operations, Distributed Systems, Special-purpose Systems, Computing Environments.

System Structures: Operating-System Services, User Operating-System Interface, System Calls, Types of System Calls, System Programs. Operating-System Structure..

Learning Outcomes: By the end of this Unit, the student will be able to

- define what the operating system is.((L2)
- what is the role of operating system in the computational environment. (L1)
- what is the structure of operating system. (L1)

UNIT-II

Process Management

Process Concept, Process Scheduling, Operations on Processes.

Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling algorithms..

Learning Outcomes: By the end of this Unit, the student will be able to

- understand process scheduling. (L2)
- explain process scheduling algorithms.(L2)

UNIT-III

Process Coordination

Synchronization: Background, The Critical-Section Problem.

Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention..

Learning Outcomes: By the end of this Unit, the student will be able to

- Summarize the methods to handle dead locks.(L3)
- Learn how to avoid dead lock condition. (L1)

UNIT-IV

Memory Management

Memory-Strategies: Background, Swapping, Contiguous memory Allocation, Paging, Segmentation.

Virtual-Memory Management: Background, Demand Paging, Copy-on-write, page Replacement.

Learning Outcomes: By the end of this Unit, the student will be able to

- explain contiguous memory.(L3)
- elaborate concept of paging.(L3)
- summarize virtual memory management, demand paging. (L3)

UNIT-V

File Management

File Systems: File Concept, Access Methods, Directory and Disk Structure.

Secondary-Storage Structure: Overview of Mass-Storage Structure, Disk Structure, Disk Scheduling.

Learning Outcomes: By the end of this Unit, the student will be able to

- spell the concept of file system, access methods.(L1)
- make use of mass storage structure. (L3)

Course Outcomes: Upon completion of the course, the student is able to

- understand the concepts of distributed operating system, system calls and system programs.(L3)
- explain process scheduling algorithms.(L3)
- relate memory management techniques.(L3)
- understand mass storage structure. (L2)

Text book:

1. A.S Tanenbaum, Modern Operating Systems, 3rd edition., Prentice-Hall of India, 2008.

Reference books:

1. William Stallings, Operating Systems: Internals and design Principles, 5th edition., Prentice Hall of India, 2006.
2. Gary Nutt, Opearting Systems: A Modern Approach, 3rd edition., Addison Wesley, 2004.
3. D.M.Dhamdhere, Operating Systems: A Concept based Approach, 2nd edition., Tata McGraw-Hill, 2007.

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SEMESTER –IV

SPH 228: Operating Systems Lab

No. of hrs/week: 3 **Credits: 2**

1.Usage of following commands: ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, touch, cd.
2. Usage of following commands: cal, cat(append), cat(concatenate), mv, cp, man, date.
3. Usage of following commands: chmod, grep, tput (clear, highlight), bc.
4. Write a shell script to check if the number entered at the command line is prime or not.
5. Write a shell script to modify "cal" command to display calendars of the specified months.
6. Write a shell script to accept a login name. If not a valid login name display message – "Entered login name is invalid".
7. Write a shell script to display date in the mm/dd/yy format.
8. Write a shell script to display on the screen sorted output of "who" command along with the total number of users .
9. Write a shell script to display the multiplication table of any number.
10. Write a shell script to find the sum of digits of a given number.
11. Write a shell script to find the factorial of a given number.
12. Write a shell script to check whether the number is Armstrong or not.

Text Books:

1. Unix Shell Programming, Stephan G Kochan, Patrick Wood, Sams,3rd Edition,2003.
2. Introduction to Unix and Shell Programming,M.G. Venkateshmurthy, Pearson, 1st Edition, 2005.
3. Unix Concepts and Applications, Sumitabha Das, 4th Edition, TMH,2006.

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

- Write a shell script to check , modify, accept
- Write a shell script for display
- Write a shell for finding

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SEMESTER –IV

SSE 276 :Vector Calculus

No. of hrs/week: 2 **Credits: 2**

Limits of vector point functions:Scalar valued and vector valued point functions, limits, Directional derivatives along co-ordinate axis, along any line

Vector differentiation : Vector Differentiation, Ordinary derivatives of vectors, Differentiability, Tangent vector of a curve, Unit tangent vector, Principle normal, curvature, Binormal, Torsion, Frenet -Serret formulae and applications

Vector identities: Gradient, Divergence, Cur, their geometrical interpretations and Successive operations

Line , surface and Volume integrals : Line Integral, Surface Integral, Volume Integral,

Stokes theorem, , Gauss divergence theorem and applications, Greens Theorem and applications.

TEXT BOOK :-

1. Vector Calculus by Santhi Narayana Published by S. Chand & Company Pvt. Ltd., New Delhi.
2. Vector Calculus by R. Gupta Published by Laxmi Publications.
3. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
4. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd. 2002.
5. P.C. Matthew's, *Vector Calculus,* Springer Verlag London Limited, 1998.

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

- define limit of vector function demonstrate the vector differentiation with examples
- define gradient of a scalar function, divergence and curl of a vector function
- explain line, surface and volume integrals
- evaluate applications on Stokes theorem, Gauss divergence theorem, and Greens theorem

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SEMESTER –IV

SSE 278 :Number Theory

No. of hrs/week: 2 **Credits: 2**

Division algorithm, Lame's theorem, linear Diophantine equation, fundamentaltheorem of arithmetic, Prime counting function, statement of prime number theorem.

Goldbach conjecture, binary and decimal representation of integers, linearcongruences, complete set of residues.

Number theoretic functions, sum and number of divisors, totally multiplicativefunctions, definition and properties of the Dirichlet product,

The Möbius inversion formula, the greatest integer function, Euler's phi-function.

Books Recommended:

1. David M. Burton, *Elementary Number Theory* 6th Ed., Tata McGraw-Hill Edition, \Indian reprint, 2007.
2. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, *Applications of Abstract Algebra*
   with Maple, CRC Press, Boca Raton, 2000.
3. Neville Robinns, *Beginning Number Theory*, 2nd Ed., Narosa Publishing House Pvt. Limited, Delhi, 2007.

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

- Define division algorithm
- Demonstrate the fundamental theorem of arithmetic
- Explain prime number theorem
- Explain complete set of residues
- Evaluate problems using Möbius inversion formula
- Define Euler's phi-function

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER –IV

SSE 280 : E-Commerce

No. of hrs/week: 2 **Credits: 2**

Introduction to E-commerce- E-Commerce Business models and Concepts-Technology Infrastructure for E-commerce, The Internet and World Wide Web, E-Commerce Infrastructure, Building an E-Commerce website, Security and Payment .
Business Concepts and Social Issues-E-Commerce marketing Concepts, E-Commerce Marketing Communications, Ethical ,Social and Political Issues in E-commerce.
E-Commerce in Action – Online Retailing and Services, Online Content and Media, Social Networks, Auctions and Portals.

Text Books:

1. Kenneth C.Laudon, Carol GuercioTravere, E-Commerce:Business, Technology, Society, 4Th Edition, Pearson ,2008
2. P.T. Joseph, *E-Commerce: An Indian Perspective*, Prentice-Hall of India, 2007.
3. E.M. Awad, Electronic Commerce from Vision to Fulfillment, 3rd Ed., PrenticeHall of India, 2006
4. Scott Bonneau, Tammy Kohl, Jeni Tennison, Jon Duckett and Kevin Williams, XML Design Handbook, Wrox Press Ltd., 2003.
5. Michael Cheshar, Ricky Kaura, and Peter Linton, Electronic Business and Commerce, Springer, 2003.
6. W.J. Pardi, XML in Action: Learn to Quickly Create Dynamic, Data-driven Sites with the Web's Hottest New Technology, Prentice Hall of India, 1999.
7. P. Weill and M.R. Vitale, Place to Space: Migrating to eBusiness Models, Harvard Business School Press, 2001.
8. D. Whiteley, E-commerce: Strategy, Technologies and Applications, Tata McGraw-Hill Edition, 2001.
9. M. Fitzgerald, Building B2B Applications with XML: A Resource Guide, John Wiley and Sons, Inc., 2001.

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

- Introduce E-commerce
- Explain the concepts for E-commerce
- Explain the concepts for internet and www – e-commerce
- Explain business concepts and social issues
- Explain social and political issues in E-commerce

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SPH 361 : MATRICES

No. of hrs/week: 4 **Credits: 4**

Preamble : Matrix mathematics applies to several branches of science, as well as different mathematical disciplines. This course aims to provide basic concepts of vector spaces, matrix form of basic geometric transformations.

Objectives:
The focus of the course is to

- study the fundamental properties of matrices and applications of matrices in geometry, physics, chemistry, combinatorics and statistics.
- introduce vector spaces and subspaces
- discuss the fundamental properties of matrices , eigen values and eigen vectors
- study the rank of a matrix and its applications
- know the applications of matrices in geometry, physics, chemistry, combinatorics and statistics

UNIT-I
R, R^2, R^3 as vector spaces over R. Standard basis for each of them. Concept of Linear Independence and examples of different bases.Subspaces of R^2, R^3.

Learning Outcomes: The student will be able to:

- Define vector spaces over a field and subspaces
- Learn the concept of linear independence of vectors and linear dependence of vectors
- Define different bases of vector spaces

UNIT-II
Translation, Dilation, Rotation, Reflection in a point, line and plane.Matrix form of basic geometric transformations. Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Learning Outcomes: The student will be able to:

- Define translation, dilation, rotation, reflection
- Evaluate eigen values and eigen vectors of a matix
- Explain eigen spaces as invariant subspaces

UNIT-III
Types of matrices, Rank of a matrix, Invariance of rank under elementary transformations,Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four.

Learning Outcomes: The student will be able to:

- Explain different types of matrices
- Evaluate rank of matrix using various methods
- Explain solutions of linear and non-homogeneous equations

UNIT-IV

Matrices in diagonal form.Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix.

Learning Outcomes: The student will be able to:

- Explain reduction of matrices to diagonal form
- Evaluate inverse of a matrix using elementary row operations
- Explain rank of a matrix using different methods

UNIT-V

Solutions of a system of linear equations using matrices.Illustrative examples ofabove concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Learning Outcomes: The student will be able to:

- Explain solutions of a system of linear equations using matrices
- Evaluate system of linear equations
- Explain the applications of matrices in Geometry, Physics, Chemistry, combinatorics and statistics

Books Recommended

1. A.I. Kostrikin, *Introduction to Algebra*, Springer Verlag, 1984.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
3. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.

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

- Define vector spaces over a field and subspaces
- Learn the concept of linear independence of vectors and linear dependence of vectors
- Evaluate eigen values and eigen vectors of a matix
- Explain eigen spaces as invariant subspaces
- Evaluate rank of matrix using various methods
- Explain solutions of linear and non-homogeneous equations
- Evaluate inverse of a matrix using elementary row operations
- Explain rank of a matrix using different methods
- Explain the applications of matrices in Geometry, Physics, Chemistry, combinatorics and statistics

B. Sc. (Mathematics, Statistics, Computer Science)
SEMESTER – V
SPH 333: Matrices Tutorial/Lab

Hours per week: 2 **Continuous Evaluation: 100Marks**
Credits: 2

1. Problems on vector spaces
2. Problems on linear independence and dependence of vectors
3. Problems on eigen values and eigen vectors
4. Find rank of a matrix
5. Reduction to normal form
6. Solutions of linear and nonlinear homogeneous equations
7. Reduction to diagonal form
8. Computation of matrix inversion using elementary row operations

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

- Define vector space
- Differentiate linear independent and linear dependent of vectors
- Evaluate eigen values and eigen vectors of a matrix
- Find rank of a matrix using different methods
- Solve linear and nonlinear homogenous equations

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SPH 363 :STATICS AND DYNAMICS

No. of hrs/week: 4 **Credits: 4**

Preamble : This course deals with equilibrium of a particle, forces, centre of gravity, work and potential energy, tangential curves, simple harmonic motions

Objectives :

- To examine the conditions of equilibrium of a particle
- To examine the coplanar forces acing on a rigid body
- To evaluate problems of equilibrium under forces
- To evaluate radial and transverse components of a plane curve
- To evaluate tangential and normal components
- To solve the problems on simple harmonic motion and projectile motion

UNIT-I

Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body

Learning Outcomes: The student will be able to:

- Explain the conditions of equilibrium of a particle
- Explain the coplanar forces acting on a rigid body

UNIT-II

Laws of friction, Problems of equilibrium under forces including friction

Learning Outcomes: The student will be able to:

- Learn about laws of friction
- Evaluate problems of equilibrium under forces including friction

UNIT-III

Centre of gravity, Work and potential energy. Velocity and acceleration of a particle along acurve: radial and transverse components (plane curve)

Learning Outcomes: The student will be able to:

- Evaluate centre of gravity, velocity and acceleration of a particle
- Evaluate radial and transverse components of a plane curve

UNIT-IV

Tangential and normal components (space curve),

Learning Outcomes: The student will be able to:

- Evaluate tangential components of a space curve
- Evaluate normal components of a space curve

UNIT-V

Newton's Laws of motion, Simple harmonic motion ,Simple Pendulum, Projectile Motion.

Learning Outcomes: The student will be able to:

- solve the problems on simple harmonic motion
- solve the problems on projectile motion

Books Recommended

1. "Statics: A Text book for the Use of the Higher Divisions in Schools and for First Year Students at the Universities" by Arthur Stanley Ramsey published by CBS Publishers and Distributors (Indian Reprint), 1998.
2. "Statics and Dynamics with Background Mathematics" by Adrian Roberts published by CambridgeUniversity Press, 2003.

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

- Explain the conditions of equilibrium of a particle
- Explain the coplanar forces acting on a rigid body
- Evaluate problems of equilibrium under forces including friction
- Evaluate centre of gravity, velocity and acceleration of a particle
- Evaluate tangential and normal components of a space curve
- solve the problems on simple harmonic motion

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)
SEMESTER – V

SPH 365 :LINEAR ALGEBRA

No. of hrs/week: 4 **Credits: 4**

Preamble : Linear algebra applies to several branches of science, as well as different mathematical disciplines. This course aims to provide basic concepts of matrices, rank of a matrix and consistency of matrices. The focus of the course is to study the fundamental properties of matrices, applications of matrices ,vector spaces and inner product spaces.

Objectives :

- To define rank of a matrix and its applications
- To evaluate eigen values and eigen vectors of a matrix
- To study vector spaces, subspaces, basis of a vector spaces and dimension of a vector space
- To know the linear transformations of a vector space, product of linear transformations
- To define inner product space

UNIT – I

Matrices I : Rank of a matrix, Elementary transformations, normal form ,Echelon form , Rank of product of matrices ,System of homogeneous equations,Linear equations, Null space and nullity of matrices

Learning Outcomes: The student will be able to:

- Define rank of a matrix
- Evaluate rank of a matrix using normal form and echelon form
- Define rank of product of matrices
- Explain the method to solve system of homogeneous equations

UNIT – II

Matrices II : Condition for consistency, Crammers' rule,Characteristic values and characteristic vectors, Cayley- Hamilton theorem ,Inverse of a matrix using Cayley-Hamilton theorem, Minimal polynomial of a matrix.

Learning Outcomes: The student will be able to:

- Explain consistency of matrices
- Evaluate Crammer's rule
- Explain characteristic values and characteristic vectors of a matrix
- Evaluate minimal polynomial of a matrix

UNIT – III

Linear Algebra -I

Vector spaces, General properties of vector spaces, Vector subspaces, Algebra of subspaces, linear combination of vectors. Linear span, linear sum of two subspaces, Linear independence and dependence of vectors, Basis of vector space, Finite dimensional vector spaces, Dimension of a vector space, Dimension of a subspace.

Learning Outcomes: The student will be able to:

- Define vector spaces and vector subspaces with examples

- Explain linear combination of vectors
- Explain basis of vector space
- Explain dimension of a vector space

UNIT – IV

Linear Algebra - II

Linear transformations, linear operators, Range and null space of linear transformation, Rank and nullity of linear transformations, Linear transformations as vectors, Product of linear transformations, Invertible linear transformation.

Learning Outcomes: The student will be able to:

- Explain the concepts of linear transformations and linear operators
- Evaluate range and null space of linear transformation
- Explain rank and nullity of linear trasformations

UNIT – V

Inner product spaces

Inner product spaces, Euclidean and unitary spaces, Norm or length of a vector, Schwartz inequality, Orthogonality, Orthonormal al set, complete orthonormal set, Gram - Schmidt orthogonalisation process.

Learning Outcomes: The student will be able to:

- Define inner product spaces, Euclidean and unitary spaces
- Explain orthogonality, orthonormality of sets
- Explain Gram-Schmidt orthogonalisation process

Books Recommended

1. "A Text Book of B.Sc. Mathematics Volume-III" by V.Venkateswara Rao , N Krishna Murthy, B.V.S.S. Sarma and S. AnjaneyaSastry, published by S.Chand& Company Ltd., New Delhi.
2. "Linear Algebra" by A.R. Vasishtha and J.N. Sharma published by Krishna Prakashan Media (P) Ltd.
3. "Linear Algebra" by Kenneth Hoffman and Ray Alden Kunze published by Pearson Education (low priced edition), New Delhi.
4. "Linear Algebra" by Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, published by Prentice Hall of India Pvt. Ltd., 4th edition New Delhi, 2007.
5. "Rings and Linear Algebra" by Pundir, Pundir published by PragathiPrakashan

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

- Define rank of a matrix
- Evaluate rank of a matrix using normal form and echelon form
- Explain characteristic values and characteristic vectors of a matrix
- Evaluate minimal polynomial of a matrix

- Explain basis of vector space
- Explain dimension of a vector space

- Evaluate range and null space of linear transformation
- Explain rank and nullity of linear trasformations

- Explain orthogonality, orthonormality of sets

B. Sc. (Mathematics, Statistics & Computer Science)
SEMESTER – V
SPH 337: Linear Algebra Tutorial/Lab

Hours per week: 2 Continuous Evaluation: 100Marks
Credits: 2

- Find rank of a matrix Reduction to normal form and Echelon form
- Problems on eigen values and eigen vectors
- Problems on Cayley-Hamilton theorem
- Find inverse of a matrix using Cayley-Hamilton theorem
- Problems on Vector spaces
- Problems on subspaces
- Problems on Linear independence and dependence of vectors
- Problems on Basis of vector space
- Problems on dimension of a vector space
- Problems on linear transformations Problems on inner product spaces

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

- Define vector space
- Differentiate linear independent and linear dependent of vectors
- Evaluate eigen values and eigen vectors of a matrix
- Find rank of a matrix using different methods
- Solve problems on subspaces and dimension of a vector space
- Define inner product space

B.Sc. Mathematical Sciences
SEMESTER – V

SAM 351: Sampling Techniques and Design of Experiments

No. of hrs/week: 4 **Credits: 4**

Preamble : Samples can be drawn in statistically rigorous and careful ways, using random selection and control methods. We will examine simple random sampling that can be used for sampling persons or records, cluster sampling that can be used to sample groups of persons or records or networks, stratification which can be applied to simple random and cluster samples, systematic selection, and stratified multistage samples. Learn modern experimental strategy, including factorial and fractional factorial experimental designs, designs for screening many factors, designs for optimization experiments, and designs for complex experiments such as those with hard-to-change factors and unusual responses. Applications include electronics and semiconductors, automotive and aerospace, chemical and process industries, pharmaceutical and bio-pharm, medical devices, and many others.

Objectives :

- To explain types of sampling
- To explain mixed sampling methods
- To explain random sampling
- To estimate population mean , variances in SRSWR & SRSWOR
- To optimize allocation of sample sizes in stratification
- To explain systematic sampling
- To explain analysis of variance for one way and two way classifications
- To design of experiments for completely randomized design, Randomised block design, and Latin square design

Unit-I

Sampling Theory: Principle steps in a sample survey, Censes versus sample survey, sampling and Non-sampling errors. Types of sampling - subjective, probability and mixed sampling methods.

Learning Outcomes: The student will be able to:

- Define sampling
- Explain types of sampling
- Explain subjective, probability and mixed sampling methods

Unit-II

Simple Random Sampling: Meaning of Samples and methods to draw, estimation of population mean, variances in SRSWR& SRSWOR.

Learning Outcomes: The student will be able to:

- Estimate population mean
- Estimate population variance

Unit-III

Stratified random sampling: Proportional and optimum allocation of sample sizes in stratification. Variances in these methods. Systematic sampling : Systematic sampling when N = nk comparison of their relative efficiencies. Advantages and Disadvantages of above methods of sampling.

Learning Outcomes: The student will be able to:

- Explain proportional and optimum allocation of sample sizes in stratification
- Evaluate variance in stratified random sampling
- Explain advantages and disadvantages for methods of sampling

Unit-IV

Analysis of Variance: One way with equal and unequal classifications and two way classifications.

Learning Outcomes: The student will be able to:

- Explain analysis of variance for one way classification
- Explain analysis of variance for two way classification

Unit - V

Design of Experiments:Principles of experimentation in Designs, analysis of completely randomised design (CRD), Randomised block design (RBD) and Latin square design (LSD) including one missing observation .efficiency of these designs and concept of factorial Experiment.

Learning Outcomes: The student will be able to:

- Analyze completely randomized design
- Analyze randomized block design
- Analyze Latin square design

Text Books:

1.TeluguAcademyBA/BSc III year paper - III Statistics - applied statistics - Telugu academy by prof.K.Srinivasa Rao, Dr D.Giri. Dr A.Anand, Dr V.PapaiahSastry.

2. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI.

Reference Books:

1.Fundamentals of applied statistics : VK Kapoor and SC Gupta.
2.Indian Official statistics - MR Saluja.
3.AnuvarthitaSankyakaSastram- Telugu Academy.

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

- Explain types of sampling
- Explain subjective, probability and mixed sampling methods
- Estimate population mean
- Estimate population variance
- Explain advantages and disadvantages for methods of sampling
- Explain analysis of variance for one way classification
- Explain analysis of variance for two way classification
- Analyze completely randomized design
- Analyze randomized block design
- Analyze Latin square design

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SAM 321: Sampling Techniques and Design of Experiments Lab

No. of hrs/week: 3 **Credits: 2**

1. Estimation of population Mean, variance by SRSWOR.
2. Estimation of population Mean, variance by SRSWR.
3. Comparison of proportional, optimum allocations with SRSWOR.
4. Systematic Sampling .
5. ANOVA-CRD.
6. ANOVA - RBD with one missing observation.
7. ANOVA - LSD with one missing observation.
8. Ms-excel practicals.

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

- Estimate population mean and population variance
- Compare proportional, optimum allocations
- Analyze systematic sampling
- Analyze completely randomized design
- Analyze randomized block design
- Analyze Latin square design

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SAM 353 Statistical Quality Control and Reliability

No. of hrs/week: 4 **Credits: 4**

Preamble : Statistical Quality Control referes to the use of statistical methods in the monitoring and maintaining of the quality of products and services

Objectives :

- To explain importance of statistical quality control in industry
- To interpret control charts and control limits
- To construct X-bar and R charts for variables
- To construct NP, P and C charts
- To explain consumer's risk
- To explain single and double sampling plans
- To estimate reliability
- To explain exponential distribution as life model.

Unit-I

Statistical Quality Control: Importance of SQC in industry, statistical basis of shewart control charts, uses of control charts. Interpretation of control charts, control limits, Natural tolerance limits and specification limits.

Learning Outcomes: The student will be able to:

- Explain importance of statistical quality control in industry
- Explain uses of control charts
- Interpret control charts and control limits

Unit – II

Variable Control Chart: Construction of $\overline{X}$, R charts for variables, Attribute control charts- NP, P charts, C chart.

Learning Outcomes: The student will be able to:

- Construct X-bar and R charts for variables
- Construct NP charts
- Construct P and C charts

Unit-III

Acceptance sampling plans: Scope, Producer's risk and consumer's risk .Concepts of AQL and LTPD.

Learning Outcomes: The student will be able to:

- Explain sampling plans
- Explain Producer's and consumer's risk

Unit-IV

Sampling Plans: Single and double sampling plans, OC and ASN functions, Double and single Sampling plans for attributes using Binomial.

Learning Outcomes: The student will be able to:

- Explain single and double sampling plans

- Explain double and single sampling plans

Unit-V

Reliability: Introduction, failure rates, Hazard function, estimation of reliability, exponential distribution as life model, its memory less property.

Learning Outcomes: The student will be able to:

- Define hazard function
- Estimate reliability
- Explain exponential distribution as life model

List of Reference Books:

1. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of applied statistics, Sultan Chand & Sons.
2. Gupta, R.C.(1974): Statistical Quality Control.
3. Montgomery, D.C. (1983): Introduction to Statistical Quality Control, John Waley& Sons.
4. Ekambaram, S K. (1963): Statistical basis of Acceptance sampling, Asia Publishing House.
5. Grant, E,L. and Laven Worth, R.S.: Statistical Quality Control, McGraw Hill.

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

- Explain uses of control charts
- Interpret control charts and control limits
- Construct X-bar and R charts for variables
- Construct NP charts
- Explain sampling plans
- Explain Producer’s and consumer’s risk
- Explain double and single sampling plans
- Define hazard function
- Estimate reliability

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SAM 353 Statistical Quality Control and Reliability Lab

No. of hrs/week: 3 **Credits: 2**

1.Construction of($\overline{X}$,R) charts.

2.Construction of P-chart-Fixed sample size.

3. Construction of P-chart-variable sample size.

4.Construction of NP-Chart .

5.Construction of C-Chart.

6.MS-Excel methods for the Serial Numbers 1.

7.MS-Excel methods for the Serial Numbers 2 to 4.

8. Problems on Reliability

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

- Construct X-Bar and R charts
- Construct P , NP and C- charts
- Evaluate problems on reliability

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SAM 355 STOCHASTIC PROCESS

No. of hrs/week: 4 **Credits: 4**

Preamble :A stochastic process is a mathematical object defined as a family of random variables. Stochastic process are widely used as mathematical models of systems and phenomena that appear to vary in a random manner.

Objectives :

- To define stochastic proess
- To classify general stochastic processes into discrete and continuous time
- To define Markov chain, transition probability matrix
- To evaluate basic limit theorm of Markov chain
- To explain pure birth process and poisson process
- To explain birth and death process
- To define discrete time branching process

UNIT – I
Basic Concepts : Definition and examples of stochastic process, classification of general stochastic processes into discrete and continuous time, discrete and continuous state spaces, types of stochastic processes, elementary problems.
Learning Outcomes: The student will be able to:
- Define stochastic process
- Classify general stochastic processes into discrete and continuous time
- Explain types of stochastic processes

UNIT – II
Markov chains-I : Definition and examples of Markov chain, Transition Probability Matrix, classification of states, recurrence, simple problems.
Learning Outcomes: The student will be able to:
- Define Markov chain
- Explain transition probability matrix
- Classify the states

UNIT – III
Markov chains-II: Basic limit theorem of Markov chain (statement only), stationary probability distribution, applications.
Learning Outcomes: The student will be able to:
- Explain basic limit theorem of Markov chain
- Explain applications of Markov chains

UNIT – IV

Continuous Time Markov chain : Pure birth process and Poisson process, Birth and Death process, problems.

Learning Outcomes: The student will be able to:

- Explain pure birth process
- Explain poisson process
- Explain birth and death process

UNIT – V

Branching process : Definition and examples of discrete time branching process, probability generating function, mean and variance, probability of extinction,simple problems.

Learning Outcomes: The student will be able to:

- Define discrete time branching process
- Explain probability generating function

List of Reference Text Books :

1. Karlin, S. and Taylor, H.M. (1975): A first course in Stochastic processes, Academic press.
2. Hoel, P.M.G., Port, S.C. and Stone, C.J. (1991): Introduction to Stochastic processes, Universal Book Stall.
3. Parzen, E. (1962): Stochastic processes, Holden-Day.
4. Cinlar, B. (1975) Introduction to Stochastic processes, Prentice Hall.
5. Adke, S.R. and Manjunath, S.M. (1984): An introduction to Finite Markov Processes, Wiley Eastern.
6. Medhi, J. (1996): Stochastic processes, New Age International (p) Ltd.
7. Ross, S.M. (1983): Stochastic processes, John Wiley.
8. Taylor, H.M. and Karlin, S. (1999): Stochastic Modelling, Academic press

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

- Define stochastic process
- Classify general stochastic processes into discrete and continuous time
- Define Markov chain
- Explain transition probability matrix
- Explain basic limit theorem of Markov chain
- Explain pure birth process
- Explain poisson process
- Define discrete time branching process

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SAM 325 STOCHASTIC PROCESS LAB

No. of hrs/week: 3 **Credits: 2**

1. Problems on Markov Chain
2. Continuous time Markov chain problems
3. Problems on branching process

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

- Evaluate problems on Markov chain
- Evaluate continuous time Markov chain problems
- Evaluate problems on branching process

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V
SPH 391 : Data Mining

No. of hrs/week: 4 **Credits: 4**

Preamble: Data mining techniques addresses the major latest techniques of discovering knowledge from a data warehouse. They contain algorithms for discovering association rules, decision trees, clustering neural networks, genetic algorithms.

Objectives :

- To make the student to understand the major tasks performed in data mining.
- To infer the statistical perspective of data mining.
- To identify the clustering algorithms.

UNIT-I

Introduction: Basic Data Mining tasks, Classification, Regression, Time series analysis, Prediction, Clustering, Summarization, Association rules, Data mining versus Knowledge discovery in databases.

Learning Outcomes: By the end of this Unit, the student will be able to

- Outline the data mining tasks. (L2)
- Make use of prediction, Clustering, Summarization. (L3)

UNIT-II

The Development of Data Mining : Data Mining Issues, Social Implication of Data Mining, Data Mining from a Database, Perspective Data Mining Techniques, Statistical Perspectives of Data Mining, Similarity Measures, Decision Trees.

Learning Outcomes: By the end of this Unit, the student will be able to

- Outline Perspective data mining techniques. (L2)
- Apply similarity measure in clustering. (L3)
- Develop Decision tree. (L3)

UNIT-III

Classification : Issues in Classification, Statistical Based Algorithms, Distance Based Algorithms, Decision Tree Based Algorithms.

Learning Outcomes: By the end of this Unit, the student will be able to

- Illustrate Statistical Based Algorithms. (L3)
- Make use of distance based algorithms. (L3)
- Examine Decision tree based algorithms. (L4)

UNIT-IV

Clustering : Introduction, Similarity and Distance Measures, Outliers, Hierarchical Algorithms, Partitional Algorithms, Minimum Spanning Tree, Squared Error Clustering Algorithm, K-Means Clustering, Nearest Neighboring Algorithm.

Learning Outcomes: By the end of this Unit, the student will be able to

- Choose Hierarchical Algorithms.(L1)
- Summarize Partitional Algorithms. (L2)
- Organize clusters using K-Means Algorithm. (L3)

UNIT-V

Association Rule: Introduction, Large Item Sets, Basic Algorithms, Apriori Algorithm, Sampling Algorithm, Partitioning, Parallel and distributed algorithms, Data parallelism, Task parallelism.

Learning Outcomes: By the end of this Unit, the student will be able to

- Explain Apriori Algorithm. (L2)
- Identify Parallel and Distributed algorithms. (L3)

Course Outcomes: Upon completion of the course, the student is able to

- relate the steps in knowledge discovery process. (L2)
- identify perspective data mining techniques. (L4)
- examine the data mining techniques. (L3)

Text Book:

1. Data Mining- Introductory and Advanced topics by Margaret H.Dunham, Pearson Education, sixth impression, 2009.
2. Data mining Techniques by Arun Pujari, University Press, 2001.
3. Introduction to Data mining with Case Studies by G.K.Gupta, PHI India, 2006.

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V
SPH 343 : Data Mining Lab

No. of hrs/week: 3 **Credits: 2**

1. Introduction to the Weka machine learning tool kit.
2. Performing data preprocessing for data mining in Weka.
3. Classification using the Weka tool kit
4. Performing clustering in Weka
5. Association rule analysis in Weka
6. Data mining Case Study

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

- Introduce Weka machine learning tool kit
- Perform data preprocessing for data mining
- Perform clustering
- Analyze association rules in Weka

B.Sc.Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SPH 393 :CRYPTOGRAPHY

No. of hrs/week: 4 **Credits: 4**

Preamble: Cryptography is the cornerstone of computer and communications security. Its foundation is based on various concepts of mathematics such as number theory, computational-complexity theory. The course explains how programmers and network professionals can use cryptography to maintain the privacy of computer data.

Objectives :

- To brief the security goals, security services and mechanisms.
- To outline different Ciphers.
- To explain different data encryption techniques.
- To brief public Key encryption algorithms.
- To outline message authentication and Hash functions.

UNIT - I

Introduction : Security goals- Confidentiality, Integrity, Availability, Attacks- Attacks threatening Confidentiality, Attacks Threatening Integrity, Attacks Threatening Availability, Passive versus Active Attacks, Services and Mechanism - Security Services, Security Mechanisms, Relation Between Services and Mechanisms, Techniques- Cryptography, Steganography

Learning Outcomes: By the end of this Unit, the student will be able to

- Spell security Goals.(L1)
- Differentiate between Passive attacks and Active attacks.(L1)
- Identify the relationship between Services and Mechanisms. (L2)

UNIT – II

Traditional Symmetric Key Ciphers : Introduction- Kerckhoff's Principle, Cryptanalysis, Categories of Traditional ciphers, Substitution Ciphers- Mono alphabetic ciphers, Poly alphabetic Ciphers, Transposition Ciphers- Keyless Transposition Ciphers, Keyed Transposition Ciphers, Combining two approaches

Learning Outcomes: By the end of this Unit, the student will be able to

- Discover Traditional Ciphers. (L3)
- Able to perform Crypta analysis. (L3)

UNIT-III

Data Encryption Techniques: Algorithms for block and stream ciphers, Symmetric key Encryption, Data Encryption Standard , Advanced Encryption Standard, RC4.

Learning Outcomes: By the end of this Unit, the student will be able to

- Understand Block and Stream Ciphers. (L3)
- Summarize Data Encryption Standards. (L2)

UNIT-IV

Algorithms for public key encryption : RSA, DH Key exchange, Digital Signatures. .

Learning Outcomes: By the end of this Unit, the student will be able to

- Explain RSA Encryption Algorithm. (L3)
- Infer Digital Signature. (L3)

UNIT –V

Message authentication and Hash functions: SHA, WHIRLPOOL

Learning Outcomes: By the end of this Unit, the student will be able to

- Analyze message Authentication. (L3)
- Appraise SHA, WHIRLPOOL. (L5)

Text Book:

1. Cryptography and Network Security, Behrouz A. Forouzan, Tata McGraw-Hill, New Delhi., Special Indian Edition, 2007 (Unit I and Unit II)
2. Cryptography and Network Security Principles and Practices, 4th Ed, Prentice-Hall of India, 2006.
3. (Unit III, Unit IV and Unit V)

Reference Books:

1. Cryptography and Network Security, William Stallings, 4th Edition, 2006 Pearson Education, Asia, New Delhi.
2. Cryptography and Network Security: AtulKahate, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003

Course Outcomes: By the end of the course the student is able to

- Know the importance of security goals, security services and mechanisms.
- Distinguish between plain text and Cipher text.
- Know RSA public Key encryption algorithm.
- Explain message authentication and Hash functions

B.Sc.Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SPH 345 :CRYPTOGRAPHY LAB

No. of hrs/week: 3 **Credits: 2**

1) Study of various cryptographic techniques.
2) Problems on Substitution techniques.
3) Problems on Transposition techniques.
4) Introduction to Unix, Vi Editor.
5) Usage of the following commands in unix: ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, cd.
6) Usage of following commands in unix :cal, cat(append), cat(concatenate), mv, cp, man, date.
7) Implement Substitution technique
8) Implement Transposition technique.
9) Study of Open SSL.
10) Implement Symmetric key Algorithm – DES using open SSL.
11) Implement Asymmetric key Algorithm – RSA using open SSL.
12) Implement Hash Algorithm – SHA using open SSL.

Text Books:

1.Cryptography and Network Security by Behrouz A. Forouzan, TMH, Special Indian Ed. 2007.
2.Unix Concepts and Applications ,Sumitabha Das, 4th Edition, TMH,2006.

Reference Books:

1. Introduction to Unix and Shell Programming M.G. Venkateshmurthy, Pearson, 1st Edition,2005.

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

- Implement substitution technique
- Implement transposition technique
- Study SSL
- Implement symmetric and asymmetric key algorithms
- Implement Hash algorithm

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SSE 375 :Theory of Equations

No. of hrs/week: 2 **Credits: 2**

General properties of polynomials, Graphical representation of a polynomials, maximum and minimum values of a polynomials

Quadratic Equations, General properties of equations, Descarte's rule of signs positive and negative rule,

Relation between the roots and the coefficients of equations. Symmetric functions, Applications symmetric function of the roots

Transformation of equations.Solutions of reciprocal and binomial equations.

Algebraic solutions of the cubic and biquadratic.Properties of the derived functions.

Books Recommended

1. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.
2. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.

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

- Explain properties of polynomials and graphical representation
- Explain quadratic equations
- Differentiate between roots and the coefficients of equations
- Explain tansformation of equations
- Solve cubic and biquadratic equations.

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SSE 377 :Probability and Statistics

No. of hrs/week: 2 **Credits: 2**

Meaning and Scope of the Statistics Introduction, Frequency distribution, Graphic representation of a frequency distribution, measures of central tendency , measures of dispersion, coefficients ofdispersion, moments, skewness, kurtosis

Introduction, meaning of correlation, Karl Pearson s coefficient of correlation, rank correlation.Linear regression, Curve fitting, fitting of straight line, fitting of second degree parabola.

Probability **:** Introduction, definition, axiomatic approach to probability, probability-mathematical notation, probability function, law of addition of probabilities, multiplication law of probability and conditional law of probability, independent events, Baye s theorem.

Random variables and distribution functions: One and two dimensional random variables (discrete and continuous).

Probability distribution: Discrete distributions Binomial, Poisson distributions and their properties and applications.

Prescribed Text Book :

1. "Fundamentals of Mathematical Statistics" by S.C. Gupta and V.K. Kapoor published by Sultan Chand & Sons
2. "Statistical Methods Combined Edition (Volumes I & II)" by N G Das published by McGraw Hill, 2008,1st edition.
3. "Statistical Methods: Concepts, Application and Computation" by Y.P. Aggarwal published by Sterling Publishers, 1998.
4. "Introduction to Mathematical Statistics" by Robert V. Hogg, Joseph W. Mckean, Allen Thornton Craig published by Pearson Education, Asia, 2007.
5. "Mathematical Statistics with Applications" by Irwin Miller and Marylees Miller published by Pearson Education, Asia, 2006,7th edition.
6. "Introduction to Probability Models" by Sheldon M. Ross published by Academic Press, IndianReprint, 2007, 9th edition.

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

- Explain measures of central tendency
- Explain measures of dispersion Differentiate between correlation coefficient and regression
- Define probability Differentiate discrete probability distribution and continuous probability distribution

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – V

SSE 379 :Combinatorial Optimization

Credits :2 Continous Evaluation:100 Marks

Introduction
Optimization problems, neighbourhoods, local and global optima, convex sets and functions, simplex method, degeneracy; duality and dual simplex algorithm, computational considerations for the simplex and dual simplex algorithms-Dantzig-Wolfe algorithms.

Integer Linear Programming
Cutting plane algorithms, branch and bound technique and approximation algorithms for travelling salesman problem.

Text Books:

1. Combinatorial Optimization: Algorithms and Complexity by C.H. Papadimitriou and K. Steiglitz, Prentice-Hall of India, 2006
2. Optimization by K. Lange, Springer, 2004.
3. Linear Programming and Network Flows by Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, John Wiley and Sons, 2004.
4. Operations Research: An Introduction by H.A. Taha, 8th Ed., Prentice Hall, 2006.

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

- Explain formulation of mathematical problem for given business problem
- Explain simplex method to solve linear programming problem
- Differentiate between simplex and dual simplex algorithms
- Explain integer linear programming

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SPH 362 :NUMERICAL METHODS

No. of hrs/week: 4 **Credits: 4**

Preamble: Numerical analysis is the study of algorithms that use numerical approximation for the problems of mathematical analysis. Numerical analysis naturally finds application in all fields of engineering and the physical sciences. Numerical analysis can only be applied to real-world measurements by translation into digits; it gives approximate solutions within specified error bounds.

Objectives: The course is framed to extend the student's knowledge about understanding numerical techniques

- to solve various categories of problems.
- It will also help in developing deep understanding of the approximation techniques and problem solving capabilities.

UNIT – I

Errors in Numerical computations : Errors and their Accuracy, Mathematical Preliminaries, Errors and their Analysis, Absolute, Relative and Percentage Errors, A general error formula, Error in a series approximation.

Learning Outcomes: After studying this unit the student can Understand the different types of errors in numerical computation Know the rules to round off a given number Understand a general error formula and also error in a series approximation

UNIT – II

Solution of Algebraic and Transcendental Equations: The bisection method, The iteration method, The method of false position, Newton Raphson method, Generalized.

Learning Outcomes: After studying this unit the student can

- Understand the usage of intermediate value theorem in locating the roots of an equation
- Understand the techniques of bisection method, iteration method, method of false position and also Newton-Raphson method and generalized Newton-Raphson method to find a real root of the given equation

UNIT – III

System of Simultaneous Equations : Direct methods, Gauss Elimination Method, LU decomposition,
Iterative Methods **:** Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.

Learning Outcomes: After studying this unit the student can

- Understand the direct methods such as Gauss elimination method and LU decomposition method to solve the given system of equations
- Understand the iterative techniques such as Gauss-Jacobi, Gauss-Siedel and SOR iterative methods to solve the given system of equations numerically

UNIT – IV

Lagrange and Newton Divided difference interpolation: linear and higher order,

Finite difference Operators:Newton forward and backwardInterpolations,Central Difference Interpolation Formulae, Gauss's central difference formulae, Stirling's central difference formula, Bessel's Formula

Learning Outcomes: After studying this unit the student can

- Understand the problem of interpolation Know the interpolation techniques when the nodes are evenly spaced
- Know the interpolation techniques when the nodes are unevenly spaced
-

UNIT –V

Numerical differentiation: forward difference, backward difference and central Differences. Integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule

Learning Outcomes : After studying this unit the student can

- Understand the problem of numerical differentiation and numerical integration
- Know the techniques for numerical differentiation with finite difference operators
- Know the techniques of Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule

Recommended Books

1. "Introductory Methods of Numerical Analysis" by S.S.Sastry published by Prentice Hall of India Pvt. Ltd., New Delhi. (Latest Edition)
2. "Higher Engineering Mathematics" by B.S. Grewal published by Khanna Publishers
3. "Mathematical Methods" by G. Shanker Rao published by I.K. International Publishing House Pvt. Ltd.
4. "Finite Differences and Numerical Analysis" by H.C Saxena published by S. Chand and Company, Pvt. Ltd., New Delhi.

Course Outcomes:

- Able to understand the numerical techniques for various category of problems
- Able to develop algorithms for approximation techniques

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SPH 364 :Complex Analysis

No. of hrs/week: 4 **Credits: 4**

Preamble: Complex analysis is the branch of mathematical analysis that investigates functions of complex numbers and it is known as the theory of functions of a complex variable. Complex analysis naturally finds application in all fields of engineering and the physical sciences. Complex analysis can be applied to real-world problems

Objectives: To introduce

- Basic properties of complex numbers
- Cauchy-Riemann equations
- Analytical functions
- Contours and their properties
- Expansion of the function using taylor's series

UNIT-I

Limits, Limits involving the point at infinity, continuity.Properties of complexnumbers, regions in the complex plane, functions of complex variable, mappings.
Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Learning Outcomes: The student will be able to:

- Define limits and continuity
- Explain properties of complex numbers
- Evaluate problems using Cauchy Riemann equations
- Explain differentiation formulas and conditions for differentiability

UNIT-II

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions.

Learning Outcomes: The student will be able to:

- Define analytical function with examples
- Evaluate analytical functions for exponential, logarithmic, and trigonometric
- Explain derivatives of functions

UNIT-III

Definite integrals of functions.Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals.

Learning Outcomes: The student will be able to:

- Explain definite integrals of functions
- Describe contours, contour integrals and its properties
- Evaluate problems on upper bounds for moduli of contour integrals

UNIT-IV

Cauchy-Goursat theorem, Cauchy integral formula.Liouville's theorem and the fundamental theorem of algebra.Convergence ofsequences and series, Taylor series and its examples.

Learning Outcomes: The student will be able to:

- Explain Cauchy Goursat theorem and its applications
- Explain Cauchy integral formula with applications
- Evaluate problems on convergence of sequences and series
- Explain Taylor's series with examples

UNIT-V

Laurent series and its examples, absolute and uniform convergence of power series.

Learning Outcomes: The student will be able to:

- Evaluate problems on Laurent series
- Explain absolute convergence of power series
- Explain uniform convergence of power series

Books Recommended

1. "Complex Analysis for Mathematics and Engineering" by John H. Mathews and Russell W. Howell published by Jones and Bartlett publishers, 5th edition.
2. "Complex Variables and Applications" by James Ward Brown and Ruel Vance Churchill published by Mc Graw-Hill Higher Education, 8th edition.
3. "Complex Analysis" by Joseph Bak and Donald J. Newman published by Springer-Verlag New York, Inc., New York, 1997,2nd edition.

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

- Explain properties of complex numbers
- Evaluate problems using Cauchy Riemann equations
- Define analytical function with examples
- Evaluate analytical functions for exponential, logarithmic, and trigonometric
- Explain definite integrals of functions
- Describe contours, contour integrals and its properties
- Explain Cauchy integral formula with applications
- Evaluate problems on convergence of sequences and series
- Explain absolute convergence of power series
- Explain uniform convergence of power series

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SPH 366 :Linear Programming

No. of hrs/week: 4 **Credits: 4**

Preamble: Linear programming is a mathematical technique for maximizing or minimizing a linear function of several variables, such as output. Linear programming is a part of operations research. Linear programming finds application in all fields of engineering, physical sciences and life sciences. Linear programming can be applied to solve real world problems.

Course Objectives:

- To introduce formulation of linear programming model
- To discuss the methods to solve linear programming problems
- To study the optimality and unboundedness in a linear programming problem
- To know the applications of sensitivity analysis

Unit-I

Linear Programming Problems, Graphical Approach for Solving some Linear Programs.Convex Sets, Supporting and Separating Hyperplanes.

Learning Outcomes: The student will be able to:

- Formulate linear programming model for a business problem
- Explain graphical approach to solve linear programming problem
- Evaluate problems on convex sets
- Explain about hyperplanes

Unit-II

Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format

Learning Outcomes: The student will be able to:

- Explain simplex method to solve linear programming problem
- Evaluate optimality and unboundedness in a linear programming problem
- Evaluate problems using simplex algroithm

Unit-III

Introduction to artificial variables, two-phase method, Big-M method and their comparison.

Learning Outcomes: The student will be able to:

- Solve problems on two phase method
- Explain problems on Big-M method
- Compare two phase method and Big-M method

Unit-IV

Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual

Learning Outcomes: The student will be able to:

- Explain duality and formulation of the dual problem
- Differentiate primal- dual problems
- Explain economic interpretation of the dual problem over primal problem

Unit-V

Sensitivity analysis.

Learning Outcomes: The student will be able to:

- Study the uncertainty in the output of a mathematical model which can be divided and allocated to different sources of uncertainty in its inputs
- Provide examples using sensitivity analysis
- Apply sensitivity analysis on various problems

Recommended Books

1. "Operations Research" by S.D. Sharma published by Kedarnath and Ramnath Co.
2. "Linear Programming and Network Flows" by Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali published by John Wiley and Sons, India, 2004, 2nd edition.
3. "Introduction to Operations Research" by Frederick S. Hiller and Gerald J. Lieberman published by TataMcGraw Hill, Singapore, 2004, 8th edition.
4. "Operations Research: An Introduction" byHamdy A. Taha published byPrentice-HallIndia, 2006, 8th edition.

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

- Formulate linear programming model for a business problem
- Explain graphical approach to solve linear programming problem
- Evaluate optimality and unboundedness in a linear programming problem
- Evaluate problems using simplex algorithm
- Explain problems on Big-M method
- Compare two phase method and Big-M method
- Explain duality and formulation of the dual problem
- Differentiate primal- dual problems
- Study the uncertainty in the output of a mathematical model which can be divided and allocated to different sources of uncertainty in its inputs
- Provide examples using sensitivity analysis

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B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SAM 352 :Optimization Techniques

No. of hrs/week: 4 **Credits: 4**

Preamble: Optimization techniques have gained importance to solve many engineering design problems by developing linear and nonlinear mathematical models. The aim of this course is to educate the student to develop a mathematical model by defining an objective function and constraints in terms of design variables and then apply a particular mathematical programming technique.

Objectives:

- To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
- To state single variable and multi variable optimization problems, without and with constraints.
- To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
- To state transportation and assignment problem as a linear programming problem to determine optimality conditions by using Simplex method.
- To explain optimal solutions for sequencing problems with n jobs

UNIT-I

Linear Programming: Linear Programming Problem (LPP), Mathematical Formulation, Graphical method of solution of LPP with two variables, Some exceptional cases, General LPP, Canonical and Standard forms of LPP.

Learning Outcomes: The student will be able to:

- define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
- state single variable and multi variable optimization problems, without and with constraints.

UNIT-II

Simplex Method: Simplex Method, Artificial variables, Big-M and Two-phase simplex Methods, Revised simplex Method, Degeneracy in Linear Programming

Learning Outcomes: The student will be able to:

- explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
- Explain Big-M method
- Explain Two-phase simplex method
- Explain degeneracy in Linear Programming

UNIT-III

Duality in Linear programming: Introduction, Formulation of a dual problem,

Properties of duality, Application of duality to solve LPP, Dual simplex method.

Learning Outcomes: The student will be able to:

- Formulate dual problem
- Explain properties of duality
- Explain application of duality to solve Linear programming problem
- Explain dual simplex method

UNIT-IV

Transportation and Assignment Problems: Introduction and LP formulation of Transportation Problem, Methods to find Initial basic feasible solutions of transportation problem, Transportation Algorithm (MODI Method) to obtain optimal solution. Assignment problem- Mathematical formulation, Hungarian Method of solution.

Learning Outcomes: The student will be able to:

- state transportation and assignment problem as a linear programming problem to determine optimality conditions by using Simplex method.

UNIT-V

Sequencing Problem: Introduction, Basic terminology, Algorithms to obtain optimal solutions for sequencing problems with n jobs and two machines and n jobs and k machines

Learning Outcomes: The student will be able to:

- explain optimal solutions for sequencing problems with n jobs

List of reference books:

1. KantiSwarup, P.K Gupta and Manmohan: Operations Research, Sultan Chand and Sons
2. Hamdy A Taha, Operations Research: An Introduction, Pearson Education
3. S.D Sharma: Operations Research, Kedarnath, Ramnath& Co.
4. H.M. Wagner: Principles of Operations Research, Prentice Hall of India.
5. G. Hadley: Linear Programming, Narosa Book Distributors
6. Gass: Linear Programming, Mc Graw Hill.

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

- define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
- explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
- Explain Big-M method
- Explain Two-phase simplex method
- Explain application of duality to solve Linear programming problem
- Explain dual simplex method
- state transportation and assignment problem as a linear programming problem to determine optimality conditions by using Simplex method.
- explain optimal solutions for sequencing problems with n jobs

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SAM 352 :Optimization Techniques Lab

No. of hrs/week: 3 **Credits: 2**

1. Simplex Method
2. Big M Method
3. Two phase simplex Method
4. Dual Simplex Method
5. Revised Simplex Method
6. Transportation problem
7. Job sequencing problem

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

- Solve linear programming problem using simplex method
- Solve linear programming problem using Big-M method and two phase simplex method
- Evaluate LPP using dual simplex and revised simplex method
- Evaluate transportation problem
- Evaluate job sequencing problem

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SAM 354 :Econometrics

No. of hrs/week: 4 **Credits: 4**

Preamble : The aim of this course is to provide students an account of the main aspects of econometric procedures, generally necessary to do applied econometric research. It will enlighten to understand the utility and disutility of various results based on econometric computations

Course Objectives :

- To review descriptive statistics
- To review estimation of parameters
- To review testing of hypothesis
- To explain forecasting
- To design linear regression model
- To explain specification analysis

Unit-I

Review of Statistics Descriptive statistics: (a) the univariate case, (b) the bivariate caseRandom Variables and Probability distributions Estimation of parameters, Testing of hypotheses.

Learning Outcomes: The student will be able to:

- Review descriptive statistics
- Review random variables and probability distributions
- Explain estimation of parameters
- Review of testing of hypothesis

Unit-II

Classical Linear Regression Model: Two Variable Case Descriptive Aspects,Properties of Least Squares estimates; tests of hypotheses and confidence intervals; Gauss - Markov Theorem Forecasting

Learning Outcomes: The student will be able to:

- Explain two variables linear regression model
- Explain properties of least squares estimates
- Explain tests of hypothesis and confidence intervals

Unit-III

Classical Multiple Linear Regression Model. Descriptive Aspects: Least Squares Estimation, R^2 and Adjusted R^2

The Classical Model: Gauss - Markov Theorem; Standard Error of Estimate Standard errors of regression coefficients , Partial Correlations Tests of Hypotheses: Single Parameters; Sets of Parameters iv) Forecasting; v) Functional Forms of Regression Models ;vi)Dummy Variables.

Learning Outcomes: The student will be able to:

- Explain least squares estimation
- Explain Gauss-Markov theorem
- Explain standard error of estimate

Unit-IV

Violations of Classical Assumptions and Remedies Multico linearity Heteroscedasticity Auto-correlation

Learning Outcomes: The student will be able to:

- Explain classical assumptions of violations
- Explain linearity and auto correlation

Unit-V

Specification Analysis, Omission of a relevant variable, Inclusion of irrelevant variable Tests of Specification Errors.

Learning Outcomes: The student will be able to:

- Analyze Omission of a relevant variable
- Explain inclusion of irrelevant variable

Text books:

1.D. N. Gujarati and D.C. Porter, Essentials of Econometrics, 4th Edition, McGraw Hill International Edition

2. Jan Kmenta , Elements of Econometrics, Indian Reprint, Khosla Publishing House, 2008, few pages for 'Review of Statistics'. Edition, McGraw Hill International Edition.

3.Christopher Dougherty, Introduction to Econometrics, 4th edition, OUP, Indian edition

4.Maddala, G.S and KajalLahiri, Introduction to Econometrics, 4th Wiley publication,2009

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

- Review descriptive statistics
- Review random variables and probability distributions
- Explain estimation of parameters
- Explain two variables linear regression model
- Explain properties of least squares estimates
- Explain least squares estimation
- Explain Gauss-Markov theorem
- Explain classical assumptions of violations
- Analyze Omission of a relevant variable

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SAM 324 :Econometrics Lab

No. of hrs/week: 3 **Credits: 2**

1. Problems on descriptive statistics
2. Problems on regression model
3. Problems on multiple regression model

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

- Evaluate problems on descrtiptive statistics
- Evaluate problems on regression model
- Evaluate problems on multiple regression model

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SAM 356 :Applied Statistics

No. of hrs/week: 4 **Credits: 4**

Preamble : Applied Statistics includes planning for the collection of data, managing data, analyzing, interpreting and drawing conclusions from data, and identifying problems, solutions and opportunities using the analysis.

Course Objectives :

- To illustrate time series and its components
- To explain growth curves and their fitting
- To learn good index numbers
- To study base shifting, splicing and deflation of index numbers
- To define vital statistics
- To measure population growth
- To learn life tables
- To determine demand curve from time series data
- To learn agricultural statistics

Unit-I

Time series: -Time series and its components with illustrations, additive, multiplicative and mixed models. Determination of trend by least squares, moving average methods. Growth curves and their fitting with reference to modified exponential, Gompertz and Logistic curves. Determination of seasonal indices by Ratio to moving average, ratio to trend and link relative methods.

Learning Outcomes: The student will be able to:

- Illustrate time series and its components
- develop additive, multiplicative and mixed models
- explain Growth cures and their fitting

Unit-II

Index Numbers: -Concept, construction, uses and limitations of simple and weighted index numbers. Laspeyer's, Paasche's and Fisher's index numbers, criterion of a good index numbers, problems involved in the construction of index numbers.Fisher's index as ideal index number. Fixed and chain base index numbers. Cost of living index numbers and wholesale price index numbers.Base shifting, splicing and deflation of index numbers.

Learning Outcomes: The student will be able to:

- study the concept of index numbers
- evaluate criterion of a good index number
- explain the cost of living index numbers

Unit-III

Vital statistics: Introduction, definition and uses of vital statistics. Sources of vital statistics ,registration method and census method. Rates and ratios, Crude death rates, age specific death rate, standardized death rates, crude birth rate, age specific fertility rate, general fertility rate ,total fertility rate. Measurement of population growth, crude rate of natural increase- Pearl's

vital index. Gross reproductive rate sand Net reproductive rate, Life tables, construction and uses of life tables and abridged life tables.

Learning Outcomes: The student will be able to:

- define vital statistics
- evaluate crude death rates
- measure population growth
- explain life tables
- construct life tables and abridged life tables

Unit-IV

Demand Analysis: Introduction. Demand and supply, price elasticity of supply and demand. Methods of determining demand and supply curves, Leontief's ,Pigous's methods of determining demand curve from time series data, limitations of these methods Pigou's method from time series data. Pareto law of income distribution curves of concentration.

Learning Outcomes: The student will be able to:

- study demand supply
- explain methods of determining deman and supply curves
- explain methods from time series data

Unit-V

Official Statistics: - Functions and organization of CSO and NSSO. Agricultural Statistics, area and yield statistics. National Income and its computation, utility and difficulties in estimation of national income.

Learning Outcomes: The student will be able to:

- explain organization of CSO and NSSO
- explain agricultural statistics
- evaluate national income
- estimate national income

List of reference books:

1. V.K.Kapoor and S.C.Gupta : Fundamentals of Applied Statistics. Sultan Chand
2. ParimalMukhopadhyay : Applied Statistics . New Central Book agency.
3. Daroga Singh and Chowdhary: Theory and Analysis of Sample survey designs.Wiley Eastern.
4. M.R.Saluja : Indian Official Statistics. ISI publications.
5. B.L.Agarwal: Basic Statistics.New Age publications.
6. S.P.Gupta : Statistical Methods. Sultan Chand and Sons.
7. PratirupaSidhanthamulu – Telugu Academy.
8. PrayogaRachana and Visleshana – Telugu Academy.

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

- Illustrate time series and its components
- develop additive, multiplicative and mixed models
- evaluate criterion of a good index number
- explain the cost of living index numbers
- evaluate crude death rates
- measure population growth
- explain methods of determining deman and supply curves
- explain agricultural statistics
- evaluate national income

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SAM 326 :Applied Statistics Lab

No. of hrs/week: 3 **Credits: 2**

1. Determination of trend by method of least squares – straight line and parabola.
2. Determination of trend by method of moving averages.
3. Determination of seasonal indices by the method of Ratio to moving averages.
4. Determination of seasonal indices by the method of Ratio to trend.
5. Determination of seasonal indices by Link relatives method.
6. Computation of all weighted indices.
7. Computation of Cost of living index number.
8. Base shifting, splicing and Deflation
9. Construction of various rates, complete and abridged life tables.
10. Construction of Lorenz curve

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

- Determine the trend by method of least squares
- Determine the trend by method of moving averages
- Determine the seasonal indices by the method of ratio
- Compute all weighted indices
- Compute cost of living index number
- construct complete and abridged life tables
- construct Lorenz curve

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI
SPH 392 : INFORMATION SECURITY

No. of hrs/week: 4 **Credits: 4**

Preamble: Information security (IS) is designed to protect the confidentiality, integrity and availability of computer system data from those with malicious intentions. Confidentiality, integrity and availability are sometimes referred to as the CIA Triad of information security. This course gives an overview of security issues, cryptography and public key encryption methods.

Objectives: To introduce critical characteristics of Information. To emphasize the need for security. To elaborate security threats. To explain classical encryption techniques

UNIT - I

Introduction to Information Security : Introduction, The History of Information Security, What Is Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing Components, Balancing Information Security and Access.

Learning Outcomes: By the end of this Unit, the student will be able to

- Familiarize with the history of information security.
- Understand balance between information security and information acess.

UNIT – II

Approaches to Information Security Implementation: The Systems Development Life Cycle, The Security Systems Development Life Cycle, Security Professionals and the Organization, Information Security: Is it an Art or a Science?, Information Security Terminology.

The Need for Security: Introduction, Business Needs First, Threats, Attacks.

Learning Outcomes: By the end of this Unit, the student will be able to

- Illustrate Security System Life Cycle. (L2)
- Know the difference between a threat and an attack. (L2)

UNIT – III

Overview of Security: Protection versus security; aspects of security – data integrity, data availability, privacy; security problems, user authentication

Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer overflow.

System Threats: Intruders, Communication threats-tapping and piracy.

Learning Outcomes: By the end of this Unit, the student will be able to

- Distinguish Protection and Security. (L3)
- Identify different security threats. (L2)
- Explain the System Threats. (L2)

UNIT-IV

Cryptography: Classical Encryption Techniques , Substitution and Transposition techniques.
Symmetric Key Algorithms: Data Encryption Standard, Advanced Encryption Standards

Learning Outcomes: By the end of this Unit, the student will be able to

- Take part of classic Encryption Techniques. (L4)
- Construct Symmetric Key Algorithms. (L3)

UNIT-V

Public key Encryption: RSA, Diffie Hellman key Exchange, ECC cryptography, Digital signatures.
Message Authentication: MAC, Hash functions. Message digests, SHA, WHIRLPOOL.

Learning Outcomes: By the end of this Unit, the student will be able to

- Demonstrate Public Key Encryption. (L2)
- Label Message Authentication. (L1)

Text Books:

1. Principles of Information Security, Michael E. Whitman and Herbert J.Mattord, Thomas India Edition, 2011.
2. Cryptography and Network Security Principles and Practices, 4th Ed, Prentice-Hall of India, 2006.

Reference Books:

1. Computer Security: Art and Science, Mathew Bishop, Addison-Wesley, 2003.
2. Computer Security Principles and Practice By William Stallings,Lawrie Brown, 2/e,Pearson Eduaction,2012.

Course Outcomes: By the end of the course the student is able to

- Identify critical characteristics of Information.
- The necessity of security.
- Name different security threats
- Know classical encryption techniques.
- Perform Message Authentication

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SPH 344 : INFORMATION SECURITY LAB

No. of hrs/week: 3 **Credits: 2**

1. Study of various cryptographic techniques
2. Problems on Substitution techniques.
3. Problems on Transposition techniques
4. Introduction to Unix, Vi Editor.
5. Usage of the following commands in unix: ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, cd.
6. Usage of following commands in unix : cal, cat(append), cat(concatenate), mv, cp, man, date.
7. Implement Substitution technique
8. Implement Transposition technique
9. Study of Open SSL
10. Implement Symmetric key Algorithm – DES using open SSL
11. Implement Asymmetric key Algorithm – RSA using open SSL
12. Implement Hash Algorithm – SHA using open SSL

Text Books:

1. Cryptography and Network Security, Behrouz A. Forouzan, TMH, Special Indian Edition, 2007.
2. Unix Concepts and Applications, Sumitabha Das, 4th Edition, TMH,2006.

Reference Books:

1. Introduction to Unix and Shell Programming by M.G. Venkateshmurthy, Pearson, 1st Edition, 2005.

Course Outcomes: By the end of the course the student is able to

- Study various cryptographic techniques
- Evaluate transposition techniques
- Implement substitution technique and transposition technique
- Study SSL
- Implement symmetric key algorithm
- Implement asymmetric key algorithm

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI
SPH394 : Database Applications

No. of hrs/week: 4 **Credits: 4**

Preamble: Database management has evolved from a specialized computer application to a central component of a modern computing environment. The knowledge about database systems has become an essential part of an education in computer science.

Objectives :

- To explain the purpose of data base system.
- To design data base.
- To build ER model.
- To write SQL queries.
- To write application programs in JSP

Unit- I

Introduction: Database-Systems Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture.

Learning Outcomes :

After completion of this unit, student will be able to

- understand database, data storage and querying.(L3)
- Know about transaction management.(L2)

Unit - II

Database Design and E-R Model: Overview, Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design Issues, Extended E-R Features, Other Aspects of Data Design. **Introduction to Relational Model:** Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Operations.

Learning Outcomes :

After completion of this unit, student will be able to

- learn entity, relationship.(l1)
- write database schema.(L2)
- perform relational operations. (L3)

Unit -III

SQL: Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database. **Intermediate SQL:** Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Authorization.

Learning Outcomes: After completion of this unit, student will be able to

- perform aggregate functions.(L4)
- execute schemas .(L4)

Unit – IV

Advanced SQL: Functions and Procedures, Triggers, Advanced Aggregate Features.
Query Processing: Steps In Query Processing, Measures Of Query Cost, Selection Operation − Basic Algorithm, Selection Using Indices, Selections Involving Comparisons, Implementation of Complex Selections, Sorting, Join Operation − Nested Loop Join, Block Nested Loop Join, Evaluation of Expressions.

Learning Outcomes: After completion of this unit, student will be able to

- implement triggers.(L5)
- execute nested loops.(L5)

Unit – V

Application Design and Development: Application Programs and User Interfaces, Web Fundamentals, Servlets and JSP, Application Architecture, Rapid Application Development, Application Security, Encryption and its applications.

Learning Outcomes: After completion of this unit, student will be able to

- Develop application programs and user interface.(L4)
- Understand encryption and its applications.(L3)

Course Outcomes: Upon completion of the course, the student is able to

- Know about data base and its architecture. (L2)
- Learn transaction management.(L2)
- Use SQL Queries in retrieving data from data base. (L4)

Text Book:

Database System Concepts, 6th Edition,Avi Silberschatz, Henry F. Korth ,S. Sudarshan Tata McGraw-Hill,2011.

Reference Books:

1. SQL, PL/SQL- The Programming Language of Oracle Ivan Bayross , BPB, 4th Edition.
2. Fundamentals of Database Systems by Ramez Elmasri, Shamkant B Navathe, 7th Edition, Pearson, 2015.

B.Sc. Mathematical Sciences
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SEMESTER – VI
SPH 346 : Database Applications Lab

No. of hrs/week: 3 **Credits: 2**

1. Perform Table Creation using SQL.
2. Perform Insertion, Deletion, Updation using SQL.
3. Perform Table Creation using Constraints Specification.
4. Perform Simple SQL Queries.
5. Perform Simple Queries using Logical operators.
6. Perform Simple queries using Date functions.
7. Perform Simple queries using String Functions.
8. Perform Simple PL/SQL program.
9. Perform PL/SQL programs using if, for, while.
10. Perform Grant, Revoke privileges.
11. Perform Programs on Exception Handling.
12. Create a Database- define Procedures, Functions, Triggers.

Text Books:

1.SQL, PL/SQL- The Programming Language Of Oracle, Ivan Bayross , BPB, 4th Ed. 2010.
2.Oracle Database 11g- The Complete Reference , Kevin Loney, TMH, Indian Edition, 2008.

Course Outcomes: By the end of the course the student is able to

- Create table using SQL
- Insert ,delete, update data using SQL
- Perform simple queries using logical operators , data functions and string functions
- Perform gran, revoke privileges
- Perform programs on exception handling
- Create a database

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)
SEMESTER – VI
SPH396 : Computer Networks

No. of hrs/week: 4 **Credits: 4**

Preamble: A computer network defined as a set of computers connected together for the purpose of sharing resources. With the result of rapid technological progress in the 21st century there is a lot progress in collecting, transporting, storing, and processing information. Organizations with hundreds of offices spread over a wide geographical area routinely expect to be able to examine the current status of even their most remote outpost at the push of a button.

Objectives :

- To introduce the connecting devices and IEEE standards
- To illustrate transmission modes, Multiplexing.
- To analyze network addressing.
- To introduce about primary and secondary servers

UNIT – I

Connecting Devices : Passive Hubs, Repeaters, Active Hubs, Bridges, Two-Layer Switches, Routers, Three-Layer Switches, Gateway. Backbone Networks – Bus Backbone, Star Backbone, Connecting Remote LANs. Virtual LANs : Membership, Configuration, Communication Between Switches, IEEE Standard, Advantages.

Learning Outcomes: By the end of this Unit, the student will be able to

- Summarize Hubs, repeaters, Bridges, switches. (L2)
- Understand virtual LANS, IEEE standards. (L3)
- Develop communication between switches. (L3)

UNIT – II

Digital Transmission: Transmission Modes : Parallel Transmission, Serial Transmission. Multiplexing : Frequency Division Multiplexing, Wavelength Division Multiplexing, Synchronous Time Division Multiplexing, Statistical Time Division Multiplexing.

Learning Outcomes: By the end of this Unit, the student will be able to

- Understand transmission modes
- Infer Multiplexing

UNIT – III

Network Layer : Logical Addressing – Ipv4 Addresses : Address Space, Notations, Classful Addressing, Classless Addressing, Network Address Translation. IPv6 Addresses: Structure, Address Space.

Internet Protocol : Internetworking : Need for Network Layer, Internet as a Datagram Network, Internet as a Connectionless Network. IPv4 : Datagram, Fragmentation, Checksum, Options.

Learning Outcomes: By the end of this Unit, the student will be able to

- Distinguish IPv4 and IPv6 addressing modes. (L4)
- Identify fragmentation and checksum. (L3)

UNIT – IV

Transport Layer : Process-to-Process Delivery : Client/Server Paradigm, Multiplexing and Demultiplexing, Connectionless versus Connection Oriented Service, Reliable Versus Unreliable, Three protocols.

User Datagram Protocol : Well-Known Ports for UDP, User Datagram, Checksum, UDP Operation, Use of UDP.

Learning Outcomes: By the end of this Unit, the student will be able to

- understand connectionless and connection oriented services.
- Distinguish between reliable and unreliable services.
- Understand the three protocols. (L3)

UNIT – V

Congestion Control and Quality of Service : Data Traffic : Traffic Descriptor, Traffic Profiles. Congestion : Network Performance. Congestion Control : Open Loop Congestion Control, Closed Loop Congestion Control.

Application Layer : Domain Name System : Name Space : Flat Name Space, Hierarchical Name Space. Domain Name Space : Label, Domain Name, Domain.

Distribution of Name Space : Hierarchy of Name Servers, Zone, Root Server, Primary and Secondary Servers.

Learning Outcomes :

By the end of this Unit, the student will be able to

- Outline data traffic and traffic profiles.(L2)
- Distinguish open loop congestion and closed loop congestion. (L3)
- Identify primary and secondary Servers. (L4)

Course Outcomes: Upon completion of the course, the student is able to

- spell how the connecting devices works.
- distinguish connection oriented and connectionless services.
- describe congestion contral

Text Book : Data Communication and Networking – Behrouz A Forouzan – Fourth Edition, Tata McGraw Hill.

Reference Books :

1) Data and Computer Communications, William Stallings, 9thEdition, Pearson,2013
2) Computer Networks ,Andrew S. Tanenbaum, 5th Edition, Prentice Hall,2013

B.Sc. Mathematical Sciences
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SEMESTER – VI

SPH 348 : Computer Networks Lab

No. of hrs/week: 4 **Credits: 2**

1. Study of Network Devices in detail.
2. Study of different types of Network Cables and practically implement the cross-wired cable and straight cabling.
3. Study of Network IP.
4. Study of Basic Network Commands and Network Configuration commands.
5. Network Sharing.
6. Connect Two Computers (One to One).
7. Connect Computers in a LAN.
8. Configuring a Switch.
9. Client – Server configuration.
10. Study of Network tools.

Course Outcomes: By the end of the course the student is able to

- Study network devices
- Evaluate different types of network cables
- Study network IP
- Study network commands and network configuration commands
- Share network and connect two computers
- Connect computers in a LAN and configure a switch

B. Sc. (Mathematics, Statistics, & Computer Science)
SEMESTER – VI
SPH 334: Numerical Methods Tutorial/Lab

Hours per week: 4 **Credits: 2**

Continuous Evaluation: 100 Marks

1. Problems on absolute , relative and percentage errors
2. Find a root of an equation using bisection method
3. Find a root of an equation using the iteration method
4. Find a root of an equation using the method of false position
5. Find a root of an equation using Newton Raphson method
6. Solving system of simultaneous equations using Gauss elimination method
7. Solving system of simultaneous equations using LU decompoostion method
8. Solving system of simultaneous equations using Gauss-Jacobi method
9. Solving system of simultaneous equations using Gauss-Siedel method
10. Problems using Newton's forward and backward interpolation formulae
11. Problems using divided difference and Lagrange's interpolation formulae
12. Problems using Stirling's and Bessel's formulae
13. Problems on Trapezoidal and simpson's rules for Numerical integration

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

- Evaluate solution of algebraic and transcendental equations
- Understand the numerical techniques for various category of problems
- Evaluate problems on system of simultaneous equations
- Solve problems on interpolation to estimate the function and function value.
- Solve problems on Numerical integration

B. Sc. (Mathematics, Statistics & Computer Science)
SEMESTER – VI
SPH 333: Complex Analysis Tutorial/Lab

Credits: 2 **Continuous Evaluation: 100 Marks**

1. Problems on Cauchy-Riemann equations Problems on analytical functions
2. Problems on contour integration
3. Problems on Cauchy Goursat theorem
4. Problems on Cauchy integral formula
5. Problems on Taylor's series
6. Problems on Laurent series
7. Problems on absolute and uniform convergence of power series

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

- Define analytic function
- Evaluate problems on analytic functions
- Understand contour integration
- Evaluate problems on Cauchy Goursat theorem and Cauchy integral formula
- Solve problems on Taylor's series
- Solve problems on Laurent series

B. Sc. (Mathematics, Statistics & Computer Science)
SEMESTER – VI
SPH 338: Linear Programming Tutorial/Lab

Credits :2 **Continuous Evaluation:100 Marks**

1. Formulation of Linear programming problem
2. Graphical approach to solve LP problem
3. Problems on convex sets
4. Simplex method to solve LPP
5. Two Phase method to solve LPP Big-M method
6. solve LPP Formulation of dual problem Problems on primal –dual

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

- Formulate Linear Programming Model
- Evaluate Linear programming problems using graphical approach
- Understand convex sets with examples
- Evaluate LP problems using simplex method
- Solve LP problems using two phase method and Big- M method
- solve problems on primal and dual

B.Sc. Mathematical Sciences
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SEMESTER – VI

SSE 376 : Transportation and Game Theory

No. of hrs/week: 2 **Credits: 2**

Transportation problem and its mathematical formulation, northwest-corner method,Leastcostmethod and Vogel approximation method for determination of starting basic solution,
algorithm for solving transportation problem

Non- Degeneracy and Degeneracy in transportation Problems

Assignment problem and its mathematicalformulation, Hungarian method for solving assignment problem, Travelling Salesman Problem

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, Dominance principle, Graphical solution procedure

Game theory: Mixed strategies using Linear Programming techniques, Algebric Methods, Matrix method and short cut method

.

Books Recommended:

1. "Linear Programming and Network Flows" by Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali published by John Wiley and Sons, India, 2004, 2nd edition.
2. "Introduction to Operations Research" by Frederick S. Hiller and Gerald J. Lieberman published by Tata McGraw Hill, Singapore, 2009, 9th edition.
3. "Operations Research: An Introduction" byHamdy A. Taha published byPrentice-HallIndia, 2006, 8th edition.

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

- state transportation and assignment problem as a linear programming problem to determine optimality conditions by using Simplex method.
- explain travelling salesman problem
- explain game theory
- explain mixed strategies using linear programming techniques and algebraic methods

B.Sc. Mathematical Sciences
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SEMESTER – VI

SSE 378 :Graph Theory

No. of hrs/week: 2 **Credits: 2**

Definition, examples and basic properties of graphs, pseudographs

Complete graphs,bi-partite graphs, isomorphism of graphs

Paths and circuits Eulerian circuits,Hamiltonian cycles, the adjacency matrix

Weighted graph, Spanning trees, Kruskal'salgorithm ,Travelling salesman's problem

Shortest pathalgorithms :Dijkstra's algorithm, Floyd-Warshall algorithm.

Books Recommended:

1. "Discrete Mathematics with Graph Theory" by Edgar G. Goodaire and Michael M. Parmenter published by Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003,2nd edition.
2. "Applied Abstract Algebra" by Rudolf Lidl and Gunter Pilz published by Springer (SIE), Indian reprint,2004, 2nd edition .

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

- Define graph and its properties
- Explain different types of graphs
- Explain Eulerian circuits and Hamiltonian cycles
- Understand kruskal's algorithm to find minimum spanning tree
- Evaluate problems on Dijkstra's algorithm

B.Sc. Mathematical Sciences
(Mathematics, Statistics, Computer Science)

SEMESTER – VI

SSE 380 :Concepts of Ethical Hacking

No. of hrs/week: 2 **Credits: 2**

Ethical Hacking overview - Hacking Laws - Footprinting - Google Hacking – Scanning – Enumeration -System Hacking - Trojans and Backdoors -Viruses and Worms - Sniffers - Social Engineering -Denial of Service - Buffer Overflows -Web Servers and Applications - Hacking Wireless Networks - Cryptography - Hacking with Linux - IDS, Firewalls, Honeypots - Penetration Testing.

Text Books:

1.Hands-On Ethical Hacking and Network Defense – By Michael T. Simpson, Kent Backman, James Corley , Cengage Learning, 2010.

2. Official Certified Ethical Hacker Review Guide – By Steven DeFino, Barry Kaufman, Nick Valenteen, Cengage Learning, 2009.

3. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy By Patrick Engebretson ,Second Edition 2013.

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

- Explain Ethical hacking overview
- Explain hacking laws , footprinting, google hacking
- Explian viruses and worms, snifferes, social engineering
- Study web servers and application
- Study wireless networks
- Study hacking with linus
- Explain penetration testing