M. G. Science Institute, Ahmedabad

Autonomous | Affiliated to Gujarat University, Ahmedabad

(Managed by The Ahmedabad Education Society)

Department of Statistics

Bachelor of Science (Hons.) in Statistics

B.Sc. (Hons.) Statistics

4 Year, 8 Semester Full-Time Programme

Choice Based Credit System (CBCS) & Grading System

Outcome-Based Education Pattern

(Effective from Academic Year 2024-25)

M B Thaker

Contents

M B Thaker

1.0 Preamble

B.Sc. (Hons.) with Statistics is a 4-year undergraduate programme spread over eight semesters. Statistics, as both art and science, plays a very pivotal role in shaping our understanding of the world. Our B.Sc. (Hons.) in Statistics is designed to equip students with the theoretical foundations, practical skills, and critical thinking abilities necessary to navigate the ever-expanding landscape of data-driven inquiry. Guided by expert faculties, students will delve into a comprehensive curriculum that covers key areas such as data summarization, probability theory, mathematical statistics, regression analysis, sampling theory, design of experiments, statistical quality control, and computational techniques. Through a combination of coursework and practicals, students will develop proficiency in statistical methods, various computational tools, and data analysis techniques essential for addressing real-world problems across diverse domains.

Upon completion of the B.Sc. (Hons.) program in Statistics, graduates will emerge as versatile professionals equipped to tackle real-world data analysis problems in academia, industry, government, and beyond. Our alumni are poised to excel as statisticians, data analysts, research scientists, consultants, and decision-makers and make impactful contributions to the globally.

2.0 Definitions

Bachelor Degree

Bachelor's Degree is designed to offer the undergoing students a broad foundation necessary for a science-based career with a special focus on multidisciplinary learning.

Bachelor Degree (Hons.)

Bachelor's Degree (Hons.) aims at providing advanced and specialized theoretical and research skills in the chosen science subject, along with the overall knowledge in the sciences, to provide the students a strong platform for an advanced academic or professional career.

Choice Based Credit System

The Choice Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising Core, minor, multi-disciplinary, or skill-based courses.

Credit

Credits means the value assigned to a course which indicates the level of instruction:

1 hour lecture per week equals 1 credit

2 hours practical per week equals 1 credit

Credit for a practical could be proposed as part of a course or as a separate practical course.

SGPA

SGPA means Semester Grade Point Average calculated for individual semesters.

CGPA

CGPA means Cumulative Grade Point Average calculated for all courses completed by the students at any point of time. CGPA is calculated for each year for both semesters clubbed together.

Course

A course is a specific subject in the academic programme taught in a particular semester for the specifically assigned number of credits.

Course Announcement

The college shall announce the elective courses it proposes to offer to the students out of the wider course basket. It is not mandatory to offer all the electives. The decision of the principal shall be final in this case. However, in the spirit of Choice Based Credit System, the college should offer choices to the students for the elective courses and not offer only the minimum number of electives.

Course Registration

It is mandatory for every student, to register every semester, for the elective courses opted for that semester. Each student, on admission, shall be assigned to a Faculty Advisor who shall advise him/her about the academic programs and counsel on the choice of courses considering the student's profile, career goals, and courses taken in the earlier semesters. With the advice and consent of the Faculty Advisor, the student shall register for a set of courses he/she plans to take up for the Semester. Students shall have to register for the courses for the semester within the first week of Semester I and immediately after the conclusion of the preceding term for subsequent Semesters II, III, IV, V, VI, VII, and VIII.

Course Outcomes

Course outcomes are the specific and measurable attributes defining the knowledge, skill and attitude of the learners are expected to demonstrate by the completion of the course.

Grading System

The Grading System is the 10-point standard scale system defined by the UGC comprising of the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Graduate Attributes

The Graduate Attributes are the generic abilities, attitudes and approaches expected to be demonstrated by the learner in the world around him/her in a longer period of the life time.

Learning Outcomes

Learning outcomes describe the measurable skills, abilities, knowledge, or values that students should be able to demonstrate as a result of completing a course.

Outcome Based Education (OBE) Approach

OBE is the approach focusing on the performance outcome comprising of the following:

a. The performer – the student (learner), not only the teacher.

M B Thaker

b. The performable (thus demonstrable or assessable) to perform
c. The performance outcome, not the activity or task to be performed.

Outcome-Based Assessment

An assessment system that asks course teachers to first identify what it is that we expect students to be able to do once they have completed a course or program. It then asks course teachers to provide evidence that they are able to do so. In other words, how will each learning outcome be assessed? What **evidence of student learning** is most **relevant for each learning outcome** and **what standard or criteria** will be used to evaluate that evidence? Assessment is therefore a key part of outcome-based education and used to determine whether or not a qualification has been achieved.

Programme Educational Objectives

Programme Educational Objectives are a set of **broad future-focused student performance outcomes** that explicitly identify what students will be **able to do with what they have learned**, and what **they will be like** after they leave school and are **living full and productive lives**. Thus, PEOs are what the programme is preparing graduates for in their **career and professional life** (to attain within a **few years** after graduation).

Programme Outcomes

Programme Outcomes are a set of **narrow statements** that describe what learners of the programme are expected to know and be able to perform or attain by the time of graduation.

Programme Specific Outcomes

The PSOs are a set of narrow statements that describe what the learners of a particular specialization of the programme are expected to know and be able to perform or attain by the time of graduation. PSOs are also a function of the various course combinations offered by the college.

Semester

The Semester means the one half of the academic year comprising of the teaching days and examination & evaluation days as per the UGC/ University norms.

Teaching and Learning Activities

The set of **pedagogical tools and techniques** or the teaching and learning activities that aim to **help students to attain** the intended learning outcomes and engage them in these learning activities through the teaching process.

3.0 B.Sc. Programme Focus

Programme Educational Objectives (PEOs)

PEO 1 Built strong foundations in core areas of statistics with a focus on Data Science and Data Analysis so that learners can contribute significantly in the area of statistical data analysis, and research data analysis.

PEO 2 Our graduates will have successful careers in industry, government, academic, or research institutions, with a commitment to continuous learning and professional development.

PEO 3 Develop professionals with high competency in recent tools and techniques related to statistics and data analysis.

PEO 4 Develop essential human values, and interpersonal, and leadership skills required for success in global professional environments.

M B Thakur

Programme outcomes (POs)

PO 1 **Professionalism and Ethics:** Exhibit responsibility and professionalism that is based on ethical, selfless, moral, and compassionate principles.

PO 2 **Leadership and Social Acuity:** Capable of taking responsibility as a leader and demonstrating responsiveness to the regional and national environments developing abilities to manage challenges for nation-building.

PO 3 **Digital Competence:** Able to use technology and skills to process information and data for the benefit of society.

PO 4 **Communication and Teamwork:** Interact effectively with stakeholders, fostering an environment of teamwork, mutual respect, and shared decision-making skills.

PO 5 **Critical Thinking:** Foster a curious mindset, analyze and develop critical thinking skills, and become active learners.

Programme Specific Outcomes (PSOs)

PSO 1 Develop communication skills to convey statistical concepts and applications for the holistic development of society upholding the principles of sustainable development and environmental consciousness.

PSO 2 Apply statistical techniques for collection, presentation, analysis, and interpretations of data and draw valid inferences, develop programming skills to analyze data using statistical software.

PSO 3 Apply the concepts of statistics, probability theory, statistical inference, sampling techniques, design of experiment, time series, etc. in real-life problems

PSO 4 Understand the applications of statistics and statistical concepts in other disciplines such as social sciences, medical science, natural sciences, business, and economics.

PSO 5 Provides a platform for pursuing higher studies leading to a postgraduate or doctorate.

4.0 B.Sc. Programme Course Types and Evaluation Pattern

Sr. No.	Course Type	Credits	Nature	CCE Marks	ECE Marks	Total Marks
1	Major Course	4	Compulsory	50	50	100
2	Minor Course	4	Compulsory	50	50	100
3	Multidisciplinary Course	4	Elective	50	50	100
4	Skill Enhancement Course	2	Elective	25	25	50
5	Ability Enhancement Course	2	Elective	25	25	50
6	Indian Knowledge System/ Value Added Courses	2	Elective	25	25	50

Courses Types Definitions:

1. **Major Course (DSC-C)**
   Discipline-specific course core is a course that a student admitted to a particular programme must successfully complete receiving the degree and which cannot be substituted by any other course.
2. **Minor Course (DSC-M)**
   A discipline Specific Minor Course refers to a set of academic courses that form a focused and specialized area of study within a particular discipline. Students have the option to pursue a minor alongside their major allowing them to gain additional expertise in a specific subject.
3. **Multidisciplinary Course (IDC)**

M B Thakker

A multidisciplinary course is a course chosen generally from a related discipline/subject, intending to seek exposure in the discipline relating to the core domain of the student.

4. **Skill Enhancement Course (SEC)**
   Skill Enhancement Course is designed to provide students with specific skills or knowledge in addition to their primary academic pursuits. The main purpose of the SEC is to provide students with practical skills, life skills, soft skills, hands-on training, etc. to increase their employability.
5. **Ability Enhancement Course (AEC)**
   The ability enhancement course is designed to improve students' communication, language, and personality development skills. The main purpose of the AEC is to introduce students to the theory, fundamentals, and tools of communication and to develop in them vital communication skills that should be integral to personal, social, and professional interactions.
6. **Indian Knowledge System (IKS)**
   Indian Knowledge System refers to the rich and diverse heritage of knowledge, wisdom, and traditions that have evolved over millennia within the Indian subcontinent.
7. **Value-aided Course (VAC)**
   Value-aided courses refer to those courses designed to enhance the standard of the students beyond those levels specified in the academic curriculum.

5.0 B.Sc. Programme Structure

B.Sc. (Hons.) Statistics is a four-year programme divided into eight semesters. A student is required to complete 176 credits for the completion of the programme and the award of B.Sc. (Hons.) Statistics degree.

The B.Sc. (Hons.) Statistics programme is aligned with the NEP-2020 structure as given in below Table.

Courses	No. of Papers	Credits Each	Total Credits
1. DSC-Major	22	4	88
2. DSC-Minor	8	4	32
3. IDC-Multi	3	4	12
4. AEC	5	2	10
5. SEC	5	2	10
Internship	1	4	4
6. IKS/VAC	4	2	8
OJT/RP	2	6	12
		Total	**176**

Details of Programme

Year	Semester	Course Type (Credits)						
1st Year	Sem-I	Major-1 (4)	Major-2 (4)	Minor-1 (4)	MDC-1 (4)	AEC-1 (2)	SEC-1 (2)	IKS-1 (2)
	Sem-II	Major-3 (4)	Major-4 (4)	Minor-2 (4)	MDC-2 (4)	AEC-2 (2)	SEC-2 (2)	VAC-1 (2)
2nd Year	Sem-III	Major-5 (4)	Major-6 (4)	Major-7 (4)	MDC-3 (4)	AEC-3 (2)	SEC-3 (2)	IKS-2 (2)
	Sem-IV	Major-8 (4)	Major-9 (4)	Major-10 (4)	Minor-3 (4)	AEC-4 (2)	SEC-4 (2)	VAC-2 (2)
	Sem-V	Major-11 (4)	Major-12 (4)	Major-13 (4)	Minor-4 (4)	Minor-5 (4)	SEC-5 (2)	-

3rd Year	Sem-VI	Major-14 (4)	Major-15 (4)	Major-16 (4)	Minor-6 (4)	AEC-5 (2)	Internship (4)	-
4th Year	Sem-VII	Major-17 (4)	Major-18 (4)	Major-19 (4)	Minor-7 (4)	-	OJT/RP-1 (6)	-
	Sem-VIII	Major-20 (4)	Major-21 (4)	Major-22 (4)	Minor-8 (4)	-	OJT/RP-2 (6)	-

6.0 Multiple Entry-Exit Option

The B.Sc. programme is fully compliant with the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC. Accordingly, the programme provides the exit option to the learners at the end of the first year with **UG Certificate** awarded, at the end of the second year with **UG Diploma** awarded, at the end of the third year with **UG Degree** awarded and at the end of the fourth year with **UG Honors Degree** awarded. The learners choosing to exit the programme at the end of the first year or at the end of the second year will be allowed to, subject to successful completion of the relevant portion of the curriculum, shall be allowed to re-enter within a period of three years and complete the degree programme within a period of maximum seven years from the year of the first admission. All the other details are as provided in Sec.3.2.3 of the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC in December 2022.

7.0 Internship Project

Every learner must undergo and complete the internships/apprenticeships in a firm/ industry/organization or training in labs with faculty or researchers in their own or other college/institute/research institution during the summer term. Completion of the Summer Internship shall be mandatory for every learner choosing to exit at the end of the first year with a UG Certificate or at the end of the second year with a UG Diploma. The Internship Project shall carry the weightage of 4 credits. Since the internship is categorized as Practice, every learner will have to actually produce the work for 120 hours during the internship.

Evaluation of the Internship Project:

It is mandatory for the student to seek advance written approval from the faculty guide and the HOD for the internship and organization before commencing the internship.

a. It is mandatory for the student to seek advance written approval from the faculty guide and the Director of the Institute about the topic and organization before commencing the SIP.
b. Students shall also seek a formal evaluation of their Internship Project from the external guide. The formal evaluation by the external guide shall be done for 50 marks and comment on the nature and quantum of work undertaken by the student, the effectiveness and overall professionalism. The learning outcomes of the Internship Project and utility of the project to the host organization must be specifically highlighted in the formal evaluation by the external guide. The Internship Project evaluation sheet duly signed and stamped by the external guide shall be included in the final Internship report.
c. The completion of the SIP shall be certified by the respective Faculty Guide & approved by the Director of the Institute.
d. The college level evaluation shall be for 50 marks through the Viva-Voce conducted by the faculty guide and HOD of the respective department.
e. Copies of SIP report and records of evaluation shall be maintained by the college for a period of 5 academic years.

8.0 Comprehensive Internal Evaluation (CIE)/Comprehensive Concurrent Evaluation (CCE)

1. The course teacher shall prepare the scheme of Comprehensive Concurrent Evaluation (Formative Assessment) before commencement of the term. The scheme of Comprehensive Concurrent Evaluation shall explicitly state the linkages of each CCE with the Course Outcomes and define the targeted attainment levels for each CO.
2. The Head of the Department shall approve the scheme of Comprehensive Concurrent Evaluation with or without modifications.
3. The course teacher shall display, on the notice board/ ERP, the approved CCE scheme of the course and the same shall also be hosted on the website, not later than the first week of the term.
4. Each CCE item shall be of minimum 25 marks.
5. For a 4 Credit Course there shall be a MINIMUM of three CCE items. The final scores shall be converted to 50, using an average or best two out of three formulae.
6. For 2 Credit Course there shall be a MINIMUM of two CCE items. The final scores shall be converted to 50.
7. CCE shall be spread through the duration of course and shall be conceptualized, executed, assessed and documented by the course teacher along with student-wise and class-wise attainment levels of the COs and the attainment levels of the course.
8. The assessment outcome of each CCE shall be duly signed by the course teacher & the programme coordinator / HOD of the college.
9. A copy of the duly signed CCE outcome shall be displayed on the notice boards/ ERP, within a week of the assessment and course teachers shall guide the students on a need basis.
10. The college may conduct additional make up / remedial CCE items at its discretion.
11. At the end of the term aggregate CCE scores/grades shall be calculated and the CO attainment levels shall be calculated by the course teacher. The same shall be displayed on the notice board/ ERP.
12. Records of CCE shall be retained for 5 years from the completion of the Academic Year. i.e. Current Academic Year (CAY) + 4 years.

The comprehensive internal evaluation shall be conducted by the college once a semester. The maximum marks for 4 credit courses shall be 50 and for 2 credit courses shall be 25 marks.

9.0 End-Semester Evaluation

1. The End Semester Evaluation (Summative Evaluation) for all the courses shall be conducted by the Examination Department/Committee of the college headed by a full-time regular faculty member nominated by the Principal as Controller of the Examination.
2. The ESE for each course shall have the weightage as follows:
    - For a 4 Credit Course: 50 marks
    - For a 2 Credit Course: 25 marks
3. The ESE for each course shall have 5 questions each of 10 marks. In case of 2 Credit courses the aggregate marks out of 50 shall be converted to the level proportionate to 25 marks.
4. All questions shall be compulsory with internal choice within the questions.

M B Thaker

5. The broad structure of the ESE question paper shall be as follows:

Question Number	COGNITIVE ABILITIES EVALUATED	Nature
Q.1	REMEMBERING	Answer any 5 out of 8 (2 marks each)
Q.2	UNDERSTANDING	Answer any 2 out of 3 (5 marks each)
Q.3	APPLYING	Answer 3 (a) or 3 (b) (10 marks)
Q.4	ANALYSING	Answer 4 (a) or 4 (b) (10 marks)
Q.5	EVALUATING	Answer 5 (a) or 5 (b) (10 marks)
	CREATING	

10.0 Passing Standard

A learner shall be said to have earned the credits for a course if he/she earns minimum 36% marks.

Formative Evaluation and Summative Evaluation shall be separate head of passing.

Grading System

The Indirect and Absolute Grading System shall be used, i.e. the assessment of individual Courses in the concerned examinations will be on the basis of marks. However, the marks shall later be converted into Grades by a defined mechanism wherein the overall performance of the learners can be reflected after considering the Credit Points for any given course. The overall evaluation shall be designated in terms of Grade. The 10-point standard scale mandated by UGC shall be used.

The performance of a student will be evaluated in terms of two indices, viz.

(a) Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester

(b) Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Grade Point (Gi) (10 points scale) = Marks of each paper out of 100 / 10

Marks out of 100	Grade Point Range (Gi)	Letter Grade	Classification
96.0-100	10	O	Outstanding
86.0-95.9	9	A+	Excellent
76.0-85.9	8	A	Very Good
66.0-75.9	7	B+	Good
56.0-65.9	6	B	Above Average
46.0-55.9	5	C	Average
36.0-45.9	4	P	Pass
Below 36.0	0	F	Fail
Absent	0	Ab	Absent

M B Thakker

The Semester Grade Point Average (SGPA) is the ratio of the sum of the product of the number of credits with the grade point scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA\ (Si) = \Sigma\ (Ci \times Gi) / \Sigma\ Ci$$

where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

The cumulative grade point average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.,

$$CGPA = \Sigma\ (Ci \times Si) / \Sigma\ Ci$$

where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that i^{th} semester.

The SGPA and CGPA shall be rounded off to 2 decimal points.

Scaling Down of the CIE Score

The marks obtained by the student for the CCE shall be scaled down, to the required extent, if the percentage of the marks of CCE exceeds the percentage of marks scored in the ESE (End Semester University Examination) by 25% for the respective course.

Degree Requirements

The degree requirements for the B.Sc. DSA programme are the completion of a minimum 136 credits and 180 credits in case of an Honours degree.

Maximum Duration for Completion of the Programme

The program of the study is four years of eight semesters. A candidate shall complete his/her degree within **seven (7)** academic years from the date of his/her admission to the first semester.

Grade Improvement

There shall be a provision for candidates to reappear for the examination for the concerned course of theory papers only (subject) in which the candidate wishes for improvement of his/her grade point of SGPA in general and CGPA in a total of the program subject to the condition that:

a) The candidate shall be eligible to reappear for improvement of grade points only after successfully passing the program.
b) The candidate may opt for the examination for any number of courses (subject/paper) of the programme for improvement of grade points but not more than three times for each course (subject/paper) as per the prevailing syllabus of the examination conducted in the regular schedule of University examinations.
c) All such provisions are there within 04 years from successful completion of the programme, but not exceeding the period of 08 years of the duration of completion of the programme.
d) In all such cases grade points are considered if there is a progress in such improvements, otherwise, original grade points shall be retained.
e) No such candidates shall be eligible for the award of Rank, Gold Medal, Cash Prize, etc.

M B Thaker

f) The validity of credits earned will be for a maximum period of seven years or as specified by the Academic Bank of Credits (ABC).

11.0 Attendance

The student must meet the requirement of 75% attendance per semester per course for grant of the term. The college may condone the shortage in attendance in exceptional circumstances, up to a maximum of 10%. The college shall have the right to withhold the student from appearing for examination of a specific course if the above requirement is not fulfilled.

12.0 Medium of Instruction

The medium of instruction and evaluation shall be English.

13.0 Detailed Course List (Annexure-1)

Detailed course list is available in Annexure-1

14.0 Detailed Syllabus for Each Course (Annexure-2)

Detailed syllabus for each course is available in Annexure-2

Annexure 1

Detailed Course List for B.Sc. (Hons.) Statistics

Statistics Major Courses
(Compulsory Course – 4 Credits Each)

Course Code	Course Title	Semester	Hours/Week
STM111 (T)	Descriptive Statistics (T)	1	4
STM112 (P)	Statistics Practical-I	1	8
STM121 (T)	Probability Theory (T)	2	4
STM122 (P)	Statistics Practical-II	2	8
STM231 (T)	Probability Distribution-I	3	4
STM232 (T)	Applied Statistics	3	4
STM233 (P)	Statistics Practical-III	3	8
STM241 (T)	Probability Distribution II	4	4
STM242 (T)	Sampling Distributions	4	4
STM243 (P)	Statistics Practical IV	4	8
STM351 (T)	Statistical Inference	5	4
STM352 (T)	Sampling Techniques	5	4
STM353 (P)	Statistics Practical-V	5	8
STM361 (T)	Design of Experiments	6	4
STM362 (T)	Statistical Quality Control	6	4
STM363 (P)	Statistics Practical-VI	6	8
STM471 (T)	Econometrics	7	4
STM472 (T)	Multivariate Analysis	7	4
STM473 (P)	Statistics Practical-VII	7	8
STM481 (T)	Time Series and Spatial Analysis	8	4
STM482 (T)	Advanced Regression Analysis	8	4
STM483 (P)	Statistics Practical-VII	8	8

Statistics Minor Courses
(Compulsory Course)

Course Code	Course Title	Semester	Credits	Hours/Week
STE113 (T)	Basics of Data Science (T)	1	2	2
STE113 (P)	Basics of Data Science (P)	1	2	4
STE123 (T)	Elementary Probability Theory (T)	2	2	2
STE123 (P)	Elementary Probability Theory (P)	2	2	4
STE244 (T)	Probability Distribution-I	4	2	2
STE244 (P)	Statistics Practical-III	4	2	4
STE354 (T)	Biostatistics	5	4	4
STE355 (P)	Biostatistics (P)	5	4	8
STE364 (T)	Operations Research	6	2	2
STE364 (P)	Operations Research (P)	6	2	4
STE474 (T)	Advanced Design of Expt.	7	2	2
STE474 (P)	Advanced Design of Expt. (P)	7	2	4
STE484 (T)	Survival Analysis & Clinical Trials	8	2	2
STE484 (P)	Survival Analysis & Clinical Trials (P)	8	2	4

M B Thaker

Statistics Multidisciplinary Courses
(Compulsory Course – 4 Credits Each)

Course Code	Course Title	Semester	Credits	Hours/week
STMDC114 (T)	Descriptive Statistics (T)	1	2	2
STMDC114 (P)	Statistics Practical-I	1	2	4
STMDC124 (T)	Probability Theory (T)	2	2	2
STMDC124 (P)	Statistics Practical-II	2	2	4
STMDC234 (T)	Probability Distribution-II	4	2	2
STMDC234 (P)	Statistics Practical	4	2	4

Ability Enhancement Courses
(Elective Course – 2 Credits Each)

Course Code	Course Title	Semester
AEC115	Communicative English-I	1
AEC125	Communicative English-II	2
AEC235	Communicative English-III	3
AEC245	Communicative English-IV	4
AEC365	Business Communication	6

Skill Enhancement Courses
(Elective Course – 2 Credits Each)

Course Code	Course Title	Semester
STSEC116 (T+P)	Essential Excel Skills for Data Science	1
STSEC126 (T+P)	Advanced Excel Skills for Data Science	2
STSEC236 (T+P)	Statistical Computing Using C++	3
STSEC246 (T+P)	Statistical Computing Using R	4
STSEC356 (T+P)	Statistical Analysis Using R	5

Indian Knowledge System
(Elective Course – 2 Credits Each)

Course Code	Course Title	Semester
IKS117		1
IKS127		3

Value Added Courses
(Elective Course – 2 Credits Each)

Course Code	Course Title	Semester
VAC237		2
VAC247		4

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Annexure 2

B. Sc. Sem I Statistics

Detailed Syllabus for Each Course B.Sc. (Hons.) Statistics

STM111 Descriptive Statistics

Semester: I	Course Title: Descriptive Statistics	Credit: 4
Course No.: STM111		Hours: 4/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the concept of Statistical Population and Sample. Recall the types of data and when to use which type of data. Remember when to use which type of charts and graphs.
CO 2	UNDERSTANDING	Understand various measures of central tendency, dispersion, skewness and kurtosis. Summarize the information in the data using different charts and summary measures. Understand the measures of correlation.
CO 3	APPLYING	Describe the sample data with suitable central tendency, dispersion, skewness and kurtosis measures. Apply regression analysis to the real-life data.
CO 4	ANALYSING	Analyze the sample data from various domains through exploratory data visualization and summary measures. Analyze qualitative data.
CO 5	EVALUATING	Organize and summarize the information by suitable presentation and computations.
CO 6	CREATING	Students can visualize the data graphically and summarize the data numerically for real-life data analysis problems.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		
CO 6		2	1	1	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Introduction to Statistics** Types of data: Primary, Secondary, Internal, and External data and their sources. Designing a questionnaire schedule. Classification of data: Qualitative, Quantitative: Discrete, Continuous; Chronological (Time series) data. Nominal, Ordinal, Interval, and Ratio data. Frequency: grouped and ungrouped data; Construction of frequency and cumulative frequency distribution. Presentation of qualitative data: Tabulation (up to four attributes). **Data Visualization**	15

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	Graphical representation of grouped data: Histogram, frequency curve, frequency polygon, ogives (cumulative frequency curves), Diagrammatic representation of data: Bar diagrams- simple Bar, multiple bars, sub-divided bar, and percentage bar diagrams. Two-dimensional diagrams: Rectangles and Pie diagrams. Stem - Leaf plot. Bivariate: Frequency distribution, Marginal and Conditional frequency distributions	
II	**Measures of Central Tendency** Concept of central tendency, various measures of central tendency and their interrelationship. Their merits and demerits. The empirical relation between mean, median, and mode. Properties and applications of measures of central tendency. Partition values (quartiles, deciles and percentiles). **Measures of Dispersion and Moments** Concept of variation/dispersion, quartile deviation, Absolute and relative measures of dispersion with their merits, demerits, and applications. Moments: raw moments, central moments, factorial moments, and their interrelationship. Skewness, Kurtosis and their measures. Box plot.	15
III	**Correlation and Regression** Bivariate data, Scatter diagram and interpretation. Concept of correlation between two variables, positive correlation, negative correlation, no correlation. Covariance between two variables: Definition, computation, effect of change of origin and scale. Karl Pearson's coefficient of correlation and its properties. Computation for ungrouped data and grouped frequency distributed data with interpretation. Correlation Ratio, Spearman's rank correlation coefficient, Kendall's Tau. Meaning of regression, the difference between correlation and regression. Simple linear regression model. Estimation of unknown constants by the method of least squares. Interpretation of parameters. Concept of coefficient of determination.	15
IV	**Curve fitting:** Fitting of second-degree curve ($Y = a + bX + cX^2$), Fitting of exponential and power curves of the type $Y = ae^{bx}$, $Y = ab^x$ and $Y = aX^b$. In all these curves, parameters are estimated by the method of least squares. **Theory of Attributes:** Attributes: Classification, notion of manifold classification, dichotomy, class frequency, order of a class, positive class frequency, negative class frequency, ultimate class frequency, relationship among different class frequencies (up to three attributes), and concept of partial and multiple association to find the relation between frequencies, fundamental set of class frequencies.	15

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	Consistency of data up to 3 attributes, Concepts of independence and association of two attributes. Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, Interpretation.	

Suggested Reference Books:

1. Applied Statistics, Publisher: Books & Allied (P) Ltd. Mukhopadhyay P. (2015).
2. Basic Statistics, Agarwal, B. L., New Age International (P) Ltd.
3. Introduction to the theory of Statistics, Mood, A. M., Greybill, F.A., Boes, D.C., McGraw Hill.
4. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons, New Delhi.
5. Statistical Methods, Tata Mcgraw Hill Publishing. Das (2009).
6. Statistical analysis: Graphs and diagrams, S. M. Nair and M. Garg, Spectrum Books (P) Ltd, New Delhi.

STM112 Statistics Practical-I

Semester: I	Course Title: Statistics Practical-I	Credit: 4
Course No.: STM112		Hours: 8/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the concept of Statistical Population and Sample. Recall the types of data and when to use which type of data. Remember when to use which type of charts and graphs.
CO 2	UNDERSTANDING	Understand various measures of central tendency, dispersion, skewness, and kurtosis. Summarize the information in the data using different charts and summary measures. Understand the measures of correlation.
CO 3	APPLYING	Describe the sample data with suitable central tendency, dispersion, skewness, and kurtosis measures. Apply regression analysis to the real-life data.
CO 4	ANALYSING	Analyze the sample data from various domains through exploratory data visualization and summary measures. Analyze qualitative data.
CO 5	EVALUATING	Organize and summarize the information by suitable presentation and computations.
CO 6	CREATING	Students can visualize the data graphically and summarize the data numerically for real-life data analysis problems.

CO-PO Mapping

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		
CO 6		2	1	1	1

Part A (Manual)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Methods of Classification and Construction of Frequency Distribution. (One-way and Two-Way)	60

M B Thaker

2	Present the data using various diagrams and graphs.	
3	Computation of measures of central tendency & dispersion	
4	Computation of partition values and their applications.	
5	Computation of moments and their applications.	
6	Computation of coefficient of skewness and kurtosis and its interpretation	
7	Computation of correlation coefficient and its interpretation.	
8	Computation of Spearman's and Kendall's Tau coefficient and its interpretation.	
9	Fitting simple linear regression model.	
10	Fitting second degree curve and exponential curve.	
11	Categorical data analysis.	

Part B (Using MS Excel)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Methods of Classification and Construction of Frequency Distribution. (One-way and Two-Way)	60
2	Present the data using various diagrams and graphs.	
3	Computation of measures of central tendency & dispersion	
4	Computation of partition values and their applications.	
5	Computation of moments and their applications.	
6	Computation of coefficient of skewness and kurtosis and its interpretation	
7	Computation of correlation coefficient and its interpretation.	
8	Computation of Spearman's and Kendall's Tau coefficient and its interpretation.	
9	Fitting simple linear regression model.	
10	Fitting second degree curve and exponential curve.	
11	Categorical data analysis.	

STE113 (T) Basics of Data Science

Semester: I	Course Title: Basics of Data Science (T)	Credit: 2
Course No.: STE113 (T)		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the concept of Statistical Population and Sample. Recall the types of data and when to use which type of data. Remember when to use which type of charts and graphs.
CO 2	UNDERSTANDING	Understand various measures of central tendency, dispersion, skewness, and kurtosis. Summarize the information in the data using different charts and summary measures.
CO 3	APPLYING	Describe the sample data with suitable central tendency, dispersion, skewness, and kurtosis measures.
CO 4	ANALYSING	Analyze the sample data from various domains through exploratory

M B Thaker

		data visualization and summary measures.
CO 5	EVALUATING	Organize and summarize the information by suitable presentation and computations.
CO 6	CREATING	Students can visualize the data graphically and summarize the data numerically for real-life data analysis problems.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		
CO 6		2	1	1	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Introduction to Statistics** Types of data: Primary, Secondary, Internal, and External data and their sources. Designing a questionnaire schedule. Classification of data: Qualitative, Quantitative: Discrete, Continuous; Chronological (Time series) data. Nominal, Ordinal, Interval, and Ratio data. Frequency: grouped and ungrouped data; Construction of frequency and cumulative frequency distribution. Presentation of qualitative data: Tabulation (up to four attributes). **Data Visualization** Graphical representation of grouped data: Histogram, frequency curve, frequency polygon, ogives (cumulative frequency curves), Diagrammatic representation of data: Bar diagrams- simple Bar, multiple bars, sub-divided bar, and percentage bar diagrams. Two-dimensional diagrams: Rectangles and Pie diagrams. Stem - Leaf plot. Bivariate: Frequency distribution, Marginal and Conditional frequency distributions	15
II	**Measures of Central Tendency** Concept of central tendency, various measures of central tendency, and their interrelationship. Their merits and demerits. The empirical relation between mean, median, and mode. Properties and applications of measures of central tendency. Partition values (quartiles, deciles and percentiles.) **Measures of Dispersion and Moments** Concept of variation/dispersion, quartile deviation, Absolute and relative measures of dispersion with their merits, demerits, and applications. Moments: raw moments, central moments, factorial moments, and their interrelationship. Skewness, Kurtosis and their measures. Box plot.	15

Suggested Reference Books:

1. Applied Statistics, Publisher: Books & Allied (P) Ltd. Mukhopadhyay P. (2015).

M B Thaker

2. Basic Statistics, Agarwal, B. L., New Age International (P) Ltd.
3. Introduction to the theory of Statistics, Mood, A. M., Greybill, F.A., Boes, D.C., McGraw Hill.
4. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons, New Delhi.
5. Statistical Methods, Tata Mcgraw Hill Publishing. Das (2009).
6. Statistical analysis: Graphs and diagrams, S. M. Nair and M. Garg, Spectrum Books (P) Ltd, New Delhi.

STE113 (P) Basics of Data Science

Semester: I	Course Title: Basics of Data Science	Credit: 2
Course No.: STE113 (P)		Hours: 4/week

Part A (Manual)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Methods of Classification and Construction of Frequency Distribution. (One-way and Two-Way)	30
2	Present the data using various diagrams and graphs.	
3	Computation of measures of central tendency & dispersion	
4	Computation of partition values and their applications.	
5	Computation of moments and their applications.	
6	Computation of coefficient of skewness and kurtosis and its interpretation	

Part B (Using MS Excel)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Methods of Classification and Construction of Frequency Distribution. (One-way and Two-Way)	30
2	Present the data using various diagrams and graphs.	
3	Computation of measures of central tendency & dispersion	
4	Computation of partition values and their applications.	
5	Computation of moments and their applications.	
6	Computation of coefficient of skewness and kurtosis and its interpretation	

STMDC114 (T) Statistics for Physics

Semester: I	Course Title: Statistics for Physics (T)	Credit: 2
Course No.: STMDC114 (T)		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the concept of Statistical Population and Sample. Recall the types of data and when to use which type of data. Remember when to use which type of charts and graphs.
CO 2	UNDERSTANDING	Understand various measures of central tendency, dispersion, skewness, and kurtosis. Summarize the information in the data using different charts and summary measures.

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CO 3	APPLYING	Describe the sample data with suitable central tendency, dispersion, skewness, and kurtosis measures.
CO 4	ANALYSING	Analyze the sample data from various domains through exploratory data visualization and summary measures.
CO 5	EVALUATING	Organize and summarize the information by suitable presentation and computations.
CO 6	CREATING	Students can visualize the data graphically and summarize the data numerically for real-life data analysis problems.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		
CO 6		2	1	1	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Introduction to Statistics** Types of data: Primary, Secondary, Internal, and External data and their sources. Designing a questionnaire schedule. Classification of data: Qualitative, Quantitative: Discrete, Continuous; Chronological (Time series) data. Nominal, Ordinal, Interval, and Ratio data. Frequency: grouped and ungrouped data; Construction of frequency and cumulative frequency distribution. Presentation of qualitative data: Tabulation (up to four attributes). **Data Visualization** Graphical representation of grouped data: Histogram, frequency curve, frequency polygon, ogives (cumulative frequency curves), Diagrammatic representation of data: Bar diagrams- simple Bar, multiple bars, sub-divided bar, and percentage bar diagrams. Two-dimensional diagrams: Rectangles and Pie diagrams. Stem - Leaf plot. Bivariate: Frequency distribution, Marginal and Conditional frequency distributions	15
II	**Measures of Central Tendency** Concept of central tendency, various measures of central tendency, and their interrelationship. Their merits and demerits. The empirical relation between mean, median, and mode. Properties and applications of measures of central tendency. Partition values (quartiles, deciles and percentiles.) **Measures of Dispersion and Moments** Concept of variation/dispersion, quartile deviation, Absolute and relative measures of dispersion with their merits, demerits, and applications. Moments: raw moments, central moments, factorial moments, and their interrelationship.	15

M B Thaker

	Skewness, Kurtosis and their measures. Box plot.	

Suggested Reference Books:

1. Applied Statistics, Publisher: Books & Allied (P) Ltd. Mukhopadhyay P. (2015).
2. Basic Statistics, Agarwal, B. L., New Age International (P) Ltd.
3. Introduction to the theory of Statistics, Mood, A. M., Greybill, F.A., Boes, D.C., McGraw Hill.
4. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons, New Delhi.
5. Statistical Methods, Tata Mcgraw Hill Publishing. Das (2009).
6. Statistical analysis: Graphs and diagrams, S. M. Nair and M. Garg, Spectrum books (P) Ltd, New Delhi.

STMDC114 (P) Statistics for Physics

Semester: I	Course Title: Statistics for Physics (P)	Credit: 2
Course No.: STMDC114 (P)		Hours: 4/week

Part A (Manual)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Methods of Classification and Construction of Frequency Distribution. (One-way and Two-Way)	30
2	Present the data using various diagrams and graphs.	
3	Computation of measures of central tendency & dispersion	
4	Computation of partition values and their applications.	
5	Computation of moments and their applications.	
6	Computation of coefficient of skewness and kurtosis and its interpretation	

Part B (Using MS Excel)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Methods of Classification and Construction of Frequency Distribution. (One-way and Two-Way)	30
2	Present the data using various diagrams and graphs.	
3	Computation of measures of central tendency & dispersion	
4	Computation of partition values and their applications.	
5	Computation of moments and their applications.	
6	Computation of coefficient of skewness and kurtosis and its interpretation	

STSEC116 Essential Excel Skills for Data Science

Semester: I	Course Title: Essential Excel Skills for Data Science	Credit: 2
Course No.: STSEC116		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember Excel shortcuts

CO 2	UNDERSTANDING	Understand Excel formulas (relative and absolute). Understand basic functions of Excel.
CO 3	APPLYING	Describe the sample data with suitable Excel functions like sum, average, median, var, stdev, etc.
CO 4	ANALYSING	Analyze the sample data from various domains using Excel.
CO 5	EVALUATING	Summarize the data using suitable charts and graphs. Summarize the data using Excel basic functions.
CO 6	CREATING	Students can visualize the data graphically and summarize the data numerically for real-life data analysis problems.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	1	1	1	
CO 2	2	1		1	
CO 3		2	3		
CO 4	1	1	2	2	1
CO 5	1	1	2	1	
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Introduction to MS Excel** • Importance of MS Excel. Understand workbooks and worksheets. Entering and editing data. Formatting cells. Creating and managing cell styles. Formatting numbers and labels. • Editing worksheet and cells. Add, edit, and delete comments. Lock and protect cells. • Enter basic formulas. Absolute and relative references. Basic functions. • Working with range names. • Create charts and graphs. Format charts and graphs. • Filtering, sorting, and conditional formatting • Calculations and functions: sum, average, min, max, and, or, not, if	15
II	**Practical Based on Unit-I** 1. Understanding spreadsheet elements. Data Entering and editing. 2. Basics of formulas in Excel. Relative and Absolute referencing. 3. Basic Functions in Excel. Working with range names. 4. Creating formatting Charts and graphs. 5. Use of various functions like sum, average, min, max, and, or, not, if 6. Filtering, sorting of the data 7. Use of conditional formatting.	30

Suggested Reference Books:

1. Microsoft Excel: Data Analysis and Business Model, PHI, Wayne, WL, 2019.
2. Microsoft Excel Formulas and Functions Dummies, Ken Bluttman, 2020.

M B Thaker

STM121 Probability Theory & Distribution

Semester: II	Course Title: Probability Theory & Distribution	Credit: 4
Course No.: STM121		Hours: 4/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the principle of counting, describe random and non-random experiment.
CO 2	UNDERSTANDING	Explain basic concepts of probability. Create sample space for some random experiment and identify the events and their types. Understand the types of random variables and their probability distributions.
CO 3	APPLYING	Apply the theory of probability to various real-life situations to find the probability of different types of events. Apply various probability distributions to real-life situations.
CO 4	ANALYSING	Explain definition of independence of events, concept of conditional probability, Bayes' theorem.
CO 5	EVALUATING	Justify the random variables in given situation and find the probability distribution.
CO 6	CREATING	Formulate univariate and bivariate probability distributions.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1		
CO 2	1	1		2	
CO 3	1	2	3		
CO 4	2	1	2	2	1
CO 5	1	1		1	
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Introduction to Probability** Random Experiment, trial, sample point, sample space, definitions of equally likely, mutually exclusive, and exhaustive events. Definition of probability: classical, relative, and axiomatic approach and its properties. Conditional probability, multiplicative law of probability, Boole's inequality, Bonferroni's inequality, and Chebyshev's Inequality. Independence of events, law of total probability, Bayes theorem and its applications.	15
II	**Random Variables: Discrete and Continuous (Univariate & Bivariate)** Random Variable (rv) with its types, probability mass function (pmf), probability density function (pdf), cumulative distribution function (cdf) with illustrations. The expectation of Random variables with properties, Expectation of a function of random variable, moment generating function (mgf),	15

	cumulant generating function (cgf), probability generating function (pgf) and their properties. Measures of location, skewness and kurtosis. Concept of Joint Distributions, Joint probability mass function, and Joint probability density function. Marginal and conditional distributions, independence of random variables, conditional expectation, and conditional variance. Product moments.	
III	**Functions of Random Variables** Distributions of functions of one- and two-dimensional random variables. Basic idea and concept of Jacobian of transformation in the derivation of distribution of function of random variables. Use of Jacobian of the transformation in distribution deriving distribution of a function of two random variables. The general form of distribution of the sum of two independent random variables, the difference between two independent random variables, the product of two independent random variables, quotient (ratio) of two independent random variables.	15
IV	**Discrete Probability Distributions:** Discrete Uniform, Bernoulli's, binomial, Poisson, Hypergeometric distributions and their properties. **Continuous Probability Distributions:** Rectangular, exponential, beta type I, beta type II and their properties.	15

Suggested Reference Books:

1. Introduction to the Practice of Statistics, Moore, S. David; McCabe, P. George W. H. Freeman and Company, New York.
2. Basic Statistics, Agarwal, B. L., New Age International (P) Ltd.
3. Introduction to the theory of Statistics, Mood, A. M., Greybill, F.A., Boes, D.C., Mc Graw Hill.
4. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons, New Delhi.
5. Mathematical Statistics, P. Mukhopadhyay, New Central Book Agency (P) Ltd, Calcutta
6. An Introduction to Probability and Statistics, V. K. Rohatgi and A.K.Md. Ehsanes Saleh, Wiley Series.

STM122 Statistics Practical-II

Semester: II	**Course Title: Statistics Practical-II**	**Credit: 4**
Course No.: STM122		**Hours: 8/week**

Part A (Manual)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Computation of probability and conditional probability.	60
2	Mutual and Pairwise independence of events.	
3	Applications of Bayes' Theorem	
4	Construction of univariate and Bivariate probability distributions.	
5	Construction of marginal and conditional probability distributions.	

M B Thakker

6	Model sampling from Binomial, Poisson distributions.	
7	Model sampling from rectangular, exponential, beta type-I, beta type-II distributions.	
8	Applications of Uniform, Binomial, Poisson, hypergeometric distributions.	
9	Applications of rectangular and exponential distribution.	
10	Fitting of Binomial distribution.	
11	Fitting of Poisson distribution.	
12	Fitting of exponential distribution.	

Part B (Using MS Excel)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Computation of probability and conditional probability.	60
2	Mutual and Pairwise independence of events.	
3	Applications of Bayes' Theorem	
4	Construction of univariate and Bivariate probability distributions.	
5	Construction of marginal and conditional probability distributions.	
6	Model sampling from Binomial, Poisson distributions.	
7	Model sampling from rectangular, exponential, beta type-I, beta type-II distributions.	
8	Applications of Uniform, Binomial, Poisson, hypergeometric distributions.	
9	Applications of rectangular and exponential distribution.	
10	Fitting of Binomial distribution.	
11	Fitting of Poisson distribution.	
12	Fitting of exponential distribution.	

STE123 (T) Elementary Probability Theory

Semester: II	Course Title: Elementary Probability Theory	Credit: 2
Course No.: STE123 (T)		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the principle of counting, describe random and non-random experiment.
CO 2	UNDERSTANDING	Explain basic concepts of probability. Create sample space for some random experiment and identify the events and their types. Understand the types of random variables and their probability distributions.
CO 3	APPLYING	Apply the theory of probability to various real-life situations to find the probability of different types of events.
CO 4	ANALYSING	Explain definition of independence of events, concept of conditional probability,
CO 5	EVALUATING	Justify the random variables in given situation and find the

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		probability distribution.
CO 6	CREATING	Formulate univariate and bivariate probability distributions.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1		
CO 2	1	1		2	
CO 3	1	2	3		
CO 4	2	1	2	2	1
CO 5	1	1		1	
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Introduction to Probability** Random Experiment, trial, sample point, sample space, definitions of equally likely, mutually exclusive, and exhaustive events. Definition of probability: classical, relative, and axiomatic approach and its properties. Conditional probability, multiplicative law of probability, Boole's inequality, Bonferroni's inequality, and Chebyshev's Inequality. Independence of events, law of total probability, Bayes theorem and its applications.	15
II	**Random Variables (Univariate & Bivariate)** Random Variable (rv) with its types, probability mass function (pmf), probability density function (pdf), cumulative distribution function (cdf) with illustrations. The expectation of Random variables with properties, Expectation of a function of random variable, moment generating function (mgf), cumulant generating function (cgf), probability generating function (pgf) and their properties. Measures of location, skewness and kurtosis. Concept of Joint Distributions, Joint probability mass function, and Joint probability density function. Marginal and conditional distributions, independence of random variables, conditional expectation, and conditional variance. Product moments.	15

Suggested Reference Books:

1. Introduction to the Practice of Statistics, Moore, S. David; McCabe, P. George W. H. Freeman and Company, New York.
2. Basic Statistics, Agarwal, B. L., New Age International (P) Ltd.
3. Introduction to the theory of Statistics, Mood, A. M., Greybill, F.A., Boes, D.C., Mc Graw Hill.
4. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons, New Delhi.
5. Mathematical Statistics, P. Mukhopadhyay, New Central Book Agency (P) Ltd, Calcutta
6. An Introduction to Probability and Statistics, V. K. Rohatgi and A.K.Md. Ehsanes Saleh, Wiley Series.

M B Thakker

STE123 (P) Elementary Probability Theory

Semester: II	Course Title: Elementary Probability Theory	Credit: 2
Course No.: STE123 (P)		Hours: 4/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the principle of counting, describe random and non-random experiment.
CO 2	UNDERSTANDING	Explain basic concepts of probability. Create sample space for some random experiment and identify the events and their types. Understand the types of random variables and their probability distributions.
CO 3	APPLYING	Apply the theory of probability to various real-life situations to find the probability of different types of events.
CO 4	ANALYSING	Explain definition of independence of events, concept of conditional probability,
CO 5	EVALUATING	Justify the random variables in given situation and find the probability distribution.
CO 6	CREATING	Formulate univariate and bivariate probability distributions.

Part A (Manual)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Computation of probability and conditional probability.	30
2	Mutual and Pairwise independence of events.	
3	Applications of Bayes' Theorem	
4	Construction of univariate and Bivariate probability distributions.	
5	Construction of marginal and conditional probability distributions.	

Part B (Using MS Excel)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Computation of probability and conditional probability.	30
2	Mutual and Pairwise independence of events.	
3	Applications of Bayes' Theorem	
4	Construction of univariate and Bivariate probability distributions.	
5	Construction of marginal and conditional probability distributions.	

Suggested Reference Books:

M B Thakker

STMDC124 (T) Probability Theory & Prob. Dist.

Semester: II	Course Title: Probability Theory & Distribution	Credit: 2
Course No.: STMDC124 (T)		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the principle of counting, describe random and non-random experiment.
CO 2	UNDERSTANDING	Explain basic concepts of probability. Create sample space for some random experiment and identify the events and their types. Understand the types of random variables and their probability distributions.
CO 3	APPLYING	Apply the theory of probability to various real-life situations to find the probability of different types of events.
CO 4	ANALYSING	Explain definition of independence of events, concept of conditional probability,
CO 5	EVALUATING	Justify the random variables in given situation and find the probability distribution.
CO 6	CREATING	Formulate univariate and bivariate probability distributions.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1		
CO 2	1	1		2	
CO 3	1	2	3		
CO 4	2	1	2	2	1
CO 5	1	1		1	
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Introduction to Probability** Random Experiment, trial, sample point, sample space, definitions of equally likely, mutually exclusive, and exhaustive events. Definition of probability: classical, relative, and axiomatic approach and its properties. Conditional probability, multiplicative law of probability, Boole's inequality, Bonferroni's inequality, and Chebyshev's Inequality. Independence of events, law of total probability, Bayes theorem and its applications.	15
II	**Random Variables (Univariate & Bivariate)** Random Variable (rv) with its types, probability mass function (pmf), probability density function (pdf), cumulative distribution function (cdf) with illustrations. The expectation of Random variables with properties, Expectation of a function of random variable, moment generating function (mgf), cumulant generating function (cgf), probability generating function (pgf) and their properties. Measures of location, skewness and kurtosis.	15

M B Thakker

	Concept of Joint Distributions, Joint probability mass function, and Joint probability density function. Marginal and conditional distributions, independence of random variables, conditional expectation, and conditional variance. Product moments.	

Suggested Reference Books:

1. Introduction to the Practice of Statistics, Moore, S. David; McCabe, P. George W. H. Freeman and Company, New York.
2. Basic Statistics, Agarwal, B. L., New Age International (P) Ltd.
3. Introduction to the theory of Statistics, Mood, A. M., Greybill, F.A., Boes, D.C., Mc Graw Hill.
4. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons, New Delhi.
5. Mathematical Statistics, P. Mukhopadhyay, New Central Book Agency (P) Ltd, Calcutta
6. An Introduction to Probability and Statistics, V. K. Rohatgi and A.K.Md. Ehsanes Saleh, Wiley Series.

STMDC124 (P) Probability Theory & Prob. Dist.

Semester: II	**Course Title: Probability Theory & Distribution**	**Credit: 2**
Course No.: STMDC124 (P)		**Hours: 4/week**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the principle of counting, describe random and non-random experiment.
CO 2	UNDERSTANDING	Explain basic concepts of probability. Create sample space for some random experiment and identify the events and their types. Understand the types of random variables and their probability distributions.
CO 3	APPLYING	Apply the theory of probability to various real-life situations to find the probability of different types of events.
CO 4	ANALYSING	Explain definition of independence of events, concept of conditional probability,
CO 5	EVALUATING	Justify the random variables in given situation and find the probability distribution.
CO 6	CREATING	Formulate univariate and bivariate probability distributions.

Part A (Manual)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Computation of probability and conditional probability.	30
2	Mutual and Pairwise independence of events.	
3	Applications of Bayes' Theorem	
4	Construction of univariate and Bivariate probability distributions.	
5	Construction of marginal and conditional probability distributions.	

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Part B (Using MS Excel)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1	Computation of probability and conditional probability.	30
2	Mutual and Pairwise independence of events.	
3	Applications of Bayes' Theorem	
4	Construction of univariate and Bivariate probability distributions.	
5	Construction of marginal and conditional probability distributions.	

STSEC126 Advanced Excel Skills for Data Science

Semester: II	Course Title: Advanced Excel Skills for Data Science	Credit: 2
Course No.: STSEC126		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember Excel functions, data validation tools.
CO 2	UNDERSTANDING	Understand Advanced Excel formula and other data validation tools.
CO 3	APPLYING	Apply pivoting technique to summarize the real-life data. Apply slicers to the data in excel. Applying page layout to excel worksheet.
CO 4	ANALYSING	Analysing data using advanced excel functions and techniques.
CO 5	EVALUATING	Summarize the data using suitable filtering and pivot table techniques.
CO 6	CREATING	Students can visualize the data using charts and slicers.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	1	1	1	
CO 2	1	1	1	2	
CO 3	1	1	3	1	
CO 4	2	1	3	1	
CO 5	1	1	2	1	
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Advanced MS Excel** • Advance functions: ifs, sumif, sumifs, averageif, averageifs, lookup, vlookup and hlookup, xlookup. • Data Validation	15

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	• Create and modify pivot tables, value field settings, Sorting and filtering pivot tables. • Charts and Slicers. • Page layouts, and page setup.	
II	**Practical Based on Unit-I** 1. Use of advanced Excel functions: ifs, sumif, sumifs, averageif, averageifs. 2. Use of lookup, vlookup, hlookup functions 3. Creating and modifying pivot tables. 4. Use of data validations. 5. Charts and slicer	30

Suggested Reference Books:

1. Microsoft Excel: Data Analysis and Business Model, PHI, Wayne, WL, 2019.
2. Microsoft Excel Formulas and Functions Dummies, Ken Bluttman, 2020.

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