Curriculum
for the Undergraduate Program
Session: 2024-2025

DEPARTMENT OF STATISTICS
SCHOOL OF PHYSICAL SCIENCES
SHAHJALAL UNIVERSITY OF
SCIENCE AND TECHNOLOGY, SYLHET

Faculty list

Sl No.	Full Name	
	Head	
	Professor Dr. Md. Azizul Baten	01716262947
	Professors	
1.	Dr. Md. Kabir Hossain	01711184818
2.	Dr. Md. Zakir Hossain	01711140801
3.	Dr. Sabina Islam	01911720525
4.	Dr. Ahmad Kabir	01711116908
5.	Mr. Md. Ahmed Kabir Chowdhury	01714227456
6.	Dr. Rahmat Ali	01778266418
7.	Dr. Md. Azizul Baten	01716262947
8.	Dr. Mohammed Taj Uddin*	01716348194
9.	Dr. Mohammad Shahidul Islam	01777827876
10.	Dr. Md. Nazrul Islam	01711466280
11.	Dr. Mohammad Ohid Ullah	01818101435
12.	Dr. S. M. Khurshid Alam	01716090465
13.	Dr. Khalidur Rahman	01712068785
14.	Dr. Md. Jamal Uddin	01716972846
15.	Dr. Luthful Alahi Kawsar	01711318223
16.	Dr. Mossamet Kamrun Nesa	01796747485
17.	Dr. Mohammad Romel Bhuia	01782728082
18.	Dr. Mirza Nazmul Hasan	01767013458
	Associate Professor	
19.	Dr. Kanis Fatama Ferdushi	01818824338
	Assistant Professors	
20.	Dr. Nahid Sultana	01728707307
21.	Dr. Mohammad Anamul Haque	01716563263
22.	Mrs. Israt Jahan	01706880947
	Lecturer	
23.	Mr. Abdullah Al Islam	01521236258

Description of the Department

Shahjalal University of Science and Technology (SUST) is the first science and technology university in Bangladesh and many of its departments are at the national and international forefront of education and research in various fields. The Department of Statistics at SUST, which began its academic journey in 1991, is one of the pioneer departments of the university. It is one of the largest concentrations of statistical education and research with 23 faculties and 401 undergraduate and 50 graduate students. Among the faculty members, there are 18 Professors, 1 Associate Professors, 3 Assistant Professors and 1 Lecturer. Along with a wide range of contemporary and demand-driven courses in undergraduate and graduate levels, the department also offers M.Phil. and Ph.D. programs. The department has already produced 5 PhD, 3 M.Phil, 749 M.S. graduates, and 986 B.Sc. (Honours) graduates. Every year average number of intakes in undergraduate level is 80 and 50 in graduate program. Currently 5 Ph.D. students are pursuing research in the department towards achieving their goals. The department has two computer laboratories equipped with more than 140 computers under complete network coverage and internet facility. Students enjoy working with state of the art statistical and other related software. We have a well-organized seminar library with sufficient books, journals, periodicals and other publications. Our faculties and students are regularly publishing their research works in scientific peer reviewed national and international journals and in book chapters. The Department has an association, named 'Parishankhyan Paribar', which is the central banner for organizing all extra-curricular activities of the department, such as cultural programs, games and sports, picnic etc. This department received grants from many projects, most notably two Higher Education Quality Enhancement Project (HEQEP) – one in collaboration with the Department of Mathematics and the other by the entity itself for infrastructural development. The Department of Statistics regularly organizes seminars and workshops on contemporary research issues which helps faculty members become updated on cutting-edge topics by sharing knowledge and views, and make students acquaint with research in the subject.

Employment opportunities for our graduates are excellent. Our students find careers in research organizations, diverse government sectors, public and private universities, commercial banks and financial institutions, central bank (Bangladesh Bank), insurance companies, UN associate organizations, national and international NGOs,

reputed national and multinational companies, and other academic institutions in home and abroad. Moreover, every year a notable number of students get admission to reputed foreign universities for higher studies with financial supports.

Part A

1.	**Title of the Academic Program:**	Undergraduate Program
2.	**Name of the University:**	Shahjalal University of Science and Technology, Sylhet.
3.	**Vision of the University:**	To be a leading university of excellence in Science and Technology with a strong national commitment and significant international impact.
4	**Mission of the University:**	UM1: To advance learning and knowledge through teaching and research in science and technology UM2: To serve as a center for knowledge creation, technological innovation and transfer among academia, industry, and society UM3: To assist in transferring Bangladesh a country with sustainable economic growth and equitable social development
5.	**Name of the Program Offering Entity:**	Department of Statistics
6.	**Vision of the Department:**	Evolving expertise in statistics to serve nationally and internationally
7.	**Mission of the Department:**	M1: Achieve excellence and expansion of knowledge in statistics as well as in data science M2: Maintain the quality of teaching and research at international standard M3: Collaborate with stakeholders for planning, statistical analysis and research

M4: Promote and tailor research for taking appropriate decision to achieve development goals of the country

8. Objectives of the Department:

i. Disseminate fundamental and advance statistical knowledge to adopt and validate data analysis technique

ii. Contribute to the theoretical and practical development of statistical methods addressing substantive problems

iii. Organizing workshops, seminars, conferences with stakeholders to improve quality of research and implement the statistical techniques

iv. Provide adequate and relevant guidelines of statistics to make planning and decision for achieving Sustainable Development Goals in Bangladesh

9. Name of the Degree: Bachelor of Science (Honours) in Statistics

10. Description of the Program:

Shahjalal University of Science and Technology (SUST), Sylhet was established in 1986. It is the first science and technology university in Bangladesh. The Department of Statistics at SUST, under the school of physical sciences, is one of the pioneer departments of the university, established in 1990. Its academic function started from 1991 with the undergraduate program: Bachelor of Science (B.Sc.) with Honours in Statistics. On average 80 students admitted into the program every academic year by the undergraduate admission committee of SUST. The department has produced 986 B.Sc. (Honours) graduates until 2023-2024. Many of them are now employed as university faculties, researchers, and other high-profile service jobs in home and abroad. In addition to that, a large number of graduates get admission with scholarships to reputed foreign universities for higher studies in each year.

The department conducts academic activities based on a syllabus structure until the 2019–2020 academic year in accordance with university regulations. The Outcome Based Education (OBE) curriculum applies to students commencing the program as from session 2020-2021. After necessary correction, the department has developed OBE curriculum for the current session (2024-2025) following 'Bangladesh National Qualifications Framework (BNQF) for Higher Education' and 'Semester System Ordinance' of the university under the guidance of Institutional Quality Assurance Cell (IQAC), SUST. In the current session, the program consists of eight semesters and the courses of each semester are arranged according to the International Standard Classification of Education (Source: ISCED-F 2013, UNESCO, Institute of Statistics: Canada: Montreal). The courses are divided into Core, General Education, Elective or Optional courses. The program includes English, Database Management & Programming, Micro and macro-economics, Mathematics as a part of general education courses along with the core courses. The required credits for obtaining the degree is 145. The goal of the program is to create graduates with the newly introduced OBE curriculum so that they can solve new challenges emerge nationally and internationally.

11. Graduate Attributes (based on need assessment):

Code	Graduate Attributes	Domain
GA 01	In-depth statistical knowledge and professional skills	Fundamental skills
GA 02	Beyond-discipline knowledge, insight and skills	Fundamental skills
GA 03	Awareness of and sensitivity to ethics and ethical standard on interpersonal, social, research, and professional levels	Social skills
GA 04	Valuing integrity, environmental sustainability, and civic engagement	Social skills
GA 05	Capacity for critical, creative, and evidence-based thinking to solve complex problems	Thinking skills
GA 06	Engage in professional behavior and have the potential to take leadership roles in their chosen careers and communities	Thinking skills
GA 07	Capacity for self-reflection, self-discovery, and personal development	Personal skills
GA 08	Capable of communicating effectively in a range of	Personal skills

	contexts including digital capabilities	

12. Program Educational Objectives (PEOs)

PEO1	To provide in-depth knowledge of descriptive and inferential statistics
PEO2	To promote creative thinking for exploring and analyzing different kinds of data produced from various disciplines
PEO3	To boost up a spirit of enquiry searching for facts and truths by developing statistical tools that supports critical analysis and decision making
PEO4	To help students comprehend the roles of statistics in science and engineering especially industrial, environmental, social, biomedical, epidemiological, agricultural, biological and economical aspects nationally as well as internationally
PEO5	To acquaint students with a spirit of ethics and social commitment in the personal and professional life to add value to the society in national and international levels

13. Program Learning Outcomes (POs):

After successful completion of the program, the graduates are expected to come up with the ability to-

A. Fundamental Skills	
PO1	Explain acquired knowledge of statistical theories and practices along with other allied subjects.
PO2	Prepare study designs and implement them through data collection, analysis, and disseminate the findings to potential stakeholders.
B. Social Skills	
PO3	Demonstrate statistical knowledge embedded with ethics and sense of social commitment for value creation to society, and collaborate with multi-disciplinary groups.
C. Thinking Skills	
PO4	Demonstrate analytical abilities and critical thinking to make data-driven decisions using statistical techniques.
D. Personal Skills	
PO5	Conduct research independently as well as in a team and communicate effectively with stakeholders.
PO6	Prepare a roadmap for future career.

14. Mapping mission of the university with PEOs

PEOs	UM 1	UM 2	UM 3
PEO 1	√	√	
PEO 2		√	
PEO 3	√		
PEO 4		√	√
PEO 5		√	√

15. Mapping POs with the PEOs

	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
PO 1	√	√			
PO 2	√	√		√	
PO 3	√				√
PO 4	√	√		√	
PO 5		√	√		√
PO 6				√	√

16. Mapping courses with the Pos

Courses	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
STA 0542 1151	√	√				
STA 0542 1152	√	√				
MAT 0541 1103	√			√		
MAT 0541 1104	√			√		
ENG 0231 1105		√	√		√	
STA 0542 1150	√				√	√
STA 0542 1251	√	√		√		
STA 0542 1253	√	√				
STA 0542 1254	√	√				
STA 0542 1256		√		√	√	√
SPS 0412 1205	√			√		
MAT 0541 1207	√			√		
ENG 0231 1209	√		√		√	√
STA 0542 1250	√				√	√

STA 0542 2151	√					
STA 0542 2153	√	√	√			
STA 0542 2154	√	√	√			
STA 0542 2156	√	√		√	√	√
MAT 0541 2105	√			√		
ECO 0311 2107	√		√		√	
STA 0542 2150	√				√	√
STA 0542 2251	√		√	√	√	
STA 0542 2252	√					
MAT 0541 2203	√			√		
MAT 0541 2205	√			√		
ECO 0311 2207	√		√		√	
CSE 0612 2209	√	√	√			
CSE 0612 2211	√	√	√			
STA 0542 2250	√				√	√
STA 0542 3151	√	√		√	√	
STA 0542 3152	√	√			√	
STA 0542 3153	√	√		√		
STA 0542 3154	√	√		√	√	
STA 0542 3155		√		√	√	√
STA 0542 3156		√		√	√	√
STA 0542 3157		√		√	√	√
STA 0542 3150	√				√	√
STA 0542 3251	√		√	√	√	
STA 0542 3252	√		√	√	√	
STA 0314 3253	√		√	√	√	
STA 0314 3254		√		√	√	√
STA 0542 3255		√		√	√	√
STA 0542 3256		√		√	√	√
STA 0542 3257	√	√		√	√	
STA 0542 3258	√	√		√	√	
STA 0542 3259		√	√	√	√	√
STA 0542 3250	√				√	√

STA 0542 4151		√	√	√	√	
STA 0542 4152		√	√	√	√	
STA 0542 4153	√	√	√	√		
STA 0542 4154	√	√	√	√		
STA 0542 4155	√	√		√	√	
STA 0542 4156	√	√		√	√	
STA 0542 4157	√	√	√	√		
STA 0542 4158	√	√	√	√		
STA 0542 4150	√		√		√	√
STA 0542 4251	√			√		
STA 0542 4252	√	√		√		
STA 0542 4253	√	√	√	√		
STA 0542 4254		√	√	√	√	
STA 0542 4255	√	√		√	√	
STA 0542 4257		√	√	√	√	√
STA 0542 4258	√	√	√	√	√	√
STA 0542 4259	√	√		√		
STA 0542 4250	√		√		√	√

STA: Statistics; GED: General Education; SPS: School of Physical Sciences; 0542 indicates Statistical courses

Part B

17. Structure of the Curriculum

a) Duration of the Program: Years: 4 Semesters: 8

b) Admission Requirements:

The admission committee of the university will conduct the admission process for the Bachelor's degree as per the rules. The student will enroll in the first semester of an academic year in individual disciplines of different schools. The admission of foreign students will be subjected to the	For admissions to higher semester (2nd to 10th) and course registration following requisites and steps have to be strictly maintained: (1) Completion of 100 level courses is mandatory for student's admission in semester of 300 level courses. (2) Completion of 200 level courses is required for admission in semester of 400 level courses.

verification of academic records as per the university rule.

Every student has to maintain her/his student status by enrolling, paying tuition fees, and doing the registration for required credits every successive semester following the requirements (Section-4 of Ordinance for Semester System for Bachelor's Degree).

Re-admission:
A student will be eligible for re-admission in the first year first semester of the subsequent session if s/he was present in at least 25% of the classes of her/his core and elective courses of the same semester.

A student has to take re-admission if her/his student status is not maintained or one or more semesters have annulled because of disciplinary action taken against him/her. In the case of semester annulment, the student has to re-admit the same level of semester. The level (Year and Semester) of re-admitter will be determined by his/ her completed credits.
The re-admitted students will always be assigned the original Registration number.

(3) A student having incomplete 100 level courses shall be allowed for admission in her/his next available semester of 100-200 level courses until s/he completes all of 100 level courses.
(4) A student having incomplete 200 level courses shall be allowed for admission in her/his next available semester of 200-300 level courses until s/he completes all of 200 level courses.
(5) Once a student reaches to 8th/10th semester of 4/5 years' program s/he will be kept at this level, if necessary, till the specified last semester of the undergraduate program for completion of credit requirement of graduation.

Every admission/course registration of a student will be counted and adjusted from the total number of semesters of the program to determine her/his remaining period of study. Student advisors of all disciplines will advise every student about her/his courses for registration and monitor her/his performances. Accordingly, a student has to register for her/his courses and pay necessary dues within the first 4 (Four) weeks of every semester (2 more weeks for late registration). A student will not be allowed to appear in the examination if her/his semester and examination fee is not fully paid off. Foreign student must have valid Visa/residential permit to appear in the examination and that has to be checked by the student advisor and the head of the discipline/institute.

c) Graduating credits: 140 (Without any Optional/Elective Course)
d) Total class weeks in a semester: 14
e) Minimum CGPA requirement for graduation: 2.0
f) Maximum academic years of completion: 6
g) Category of Courses:

Course Category	**Course Type**	**Course Title**	**Credits**
General Education (GED) Courses	Theory	1. Basic Algebra	3.0
		2. Calculus	3.0
		3. English Language	2.0
		4. Introduction to Financial Mathematics	3.0
		5. Linear Algebra	3.0
		6. Academic Writing	2.0
		7. Advanced Calculus & Differential Equations	3.0
		8. Principles of Microeconomics	3.0
		9. Numerical Methods	3.0
		10. Real Analysis	3.0
		11. Principles of Macroeconomics	3.0
		12. Database Management & Programming	2.0
	Lab	1. Database Management & Programming Lab	3.0
		Total	**36.0 Credits**
Core Courses	Theory	1. Principles of Statistics	3.0
		2. Introduction to Probability	3.0
		3. Sampling Techniques – I	3.0
		4. Probability Distributions	3.0
		5. Theory of Statistics	3.0
		6. Regression Analysis – I	3.0
		7. Design & Analysis of Experiments –I	3.0
		8. Statistical Inference	3.0
		9. Statistical Simulation and Data Analysis with R & Python	2.0

		10. Linear Programming	3.0
		11. Stochastic Processes	3.0
		12. Demography	3.0
		13. Regression Analysis – II	3.0
		14. Economic Statistics	3.0
		15. Applied Statistics	3.0
		16. Design & Analysis of Experiments – II	3.0
		17. Sampling Techniques – II	3.0
		18. Multivariate Analysis	3.0
		19. Biostatistics and Epidemiology	3.0
		20. Generalized Linear Models	2.0
		21. Introduction to Data Science	2.0
		22. Research Methodology	2.0
	Lab	1. Principles of Statistics Lab	2.0
		2. Sampling Techniques – I Lab	2.0
		3. Introduction to Computer and SPSS Lab	1.5
		4. Theory of Statistics Lab	2.0
		5. Statistical Computing: C++ & STATA Lab	1.5
		6. Regression Analysis – I Lab	1.5
		7. Design & Analysis of Experiments – I Lab	2.0
		8. Statistical Inference Lab	2.0
		9. Statistical Simulation and Data Analysis with R & Python Lab	1.5
		10. Demography Lab	1.5
		11. Data Analysis with SAS Lab	1.5
		12. Regression Analysis – II Lab	2.0
		13. Economic Statistics Lab	1.5
		14. Applied Statistics Lab	1.5
		15. Design & Analysis of Experiments – II Lab	1.5
		16. Sampling Techniques – II Lab	1.5

		17. Multivariate Analysis Lab	1.5
		18. Biostatistics and Epidemiology Lab	1.5
		19. Presentation & Viva-voce (total 8 courses)	8.0
		Total	**100.0 Credits**
Optional /Elective Courses	Theory	Comprehensive	4.0
	Lab	-	-
		Total	**4.0 Credits**
Capstone Courses	Lab	1. Field Work	1.0
		2. Research Project	3.0
		Total	**4.0 Credits**
Total		**64 courses**	**140 (+4) credits**

18. Year/Semester wise distribution of courses

First Year First Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
STA 0542 1151	Principles of Statistics	Core	3	0	3.0
STA 0542 1152	Principles of Statistics Lab	Core	0	4	2.0
MAT 0541 1103	Basic Algebra	General Education	3	0	3.0
MAT 0541 1104	Calculus	General Education	3	0	3.0
ENG 0231 1105	English Language	General Education	2	0	2.0
STA 0542 1150	Presentation & Viva voce	Core	0	0	1.0
Total			11	4	**14.0**

First Year Second Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
STA 0542 1251	Introduction to Probability	Core	3	0	3.0
STA 0542 1253	Sampling Techniques – I	Core	3	0	3.0
STA 0542 1254	Sampling Techniques – I Lab	Core	0	4	2.0
STA 0542 1256	Introduction to Computer and SPSS (Lab)	Core	0	3	1.5
SPS 0412 1205	Introduction to Financial Mathematics	General Education	3	0	3.0
MAT 0541 1207	Linear Algebra	General Education	3	0	3.0
ENG 0231 1209	Academic Writing	General Education	2	0	2.0
STA 0542 1250	Presentation & Viva voce	Core	0	0	1.0
Total			14	7	**18.5**

Second Year First Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
STA 0542 2151	Probability Distributions	Core	3	0	3.0
STA 0542 2153	Theory of Statistics	Core	3	0	3.0
STA 0542 2154	Theory of Statistics Lab	Core	0	4	2.0
STA 0542 2156	Statistical Computing with C++ & STATA (Lab)	Core	0	3	1.5
MAT 0541 2105	Advanced Calculus & Differential Equations	General Education	3	0	3.0
ECO 0311 2107	Principles of Microeconomics	General Education	3	0	3.0
STA 0542 2150	Presentation & Viva voce	Core	0	0	1.0
Total			12	7	**16.5**

Second Year Second Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
STA 0542 2251	Regression Analysis – I	Core	3	0	3.0
STA 0542 2252	Regression Analysis – I Lab	Core	0	3	1.5
MAT 0541 2203	Numerical Methods	General Education	3	0	3.0
MAT 0541 2205	Real Analysis	General Education	3	0	3.0
ECO 0311 2207	Principles of Macroeconomics	General Education	3	0	3.0
CSE 0612 2209	Database Management & Programming	General Education	2	0	2.0
CSE 0612 2211	Database Management & Programming Lab	General Education	0	6	3.0
STA 0542 2250	Presentation & Viva voce	Core	0	0	1.0
Total			14	09	**19.5**

Third Year First Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
STA 0542 3151	Design & Analysis of Experiments – I	Core	3	0	3.0
STA 0542 3152	Design & Analysis of Experiments – I Lab	Core	0	4	2.0
STA 0542 3153	Statistical Inference	Core	3	0	3.0
STA 0542 3154	Statistical Inference Lab	Core	0	4	2.0
STA 0542 3155	Statistical Simulation and Data Analysis with R & Python	Core	2	0	2.0
STA 0542 3156	Statistical Simulation and Data Analysis with R & Python Lab	Core	0	3	1.5
STA 0542 3157	Linear Programming	Core	3	0	3.0
STA 0542 3150	Presentation & Viva-voce	Core	0	0	1.0
Total			11	11	**17.5**

Third Year Second Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
STA 0542 3251	Stochastic Processes	Core	3	0	3.0
STA 0314 3253	Demography	Core	3	0	3.0
STA 0314 3254	Demography Lab	Core	0	3	1.5
STA 0542 3256	Data Analysis with SAS (Lab)	Core	0	3	1.5
STA 0542 3257	Regression Analysis – II	Core	3	0	3.0
STA 0542 3258	Regression Analysis – II Lab	Core	0	4	2.0
STA 0542 3259	Field Work	Core	7 Days		1.0
STA 0542 3250	Presentation & Viva-voce	Core	0	0	1.0
Total			09	10	**16**

Fourth Year First Semester

Course Code	Course Title	Course Category	Hours/Week		Credits
			Theory	Lab	
STA 0542 4151	Economic Statistics	Core	3	0	3.0
STA 0542 4152	Economic Statistics Lab	Core	0	3	1.5
STA 0542 4153	Applied Statistics	Core	3	0	3.0
STA 0542 4154	Applied Statistics Lab	Core	0	3	1.5
STA 0542 4155	Design & Analysis of Experiments – II	Core	3	0	3.0
STA 0542 4156	Design & Analysis of Experiments – II Lab	Core	0	3	1.5
STA 0542 4157	Sampling Techniques – II	Core	3	0	3.0
STA 0542 4158	Sampling Techniques – II Lab	Core	0	3	1.5
STA 0542 4150	Presentation & Viva-voce	Core	0	0	1.0
Total			12	12	**19.0**

Fourth Year Second Semester

Course Code	**Course Title**	**Course Category**	**Hours/Week**		**Credits**
			Theory	**Lab**	
STA 0542 4251	Multivariate Analysis	Core	3	0	3.0
STA 0542 4252	Multivariate Analysis Lab	Core	0	4	1.5
STA 0542 4253	Biostatistics and Epidemiology	Core	3	0	3.0
STA 0542 4254	Biostatistics and Epidemiology Lab	Core	0	4	1.5
STA 0542 4255	Generalized Linear Models	Core	2	0	2.0
STA 0542 4257	Research Methodology	Core	2	0	2.0
STA 0542-4261	Introduction to Data Science	Core	2		2.0
STA 0542 4258	Research Project	Core	30 Days		3.0
STA 0542 4259	Comprehensive	Optional	4	0	4.0
STA 0542 4250	Presentation & Viva-voce	Core	0	0	1.0
Total			12 (+4)	08	**19 (+4)**

Part C

Detailed Course Curriculum 2024-2025

First Year First Semester Course Details

Course Code: STA 0542 1151	**Credit:** 3.0	**Year: 1st**	**Semester: 1st**
Course Title: Principles of Statistics		**Course Status:** Theory	

Rationale of the Course: This course is a fundamental one which will develop the foundation skills that prepare students to pursue more advanced topics in statistics. Therefore, this course is designed to acquire knowledge on introductory statistical concepts.

Course Objectives: The objectives of the course are

- To provide a good understanding of statistical principles and descriptive methods,
- To make students understand the graphical presentation of data,
- To help students conceptualize introductory concepts of bivariate data analysis,
- To acquaint students with various ways of measuring statistical data.

Course Contents

Introduction: Meaning of statistics, Descriptive and inferential statistics, Elements of statistics-Population and its classifications, Parameter, Sample, Statistic, Estimator, Estimate, Variable, Attribute, Scales of Measurements, Data classification.

Summarisation and presentation of data: Classification and tabulation of data, Formation of Frequency distribution, Charting data-Bar diagram, Pareto diagram, Pie diagram, Scatter diagram, Line graph, graphs of frequency distribution-Histogram, Frequency Polygon, Frequency curve, cumulative frequency curve or Ogive, Stem and leaf plot.

Measures of central tendency or averages: Concept of central tendency**,** Objectives of averaging, Characteristics of a good average, Averages-Arithmetic mean, Geometric mean, Harmonic mean, Median, Mode with their uses, merits and limitations; Properties of arithmetic mean and geometric mean, Relationship among the averages, Weighted arithmetic mean and geometric mean, Quantiles-Quartiles, Deciles and Percentiles; Uses of quantiles, Determination of mode, median and quantiles graphically, Theorems related to averages.

Measures of dispersion: Meaning, Importance of studying dispersion, Characteristics of an ideal measure of dispersion, Absolute measures of dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Relative measures of dispersion- coefficient of Range, coefficient of Mean deviation, coefficient of Quartile deviation, coefficient of variation, Uses, merits and demerits, measures of dispersion; Properties of standard deviation, Relations among various measures of dispersion, Theorems related to dispersion, Chebyshev's Theorem, Box-plot, Hinges and 5 number summary.

Shape characteristics of distribution: Introduction, Moments, relation between raw and central Moments, Effect of change of origin and scale on Moments, Sheppard's correction for Moments, Coefficients based on Moments, Importance of Moments, Study of Skewness and Kurtosis with their various measures and Theorems.

Association of Attributes: Basic ideas, Purpose of studying association of Attributes, Types of association, Methods of studying association.

Correlation and Regression: Definition and types, Significance of the study of Correlation and Regression, Simple Correlation and Regression. Assumptions for Regression analysis, Fitting of simple regression line- principles of least squares method, Methods of studying correlation, Properties of correlation and regression coefficients, Difference between correlation and regression analysis, Theorems related to Correlation and Regression.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain statistics along with the fundamental concept of population, sample, parameter, estimator, statistic, variables, attributes, data, classification, tabulation, frequency distribution, chart, central tendency, dispersion, moments, skewness, kurtosis, correlation and regression;
CO2	Describe the different measures of central tendency, dispersion, skewness and kurtosis, simple correlation and regression, along with their merits and demerits;
CO3	Apply charts, classification, statistical table, various frequency distributions to summarise and present the data;

CO4	Determine the properties of the measures and relationships among measures, using the mathematical/algebraic operations;
CO5	Analyse the different forms of association of attributes and their measures.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2				
CO2	2					
CO3	1					
CO4	1					
CO5	3			1		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Mid-semester examination 1 Semester-end examination
CO2	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Mid-semester examination 2 Semester-end examination
CO3	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination
CO4	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination
CO5	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination

Main Texts

1. Ross S. M., (2010), Introductory Statistics, 3rd Edition, Academic Press, USA

Reference Books

1. Weiss N. A., (2016), Introductory Statistics, 10th Edition, Pearson
2. Rahman M. S., (2020), Statistics and Probability: An Introductory Analysis, Kazi Prokashoni, Dhaka
3. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Revised Edition, Sultan Chand and Sons, New Delhi, India
4. Islam M. N., (2006), Introduction to Statistics and Probability, 3rd Edition, Book World, Dhaka
5. Mostafa, M. G., (1989), Methods of Statistics, Karim Press and Publication, Dhaka, Bangladesh
6. Methods of Statistics (K.C. Bhuiyan)

Course Code: STA 0542 1152	**Credit:** 2.0	**Year: 1st**	**Semester: 1st**
Course Title: Principles of Statistics Lab		**Course Status: Theory**	

Rationale of the Course: This course aims to use learned skills for investigating statistical data. In particular, students will be able to conduct exploratory data analysis for a variety of scenarios.

Course Objectives: The objectives of the course are

- To provide skills on exploratory data analysis,
- To make students capable of performing bivariate data analysis.

Course Contents

Condensation and tabulation of data, Frequency distribution, graphical representation of data, measures of central tendency, dispersion, Skewness and Kurtosis, measures of association, Correlation and Regression.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Summarise the data using classification, tabulation and frequency

	distribution;
CO2	Calculate various measures associated with central tendency, dispersion, moments, skewness, kurtosis, association of attributes, simple correlation and regression;
CO3	Present the data applying various diagrams and graphs;
CO4	Interpret the data.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2				
CO2	2	2				
CO3	2	1				
CO4	2	2				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors/assignment	Assignment/evaluation/class test (individual/group) Semester-end examination
CO 2	Lecture using board/ projectors/assignment	
CO 3	Lecture using board/ projectors/assignment	
CO 4	Lecture using board/ projectors/assignment	

Main Texts

- Ross S. M., (2010), Introductory Statistics, 3rd Edition, Academic Press, USA

Reference Books

1. Weiss N. A., (2016), Introductory Statistics, 10th Edition, Pearson
2. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Revised Edition, Sultan Chand and Sons, New Delhi, India
3. Rahman M. S., (2020), Statistics and Probability: An Introductory Analysis, Kazi Prokashoni, Dhaka
4. Islam M. N., (2006), Introduction to Statistics and Probability, 3rd Edition, Book World, Dhaka
5. Mostafa, M. G., (1989), Methods of Statistics, Karim Press and Publication, Dhaka, Bangladesh

Course Code: MAT 0541 1103	**Credit: 3.0**	**Year: 1st**	**Semester: 1st**
Course Title: Basic Algebra		**Course Status:** General Education	

Rationale of the Course: Acquiring knowledge regarding higher Algebra, that are frequently used in higher level of statistics education.

Course Objectives: The objectives of the course are

- Make students understand the set theory,
- Provide knowledge on complex numbers,
- Acquaint students with basic tools of different trigonometric series,
- Helping students to conceptualize the basic theories of inequalities,
- Facilitate necessary knowledge on linear equations of different orders.

Course Contents

Sets: Ideas of set, subset, superset, power set and product set; basic set operations, real number system. **Complex numbers:** Complex numbers and their properties, De Moivere's theorem and its application, nth roots. **Summation of trigonometric series:** Method of difference, C+iS method. **Inequalities:** Properties and solutions of inequalities with their geometrical representations; Inequalities involving mean; Inequalities of Weierstrass, Cauchy, Tchebyshev and Jensen. **Theory of equations:** Polynomial and division algorithm; Fundamental theorem of algebra; Relations between roots and coefficients; Multiple roots; Transformations of equations;

Increasing or decreasing of all roots; Removal of any term of an equation; Synthetic division; Nature of the roots; Descarte's rule of signs.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Apply set theory in solving probability problems;
CO2	Employ complex numbers in solving statistical problems;
CO3	Outline the necessity and usefulness of different algebraic expressions, equations and models;
CO4	Employ inequalities in developing statistical theories;
CO5	Demonstrate how trigonometric series can be useful in statistics.

Mapping Course Learning Outcomes (COs) with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2			2		
CO2	2			2		
CO3	2			2		
CO4	2			2		
CO5	2			2		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ Blackboard solution	Semester-end examination
CO 2	Lecture using board/	Assignment/ Presentation

	Assignment	(Individual/group) Midterm Examination 1; Semester-end examination
CO 3	Lecture using board/ projectors	Semester-end examination
CO 4	Lecture using board/ projectors	Midterm Examination 2; Semester-end examination
CO 5	Lecture using board/ Tutorial	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination

Main Text

- Hall & Knight, (2019), Higher Algebra, Arihant Publications India Limited

Reference Books

1. Abramson, J. P., et al, (2015), Algebra and Trigonometry, OpenStax College, Rice University, ISBN 1938168372, 9781938168376
2. Bernard & Child, (2019), Higher Algebra, Arihant Publications India Limited
3. Rahman M. A., (1994), College Higher Algebra with Trigonometry and Set Theory, Nahar Book Depot & Publications
4. Shahidullah A. N. M. & Bhattacharjee P. K., (1992), A Textbook on Higher Algebra and Trigonometry, 9th Edition, Chattogram
5. Lipschutz S., (1998), Set Theory and Related Topics, 2nd Edition, Schaums Outline Series, McGraw-Hill Education
6. Spiegel M. R., (2009), Vector Analysis, 2nd Edition, Schaums Outline Series, McGraw-Hill Education

Course Code: MAT 0541 1104	**Credit:** 3.0	**Year: 1st**	**Semester: 1st**
Course Title: Calculus		**Course Status:** General Education	

Rationale of the Course: Acquiring solid foundations for applications of calculus in statistical theory.

Course Objectives: The objectives of the course are

- To make students understand the basic concepts of differential and integral calculus,
- To help students for solving statistical problems using necessary calculus.

Course Contents

Differential Calculus: Functions of the real variable and their graphs; limit, continuity and derivative; physical meaning of derivative of a function; higher derivatives; Leibnitz's theorem; Rolle's theorem; mean value theorem; Taylor's theorem; Taylor's and Maclaurin's series without proofs; maximum and minimum values of a function; functions of two and three variables; partial and total derivatives; concavity and convexity of a function. **Integral Calculus:** Physical meaning of integration of a function; evaluation of indefinite integrals; definition of Riemann integral; fundamental theorem of integral calculus and its application to definite integrals; double and triple integration; application of integration in finding lengths, areas, volumes and arc lengths.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Differentiation of a function, including application
CO2	Apply Rolle's Theorem and the Mean Value Theorem to analyze differentiable functions, and use Taylor and Maclaurin series to approximate functions and evaluate limits
CO3	Apply the principles of partial derivatives to solve geometric and physical problems
CO4	Evaluate indefinite and definite integrals using appropriate techniques
CO5	Compute areas under curves and volumes of solids using appropriate integration techniques

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					
CO2	2			2		
CO3	2					
CO4	2					
CO5	2			2		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Semester-end examination
CO 2	Lecture using board/ projectors	Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Tutorial	Quiz/ Semester-end examination

Main Text:

Anton, H. (1995). Calculus with Analytic Geometry, 5th Edition, John Wiley and Sons, NY, USA.

Reference Books

1. Das & Mukherjee, Differential Calculus, 52nd Edition, U. N. Dhur & Sons Limited, Kolkata
2. Das & Mukherjee, Integral Calculus, U. N. Dhur & Sons Limited, Kolkata
3. Swokowski E. W., Calculus with Analytic Geometry, 2nd Edition, Wadsworth Inc, USA

4. Thomas & Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education Inc and Dorling Kinderslay Publishing Inc, New Delhi
5. Tierney, Calculus with Analytic Geometry, 3rd Edition, Allyn & Bacon Inc, USA

Course Code: ENG 0231 1105	**Credit:** 2.0	**Year: 1st**	**Semester: 1st**
Course Title: English Language		**Course Status:** General Education	

Rationale of the Course: This course is expected to develop two basic skills i.e. reading and writing. A variety of reading strategies and texts will be used to effectively develop first year students' academic reading skills thereby facilitating their future study. Also, the course focuses on developing the writing skills of students by familiarizing them with grammar rules, providing them with practice and enabling them to demonstrate the accurate use of grammar in their writing.

Course Objectives: The objectives of the course are

- To enable students to write with accuracy,
- To facilitate effective and comprehensible writing,
- To raise awareness of common errors that occur in writing,
- To develop students' ability to understand write-ups on issues of general concern,
- To improve the vocabulary of learners for effective communication.

Course Contents

a) Reading

- Different Reading Strategies
- Guessing Meaning from the Context
- Critical Reading (Analyze)
- Critical Reading (Synthesize)
- Critical Reading (Evaluate)
- Annotation
- Summary Writing

b) Writing

- Forms and functions of different word categories (noun, verb, adjective, etc.)
- Aspects and uses of tense
- Subject-verb agreement
- Use of infinitive, gerund, present participle, past participle, modals, causatives, conditionals, subjunctives, modals.
- Use of sentence connectors/ cohesion markers/ punctuation
- Effective combination of sentences (simple, complex, compound)
- Developing a paragraph

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO 1	Apply grammar rules;
CO 2	Express oneself correctly by using appropriate words, phrases, sentences or ideas ;
CO 3	Critically reflect on a text (grasp abstract ideas and interpret them effectively, arrive at well-reasoned conclusions and solutions);
CO 4	Create using earned knowledge both independently and in collaboration with peer groups;
CO 5	Demonstrate a comprehension of subject knowledge and its subsequent use.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		1	1		1	
CO2		1	1		1	
CO3		1	1		1	
CO4		1	1		1	
CO5		1	1		1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 2	Lecture using board/ Tutorial	Quiz/ Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ projectors	Semester-end examination
CO 4	Lecture using board/ projectors	Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination

Reference Books

1. American edition American English grammar by example nodrm, *A New English Grammar*, 2021, ISBN 10:8650107737
2. F. Stafford, N. Stephens , *Learn and Practise English Grammar 1* , Thomson, 2005.
3. Gerald C. Nelson, Sidney Greenbaum, An Introduction to English Grammar, Edition: 4, Routledge, 2016.
4. Liz and John Soars. *New Headway Upper Intermediate Student's Book*. Oxford University Press, 2014.
5. Martin J. Endley, *Linguistic Perspectives on English Grammar*, Information Age Publishing, 2010.
6. Payle, Michael. *Cliff's TOEFL Preparation Guide.* 12th ed., Cliffs Notes Inc., 2019.
7. Tibbits, E. E.,editor. *Exercises in Reading Comprehension*. Longman, 2013.

Supplementary Materials

- A selection of 08-10 editorials and reports from newspapers/magazines/journals,etc.
- Reading texts in New Headway Upper Intermediate Student's Book (Current edition)
- Selected passages from recommended books
- A selection of other materials may be supplied as handouts by the instructor as necessary

Course Code: STA 0542 1150	Credit: 1.0	Year: 1st	Semester: 1st
Course Title: Presentation & Viva-voce		Course Status: Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;

CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					
CO2	2				1	
CO3	2				1	1
CO4	1					1
CO5	1				1	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

First Year Second Semester Course Details

Course Code: STA 0542 1251	**Credit: 3**.0	**Year: 1st**	**Semester: 2nd**
Course Title: Introduction to Probability		**Course Status: Theory**	

Rational of the Course: The basic concepts of probability are essential in almost all areas of statistics. Most of the statistical methods, in some way, are related to probability theory. Therefore, acquiring knowledge on basic probability and probability distribution is necessary for the graduates of statistics.

Course Objectives: The objectives of the course are

- Make students understand the fundamental concepts of probability,
- Helping students to develop ability in applications and methods of basic probability.

Course Contents

Probability: Sets and their properties, experiment, random experiment, sample space, events, union and intersection of events, different types of events, probability of events, classical approach of probability, empirical approach of probability, axiomatic development of probability, conditional probability, independence of events, additive and multiplicative laws of probability. Theorem of total probability and compound probability, Bayes' theorem, realization of m among n events. Solving probability problems. **Random variables:** definition, probability function, distribution function, joint, marginal and conditional probability functions. **Mathematical expectation:** expectation and variance of a random variable, properties of mathematical expectation and variance, conditional expectation and conditional variance, covariance and correlation, Chebyshev's and Markov inequalities. Moments, moment generating function, and characteristic function. Introduction to probability distributions.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Demonstrate basic concepts of probability and its axioms and discrete and continuous random variable;
CO2	Derive the marginal probability distributions and conditional probability distributions from joint probability distributions ;
CO3	Differentiate between prior and posterior probabilities by using Bayes theorem;
CO4	Calculate mean and variance from moment generating function as well as conditional expectation and conditional variance;

C05	Familiar with common discrete and continuous distribution of random variables.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1		1		
CO2	2	1		1		
CO3	2	1		1		
CO4	2			1		
CO5	2	2		1		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Semester-end examination
CO 2	Lecture using board/ Tutorial	Quiz Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Tutorial	Quiz Semester-end examination
CO 4	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Ross S. M., (2018), A First Course in Probability, 9th Edition, Academic Press, NY
2. Khan M. S. H., (2022), Elements of Probability Theory & its Applications, The University Press Limited, Dhaka.

Reference Books

1. Islam M N, (2006), Introduction to Statistics and Probability, 3rd Edition, Book World, Dhaka
2. Roy M. K., (2011), Fundamentals of Probability and Probability Distributions, 8th Edition, ROMAX Publications, Chittagong
3. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons, New Delhi, India
4. Hoq A. K. M. S., (1996), Probability: An Introduction, 1st Edition, Dhaka
5. Meyer A., Probability and Statistics, Addison-Wesley, USA
6. Mostafa M. G., (1989), Methods of Statistics, Karim press and publication, Dhaka Bangladesh
7. Mosteller et al, Probability with Statistical Applications, 2nd Edition, Addison-Wesley, USA
8. Parzen E, Modern Probability Theory and Its Applications, John Wiley, NY
9. Rahman M. S., (2020), Statistics and Probability: An Introductory Analysis, Kazi Prokashoni, Dhaka

Course Code: STA 0542 1253	**Credit:** 3.0	**Year: 1st**	**Semester: 2nd**
Course Title: Sampling Techniques – I		**Course Status: Theory**	

Rationale of the Course: Sample survey is an essential tools for collecting primary data. To conduct a sample survey, students need to know proper sampling techniques. Therefore, this course is designed to acquire knowledge on several sampling techniques.

Course Objectives: The objectives of the course are

- Familiarize students with the concepts of sampling, sampling techniques, census, survey design and methods of data collection,

- Conceptualize different sampling techniques such as simple random sampling, stratified random sampling, systematic sampling, cluster sampling,
- Facilitate necessary knowledge to compare the efficiency among different sampling techniques,
- Provide knowledge to select appropriate sampling technique for collecting data according to the requirement of problems to be analyzed.

Course Contents

Introduction: Concept and scope of sampling, sampling versus census, steps of survey, questionnaire, pilot survey, probability and non-probability sampling, sampling and non-sampling errors, bias and precision, determination of sample size.

Random sampling design: simple random sampling, stratified random sampling, systematic sampling, and cluster sampling. Estimation of population total, mean, proportion and their standard errors. Ratio and regression methods of estimation. Merits, demerits and applications of different sampling techniques.

Non-probability sampling: Convenience sampling**,** Purposive/judgment sampling, quota sampling, snowball sampling: merits, demerits and applications.

Course Learning Outcomes (COs): By the end of the course, students will be expected to–

CO1	Prepare the layouts of different sampling techniques;
CO2	Apply methods and analytical tools for collecting data;
CO3	Compare efficiency of alternative sampling designs;
CO4	Estimates of parameters along with confidence intervals of the parameters;
CO5	Collaborate in a project for collecting primary data.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3				
CO2	2	3				
CO3		3				
CO4						
CO5	2	3				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	assignment/presentation (individual/group), semester end examination
CO 3	Lecture using board/ assignment	assignment/presentation (individual/group), semester end examination
CO 4	Lecture using board/ assignment	assignment/presentation (individual/group), semester end examination
CO 5	Lecture using board/ Group works	presentation (individual/group), semester end examination

Main Texts

1. Cochran W. G., (1977), Sampling Techniques, 3rd Edition, John Wiley, NY
2. Lohr S. L., (2010), Sampling: Design and Analysis, 2nd Edition, MPS Limited, Macmillan, USA

Reference Books

1. Singh, R., & Mangat, N. S. (2013). *Elements of survey sampling* (Vol. 15). Springer Science & Business Media
2. Raj D., (1968), Sampling Theory, Tata McGraw-Hill, Delhi
3. Islam M. N., (2005), An Introduction to Sampling Methods, 1st Edition, Book World, Dhaka.
4. Kish L., (1968), Survey Sampling, Wiley, 1st Edition, NY

5. Sukhatme P. V., (1984), Sampling Theories and Surveys with Applications, 3rd Edition, Iowa State University Press, USA

Course Code: STA 0542 1254	**Credit:** 2.0	**Year: 1st**	**Semester: 2nd**
Course Title: Sampling Techniques – I Lab		**Course Status: Theory**	

Rationale of the Course: This course gives methodological knowledge on the different techniques to draw a sample from the population. This Lab course is designed to apply the several sampling techniques on different situations of the data for conducting a sample survey.

Course Objectives: The objectives of the course are

- Help students develop ability to draw sample using different sampling techniques such as simple random sampling, stratified random sampling, systematic sampling, cluster sampling;
- Make students capable to measure the efficiencies of different sampling techniques and compare them.

Course Contents

Random sampling and sampling techniques: drawing sample from the population with replacement and without replacement using random number. Construct sampling distribution, Estimate unbiased estimators of population mean/total, proportion, and their standard errors as well as confidence intervals using different sampling techniques: simple random sampling, stratified random sampling, systematic sampling, and cluster sampling. Compare different sampling techniques. Determine sample size.

Ratio and regression method of estimation: estimate the ratio estimators and difference estimators of mean and total with standard errors.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Determine appropriate methods and analytical tools for collecting data;
CO2	Draw sample from population through different sampling techniques;
CO3	Collect primary data from different sources;
CO4	Produce necessary estimates of parameters along with confidence intervals of the parameters;
CO5	Compare efficiency of alternative sampling designs.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3				
CO2	2	3				
CO3		3				
CO4						
CO5	2	3				

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors	
CO 3	Lecture using board/ projectors	
CO 4	Lecture using board/ Tutorial	
CO 5	Lecture using board/ Assignment	

Main Texts

1. Cochran W. G., (1977), Sampling Techniques, 3rd Edition, John Wiley, NY
2. Lohr S. L., (2010), Sampling: Design and Analysis, 2nd Edition, MPS Limited, Macmillan, USA

Reference Books

1. Singh, R., & Mangat, N. S. (2013). *Elements of survey sampling* (Vol. 15). Springer Science & Business Media

2. Raj D., (1968), Sampling Theory, Tata McGraw-Hill, Delhi
3. Islam M. N., (2005), An Introduction to Sampling Methods, 1st Edition, Book World, Dhaka.
4. Kish L., (1968), Survey Sampling, Wiley, 1st Edition, NY
5. Sukhatme P. V., (1984), Sampling Theories and Surveys with Applications, 3rd Edition, Iowa State University Press, USA

Course Code: STA 0542 1256	**Credit: 1.5**	**Year: 1st**	**Semester: 2nd**
Course Title: Introduction to Computer and SPSS Lab		**Course Status: Lab**	

Rationale of the Course: Acquiring knowledge on basic computer and statistical applications with SPSS.

Course Objectives: The objectives of the course are

- Acquaint students with the fundamental computing tools in quantitative analytical methods,
- Provide knowledge of data analysis with Excel and SPSS,
- Facilitate necessary knowledge about data wrangling and exploratory data analysis,
- Develop skills to apply probability distributions, regression and linear models.

Course Contents

Introduction to Computer and MS Office: Practically learn basic idea on computers including internet; learn MS word, perform standard statistical analysis using Excel including graphical representation of data; Learn power point presentation. **Statistical Analysis using SPSS:** Data entry, data cleaning and data management, graphical representation of data, calculation of different measures of central tendency, dispersion, skewness, kurtosis, association of attributes, correlation and regression.

Course learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Explain basic tools of computer including system and application based software;
CO2	Prepare data including data entry, organizing, cleaning and saving data in a suitable way, for instance,Excel and SPSS;
CO3	Modify a dataset for required analysis using SPSS;
CO4	Create graphical presentation of data using Excel and SPSS;
CO5	Solve descriptive and inferential statistical problems using Excel and SPSS.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3		3	3	1
CO2		3		1	2	1
CO3		3			2	1
CO4		3		1	2	1
CO5		3		2	3	2

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/computer/tutorial using statistical software	Quiz/ Assignment/Lab Reports (individual/group) Class assessment, Semester-end Examination including Viva-voce
CO 2		
CO 3		
CO 4		
CO 5		

Main Texts

1. Field, A., (2018), Discovering Statistics Using IBM SPSS Statistics: North American Edition 5th Edition
2. George D., & Mallery P., (2016), IBM SPSS Statistics 23 Step by Step: A Simple Guide and Reference, 14th Edition, Routledge
3. Lambert J., (2018), Microsoft PowerPoint 2019 Step by Step, 1st Edition, Microsoft Press, USA

4. Lambert J., (2018), Microsoft Word 2019 Step by Step, 1st Edition, Microsoft Press, USA

Course Code: SPS 0412 1205	**Credit: 3.0**	**Year: 1st**	**Semester: 2nd**
Course Title: Introduction to Financial Mathematics		**Course Status:** General Education	

Rationale of the course:
This course provides students with a solid foundation in financial mathematics, banking operations, risk management, and financial market structures. It combines theoretical knowledge with practical tools to analyze financial products, value cash flows, and interpret regulatory and accounting frameworks. Students will develop critical analytical skills needed for sound financial decision-making in banking and investment environments.

Course Objectives: The objectives of the course are

- To make students understand the use of various interest rate measures including simple, compound, and effective rates, to analyze and value financial instruments such as annuities, loans, and bonds.
- To help students conceptualize investment returns using yield rates, duration, and convexity to support sound financial decision-making.
- To make students applying key risk management frameworks, including operational risk identification and mitigation strategies guided by Basel regulations.
- To acquaint students with interpreting stock market activity in primary and secondary markets, and apply fundamental accounting principles to track and analyze financial transactions and statements.

Course Contents:
Interest rate measurement: interest rate (rate of interest), simple interest, compound interest, accumulation function, future value, current value, present value, net present value, discount factor, discount rate (rate of discount), convertible m-thly, nominal rate, effective rate, inflation and real rate of interest, force of interest, equation of value.

Valuation of annuities: annuity-immediate, annuity due, perpetuity, payable m-thly or payable continuously, level payment annuity, arithmetic increasing/decreasing annuity, geometric increasing/decreasing annuity, term of annuity.
Loan repayment: principal, interest, term of loan, outstanding balance, final payment (drop payment, balloon payment), amortization.
Bond valuation: price, book value, market value, amortization of premium, accumulation of discount, redemption value, par value/face value, yield rate, coupon, coupon rate, term of bond, callable/non-callable, call price, call premium, accumulated value with reinvestment of coupons.
Measuring the rate of return of an investment: yield rate/rate of return, current value, duration and convexity (Macaulay and modified), portfolio, spot rate, forward rate, yield curve, cash flow and duration matching, and immunization (including full immunization and redington immunization).
Risk Management: types and causes of operational risk; risk culture and governance; sources and use of fund- portfolio management: primary reserve, secondary reserve, loans and investment- capital adequacy.
Stock Market Analysis: Primary and Secondary Stock Market Data Analysis, Role and Functions of Stock Market.
Principles of Accounting: transactions, ledger books, cash book, accounting procedures, trial balance, financial statement, and company financial accounts.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Apply financial mathematics principles to calculate interest, present and future values, and solve problems involving simple and compound interest, annuities, and loan repayments.
CO2	Analyze and value bonds and other financial instruments using concepts such as yield rate, duration, convexity, and reinvestment of cash flows.
CO3	Identify and assess different types of financial risks and demonstrate knowledge of risk management frameworks, including capital adequacy standards (Basel I, II, III).
CO4	Interpret basic accounting records and financial statements by applying standard accounting principles, including transaction recording and preparation of ledgers and trial balances.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2		2		2	
CO2			2			
CO3			2	3		3
CO4			2	2	2	2

Main Text:

Broverman, S. A. (2024). Mathematics of investment and credit. Actex Publications. 8th ed.

Reference Books

1. Thomas, A., & Ward, A. M. (2019). EBOOK: Introduction to Financial Accounting, 9e. McGraw Hill.
2. Reed, E. W. (1993). Commercial bank management.
3. Vaaler, L. J. F., Harper, S. K., & Daniel, J. W. (2021). Mathematical interest theory (Vol. 57). American Mathematical Soc..
4. Brown, R. L., & Kopp, S. (2012). Financial Mathematics: Theory and Practice. McGaw-Hill Ryerson.
5. Chan, W. S., & Tse, Y. K. (2018). Financial mathematics for actuaries.
6. Mishkin, F. S. (2007). The economics of money, banking, and financial markets. Pearson education.

Course Code: MAT 0541 1207	**Credit:** 3.0	**Year: 1st**	**Semester: 2nd**
Course Title: Linear Algebra		**Course Status:** General Education	

Rationale of the Course: Acquiring knowledge of linear algebra to solve problems on different statistical models.

Course Objectives: The objectives of the course are

- Acquaint students with basic concepts of matrices and matrix algebra,
- Facilitate necessary knowledge on methods of solving systems of linear equations,
- Make students understand the basic concepts of vector spaces,
- Provide knowledge on concepts of linear transformations,
- Help students to conceptualize operations in matrix and describe their properties,
- Facilitate understanding on methods of computing using eigenvalues and eigenvectors.

Course Contents

Matrix: Definition of a matrix, different types of matrices, addition and multiplication of matrices. Adjoint and inverse of matrix, Cramer's rule, application of inverse matrix and Cramer's rule. Elementary row operations and echelon forms of matrices, rank, row rank, column rank of a matrix and their equivalence, use of rank and echelon forms in solving system of homogeneous and nonhomogeneous equations. Quadratic forms & their properties. g-inverse. Vector space and subspace over reals and direct sum, linear combination, linear dependence and independence of vectors, basis and dimension of vector space, quotient space and isomorphism theorems, linear transformations, kernel, rank and nullity nonsingular transformations and matrix representation, changes of basis, eigenvector. Eigenvalues, characteristic equations and Cayley-Hamilton theorem. Similar matrices, canonical forms orthogonal and Hermitian matrices, inner product, orthogonal vectors and orthonormal bases, Gram-Schmidt orthogonalization process. Bilinear and quadratic forms. Kronecker sums and products of matrices.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Solve systems of linear equations;
CO2	Describe the concept of vector spaces;
CO3	Calculate determinants of matrices, eigenvalues and eigenvectors;
CO4	Describe linear transformations to find matrices;
CO5	Apply linear algebra to discrete calculus, graphs and networks.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2			2		
CO2	2					
CO3	2					
CO4	2			2		
CO5	2			2		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 2	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board	Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination

Main Text:

1. Hadely G., (1961), Linear Algebra, Addison-Wesley, NY
2. Searle S. R., Matrix Algebra Useful for Statistics, John Wiley, NY

Reference Books

1. Ayres F., Theory and Problems of Matrices, Schaum's Outline Series, McGraw Hill, NY
2. Bering E. D., Linear Algebra and Matrix Theory
3. Hamilton A. G., Linear Algebra, 4th Edition, Cambridge University Press
4. Khanna M. I. & Pundir S. K., Linear Algebra, 11th Edition, Jai Prakash Nath & Co, India
5. Kolman B., Elementary Linear Algebra, 9th Edition, Pearson Education Inc, New Jersey
6. Lipschutz S. & Lipson M., Linear Algebra, 6th Edition, Schaum's Outline Series, McGraw Hill, NY
7. Morris A. O., Linear Algebra, 2nd Edition, Chapman and Hall/CRC, USA
8. Narayan S., Mittal P. K., (2010), A Textbook of Matrices, Sultan Chand & Co., India.
9. Rahman M. A., College Linear Algebra, 7th Edition, Nahar Book Depot & Publications

Course Code: ENG 0231 1209	**Credit:** 2.0	**Year: 1st**	**Semester: 2nd**
Course Title: Academic Writing		**Course Status:** General Education	

Rationale of Course: This course is designed to teach students the basics of academic writing and enable them to write paragraphs, essays and letters using appropriate vocabulary and formats.

Course Objectives: The objectives of the course are

- To develop students' understanding of the specifics of academic writing,
- To instruct students on writing academic papers, e.g. essays, assignments, reports, etc.,
- To facilitate proper writing of letters of complaint, job applications,
- To offer students the environment to strengthen their vocabulary.

Course Contents

- Features of Academic Writing Style: Complexity, formality, precision, objectivity, explicitness, accuracy, hedging, organization, planning, impersonal, cohesive, coherent, authenticity, etc.
- Formal and informal English
- Paragraph Development: Topic sentence, developers, modulators, terminators
- Essay Types:
  Argumentative essays
  Persuasive essays
  Expository essays

- Essay Development:
  - Effective introduction
  - Body paragraphs
  - Conclusion
- Formal letters on social, official and business correspondence, fax, e-mail, letters of opinion, complaint
- Report writing (academic and nonacademic)
- Formatting:
  - In-text citation
  - Referencing (APA, Harvard, Vancouver etc.)

Course Learning Outcomes (COs): By the end of the course, students will be expected to -

CO 1	Organize ideas coherently in paragraphs and essays;
CO 2	Create varied correspondence correctly;
CO 3	Adhere to the rules of writing mechanics ;
CO4	Use appropriate vocabulary and phrases;
CO5	Self-correct and collaborate with peer groups.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1		1		2	2
CO2					2	2
CO3					2	2
CO4	1		1		2	2
CO5	1		1		2	2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 2	Lecture using board/ projectors	Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 5	Lecture using board/ Tutorial	Quiz/ Semester-end examination

Books and Resources

1. Alice Oshima and Ann Hogue. *Introduction to Academic Writing,* THIRD EDITION, Longman, 2007
2. Chalmers, Robert. *Academic English Course Book.* Chalmers, 2011.
3. Dorothy E Zemach and Lisa A Rumisek. *Academic Writing: from paragraph to essay*, Macmillan, 2003
4. George Orwell. "Politics and the English Language." Penguin Modern Classics, Paperback – International Edition, January 15, 2013
5. Hewings, Martin, and Craig Thaine. *Cambridge Academic English: An Integrated Skills course for EAP*.Cambridge University Press, 2012.
6. Imhoof, Maurice L., and Herman Hudson. *From Paragraph to Essay: Developing*
7. *Composition Writing*. Longman, 1975.
8. Stephen Bailey. *Academic Writing: A practical guide for students, Routledge, 2003*

Course Code: STA 0542 1250	**Credit:** 1.0	**Year:** 1st	**Semester:** 2nd
Course Title: Presentation & Viva-voce		**Course Status:** Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					
CO2	2				1	
CO3	2				1	1
CO4	1					1
CO5	1				1	1

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Second Year First Semester Course Details

Course Code: STA 0542 2151	**Credit:** 3.0	**Year: 2nd**	**Semester: 1st**
Course Title: Probability Distributions		**Course Status: Theory**	

Rationale of the Course: This course is designed to provide a comprehensive understanding of probability theory and statistical distributions, essential for advanced studies in statistics and data analysis. Beginning with a review of fundamental concepts, the course will ensure a solid foundational understanding of probability distributions. Students will explore both common univariate discrete and continuous distributions in depth and will also be introduced to more complex distributions. The curriculum will cover special topics in truncated and censored distributions and will include an introduction to bivariate distributions. This course will equip students with the necessary tools to analyze and interpret a wide range of

probabilistic models, fostering a robust analytical skill set applicable in real-world scenarios across various scientific, engineering, and social science disciplines.

Course Objectives: The objectives of the course are

- Explore basic and advanced ideas in probability and statistics to understand various types of random variables and their distributions.
- Study a variety of probability models, from simple to complex ones like truncated and censored distributions, to enhance critical thinking and analytical abilities.
- Learn how different probability distributions are connected, aiding in the comprehension of basic principles and the development of advanced analytical methods crucial for real-world data analysis and decision-making.
- Develop practical proficiency in applying different probability distributions to address challenges in diverse fields.

Course Contents

Review of Related Concepts: Probability function, Random variable, moment generating function, characteristic function, factorial moment generating function, cumulamt cumulant generating function, probability generating function of a random variable; Expectation and variance of a random variable. **Univariate Discrete Distributions:** Detail study of Bernoulli, Binomial, Poisson, Geometric, Hypergeometric, Negative Binomial, Multinomial, Rectangular distributions. Idea of Logarithmic, Beta Binomial, Generalized Negative Binomial, Negative Hypergeometric, Power Series Distributions. **Univariate Continuous Distributions:** Detail study of Uniform, Exponential, Weibull, Gamma, Beta, Normal, Half Normal, Log Normal, Cauchy distributions. Idea of Inverted Gamma, Inverse Gaussian, Laplace, Logistic, Gumbel, Rayleigh, Maxwell, Erlang, Pareto distributions. Pearsonian system of distributions. **Truncated Distributions:** Study of some special truncated and censored discrete and continuous distributions. **Elementary Concepts of Bivariate Distribution:** Binomial, Poisson, Geometric, Normal, Gamma and Beta.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Recall fundamental concepts of probability theory, including probability functions, random variables, and various types of generating functions;
CO2	Explain the properties and applications of univariate discrete and continuous distributions, including but not limited to Bernoulli, Binomial, Poisson, Geometric, Hypergeometric, Normal, Exponential, and Gamma distributions;
CO3	Apply appropriate probability distributions, probability generating functions to model, solve, and derive moments and properties for real-world problems;
CO4	Differentiate between various probability models, including truncated and censored distributions, to enhance critical thinking and analytical abilities;
CO5	Assess how different probability distributions relate to each other to determine which models are best for specific datasets, based on their assumptions and characteristics.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1					
CO2	2					
CO3		2				
CO4				2		
CO5				2		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO1	Lecture using board/ Assignment	Mid-term Examination-1,Assignment Evaluation
CO2	Lecture using board/ Assignment	Mid-term Examination-1, Assignment Evaluation, Semester-end examination
CO3	Lecture using board/ Assignment	Assignment Evaluation, Semester-end

		examination
CO4	Lecture using board/ Assignment	Assignment Evaluation, Semester-end examination
CO5	Lecture using board/ Assignment	Assignment Evaluation, Semester-end examination

Main Texts

1. Krishnamoorthy K., (2006), Handbook of Statistical Distributions with Applications, Chapman and Hall/CRC
2. Johnson, N., Kotz S. and Kemp, A., (2008), Univariate Discrete Distributions, 3rd Edition, John Wiley and Sons, New York
3. Johnson, N. and Balakrishnan N., (1995), Continuous Univariate Distribution, 2nd Edition, John Wiley and Sons, New York
4. Rahman M. S., (2020), Statistics and Probability: An Introductory Analysis, Kazi Prokashoni, Dhaka

Reference Books

1. Devore, J. L., (2011): Probability and Statistics for Engineering and Sciences, 8th Edition, Duxbury Press.
2. Evans, M., Hasting, N. and Peacock, B., (2000): Statistical Distributions, 3rd Edition, Wiley, New York.
3. Hogg, R. V. and Craig, A. T., (2012): Introduction of Mathematical Statistics, 7th Edition, Pearson Education, Asia
4. Islam, M. N., (2006), Introduction to Statistics and Probability, 3rd Edition, Dhaka
5. Ross, S. M., (2014): Introduction to Probability and Statistics for Engineers and Scientist, 5th Edition, Academic Press
6. Roy, M. K., (2011), Fundamentals of Probability & Probability Distributions, ROMAX Publications, Chittagong

Course Code: STA 0542 2153	**Credit:** 3.0	**Year: 2nd**	**Semester: 1st**
Course Title: Theory of Statistics		**Course Status: Theory**	

Rationale of the Course: This course includes inferential statistics such as sampling distribution and hypothesis testing which are the inevitable tools for analyzing statistical data. Students can therefore learn the fundamentals of inferential statistics and use them to evaluate data.

Course Objectives: The objectives of the course are

- Help students conceptualize basic theories in introductory statistical techniques and their applications in different scientific fields,
- Provide solid knowledge regarding parent and sampling distributions,
- Help students develop the capability of testing statistical hypothesis and drawing inference.

Course Contents

Introduction: Concept of parameter and statistic, sampling distribution, transformation of variates, standard errors of statistics. Sampling distribution from normal and non-normal populations, distribution of various statistics. Central limit theorem. Distribution of functions of random variables of continuous and discrete types, joint distribution of $\bar{x}$ and s^2, detailed study of χ^2, Student's t and F distributions, distribution of correlation coefficient in the null case, distribution of regression coefficient. **Concept of tests of hypothesis:** Hypotheses, errors in testing hypotheses. Testing hypotheses for assigned mean, variance, proportion and correlation. Comparison of means, proportions, variances and correlation, Bartletts test of homogeneity of variances. Exact test for 2×2 table, test for r×c contingency table. **Order statistics**: Properties of order statistics, joint distribution of *n* order statistics, marginal distributions of order statistics, distribution of the median and range.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain properties and parameters of relevant parent and sampling distribution;
CO2	Produce appropriate approximation to relevant sampling distribution;
CO3	Formulate appropriate test statistic for testing hypotheses;
CO4	Interpret results in different fields of research.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill

Learning Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	1			
CO2	3	1	1			
CO3	3	1	1			
CO4	3	1	1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ semester end examination
CO 2	Lecture using board/ projectors	Quiz/ semester end examination
CO 3	Lecture using board/ Assignment	assignment/presentation (individual/group), mid-term examination
CO 4	Lecture using board/ Tutorial	Quiz/ semester end examination

Main Texts

1. Mood A., Graybill F., Boes D., (1974), Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill, NY
2. Hogg R. V., McKean J., & Craig A. T., (2012), Introduction to Mathematical Statistics, 7th Edition, Pearson

Reference Books

1. Ali M. A., (1973), Theory of Statistics, Vol-II, Dhaka Book Mart
2. David H A, Nagaraja H. N., (2003), Order Statistics, 3rd Edition, Wiley, NY
3. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons, New Delhi, India

Course Code: STA 0542 2154	**Credit:** 2.0	**Year: 2nd**	**Semester: 1st**
Course Title: Theory of Statistics Lab		**Course Status:** Lab	

Rationale of the Course: Apply acquired knowledge of inferential statistics to analyze data.

Course Objectives: The objectives of the course are

- Acquaint students with the application of fundamental statistical theories,
- Make students capable of analyzing, presenting and interpreting data and results.

Course Contents

Sampling from normal and non-normal populations. Testing hypotheses for assigned mean, variance, proportion and correlation. Comparison of means, proportions, variances and correlation, Bartletts test of homogeneity of variances. Exact test for 2×2 table, test for r×c contingency table.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Perform analysis in different fields of study;
CO2	Conduct statistical tests of hypotheses for one sample, two independent samples, two correlated samples and interpret parameters;
CO3	Perform statistical tests of hypotheses for several samples along with interpreting parameters;
CO4	Conduct statistical tests of hypotheses for correlation and regression coefficients along with interpreting parameters;
CO5	Perform statistical tests of hypotheses for association of attributes.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	1	1			
CO2	3	1	1			
CO3	3	1	1			
CO4	3	1	1			
CO5	3	1	1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	
CO 4	Lecture using board/ assignment	
CO 5	Lecture using board/ assignment	

Main Texts

1. Mood A., Graybill F., Boes D., (1974), Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill, NY
2. Hogg R. V., McKean J., & Craig A. T., (2012), Introduction to Mathematical Statistics, 7th Edition, Pearson

Reference Books

1. Ali M. A., (1973), Theory of Statistics, Vol-II, Dhaka Book Mart
2. David H A, Nagaraja H. N., (2003), Order Statistics, 3rd Edition, Wiley, NY
3. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand and Sons, New Delhi, India

Course Code: STA 0542 2156	**Credit:** 1.5	**Year: 2nd**	**Semester: 1st**
Course Title: Statistical Computing: C++ & STATA Lab		**Course Status:** Lab	

Rationale of the Course: To develop analytical skills using C++ programming language and statistical software STATA.

Course Objectives: The objectives of the course are

- Apply and use the basic programming constructs of C++,
- Facilitate necessary skills on data wrangling and exploratory data analysis,
- Assisting the students to use STATA for statistical data analysis.

Course Contents

Basics of C++: Structure of a program, Variables and types, Constants, Operators, Basic Input/Output. **Program structure:** Control Structures, Functions. **Compound data types:** Arrays, Character sequences, Pointers, Dynamic Memory, Data structures, Other data types

Classes: Classes, Special members, Friendship and inheritance, Polymorphism.

Statistical Analysis using STATA: Data entry, data cleaning and data management, graphical representation of data, calculation of different measures of central tendency, dispersion, skewness, kurtosis, different types of correlation, test of hypothesis, application of different linear regression models including model diagnostics.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Demonstrate with the application of Programming Concepts: Establish proficiency in C++ by writing and analyzing programs that incorporate fundamental concepts such as variables, data types, operators, basic input/output, control structures, functions, arrays, pointers, and dynamic memory management.
CO2	Develop along with utilization of Object-Oriented Techniques: Create and manipulate classes in C++ to develop complex applications, leveraging special member functions, inheritance, polymorphism, and data structures to solve real-world problems efficiently.
CO3	Perform Data Management and Statistical Analysis: Use STATA to perform comprehensive data management tasks, including data entry, cleaning, and preparation, and generate graphical representations to visualize data insights.
CO4	Conduct Advanced Statistical Tests and Regression Analysis: Apply various statistical methods and hypothesis tests using STATA to interpret data, calculate measures of central tendency, dispersion, skewness, and kurtosis, and implement different linear regression models, including model diagnostics, to draw meaningful conclusions from data.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill

Learning Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3		2	2	1
CO2		3		2	2	1
CO3	3	3		2	2	3
CO4		3		2	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/computer/Tutorial using statistical software	Quiz/ Assignment/Lab Reports (Individual/group) Class assessment, Semester-end Examination including Viva-voce
CO 2		
CO 3		
CO 4		

Main Texts

1. Lippman, S., Lajoie, L., and Moo, B., (2013), C++ Primer.
2. Stroustrup, B. (2013). The C++ Programming Language Fourth Edition.
3. Hamilton L. C., (2012), Statistics with Stata, 12th Edition, STATA Bookstore

Reference Books

1. Mitchel M. N., A Visual Guide to Stata Graphics, 3rd Edition, STATA Bookstore
2. Press W. H., *et al.*, Numerical Recipes in C++: The Art of Scientific Computing, 2nd Edition, Cambridge University Press, UK

Course Code: MAT 0541 2105	**Credit:** 3.0	**Year: 2nd**	**Semester: 1st**
Course Title: Advanced Calculus & Differential Equations		**Course Status:** General Education	

Rationale of the Course: The first section of the course goes over the graphs, limits, continuity, and differentiability of various functions as well as their attributes. The derivative is used to address maximization-minimization problems and problems involving related rates, which have numerous applications in various branches of science and technology. This course also covers multivariable calculus, including partial derivatives, multiple integrals, and their applications. These are used to calculate areas, lengths, surface areas, and volumes.

Course Objectives: The objectives of the course are

- To understand elementary analytical solution techniques for the solution of ordinary differential equations (ODEs),
- To provide the knowledge of linear ODEs in terms of independent homogeneous and non-homogeneous solutions,
- To understand series, including convergence properties and use in representing functions,
- To develop skills on the use of approximation in studying mathematical and scientific problems and the importance of accuracy of approximations.

Course Contents

Advanced Calculus: Concept of improper integrals; Gamma and Beta functions; their incompleteness and other properties; Functions of several variables and limit and continuity; Taylor's expansion of such functions; maxima and minima of functions of more than one variable; Lagrange's multipliers; multiple integrals; Jacobians of transformation; Dirichlet integral and its extension; Laplace transformation; concept of Fourier series, inverse Laplace transformation, Lotka-Voltera integral equation, convolution theorem. **Differential Equations:** Definition; solution of differential equations; basic theory of linear differential equations; basic theory of non-linear differential equations; equations of the first order and their solution; homogeneous differential equations; linear differential equations of the second and higher order and their solution, system of differential equations.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Analyze improper integrals, including Gamma and Beta functions, and explore their properties and applications;
CO2	Investigate the behavior of functions of several variables, including their limits, continuity, and Taylor expansions, and apply these concepts to find maxima and minima

CO3	Solve optimization problems using Lagrange's multipliers and apply multiple integrals and Jacobians of transformation in real-world contexts
CO4	Understand and apply Dirichlet integrals, their extensions, and Laplace transformations, as well as concepts of Fourier series and inverse Laplace transformations
CO5	Solve and analyze linear and non-linear differential equations of various orders, applying appropriate techniques to model and interpret real-world phenomena

Mapping Course Learning Outcomes (COs) with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2			2		
CO2	2			1		
CO3	2			1		
CO4	2			2		
CO5	2			1		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ projectors	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group)

		Semester-end examination

Main Text
Anton H., Bivens I., & Davis S., (2012), Calculus Early Transcendentals, 10th Edition, John Wiley & Sons Inc

Reference Books

1. Thomas G. B., Finney R. L., (1995), Calculus and Analytic Geometry, 9th Edition, Addison Wesley
2. Wrede R., Spiegel M., (2010), Advanced Calculus, 3rd Edition, Schaum's Outlines Series, McGraw-Hill Education
3. Widder D. V., (2012), Advanced Calculus, 2nd Edition, Dover Publications
4. Ross S. L., (1985), Differential Equations, 3rd Edition, John Wiley & Sons, Inc
5. Ayres F., Differential Equations, 3rd Edition, McGraw-Hill Education
6. Sharma B. D., (2001), Differential Equations, Kedar Nath Ram Nath, India

Course Code: ECO 0311 2107	**Credit:** 3.0	**Year: 2nd**	**Semester: 1st**
Course Title: Principles of Microeconomics		**Course Status:** General Education	

Rationale of the Course:
Microeconomics is the branch of economics that focuses on individual agents and their decision-making processes regarding the allocation of limited resources. By analyzing the forces of supply and demand, students can grasp the mechanisms that shape the allocation of goods and services in society. Moreover, microeconomics provides insights into consumer behavior. By analyzing factors such as preferences, income, and prices, firms can identify and respond to consumer demands, thereby increasing their chances of success in the market. Furthermore, studying microeconomic data analytics enables students to predict efficiency in resource allocation. Finally, microeconomics aids in comprehending the impacts of government policies and regulations. By studying how markets respond to interventions, such as taxes or subsidies, we can assess the intended and unintended consequences on consumers, producers, and overall economic efficiency.

Course Objectives: The objectives of the course are

- To provide a brief and simple introduction to the subject matter and scope of Economics.
- Outlines the theory of markets with relevant applications to business, social and individual issues. The course covers the principles and consequences of "rational" choice by individual economic agents in markets.
- To provide an introductory analysis of the role of governments in seeking to ensure the efficient operation of markets.
- To provide students with a practical understanding of the core economic principles that explain why individuals, companies and governments make the decisions they do, and how their decision-making might be improved to make best use of available resources.

Course Contents

Basic Concepts in Economics: Definition of Economics and Scope, Economic Resources and their Allocation Problems in Economics, Scarcity, Choice, Opportunity Cost, Production Possibilities Frontier (PPF), Understanding Efficiency vs Equity, Economic Principles and Economic Models.

Demand and Supply: Demand- The Law of Demand, the Demand Curve, Factors Affecting the Demand Curve, Shifts versus Movement along the Demand Curve, Elastic and Inelastic Demand, Elasticity and Revenue; **Supply-** The Law of Supply, the Supply Curve, Factors Affecting the Supply Curve, Shifts versus Movement along the Supply Curve, Elasticity of Supply.

Market Equilibrium and Welfare: Interaction of Demand and Supply, Effect on the Equilibrium of a Shift in Demand or Supply or both, Consumer Surplus (CS) and Producer Surplus (PS), Effect of a Tax or Subsidy, Price Controls as a Government Policy: Price Ceiling and Price Floor.

Consumer Behavior: Utility and Choice, Marginal Utility, Law of Diminishing Marginal utility, Indifference Curves and their Properties, Budget Sets, Consumer Equilibrium in Cardinal and Ordinal Approach, Income and Substitution Effects, Deriving the Demand Curve from the Budget Sets and Indifference Map.

Production: Concept of a Production Functions, Total, Average and Marginal Product, Law of Diminishing Returns, Optimum Stage of Production (Production and Employment Decision in the short run), Returns to scale.

Cost and Revenue: Accounting and Economic Cost, Fixed and Variable Costs, Short Run and Long Run Costs, Total, Average and Marginal Costs; Total, Average and Marginal Revenue; Isoquants, Isocosts, and the Least Cost Combination, Equating Marginal Revenue with Marginal Cost.

Perfectly Competitive Markets: Characteristics of Perfectly Competitive Market,Profit Maximization in Short Run and Long Run, Loss, Shut Down, Entry and Exit Conditions.

Imperfectly Competitive Markets: Characteristics and Sources of Monopoly, Production and Pricing Decisions of Monopoly, Oligopoly and Monopolistic Competition, Price Discrimination.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explore the fundamentals of microeconomics and how individual agents make decisions;
CO2	Analyze market demand, supply, elasticity, and determine equilibrium price and quantity;
CO3	Explore consumer behavior, considering budget constraints and price dynamics;
CO4	Examine production and cost structures of firms, and analyze production decisions in both short-run and long-run scenarios;
CO5	Investigate different market structures and the factors influencing pricing decisions within those structures.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6

(CO)						
CO1	3		2	3		
CO2			3			3
CO3		3		2		3
CO4			3		2	
CO5				3	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Tutorial	Quiz/ Semester-end examination

Reference Books

1. Case, K. E., Fair, R. C., & Oster, S. E. (2019). Principles of Economics, Global Edition (13th ed.). Pearson.
2. Frank, R., Bernanke, B., Antonovics, K., & Heffetz, O. (2022). Principles of Economics (8th ed.). McGraw-Hill Education.
3. Arnold, R. A. (2018). Economics, Southwestern Publishing Company, Thirteenth Edition
4. Mankiw, N G (2022). Principles of Microeconomics, Thomson South Western Publishing, Ninth Edition

5. Perloff, Jeffrey M. (2015). Microeconomics. Seventh Edition

Course Code: STA 0542 2150	**Credit:** 1.0	**Year:** 2nd	**Semester:** 1st
Course Title: Presentation & Viva-voce		**Course Status:** Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2				2	
CO2	2				3	
CO3	2				3	2
CO4	2				3	3
CO5	1				3	2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Second Year Second Semester Course Details

Course Code: STA 0542 2251	**Credit:** 3.0	**Year: 2nd**	**Semester: 2nd**
Course Title: Regression Analysis – I		**Course Status: Theory**	

Rationale of the Course: The use of multiple linear regression is explained in detail in this introductory course, which also provides an introduction of several forms of regression. Regression analysis theory, multiple linear regression theory, traditional estimation and testing theory, and residual analysis theory are all covered in this course. Additionally, it covers the creation, analysis, and validation of linear regression models.

Course Objectives: The objectives of the course are

- Familiarize students with the concepts of the statistical modeling,
- Helping students to develop ability in model fitting through estimation of parameters,
- Provide knowledge of assessing fitted model, testing relevant hypotheses and perform forecasting,
- Acquaint students with basic tools of regression models, techniques and interpretations to use in practice.

Course Content

Correlation Analysis: Basic idea of correlation and coefficient of correlation, rank correlation, spurious correlation, non-sense correlation. **Other Techniques of Correlation:** Point-biserial and biserial correlations, Fourfold correlation, poly-choric correlation, and intra-class correlation. **Simple Linear Regression:** The concept of population and sample regression functions, method of least squares, estimation of regression coefficients, OLS estimators, and correlation ratio. **Topics on Estimation and Hypothesis Testing**: The classical linear regression model, Gauss-Markov theorem, estimation of error variance, hypothesis testing. **Bivariate Quantitative Data:** Regression curves from bivariate distributions, bivariate normal distribution, marginal distribution, conditional distribution. **Multiple Linear Regression**: Regression through the origin, scaling and units of measures, different functional forms of regression models. Three variable regression, estimation of parameters and standard error, separation of effects, multiple and partial correlation, concepts of polynomial regression. **Residual Analysis:** Basic concepts, analysis of residuals by graphs, lack of fit of model adequacy.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Identify relationships among variables along with assumptions;
CO2	Formulate simple linear regression model with underlying assumptions involved;
CO3	Estimate simple linear regression model parameters along with residual analysis;
CO4	Create multiple linear regression model, regression through origin, and

	different functional form of regression models;
CO5	Relate appropriate regression models and their limitations in diverse sectors.

Mapping Course Learning Outcomes (COs) with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					
CO2	2					
CO3	2					
CO4	2					
CO5	3		3	2	2	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ projectors	Quiz/ Midterm Examination 2
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Montgomery D. C., Peck E. A., Vining G. G., (2012), Introduction to Linear Regression Analysis, 5th Edition, John Wiley, NY
2. Gujarati, D. N., (2009), Basic econometrics: Tata McGraw-Hill Education
3. Draper N. R. & Smith H., (1998), Applied Linear Regression, 3rd Edition, John Wiley, NY

Reference Books

1. Chatterjee S., & Price P., Regression Analysis by Example, John Wiley, NY
2. Graybil F. A., An Introduction to Linear Statistical Models, Vol-1, McGraw Hill, NY
3. Griffiths W. E., et al., Learning and Practicing Econometrics, John Wiley & Sons, NY
4. Johnston, J., & Di Nardo, J., (2007), Econometric Methods-University of California, Irvine: The McGraw-Hill Companies, Inc.
5. Judge G. G., *et al.*, The Theory and Practice of Econometrics, 2nd Edition, John Wiley & Sons, NY
6. Koutsoyiannis, A., (1979), Theory of Econometrics, The Macmillan Press Ltd, London.
7. Seber G. A. F., General Linear Regression Analysis, Wiley & Sons Ltd, NY
8. Weisberg S., Applied Linear Regression, 2nd Edition, John Wiley, NY

Course Code: STA 0542 2252	**Credit: 1.5**	**Year: 2nd**	**Semester: 2nd**
Course Title: Regression Analysis – I Lab		**Course Status:** Lab	

Rationale of the Course: Apply acquired knowledge to solve practical problems based on the theory learnt. In particular, students can know how to actually use a statistical package to put the theory into practice and address a particular research subject.

Course Objectives: The objectives of the course are

- To demonstrate students how to use correlation theory to measure the strength of relationships among random phenomena,
- To equip students with the tools and techniques to use regression models in practice.

Course Contents

Correlation analysis: Correlation coefficient, rank correlation, biserial correlation, poly-choric correlation, and intra-class correlation. **Simple Linear Regression:** OLS estimators, correlation ratio, hypothesis testing, regression through the origin, scaling and units of measures. **Multiple Linear Regression**: Estimation of parameters and standard error, separation of effects, multiple and partial correlation. **Model Adequacy:** Analyses of residuals by graphs, lack of fit.

Course Learning Outcomes (COs): At the end of course, students will be able to –

CO1	Measure the strength of relationships among random variables;
CO2	Apply linear regression models to estimate the model parameters;
CO3	Interpret model parameters for the given dataset;
CO4	Check model adequacy;
CO5	Find the best fitted regression equation to predict the mean value of a dependent variable.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2					
CO2	2					
CO3	2					
CO4	2					
CO5	3					

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors	
CO 3	Lecture using board/ Assignment	
CO 4	Lecture using board/ Assignment	
CO 5	Lecture using board/ Assignment	

Main Texts

1. Montgomery D. C., Peck E. A., Vining G. G., (2012), Introduction to Linear Regression Analysis, 5th Edition, John Wiley, NY
2. Gujarati, D. N., (2009), Basic econometrics: Tata McGraw-Hill Education
3. Draper N. R. & Smith H., (1998), Applied Linear Regression, 3rd Edition, John Wiley, NY

Reference Books

1. Chatterjee S. & Price P., Regression Analysis by Example, John Wiley, NY
2. Griffiths W. E., et al, Learning and Practicing Econometrics, John Wiley & Sons, NY
3. Koutsoyiannis, A., (1979), Theory of Econometrics, The Macmillan Press Ltd, London.
4. Weisberg S., Applied Linear Regression, 2nd Edition, John Wiley, NY

Course Code: MAT 0541 2203	**Credit: 3.0**	**Year: 2nd**	**Semester: 2nd**
Course Title: Numerical Methods		**Course Status:** General Education	

Rationale of the Course: Acquire knowledge on numerical algorithms.

Course Objectives: The objectives of the course are

- To provide knowledge on numerical methods to solve algebraic and transcendental equations,
- To facilitate necessary knowledge on different methods of interpolations and extrapolations,
- To apply appropriate numerical methods to solve differential equations and to calculate definite integrals,

- To conceptualize the ideas about various numerical root finding methods,
- To equip with various methods of convergence and understand the errors,
- To facilitate necessary knowledge about explaining and understanding of methods to solve the simultaneous equations.

Course Contents

Numerical methods: Interpolation and extrapolation; shifting operators; difference operators and their relationships; Newton's interpolation formulae; Lagrange's formula; Newton's divided difference formula; central difference formulae (Stirling and Bessel's); relationship between divided difference and simple difference; inverse interpolation formula; Finding root of single variable by different methods (Bi-section, Iteration, Newton-Raphson, Weddle's rule), numerical differentiation; numerical integration by Trapezoidal rule, Simpson's 1/3 and 3/8 rules; convergence of these methods and their inherent errors; numerical solution of simultaneous linear equation; by iteration and by successive elimination of the unknowns.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Apply interpolation and extrapolation techniques, including Newton's and Lagrange's formulas, to estimate function values and analyze shifting and difference operators.
CO2	Use Newton's divided difference and central difference formulas (Stirling and Bessel's) to construct interpolation polynomials and understand their relationship with simple differences.
CO3	Implement various root-finding algorithms such as Newton-Raphson, bisection, false position, and secant methods for solving nonlinear equations.
CO4	Perform numerical differentiation and integration using Trapezoidal rule, Simpson's 1/3 and 3/8 rules, and Weddle's rule, and evaluate their accuracy and convergence behavior.
CO5	Solve systems of simultaneous linear equations using iterative methods and successive elimination techniques, assessing their stability and error propagation.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2			1		
CO2	2			1		
CO3	2			1		
CO4	2			1		
CO5	2			1		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 4	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Text

Scarborough J. B., (2017), Numerical Mathematical Analysis, 6th Edition, Oxford & IBH, New Delhi

Reference Books

1. Freeman H., Finite Difference for Actuarial Students, 2nd Edition, Cambridge University Press, UK
2. Noble B., Numerical Methods, Vol. I and II

Course Code: MAT 0541 2205	**Credit: 3.0**	**Year: 2nd**	**Semester: 2nd**
Course Title: Real Analysis		**Course Status:** General Education	

Rationale of the Course: Acquiring knowledge on open and closed sets, bounded sets, interior point of a set, supremum and infimum, completeness, various types of sequences such as convergent, monotonic and cauchy sequence. Moreover, students will learn different types of infinite series**,** limit and continuity, derivatives and Riemann integration**.**

Course Objectives: The objectives of the course are

- To provide the knowledge of real number system,
- To conceptualize the idea of sequences and infinite series,
- To facilitate necessary knowledge on limit and continuity,
- To develop skills on derivatives and Riemann integration.

Course Content

Real numbers system: infinite sets, countable sets, and bounded sets of real numbers; supremum and infimum; the completeness property of real numbers. **Sequence of real numbers:** sequences and their limits; monotone sequences; Monotone Convergence Theorem; Subsequences; Bolzano-Weierstrass Theorem; Cauchy sequences; Cauchy Convergence criterion, properly divergent sequences. **Infinite series:** convergence of infinite series: Cauchy Convergence Criterion for series; absolute and conditional convergence; various tests for convergence: power series, **Limits and continuity of functions:** limit of functions; Squeeze theorem; continuous functions and their combinations; Boundedness Theorem; Maximum-Minimum Value Theorem; Sign Preservation theorem; Root Location Theorem; Bolzano's Intermediate Value Theorem; Fixed Point Theorem; uniform continuity. **Differentiability of functions:** differentiability; Interior Extremum Theorem; Rolle's theorem; Mean Value Theorem; Darboux's Theorem; Taylor's Theorem. **Riemann integrals:** Riemann integrability of functions; properties of Riemann integrals; Riemann's Criterion for integrability; integrability of monotone and continuous functions; Fundamental Theorem of integral calculus.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain the structure and completeness of the real number system.
CO2	Analyze convergence properties of sequences and series using key theorems.
CO3	Apply convergence tests to infinite series, including power series.
CO4	Evaluate limits and continuity of functions using foundational theorems.
CO5	Apply theorems of differentiability and integration to real-valued functions.

Mapping Course Learning Outcomes (COs) with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2			1		
CO2	2			1		
CO3	2			1		
CO4	2			1		
CO5	2			1		

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ projectors	Quiz/Midterm Examination 2 Semester-end examination

CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Bartle R. G. & Sherbert D. R., (2011), Introduction to Real Analysis, John Wiley & Sons Inc
2. Rudin W., (1976), Principles of Mathematical Analysis, McGraw-Hill Book Company

Reference Books

1. Chatterjee P. N., (1995), Real Analysis, Rajhans Prakashan Mandir, Meerut, India
2. Chowdhury F. & Chowdhury M. R., (2010), Essentials of Real Analysis, Pi Publications, Dhaka
3. Davidson K. R. & Donsig A. P., (2002), Real Analysis with Real Applications, Prentice Hall Inc
4. Malik S. C. & Arora S., (2009), Mathematical Analysis, New Academic Science Ltd, United Kingdom
5. Mapa S. K., (2006), Introduction to Real Analysis, Sharat Book Distributor, Kolkata, India
6. Trench W. F., (2011), Introduction to Real Analysis, Trinity University San Antonio, Texas, USA

Course Code: ECO 0311 2207	**Credit:** 3.0	**Year: 2nd**	**Semester: 2nd**
Course Title: Principles of Macroeconomics		**Course Status:** General Education	

Rationale of the Course: This course is designed to provide students with a thorough understanding of macroeconomic principles and theories. By focusing on key macroeconomic concepts and their application, students will gain the necessary knowledge and skills to analyze and interpret macroeconomic data, assess Labor market dynamics, evaluate economic growth patterns, explore consumption and saving behavior, investigate investment decisions, examine monetary and banking systems, analyze business cycles, and explore the complexities of monetary and fiscal policy. Understanding macroeconomic theory is crucial for individuals in economics and finance as it allows them to comprehend the broader economic environment in which businesses operate. By grasping the macroeconomic factors that influence economic conditions, students can make informed decisions regarding macroeconomic strategies and policy implications.

Course Objectives: The objectives of the course are

- The main objective of this course to equip students with a solid foundation in macroeconomic theory, measurement, and analysis, providing them with the necessary tools to assess economic conditions, anticipate market trends, and make sound financial and business decisions.
- The course also aims to foster critical thinking and analytical skills through the examination of real-world macroeconomic issues and case studies.
- Students will be encouraged to apply theoretical concepts to practical scenarios, enabling them to develop macroeconomic problem-solving abilities and enhance their decision-making capabilities.
- Furthermore, the course explores the relationship between inflation and unemployment, which is vital for comprehending the dynamics of the overall economy.
- By studying the factors that drive output, inflation and its impact on employment levels, students will gain insights into the policy challenges faced by policymakers and the potential trade-offs between macroeconomic objectives.

Course Contents

Introduction to Macroeconomics: Macroeconomic principles and objectives;Circular Flow Model and Components of Macroeconomics; Key Macroeconomic Performance Indicators: GDP, GNI, NI and Personal disposable income; Various Methods of GDP Measurement and their Shortcomings; Real vs. Nominal GDP; Growth Rate and Business Cycle.

Determination of National Income: Psychological law of Consumption, Consumption function, Saving and Investment Function, Government and External Sector functions; Leakages and Injections; Equilibrium Output and Multiplier; the Paradox of Thrift.

AD-AS Model: Aggregate Demand Curve-Definition, Shape and Determinants; Aggregate Supply Curve-Definition, Shape and Determinants, Classical vs. Keynesian views on AS Curves; Macro-Equilibrium using AD-AS.
Inflation: Definitions and Types of Inflation; Price Indices—GDP Deflator and CPI; Demand pull and Cost push Inflation; Benefits and Costs of Inflation.
Unemployment: Definitions of Unemployment; Calculation of Labor Force and Unemployment; Causes and Consequences of Unemployment, Remedial Measures and Phillips Curve.
Money, Commercial Banking and Finance: Definition and Functions of Money, Components of Money Supply and Money Demand, Commercial Banks and the Money Creation; Linkage between Macroeconomics and Finance, Causes of Financial Crisis.
Central Banking and Monetary Policy: Structure and Functions of Central Bank, Objectives, Types and Instruments of Monetary Policy; Operation and Lags of Monetary Policy.
Budget and Fiscal Policy: Definition, Objectives, Types and Instruments of Fiscal Policy; Budget, Types of Taxation; Heads of Government Expenditure; Fiscal Policy Multipliers.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Solve equilibrium outcomes in simple models of the Macroeconomics;
CO2	Differentiate between the classical and Keynesian approaches to macroeconomics, synthesizing the underlying theories and their implications for capturing economic phenomena;
CO3	Evaluate macroeconomic theories by comparing their predictions to real-world data, developing the ability to critically assess the validity and applicability of various theoretical frameworks;
CO4	Evaluate macroeconomic policies using the models introduced and developed throughout the course;
CO5	Formulate theoretical frameworks that explain the functioning of unconventional monetary policy under specific economic or financial conditions and their effectiveness and limitations of such policies.

Mapping Course Learning Outcomes (COs) with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		2	2		
CO2			2			3
CO3		3		2		3
CO4			3			2
CO5				3	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ projectors	Quiz/ Semester-end examination

Reference Books

1. Case, K. E., Fair, R. C., & Oster, S. E. (2019). *Principles of Economics, Global Edition* (13th ed.). Pearson.
2. Frank, R., Bernanke, B., Antonovics, K., & Heffetz, O. (2022). *Principles of Economics* (8th ed.). McGraw-Hill Education.
3. Arnold, R. A (2018). *Macroeconomics*, South Western Publishing Company, Thirteenth Edition.
4. Mankiw, G. (2022). *Principles of Economics*, Thomson South Western Publishing, Eleventh Edition.

Course Code: CSE 0612 2209	**Credit:** 2.0	**Year: 2nd**	**Semester: 2nd**

Course Title: Database Management & Programming	**Course Status:** General Education

Rationale of Course: Acquiring basic concepts of database management system and its programming.

Course Objectives: The objectives of the course are

- Provide necessary knowledge on the issues involved in the design and implementation of a database system,
- Helping the students to understand the physical and logical database designs, database modeling, relational, hierarchical and network models,
- Make the students understand the data manipulation language to query, update, and manage a database,
- Helping the students to understand essential DBMS concepts such as: database security, integrity, concurrency, distributed database, Client/Server (Database Server), Data Warehousing,
- Develop skills on design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing and implementing a DBMS.

Course Content

Computer Basics: Concept on Computer Hardware, Software and its classification, networking and Internet**. Introduction to Database:** Database management system, relational database management system, entity-relationship model, relational model, SQL, sorting, indexing, integrity constraints, transaction concept, database system architecture. **Database Management:** Creating a database, opening a database, modifying a database, modifying a database structure, indexing, sorting, searching a database, designing a customer screen, designing a report, designing a menu. **Database Programming:** Programming concept, a simple program, memory variables, constants, operators, commands, arrays, macros, different type of processing, procedures, functions. programming for data entries, update, report, menu and searching.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Describe the fundamentals of database systems;
CO2	Differentiate between different database models;
CO3	Design a relational database including creation of queries in relational databases;
CO4	Use indexing for databases;
CO5	Implement concurrency control mechanisms.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	1			
CO2	2	2	2			
CO3	2	2	1			
CO4	2	2	2			
CO5	2	2	1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Assignment using computer	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ Assignment using computer	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination

CO 5	Lecture using board/ Assignment using computer	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Korth H. F., Sudarshan S., Silberschatz A., (2010), Database System Concepts, McGraw-Hill Education
2. Elmasri R. & Navathe S. B., (2009), Fundamentals of Database Systems, 5th Edition, Pearson Education India

Reference Book

- Ramakrishnan, R., Gehrke, J., & Gehrke, J., (2003), Database management systems, Vol. 3, McGraw-Hill, NY

Course Code: CSE 0612 2211	**Credit:** 3.0	**Year: 2nd**	**Semester: 2nd**
Course Title: Database Management & Programming Lab		**Course Status:** General Education	

Rationale of the Course: Apply acquired knowledge to design and implement database system and SQL.

Course Objectives: The objectives of the course are

- Make the students understand the Windows operating system, word processor, electronic spreadsheet, and presentation software,
- Helping the students to create, modify, indexing, sorting a database, design a customer screen, design a report, designing a menu,
- Helping students to write database programming.

Course Content

Computer Basics: Basic concepts of Windows operating system, word processor, electronic spreadsheet, and presentation software. **Database Management**: Create, modify, indexing, sorting a database, design a customer screen, design a report, designing a menu. **Database Programming**: Basic programming with database.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Perform basic computer operations;
CO2	Describe the fundamentals of database systems;
CO3	Differentiate between different database models;
CO4	Design a relational database including creation of queries in relational databases;
CO5	Use indexing for databases including implementation of concurrency control mechanisms.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2	1			
CO2	2	2	2			
CO3	2	2	1			
CO4	2	2	2			
CO5	2	2	1			

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ computer	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors	
CO 3	Lecture using board/ projectors	
CO 4	Lecture using board/ computer	
CO 5	Lecture using board/ computer	

Main Texts

1. Korth H. F., Sudarshan S., Silberschatz A., (2010), Database System Concepts, McGraw-Hill Education

2. Elmasri R., & Navathe S. B., (2009), Fundamentals of Database Systems, 5th Edition, Pearson Education India

Reference Book

- Ramakrishnan, R., Gehrke, J., & Gehrke, J., (2003), Database management systems, Vol. 3, McGraw-Hill, NY

Course Code: STA 0542 2250	**Credit:** 1.0	**Year: 2nd**	**Semester: 2nd**
Course Title: Presentation & Viva-voce		**Course Status:** Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- To gain confidence in their own ability to present and explain the basic concepts of the courses,
- To provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2		2		2	
CO2	2		2		3	
CO3	2	2			3	2
CO4	2				3	3
CO5	1	2	2		3	2

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Third Year First Semester Course Details

Course Code: STA 0542 3151	**Credit:** 2.0	**Year: 3rd**	**Semester: 1st**
Course Title: Design & Analysis of Experiments – I		**Course Status: Theory**	

Rationale of the Course: Statistical methods are greatly used in experimental studies and serve as essential tools in designing experiments to avoid bias. Moreover, data generated in experimental studies need to be analyzed using various statistical tools and modeling techniques. Therefore, a statistician should have sound knowledge and skills in design and analysis of experiments to conduct any experimental research.

Course Objectives: The objectives of the course are

- To acquaint students with the basic principles and methods of standard experimental design,
- To help students developing the ability to analyze experimental data.

Course Contents

Introduction: Basic ideas of analysis of variance, One-way classification with equal and unequal observations, Two-way and three-way classification with single and multiple observations per cell, Experimental errors and their control, Analysis of variance with fixed effect, random effect and mixed effect models, Model adequacy checking. **Multiple comparison:** Introduction, Tukey's W-test, Newman-Keuls several range test, Duncan multiple range test, Dunnett's test, Bonferroni test. **Experimental designs:** Introduction, Principles of experimental design, uniformity trial, choice of size and shape of plots and blocks, estimation and analysis of completely randomized design, randomized block design and Latin square design. Orthogonality of designs, Analysis of replicated Latin square design, Graceo-Latin square design. **Factorial Experiment**: Introduction to factorial design, factorial experiment for two or three levels up to n factors.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain various concepts of experimental designs and analysis of variance;
CO2	Differentiate various experimental design and other related topics;
CO3	Perform analysis of data generated from different experimental designs;
CO4	Estimate parameters and variance components of different models related to various design of experiments;
CO5	Derive relative efficiencies of various design of experiments.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3		2		
CO2	3	3		2	3	
CO3	3	3		2	3	
CO4	3	3		1	1	
CO5	3	3		2	3	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ Tutorial	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors/Tutorial	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ projectors/	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Montogomery D. C., (2020), Design and Analysis of Experiments, 10th Edition, Wiley, NY
2. Das M. N., & Giri N. C., (2017), Design and Analysis of Experiments, 3rd Edition, New Age International, Delhi
3. Sahai H., & Ageel, M. I., (2000), The Analysis of Variance: Fixed. Random and Mixed Models, MA: Birkhauser, Boston

Reference Books

1. Bhuyan M. R., Fundamentals of Experimental Design, 2nd Edition, Book World Publications, Dhaka
2. Cochran W. G., & Cox D. R., Experimental Design, 2nd Edition, John Wiley & Sons, NY
3. Davis O. L., Design and Analysis of Industrial Experiments, Oliver & Boyd, London
4. Federer W. T., Experimental Design: Theory and Application, Oxford & IBH Publishing Company, NY
5. Gomez K. A., & Gomez A. A., Statistical Procedures for Agricultural Research, 2nd Edition, Wiley, NY
6. Sheffe H., The Analysis of Variance, John Wiley & Sons, NY
7. Winer B. J., Statistical Principles in Experimental Design, 2nd Ed., McGraw Hill Company, Ltd

Course Code: STA 0542 3152	**Credit:** 2.0	**Year: 3rd**	**Semester: 1st**
Course Title: Design & Analysis of Experiments – I Lab		**Course Status:** Lab	

Rationale of the Course: Apply acquired knowledge for solving the problems on design of experiments.

Course Objectives: The objectives of the course are

- To detect experimental errors and control them,
- To acquaint students with the methods of conducting experiments with standard designs,
- To develop ability to perform factorial design of experiments.

Course Contents

Introduction: One-way classification with equal and unequal observations, Two-way and three-way classification with equal number of observations per cell, Experimental error and interpretation of data, Analysis of variance with fixed effect, random effect and mixed effect models, Model adequacy checking. **Multiple comparison:** Tukey's W-test, Newman-Keuls several range test, Duncan multiple range test, Dunnett's test, Bonferroni test. **Experimental designs:** Estimation and analysis of completely randomized design, randomized block design and Latin square design. **Orthogonality of designs:** Dealing with missing data in experimental design. **Factorial Experiment:** Analysis of factorial experiments for two and three levels.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Perform ANOVA for one-way and two-way classified data;
CO2	Test the equality of treatment means;
CO3	Determine the within group and between group variability;
CO4	Analyze single factor experiments;
CO5	Perform factorial experiments.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3			1	
CO2	3	3			1	
CO3	3	3			1	
CO4	3	3			1	
CO5	3	3			1	

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ Tutorial/assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors	
CO 3	Lecture using board/ projectors	
CO 4	Lecture using board/ Tutorial/assignment	
CO 5	Lecture using board/ Tutorial/assignment	

Main Texts

1. Montogomery D. C., (2020), Design and Analysis of Experiments, 10th Edition, Wiley, NY

2. Das M. N. & Giri N. C., (2017), Design and Analysis of Experiments, 3rd Edition, New Age International, Delhi
3. Sahai H. & Ageel M. I., (2000), The Analysis of Variance: Fixed. Random and Mixed Models, MA: Birkhauser, Boston

Reference Books

1. Bhuyan M. R., Fundamentals of Experimental Design, 2nd Edition, Book World Publications, Dhaka
2. Davis O. L., Design and Analysis of Industrial Experiments, Oliver & Boyd, London
3. Federer W. T., Experimental Design: Theory and Application, Oxford & IBH Publishing Company, NY
4. Gomez K. A., & Gomez A. A., Statistical Procedures for Agricultural Research, 2nd Edition, Wiley, NY
5. Sheffe H., The Analysis of Variance, John Wiley & Sons, NY
6. Winer B. J., Statistical Principles in Experimental Design, 2nd Ed., McGraw Hill Company, Ltd

Course Code: STA 0542 3153	**Credit:** 3.0	**Year: 3rd**	**Semester: 1st**
Course Title: Statistical Inference		**Course Status: Theory**	

Rationale of the Course: This course covers the basic ideas and methods of statistical inference, such as estimates and testing of single and multiple hypotheses. Additionally, several fundamental concepts in probability theory and random variables will be briefly reviewed.

Course Objectives: The objectives of the course are

- Facilitate necessary knowledge about the techniques for estimating the population parameters,
- Make students understand the properties of point estimates,
- Acquaint students with the basic concepts of interval estimates,
- Help students understand the basic concepts of hypotheses testing using both parametric and non-parametric approaches.

Course Contents

Point estimation: Basic concepts, principles of point estimation**. Properties of point estimators**: Unbiasedness, sufficiency, consistency, efficiency, asymptotic efficiency. Cramer-Rao lower bound, MVB estimate. **Method of point estimation**: Method of maximum likelihood, method of moments, method of least squares, method of minimum chi-squares, method of minimum variance, and Bayes' method**. Interval estimation**: Concept of central and non-central confidence interval. Confidence interval for parameters of normal, binomial and Poisson distributions, large sample confidence interval. **Parametric tests**: Review of basic concepts, simple hypothesis & composite hypothesis, Type I error, Type II error, size and power of the test, critical region. Best critical region, Neyman-Pearson fundamental lemma, most powerful tests, uniformly most powerful critical region, UMP tests. **Non-parametric tests**: Tests based on runs, tests of goodness of fit. Rank order statistics. One sample and paired sample techniques. The sign test and signed rank test. General two sample problem. Linear rank statistics and the general two-sample problem. Linear rank tests for the location problem, linear rank tests for the scale problem. Tests of equality of k independent samples. Measures for bivariate samples. Measures of association in multiple comparison.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Define point estimation, interval estimation, parametric test and non-parametric test;
CO2	Estimate the parameters using different techniques of point estimation;
CO3	Construct interval estimation of the parameters using different techniques;
CO4	Investigate the criteria for testing the hypothesis to find the best critical region;
CO5	Formulate the steps involving in testing the non-parametric distributions.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	2		1		
CO2	3	2		1		

CO3	3	2		1		
CO4	3	2		3		
CO5	3	2		1		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ projectors	Quiz/ Semester-end examination

Main Texts

1. Mukhopadhyay, N. (2000). Probability and Statistical Inference, CRC Press
2. Rohatgi, V. K. (2013). Statistical Inference. Dover Publications, Inc.
3. Mood A., Graybill F., Boes D., (1974), Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill, NY

Reference Books

1. Beaumont W., Intermediate Mathematical Statistics, 2nd Edition, Cambridge University Press, London
2. Cox D. R., & Hinkley D. V., Theoretical Statistics, Chapman and Hall, London
3. Graybill F. A., Introduction to Linear Statistical Models, McGraw Hill, NY
4. Hogg R. V., & Craig A. T., Introduction to Mathematical Statistics, Macmillan, NY
5. Hollander M., & Wolf D. A., Nonparametric Statistical Methods, 2nd Edition, John Wiley & Sons, Inc, NY
6. Kendall M. G., & Stuart A., The Advance Theory of Statistics, Vol-2, 4th Edition, Charles-Grifin, London
7. Lindley D. V., The Use of Prior Probability Distributions in Statistical Inference and Decisions, Proceedings of the Fourth Berkeley Sym POsium on Mathematical Statistics and Probability, Vol 1
8. Zacks S., Theory of Statistical Inference, John Wiley, NY

Course Code: STA 0542 3154	**Credit:** 2.0	**Year: 3rd**	**Semester: 1st**
Course Title: Statistical Inference Lab		**Course Status:** Lab	

Rationale of the Course: Apply acquired knowledge on methods of estimation and tests of hypotheses.

Course Objectives: The objectives of the course are

- To acquaint the students with the methods of point estimation,
- To familiarize the students with the techniques of interval estimation,
- To help the students developing the ability to perform hypothesis testing using real data.

Course Contents

Drawing sample from univariate and bivariate normal distributions. Point estimation of parameters of univariate distributions by method of moments, method of maximum likelihood and method of least squares. Construction of confidence intervals for parameters of normal distribution, construction of large sample confidence interval for parameters of binomial and Poisson distribution. Tests of hypothesis regarding parameters of univariate and bivariate normal distributions, tests of hypothesis regarding parameters of discrete and continuous distributions. Calculation of best critical region and drawing power curve. Non-parametric tests.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Generate random sample from different distributions;
CO2	Apply point estimation methods to estimate the parameters using the sample

	from different distributions;
CO3	Construct interval estimation of the parameters using the sample from different distributions;
CO4	Obtain the test with the best critical region;
CO5	Choose a non-parametric test that is suitable under the assumptions of nonparametric distributions.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3				
CO2	3	3				
CO3	3	3		2	2	
CO4	3	3		2	2	
CO5	3	3		2	2	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ projectors/ assignment	
CO 3	Lecture using board/ projectors/ assignment	
CO 4	Lecture using board/ projectors/ assignment	
CO 5	Lecture using board/ projectors/ assignment	

Main Texts

1. Hogg R. V., & Craig A. T., Introduction to Mathematical Statistics, Macmillan, NY
2. Mood A., Graybill F., Boes D., (1974), Introduction to the Theory of Statistics, 3rd Edition, McGraw Hill, NY

Reference Books

1. Casella G., & Berger R. L., (1990), Statistical Inference, 2nd Edition, Duxbury Thomson Learning, USA
2. Beaumont W., Intermediate Mathematical Statistics ,2nd Edition, Cambridge University Press, London
3. Graybill F. A., Introduction to Linear Statistical Models, McGraw Hill, NY
4. Hollander M., & Wolf D. A., Non-parametric Statistical Methods, 2nd Edition, John Wiley & Sons, Inc, NY
5. Zacks S., Theory of Statistical Inference, John Wiley, NY

Course Code: STA 0542 3155	**Credit: 2.0**	**Year: 3rd**	**Semester: 2nd**
Course Title: Statistical Simulation and Data Analysis with R & Python		**Course Status: Theory**	

Rationale of the Course: In the contemporary environment, it is difficult to envisage and execute any scientific activity without the knowledge of software. Under R & Python programs, students will handle statistical and mathematical operations. Moreover, students will be able to understand built-in functions of R & Python with own programming language that can handle any particular task. Under simulation techniques which will be taught using R software, students will perform basic statistical analysis.

Course Objectives: The objectives of the course are

- Enhancing the skills of basic operations in R and Python,
- Develop ability in solving basic statistical problems using R & Python,
- Foster the analytical and critical thinking ability to write code in R & Python.
- Provide fundamental knowledge on the basic simulation mechanism.

Course Contents

Simulation: Introduction to simulation-concept and meaning of simulation studies and modelling; Basic nature of simulation, discrete and continuous simulation; random number generation, random variate generation details; Series and their

convergence; simple Monte Carlo integration, Polynomial and relational functions, incomplete gamma function, incomplete beta function, error function, chi-square probability function, cumulative probability function, exponential integrals, Student's t distribution, F distribution, cumulative binomial distribution, hypergeometric distribution, multidimensional function minimization. **R and Python-Language:** Overview of basic operations, list and data frames, data management, grouping, loops and conditional execution, functions; summary statistics and graphical procedures; statistical models with different probability distributions; simulation with R and Python.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Demonstrate along with the application of Simulation Concepts: Students will be able to describe the fundamental concepts and methodologies of simulation studies and modeling, including discrete and continuous simulation, random number generation, and random variate generation.
CO2	Perform Monte Carlo Integration and Function Analysis: Students will be able to perform simple Monte Carlo integration and analyze various mathematical and statistical functions, such as polynomial and relational functions, incomplete gamma and beta functions, error functions, chi-square, Student's t, F distributions, cumulative binomial, and hypergeometric distributions.
CO3	Implement Simulations using R and Python: Students will gain proficiency in using R and Python for simulation purposes, including data management, grouping, loops, conditional execution, and implementing statistical models with different probability distributions.
CO4	Analyze with the Minimization of Multidimensional Functions: Students will learn techniques for multidimensional function minimization and be able to apply these techniques to real-world data analysis scenarios using appropriate computational tools in R and Python.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill

Learning Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3		2		
CO2		3			2	2
CO3		3		3	3	3
CO4		3		3	3	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 4	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination

Main Texts

1. Ross S. M., (2006), Simulation, 4th Edition, Academic Press, London
2. Cohen Y. & Cohen J. Y., (2008), Statistics and Data with R: An applied approach through examples, John Wiley & Sons
3. VanderPlas J., (2016), Python data science handbook: Essential tools for working with data. O'Reilly

Reference Books

1. Crawley M. J., The R Book, 2nd Edition, Wiley, NY

2. Graham C. & Talay D., (2013), Stochastic simulation and Monte Carlo methods: mathematical foundations of stochastic simulation (Vol. 68). Springer Science & Business Media.
3. Ripley D Brian, Stochastic Simulation, Wiley, NY
4. Rubinstein Y R, Simulation and the Monte Carlo Method, Wiley, NY
5. Verzani J, Using R for Introductory Statistics, Chapman & Hall/CRC, NY
6. Rahman M. S., (2017), R Programming and Data Analysis, 1st Edition, Kazi Prokashoni, Dhaka

Course Code: STA 0542 3156	**Credit: 1.5**	**Year:** 3rd	**Semester:** 2nd
Course Title: Statistical Simulation and Data Analysis with R & Python Lab		**Course Status: Lab**	

Rationale of the Course: Acquiring skill to perform basic statistical computing algorithms and data analysis using R & Python.

Course Objectives: The objectives of the course are

- Make the students able to conduct basic operations in R and Python,
- Develop ability in solving basic statistical problems using R & Python,
- Foster the analytical and critical thinking ability to write code in R & Python.

Course Contents

R and Python Language: A basic operation in R & Python programming, Data management in R & Python, Graphical representation of data-XY plot, bar chart, pie chart, histogram and so on. **Data analysis using R & Python:** Regression including ANOVA, all possible regressions, sequential methods, model diagnostics, comparisons of regressions, Analysis of randomized block design, treatment comparisons, analysis of non-orthogonal designs, split-plot analysis, Other topics as covered in the theory part.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Master Basic Operations in R and Python: Students will be able to perform basic operations in R and Python, including managing lists and data frames, handling data management tasks, and utilizing loops and conditional execution.
CO2	Utilize Functions and Data Grouping Techniques: Students will be proficient in creating and using functions in R and Python, as well as applying data grouping techniques to organize and analyze datasets effectively.
CO3	Generate Summary Statistics with Visualizations: Students will learn to compute summary statistics and create graphical visualizations to represent data insights using R and Python.
CO4	Develop along with the Application of Statistical Models: Students will be able to develop statistical models with different probability distributions and conduct simulations to analyze and interpret data using R and Python.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3		2		
CO2		3			2	2
CO3		3		3	3	3
CO4		3		3	3	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/computer/tutorial using statistical software	Quiz/ Assignment/Lab Reports (Individual/group) Class assessment, Semester-end Examination including Viva-voce
CO 2		
CO 3		
CO 4		

Main Texts

1. Ross S. M., (2006), Simulation, 4th Edition, Academic Press, London

2. Cohen Y. & Cohen J. Y., (2008), Statistics and Data with R: An applied approach through examples, John Wiley & Sons
3. VanderPlas J., (2016), Python data science handbook: Essential tools for working with data. O'Reilly

Reference Books

1. Crawley M. J., The R Book, 2nd Edition, Wiley, NY
2. Graham C. & Talay D., (2013), Stochastic simulation and Monte Carlo methods: mathematical foundations of stochastic simulation (Vol. 68). Springer Science & Business Media.
3. Ripley D Brian, Stochastic Simulation, Wiley, NY
4. Rubinstein Y R, Simulation and the Monte Carlo Method, Wiley, NY
5. Verzani J, Using R for Introductory Statistics, Chapman & Hall/CRC, NY
6. Rahman M. S., (2017), R Programming and Data Analysis, 1st Edition, Kazi Prokashoni, Dhaka

Course Code: STA 0542 3157	**Credit:** 3.0	**Year: 3rd**	**Semester: 1st**
Course Title: Linear Programming		**Course Status: Theory**	

Rationale of the Course: Acquiring knowledge to learn methods for solving linear programming problems. In particular, idea and method for solving the linear programming problem, as well as duality and sensitivity analysis. Moreover, the two person zero sum game is described in the introduction to game theory along with the methods of solution and game theory problems.

Course Objectives: The objectives of the course are

- Foster analytical and critical thinking ability and provide ideas to formulate linear programming problem and theoretical knowledge of solving such type of problems by using appropriate methods,
- Helping the students to develop skills of modeling and optimization of various types (integer and non-integer) of linear programming problem,
- Facilitate necessary knowledge on analyzing the duality and sensitivity problems through different methods,
- Provide knowledge of various methods on game theory and transportation problem.

Course Contents

Elements of linear programming: Formulation of linear programming problems. **Methods of solution:** Graphical method, simplex method, revised simplex method, primal-dual problems and their solutions, sensitivity analysis. **Integer linear programming models:** Integer programming graphical solution, methods of solution: cutting plane algorithm, branch and bound algorithm. **Transportation and Assignment Models:** General LP model for transportation problems, Transportation problem and it's solutions, Assignment model and it's solutions. **Network Models:** methods of solution: Minimal-spanning tree problem, Maximal-flow problem, Shortest-route problem. **Game theory:** Two-person zero-sum game. Equivalence of two-person zero sum game and a linear programming problem, methods of solution of the game problems.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain the various terminology of linear programming problem;
CO2	Formulate or construct linear programming problem;
CO3	Compare and contrast various linear programming models;
CO4	Identify appropriate methods to solve real life problem;
CO5	Estimate the dual of a linear programming problem to find out primal solution of linear programming problem.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1						
CO2		3			3	
CO3		3		2	2	
CO4		3		3	2	3
CO5		3		3	2	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ projectors	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Bazaraa M. S., Jarvis J. J., Sherali H. D., (2009), Linear programming and Network flows, 4th Edition, Wiley
2. Taha H. A., (2010), Introduction to Operation Research, 9th Edition, Pearson

Reference Books

1. Barry Render, Ralph M. Stair, Jr., Michael E. Hanna, Quantitative Analysis for Management, Eleventh Edition, Pearson.
2. Bernard W. Taylor III, Introduction to Management Science, Eleventh Edition, Pearson.
3. Gass S. I., Linear Programming, 5th Edition, McGraw Hill, NY
4. Hadley G., Linear Programming, Addison-Wesley Publishing Company, USA
5. Vajda S., Mathematical Programming, Dover Publications, USARay S. C., Data Envelopment Analysis: Theory and Techniques for Economics and Operations Research, Cambridge University Press, UK;
6. Vajda S., Mathematical Programming, Dover Publications, USA

Course Code: STA 0542 3150	**Credit:** 1.0	**Year: 3rd**	**Semester: 1st**
Course Title: Presentation & Viva-voce		**Course Status:** Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- To gain confidence in their own ability to present and explain the basic concepts of the courses,
- To provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs) with the POs

3: Strong 2: Moderate 1: Weak

Course	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill

Learning Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3				3	
CO2	3				3	
CO3	3				3	3
CO4	2				3	3
CO5	1				3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Third Year Second Semester Course Details

Course Code: STA 0542 3251	**Credit:** 3.0	**Year: 3rd**	**Semester: 2nd**
Course Title: Stochastic Processes		**Course Status: Theory**	

Rationale of the Course: Acquiring knowledge to model the phenomena and systems that appear to vary not only in a random manner but also with time or any other index.

Course Objectives: The objectives of the course are

- Acquaint students with the concepts of modern probability theory, generating functions, limit theorems and the collection of random variables,
- Facilitate necessary knowledge about Markov chain, derivation of equations and distributions for discrete-state stochastic processes,
- Help students to develop ability to evaluate the characteristics of stochastic systems.

Course Contents

Modern Probability Theory: Borel field and extension of probability measure, probability of a set function, probability measure notion of random variables, probability space, conditional expectation in Sigma-algebras and properties. **Generating Functions:** Characteristic functions and probability generating functions with properties, probability generating functions with properties. **Convergence of Random Variables:** Convergence of random variables, convergence of distribution functions, laws of large numbers, central limit theorems, conditions, Martingales. **Elementary Concepts of Stochastic Process:** Definition, different types of stochastic processes, Markov chain: homogeneous Markov process, transient states, transition matrix, higher transition probabilities, classification of states and chains, ergodic properties. **Finite Markov Chain:** Evaluation of P^n, stability of a Markov system, general theory of random walk with reflecting barriers, absorption probabilities, application of recurrence time, gambler's ruin problem. **Markov Process with Discrete State Space:** Poisson process and its related distributions. **Extension of Poisson Processes:** Generalizations of Poisson process, simple birth process, simple death process, simple birth-death process, general birth process, effect of immigration, non-homogeneous birth death process, recurrent events, renewal equation, delayed recurrent events, number of occurrences of a recurrent event. **Queuing Theory:** Kendall notation, M/M/1, M/M/1/N, M/M/m queues.

Course Learning Outcomes (COs): By the end of the course, students will be expected to -

CO1	Select the suitable probability function for a probability space;
CO2	Define the convergence of a sequence of random variables;
CO3	Formulate non-deterministic systems with Markov chains or Poisson processes and also identification of long-run behavior of chains or processes, especially in environment and business sectors;
CO4	Apply the tools and techniques of queuing systems in public health, transportation and IT sectors to optimize the use of resources.

Mapping Course Learning Outcomes (Cos) with the Pos

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		3			
CO2	3		3	3		
CO3	2		3	3	3	
CO4	1		3	3	3	

Mapping Course Learning Outcomes (Cos) with the Teaching-Learning& Assessment Strategy

Cos	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1/ Semester-end examination
CO 3	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 4	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Ross S. M., Stochastic Processes, 2nd Edition, Jhon Wiley & Sons, NY
2. Bhat, B. R., (2007), Modern probability theory: New Age International.
3. Medhi, J., (1994), Stochastic processes: New Age International.
4. Sufian A. J. M., (2017), Stochastic Processes and Their Applications in Business, The University Press Limited

Reference Books

1. Roy, M. K., (2000), Fundamentals of Probability and Probability Distributions: Romax Publications.
2. Ross, S. M., (2014), Introduction to probability models: Academic press
3. Ash R. B., Real Analysis and Probability, Academic Press, USA
4. Bailey N. T. J., The Element of Stochastic Processes, Wiley Inter Science Publications, NY
5. Bartlett M. S., An Introduction to Stochastic Processes, 3rd Edition, Cambridge University Press, UK
6. Bhat U. N. & Miller G. K., Elements of Applied Stochastic Processes, 3rd Edition, Jhon Wiley & Sons, NY
7. Billingsley P., Probability and Measure, Anniversary Edition, Jhon Wiley & Sons, NY
8. Chung K. L. & Aitsahlia F., Elementary Probability Theory with Stochastic Processes, 4th Edition, Springer
9. Cox D. R. & Miller W., The Theory of Stochastic Processes, Chapman and Hall, London
10. Grimmett G. R. & Stirzaker D. R., Probability and Random Processes, 3rd Edition, Oxford University Press, UK
11. Karlin S. & Taylor H. M., A First Course in Stochastic Processes, 2nd Edition, Academic Press, NY
12. Taylor H. M. & Karlin S., An Introduction to Stochastic Modeling, 3rd Edition, Academic Press, NYD Irwin Inc, Homewood, Illinois

Course Code: STA 0314 3253	**Credit:** 3.0	**Year: 3rd**	**Semester: 2nd**
Course Title: Demography		**Course Status: Theory**	

Rationale of the Course: Demographic data is a useful source of knowledge about a nation's socioeconomic development, population trends and growth, and general public health conditions. Demographic data are therefore crucial for both statistics and the field of public health. Therefore, this course focuses on identifying the demographic life events and laying out the steps involved in statistical analysis.

Course Objectives: The objectives of the course are

- To generate knowledge on demographic tools and techniques,
- To facilitate necessary skills to estimate the demographic components and apply the knowledge on policy making.

Course Contents

Basic concept of demography: Demography and population studies, nature and scope of demography, importance of demography, vital statistics, demographic characteristics in Bangladesh. **Sources of demographic data:** Census, survey, population register, sample vital registration system in Bangladesh. Sources and types of errors in demographic data, detection and reduction of errors, the stock and flow data. **Introduction to demographic methods:** Rates, ratios, proportions, cohort, age-sex composition, rates of vital events, errors in age data, detection of errors in age data, population pyramid, concept of population change, rates of population growth and its different measures, balancing equation, history of population growth in Bangladesh. **Fertility and its measures:** Crude birth rate, general fertility rate, age-specific fertility rate, total fertility rate, sex ratio, child woman ratio, cohort fertility rate, marital fertility rate, number of children ever born, cumulative fertility, fertility differentials, gross and net reproduction rate, Bongaarts' model of fertility. **Mortality and its measures:** Crude death rate, age-specific death rate, live birth, still birth, neo-natal, infant death rate, infant and child mortality, adjusted infant mortality. **Nuptiality and its measures:** Concept of marriage, divorce, separation, estimation of mean and median age at marriage, estimation of singulate mean age at marriage, nuptiality table. **Life table:** Definition, importance and classification, function, construction and application, force of mortality. Migration: definition, types of migration, effect of migration, various measures of migration. **Growth curve:** Fitting of exponential, Gompertz and logistic curve.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Describe various demographic components;
CO2	Explain the demographic process related to various components of demography;
CO3	Analyze the demographic data by troubleshooting the measurement errors including the problem of age heaping;
CO4	Compare and contrast fertility and mortality situation of different regional population by the method of standardization;

Mapping Course Learning Outcomes (COs)with the POs

Course	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill

Learning Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		1			
CO2			2	3		
CO3				3	3	
CO4			3	3	3	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ tutorial	Quiz/ Midterm Examination 2 Semester-end examination

Main Texts

1. Islam M. N., (2015), An Introduction to Demographic Techniques, Mullick & Brothers, Dhaka
2. Kpedekpo G. M. K., (1982), Essentials of Demographic Analysis for Africa, Heinemann, London

Reference Books

1. Bogue D., Principles of Demography, John Wiley & Sons, NY
2. Cox D. R., Demography, 5th Edition, Cambridge University Press, Cambridge
3. Keyfitz N., Introduction to Mathematics of Population, Addison-Wesley, USA
4. Pollard A. H., et al., Demography, Willey Eastern, India
5. Rowland D. T., (2003), Demographic Methods and Concepts, Oxford University Press Inc., New York, USA

6. Spiegelman M., Introduction to Demography, Revised edition, Harvard University Press, Cambridge
7. Shryock H. & Siegel J., The Method and Materials of Demography, Academic Press, NY

Course Code: STA 0314 3254	**Credit:** 1.5	**Year: 3rd**	**Semester: 2nd**
Course Title: Demography Lab		**Course Status:** Lab	

Rationale of the Course: Acquiring knowledge to apply various demographic tools and techniques for analyzing real life data.

Course Objectives: The objectives of the course are

- To apply different demographic tools and techniques into real life data,
- To develop necessary skills to provide an estimate of demographic components for proper planning of a nation.

Course Contents

Calculation of various rates, ratios, proportions for demographic data (CBR, CDR, GRR, NRR, TFR, SR, *etc.*) construction of population pyramid, calculation of various measures of population growth, construction of life tables (*complete* and *abridge*), calculation of various measures of population growth, construction of life tables (*complete* and *abridge*), fitting of growth curves. Other topics as covered in the theory part.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Apply various demographic tools and techniques into real life data;
CO2	Construct population pyramid and life table from a set of data;
CO3	Estimate growth rate by using different mathematical models from a set of data;
CO4	Demonstrate projected population of a region;

Mapping Course Learning Outcomes (COs)with the POs

Course	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill

Learning Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3		3		
CO2		3		3		
CO3		3		3	3	
CO4					3	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ Tutorial	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ Assignment	
CO 3	Lecture using board/ Tutorial	
CO 4	Lecture using board/ Tutorial	

Main Texts

1. Islam M. N., (2015), An Introduction to Demographic Techniques, Mullick & Brothers, Dhaka
2. Kpedekpo G. M. K., (1982), Essentials of Demographic Analysis for Africa, Heinemann, London

Reference Books

1. Bogue D., Principles of Demography, John Wiley & Sons, NY
2. Cox D. R., Demography, 5th Edition, Cambridge University Press, Cambridge
3. Keyfitz N., Introduction to Mathematics of Population, Addison-Wesley, USA
4. Pollard A. H., et al, Demography, Willey Eastern, India
5. Rowland D. T., (2003), Demographic Methods and Concepts, Oxford University Press Inc., New York, USA
6. Spiegelman M., Introduction to Demography, Revised edition, Harvard University Press, Cambridge
7. Shryock H. & Siegel J., The Method and Materials of Demography, Academic Press, NY

Course Code: STA 0542 3256	**Credit: 1.5**	**Year: 3rd**	**Semester: 2nd**
Course Title: Data Analysis with SAS (Lab)		**Course Status: Lab**	

Rationale of the Course: In this course, students will be able to understand the fundamentals of SAS software.

Course Objectives: The objectives of the course are

- Enhancing the skills of basic operations in SAS,
- Develop ability in solving basic statistical problems using SAS,
- Foster the analytical and critical thinking ability to write code in SAS,
- Provide knowledge of properly assessing perfections of a program written in SAS.

Course Contents

Introduction: Overview of SAS Foundation**. SAS Programs:** Introduction to SAS programs, submitting a SAS program, SAS program syntax**. Accessing Data:** Examining SAS data sets, accessing SAS libraries**. Producing Detail Reports:** Sub-setting report data, sorting and grouping report data, enhancing reports**. Formatting Data Values:** Using SAS formats, creating user-defined formats**. Reading SAS Data Sets:** Reading a SAS data set, customizing a SAS data set**. Reading Spreadsheet and Database Data:** Reading spreadsheet data, reading database data**. Reading Raw Data Files:** Introduction to reading raw data files, reading standard delimited data, reading nonstandard delimited data, handling missing data**. Manipulating Data:** Using SAS functions, conditional processing**. Combining Data Sets:** Concatenating data sets, merging data sets one-to-one, merging data sets one-to-many, merging data sets with nonmatches**. Creating Summary Reports:** Using the FREQ procedure, using the MEANS and UNIVARIATE procedures, using the Output Delivery System**. SAS Procedures:** PROC steps–PRINT, SORT, FORMAT, MEANS, UNIVARIATE, TABULATE, CORR, SUMMARY, CONTENTS, TRANSPOSE, FREQ, T-TEST, ANOVA, GLM, REG, POT, SAS graphics.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Identify SAS Program Structure along with Data Access: Students will study the fundamentals of SAS programs, including program syntax and how to submit a SAS program. They will also figure out how to examine SAS data sets and access SAS libraries;
CO2	Produce with the Enhancement of Detail Reports: Students will be able to produce detailed reports by sub-setting, sorting, and grouping report data. They will also study how to enhance reports using various formatting techniques, including SAS formats and user-defined formats;
CO3	Read along with the Manipulation of Data from Various Sources: Students will develop the skills to read and customize SAS data sets, read spreadsheet and database data, and handle raw data files, including both standard and nonstandard delimited data and missing data. They will also study how to manipulate data using SAS functions and conditional processing;
CO4	Combine Data Sets with Summary Reports: Students will be able to combine data sets using concatenation and merging techniques (one-to-one, one-to-many, and nonmatches). Additionally, they will study how to create summary reports using various SAS procedures such as FREQ, MEANS, UNIVARIATE, and the Output Delivery System, as well as other key SAS procedures for data analysis and graphics.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3			2	2
CO2		3		3	3	3
CO3		3		3	3	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/computer/tutorial using statistical	Quiz/ Assignment/Lab Reports (Individual/group) Class assessment, Semester-end
CO 2		
CO 3		

	software	Examination including Viva-voce

Main Texts

1. Der G. & Brian S. E., (2008), A Handbook of Statistical Analyses Using SAS, 3rd Edition, CRC Press

Reference Books

1. Cody R., SAS® by Example: A Programmer's Guide, SAS Institute
2. Cody R., SAS® Functions by Example, 2nd Edition, SAS Institute
3. Cody R., SAS® Statistics by Example, SAS Institute
4. Raithel M. A., How to Become a Top SAS® Programmer, SAS Institute

Course Code: STA 0542 3257	**Credit:** 3.0	**Year: 3rd**	**Semester: 2nd**
Course Title: Regression Analysis – II		**Course Status: Theory**	

Rationale of the Course: Providing students with a comprehensive understanding of the advanced statistical tools employed for linear regression.

Course Objectives: The objectives of the course are

- To provide a thorough foundation for general linear regression model,
- To facilitate necessary knowledge on fitting regression models,
- To provide knowledge of understanding sampling distribution of parameter estimates,
- To foster analytical and critical thinking ability to carry out hypothesis tests and model diagnostics,
- To enhance skills of alternative model fitting in case of violation of classical assumptions.

Course Contents

Multiple regression and linear estimation: Generalized and weighted least squares. Gauss-Markov Aitken's theorem. Estimation and tests for linear restriction. **Heteroscedasticity:** Detection and testing for heteroscedasticity, estimation with heteroscedastic disturbances. **Multicollinearity:** Concept of exact and near multicollinearity, estimable functions, effects of multicollinearity, detection and remedial measures of multicollinearity. Selection of variables. **Autocorrelation:** Sources and consequences of autocorrelation, tests for autocorrelated disturbances, estimation of parameters. **Dummy variables:** General concepts, use of dummy variables in regression analysis. **Errors in variables:** Basic ideas, consequences and tests for error in variables, estimation of parameters, errors in equation. Errors in equation.

Course Learning Outcomes (COs): At the end of course, students will be able to –

CO1	Recall simple linear regression model with model assumptions;
CO2	Fit multiple linear regression model along with checking the model assumptions;
CO3	Transform predictors and response variables to improve model fit;
CO4	Assess parameter estimates globally, in subsets, and individually;
CO5	Deal with categorical predictors and interactions among predictors.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3				
CO2	3	3				
CO3	3	3		2		
CO4	3	3		2	3	
CO5	2	3		3	2	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Semester-end examination

CO 2	Lecture using board/ Assignment	Assignment/ Presentation (Individual/group) Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ Tutorial	Quiz/Semester-end examination

Main Texts

1. Gujarati D. N., (2009), Basic Econometrics, 3rd Edition, McGraw Hill, NY
2. Johnston J., (1979), Econometric Methods, McGraw Hill, NY
3. Neter, J., *et al*, (1983), Applied Linear Regression Models, Richard D Irwin Inc, Homewood, Illinois

Reference Books

1. Chatterjee S., & Price B., (2012), Regression Analysis by Example, 5th Edition, John Wiley & Sons, NY
2. Draper N. R. & Smith H., (1998), Applied Regression Analysis, 3rd Edition, John Wiley & Sons, NY
3. Griffiths W. E., *et al*, (1994), Learning and Practicing Econometrics, 1st Edition, John Wiley & Sons, NY
4. Judge, G. G., *et al*, (1985), The Theory and Practice of Econometrics, 2nd Edition, John Wiley & Sons, NY
5. Koutsoyiannis, A., (2001), Theory of Econometrics, 2nd Edition, Macmillan, London
6. Montogomery, D. C., & Peck, E. A., (2012), Introduction to Linear Regression Analysis, John Wiley & Sons, NY

Course Code: STA 0542 3258	**Credit:** 2.0	**Year: 3rd**	**Semester: 2nd**
Course Title: Regression Analysis – II Lab		**Course Status:** Lab	

Rationale of the Course: Apply acquired empirical knowledge of fitting multiple linear regression models through data.

Course Objectives: The objectives of the course are

- Familiarize students with the skills of fitting multiple linear regression models,
- Helping the students to test multi-collinearity, autocorrelation in data and fitting models after removing those problems,
- Make the students able to fit models with dummy variables and perform tests of hypotheses.

Course Contents

Fitting of multiple regression models, tests of parameters of a multiple regression model. Detection and tests for heteroscedasticity, multi-collinearity, fitting of model after removing these problems. Tests of autocorrelation and estimation of parameters with auto-correlated disturbances. Fitting of dummy variables model and tests.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Fit multiple linear regression model along with checking the model assumptions;
CO2	Detect violation of assumptions and possible soultions;
CO3	Transform predictors and response variables to improve model fit;
CO4	Formulate and solution of models with dummy variables;
CO5	Perform tests of hypotheses of regression parameters.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3			1	
CO2	3	3			1	
CO3	3	3		2	1	
CO4		3		3	2	

CO5	3	3			2	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2		
CO 3		
CO 4		
CO 5		

Main Texts

1. Gujarati D. N., (2009), Basic Econometrics, 3rd Edition, McGraw Hill, NY
2. Johnston J., (1979), Econometric Methods, McGraw Hill, NY
3. Neter, J., *et al*, (1983), Applied Linear Regression Models, Richard D Irwin Inc, Homewood, Illinois

Reference Books

1. Chatterjee S., & Price B., (2012), Regression Analysis by Example, 5th Edition, John Wiley & Sons, NY
2. Draper N. R. & Smith H., (1998), Applied Regression Analysis, 3rd Edition, John Wiley & Sons, NY
3. Griffiths W. E., *et al*, (1994), Learning and Practicing Econometrics, 1st Edition, John Wiley & Sons, NY
4. Judge, G. G., *et al*, (1985), The Theory and Practice of Econometrics, 2nd Edition, John Wiley & Sons, NY
5. Koutsoyiannis, A., (2001), Theory of Econometrics, 2nd Edition, Macmillan, London
6. Montogomery, D. C., & Peck, E. A., (2012), Introduction to Linear Regression Analysis, John Wiley & Sons, NY

Course Code: STA 0542 3259	**Credit:** 1.0	**Year: 3rd**	**Semester: 2nd**
Course Title: Field Work		**Course Status:** Capstone	

Rationale of the Course: Acquiring practical experience of collecting data with a tour to an industry or organization or institution or by a field visit can help student gain some real life skills of data collection, collaboration and networking.

Course Objectives: The objectives of the course are

- Provide students with hands-on experience of collecting data from various sources,
- Facilitate students to develop industry-academia collaboration and networking.

Course Contents

The topic and location of the field work will be decided by a general meeting of the teachers of the department. A small group of students will be assigned to teachers by the department for supervision. The evaluation will be made jointly by supervisors and chairman of the respective examination committee. All students will have to submit a written report through their assigned teachers to the department.

Reference Books

Recommended readings and books referred by the supervisors of the field work.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Conduct field survey to collect necessary data from relevant sources;
CO2	Apply appropriate sampling technique to obtain a representative sample;
CO3	Develop effective collaboration with various industries, organizations and institutions to collect necessary data for the betterment of their future job placement;
CO4	Illustrate hands-on experience of physically visiting the field of study and having direct interaction with the study subjects or experimental units;
CO5	Prepare field work report including dissemination of the outcome from the field works report.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3			2	2
CO2		3		2	2	2
CO3			3	2	3	3
CO4		3	3		3	2
CO5		3	2	2	3	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Field demonstration	Semester-end presentation/oral examination and evaluation of written report
CO 2	Field demonstration	Semester-end presentation/oral examination and evaluation of written report
CO 3	Field demonstration	Semester-end presentation/oral examination and evaluation of written report
CO 4	Field demonstration	Semester-end presentation/oral examination and evaluation of written report
CO 5	Field demonstration	Semester-end presentation/oral examination and evaluation of written report

Course Code: STA 0542 3250	**Credit:** 1.0	**Year: 3rd**	**Semester: 2nd**
Course Title: Presentation & Viva-voce		**Course Status:** Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6

(CO)						
CO1	3		3		3	
CO2	3		3		3	
CO3	3	3			3	3
CO4	2				3	3
CO5	1	3	3		3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Fourth Year First Semester Course Details

Course Code: STA 0542 4151	**Credit:** 3.0	**Year: 4th**	**Semester: 1st**
Course Title: Economic Statistics		**Course Status: Theory**	

Rationale of the Course: In order to undertake empirical economic research, a variety of economic approaches are covered in this course. Models for panel data, income distribution model, cobb-Douglas production function are some of the subjects covered. Therefore, this course provides students to acquire knowledge on the statistical methods of analyzing economic data.

Course Objectives: The objectives of the course are

- Make the students understand the concept of consumer and producer behavior,
- Acquaint students with the knowledge of national income and wealth distributions and their inequalities,
- Provide knowledge of productivity and its functional form,
- Understand the link between inter sector productivity,
- Familiarize students with the concepts of different growth models.

Course Contents

Index number: Problems in construction of index numbers, purpose of the index, price index, Quantity index,Value index, tests of index numbers, cost of living index, family budget method.

Time series: General ideas, Components, Decomposition, Trend, Seasonality. Different methods of finding trends & seasonality.

Distribution of personal income: Empirical distribution, Pareto's law, Lorenz curve, Concentration ratio, The lognormal distribution, Stochastic model of income distribution.

Attributes of consumer behavior: Engel curves and lognormal demand curves. Maximization of utility, demand function, price, income and cross elasticities of demand. Preference theory of demand.

Theory of production: Production function, concepts of average productivity, marginal productivity, marginal rate of technical substitution, efficiency of production, factor intensity, returns to scale and homogeneity of production function, production possibility curve, cost function, minimizing cost for a given level of output, maximization of profit subject to constraint cost, maximization of profit for a given output, Cobb-Douglas production function, constant elasticity substitution (CES) production function.

Dynamic economics: Cobweb model, Harrod-Domar model of economic growth, Natural and non-natural technical change, two sector growth models.

Input-output analysis: Meaning of input output, main features of input output, assumptions, Leontiefs static and dynamic model, limitations, importance and application of the analysis.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain the concerns surrounding consumer behavior, income and wealth

	inequalities, characteristics, and indicators;
CO2	Describe time series analysis, index numbers, income inequalities and different types of economic models;
CO3	Optimize production and cost functions;
CO4	Evaluate inter-industrial relationships for productivity;
CO5	Apply different growth models in development planning.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		2	3			
CO2	2		3			
CO3		3	3	2	2	
CO4			3	2	2	
CO5		3		2	3	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/Mid-term Examination-1 Semester-end examination
CO 4	Lecture using board/ Tutorial	Quiz/Semester-end examination
CO 5	Lecture using board/ Assignment	Assignment/Presentation (individual/group), Mid-term Examination-2, Semester-end examination

Main Texts

1. Allen R. G. D., (1970), Mathematical Economics, MacMillan, London
2. Chiang A. C., Wainwright K., (2005), Fundamental Methods of Mathematical Economics, 4th Edition, McGraw Hill, NY
3. Singh S. P., Parashar A. K., Singh H. P., (1999), Econometrics and mathematical economics, S. Chand and Company, 7th Revised Edition

Reference Books

1. Bridge J. L., Applied Econometrics, North Holland, Amsterdam
2. Chatfield C., The Analysis of Time Series: An Introduction, 6th Edition, Chapman & Hall, London
3. Gupta S. C. & Kapoor V. K., Fundamentals of Applied Statistics, 4th Reprint Edition, Sultan Chand & Sons, New Delhi
4. Henderson J. M. & Quandt R. E., Microeconomic Theory: A Mathematical Approach, 3rd Edition, McGraw Hill, NY
5. Kakwani N. C., (1980), Income Inequality and Poverty: Methods of Estimation and Policy Application, A World Bank Research Publication by Oxford University Press
6. Klein L. R., An Introduction to Econometrics, Literary Licensing, LLC
7. Koutsoyiannis A., Modern Microeconomics, 2nd Edition, Macmillan, London

Course Code: STA 0542 4152	**Credit: 1.5**	**Year: 4th**	**Semester: 1st**
Course Title: Economic Statistics Lab		**Course Status:** Lab	

Rationale of the Course: Apply acquired knowledge on the statistical methods of analyzing economic data.

Course Objectives: The objectives of the course are

- Make the students to fit demand curves,
- Helping the students to calculate price and income elasticity of demand,
- Provide the knowledge to fit income and wealth distributions and also to estimate income and wealth inequalities,
- Helping the students to estimate various production functions.

Course Contents

Computation of price and income elasticity of demand, fitting demand curves, fitting Engel's curves, fitting of Pareto and lognormal distribution, Lorenz curve and Gini's concentration ratio, estimation of production functions: Cobb-Douglas (CD), CES, trans-log, generalized forms of CD and CES production functions. Maximization of production function, Minimization of cost function, Construction of Input output table and its interpretation, Fitting different economic growth curves.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Compute price and income elasticity of demand, income and wealth inequalities;
CO2	Fit demand curves, Engel's curve, income distributions, and different economic growth curves;
CO3	Estimate the parameters of the production functions along with their interpretations.
CO4	Conduct different input-output analysis.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		3	2		2	
CO2		3	2	2	2	
CO3		3	3	2	2	
CO4		3		3	2	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1		
CO 2		Quiz/ assignment/presentation
CO 3	Lecture using board/ Tutorial/Assignment	(individual/group), semester end examination
CO 4		

Main Texts

1. Allen R. G. D., (1970), Mathematical Economics, MacMillan, London
2. Chiang A. C., Wainwright K., (2005), Fundamental Methods of Mathematical Economics, 4th Edition, McGraw Hill, NY
3. Singh S. P., Parashar A. K., Singh H. P., (1999), Econometrics and mathematical economics, S. Chand and Company, 7th Revised Edition

Reference Books

1. Bridge J. L., Applied Econometrics, North Holland, Amsterdam
2. Chatfield C., The Analysis of Time Series: An Introduction, 6th Edition, Chapman & Hall, London
3. Gupta S. C. & Kapoor V. K., Fundamentals of Applied Statistics, 4th Reprint Edition, Sultan Chand & Sons, New Delhi
4. Kakwani N. C., (1980), Income Inequality and Poverty: Methods of Estimation and Policy Application, A World Bank Research Publication by Oxford University Press
5. Klein L. R., An Introduction to Econometrics, Literary Licensing, LLC
6. Koutsoyiannis A., Modern Microeconomics, 2nd Edition, Macmillan, London

Course Code: STA 0542 4153	**Credit:** 3.0	**Year: 4th**	**Semester: 1st**
Course Title: Applied Statistics		**Course Status: Theory**	

Rationale of the Course: The goal of statistics is to derive meaning from data. In order to perceive the relationships in the data and use systematic methods to comprehend the links using mathematics, this course will cover approaches for data collection, presentation, and summarization. Therefore, students can acquire knowledge to the key areas of official statistics, industrial statistics and educational statistics.

Course Objectives: The objectives of the course are

- Acquaint students with statistical tools for quality control in industry,
- Facilitate necessary knowledge on various statistical tools to analyze educational and psychological data,
- Develop skills to collect, analyze and represent quantitative and qualitative information in the official statistics.

Course Contents

Statistical quality control: Process and product control, Meaning of quality, Components of quality, Factors affecting the quality, Quality control, Chance and assignable causes of variations, Concept of statistical quality control (SQC), Uses of SQC, Control charts, 3-sigma control limits, Tools for SQC-control charts for variables and attributes: control charts for mean, range, standard deviation; *p*-chart or control chart for fraction defective, *d*-chart or control chart for number of defectives; Control chart for number of defects per unit or *c*-chart. Natural tolerance limits and specification limits-modified control limits.

Acceptance sampling by attributes: Acceptance quality level (AQL), Lot tolerance proportion or percent defective (LTPD), Process average fraction defective, Consumer's risk, Producer's risk, Rectifying inspection plans, Average outgoing quality limit (AOQL), Operating characteristic (OC) curve, Average sample number (ASN), Average amount of total inspection (ATI). Dodge and Romig rectifying sampling inspection plans-detail study of single, double and sequential sampling plans.

Psychological and educational statistics: Introduction, Scaling individual test items in terms of difficulty (sigma-scaling), Scaling of scores on a test-*Z* (or sigma) score and *Z* (or sigma) scaling, standard scores, normalised scores, *T*-scores; Percentile scores, Scaling of rankings in terms of normal probability curve, Scaling of ratings in terms of normal curve, Reliability of test scores, Coefficient of reliability, Error variance or standard error of measurement, Index of reliability, Parallel tests, Methods of determining test reliability-the test-retest method, alternate or parallel forms method, split-half method, the Rulon method, method of rational equivalence or Kuder-Richardson formula; Effects of test length and different ranges on the reliability of test; Validity of test scores, Calculation of validity, Comparison between reliability and validity, Intelligence Quotient (IQ).

Published Statistics in Bangladesh: Official, semi-official and non-official statistics, Sources of published statistics in Bangladesh, Listing of important statistical publications of Bangladesh with organisations, frequencies and main coverages, Types of classification of statistics in Bangladesh, Limitations of published statistics of Bangladesh and recommendation for increasing the quality.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain statistical quality control, control chart, 3-sigma control limits, sampling inspection by attributes, test in education and psychology, scaling individual test items, scaling of scores, reliability and validity of test scores, Intelligence quotient; official, semi-official and non-official statistics;
CO2	Describe the techniques for statistical quality control, various sampling inspection plans with related concepts, methods of determining test reliability and validity, published statistics in Bangladesh;
CO3	Determine the mathematical expressions for control limits and curves associated with control charts and sampling inspection plans respectively;
CO4	Differentiate process control from product control, control chart for variables from control chart for attributes, reliability of test scores from validity of test scores.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	3			
CO2	3	3		2		
CO3	3	3		2		
CO4	3	3	3			

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Mid-semester examination 1 Semester-end examination
CO 2	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Mid-semester examination 2 Semester-end examination
CO 3	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination
CO 4	Lecture using board/ projector Assignment	Assignment/evaluation/class test/quiz test Semester-end examination

Main Texts

1. Leavenworth, R. S., & Grant, E. L. (2004), Statistical Quality Control, 7th Edition, Tata McGraw Hill, India
2. Guilford J. P. & Benjamin F., (1977), Fundamental Statistics in Psychology and Education, 6th Edition, McGraw Hill

Reference Books

1. Banks J., Principles of Quality Control, 1st Edition, Wiley
2. Duncan A. J., Quality Control and Industrial Statistics, 5th Edition, Irwin Publication
3. Guilford J. P., Psychometric Methods, McGraw Hill, NY
4. Gupta S. C., Kapoor V. K., Applied Statistics, Sultan Chand & Sons, New Delhi, India
5. Publications of BBS, Bangladesh Bank, NIPORT and Other Organizations
6. Wordsworth H. M., *et al*, Modern Methods for Quality Control and Improvement, 2nd Edition, Wiley
7. Biswas, S., Statistics of quality control, new central book agency.

Course Code: STA 0542 4154	**Credit: 1.5**	**Year: 4th**	**Semester: 1st**
Course Title: Applied Statistics Lab		**Course Status:** Lab	

Rationale of the Course: Application of acquired knowledge to the key areas of industrial statistics and educational statistics.

Course Objectives: The objectives of the course are

- Make the students able to use statistical tools for quality control in industry,
- Help the students to analyze educational and psychological data using statistical tools.

Course Contents:

Control charts for mean, range, standard deviation; *p*-chart, *d*-chart, *c*-chart, modified control limits. OC, ATI, AOQ curves for single sampling plan; Determination of LTFD, AOQL for single sampling plan; OC, ASN curves for double and sequential sampling plans; Scaling individual test items in terms of difficulty, Scaling of scores on a test- Z-scores, standard scores, normalised scores, *T*-scores; Percentile scores, Scaling of rankings and ratings in terms of normal curve, Determining the coefficient of reliability of test scores.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Calculate control limits associated with control charts, modified control limits, and OC, ASN, ATI, AOQ for various sampling inspection plans using industrial data;
CO2	Draw control charts, and OC, ASN, ATI, AOQ curves for various sampling inspection plans;
CO3	Determine difficulty value of test items; test scores, percentile scores, coefficient of reliability using educational and psychological data;
CO4	Interpret industrial, educational and psychological data.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course	Fundamental Skill	Social Skill	Thinking Skill	Personal Skill

Learning Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	3			
CO2	3	3		2		
CO3	3	3		2		
CO4	3	3		2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projector Assignment	Assignment/evaluation/class test (Individual/group) Semester-end examination
CO 2	Lecture using board/ projector Assignment	
CO 3	Lecture using board/ projector Assignment	
CO4	Lecture using board/ projector Assignment	

Main Texts

1. Leavenworth, R. S., & Grant, E. L., (2004), Statistical Quality Control, 7th Edition, Tata McGraw Hill, India
2. Guilford J. P. & Benjamin F., (1977), Fundamental Statistics in Psychology and Education, 6th Edition, McGraw Hill

Reference Books

1. Banks J., Principles of Quality Control, 1st Edition, Wiley
2. Duncan A. J., Quality Control and Industrial Statistics, 5th Edition, Irwin Publication
3. Guilford J. P., Psychometric Methods, McGraw Hill, NY
4. Gupta S. C., Kapoor V. K., Applied Statistics, Sultan Chand & Sons, New Delhi, India
5. Publications of BBS, Bangladesh Bank, NIPORT and Other Organizations
6. Wordsworth H. M., *et al*, Modern Methods for Quality Control and Improvement, 2nd Edition, Wiley

Course Code: STA 0542 4155	**Credit:** 3.0	**Year: 4th**	**Semester: 1st**
Course Title: Design & Analysis of Experiments – II		**Course Status: Theory**	

Rationale of the Course: The theories and methods employed in the factorial design are covered in this course. The course looks at factorial experiment design, execution, and data analysis. This course includes covers nested and split designs, as well as experiments with random components. Therefore, students will be able to acquire knowledge on advanced design of experiments.

Course Objectives: The objectives of the course are

- To facilitate necessary knowledge about estimable function and tests of hypothesis,
- To foster the analytical and critical thinking ability to prepare layout and analyze data from incomplete block design of experiments,
- To provide knowledge on layout and analysis of confounded factorial design of experiments,
- To provide knowledge of asymmetric factorial designs,
- To develop skills on analysis of covariance.

Course Contents

Estimation: Linear estimation, estimable parametric functions and conditions for estimability, methods of estimation for analysis of variance models, solution of normal equations for less than full rank, optimality properties of least squares estimators, test of hypothesis. **Weighing design:** method of estimation. Use of incomplete blocks, construction and analysis of BIB designs, incomplete block design as weighting designs (intra and inter-block analysis). Missing plot. Orthogonal Latin squares. Youden squares. Lattice designs. Partially balanced incomplete block

designs. **Factorial experiment:** s^n factorial experiments and their analysis. Confounding, total, partial and simultaneous confounding in two and three levels up to n factors, fractional replicates and their construction. Asymmetric factorial experiments. **Split-plot design:** analysis of split-plot design, split-split-plot design: analysis of split-split-plot design. **Strip-plot design:** Analysis of strip-plot design, nested design: analysis of nested design. **Analysis of covariance:** analysis of covariance of non-orthogonal data in two-way classification. Analysis of covariance with one and more than one ancillary variables. Covariance and analysis of experiments with missing observations, transformation.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain estimable function including identification of conditions of estimability;
CO2	Layout incomplete block design of experiments and its analysis;
CO3	Prepare confounded factorial experiment and advanced experimental designs along with the analysis of data from such designs;
CO4	Outline asymmetrical experimental design and its analysis;
CO5	Formulate analysis of covariance (ANCOVA) model along with its analysis.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3				
CO2	3	3		2	2	
CO3	3	3				
CO4	2	3		2	2	
CO5	3	2			3	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ tutorial	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Montogomery D. C., (2020), Design and Analysis of Experiments, 10th Edition, Wiley, NY
2. Lawson, J. (2015), Design and Analysis of Experiments with R, Chapman and Hall/CRC

Reference Books

1. Bhuyan M. R., Fundamentals of Experimental Design, 2nd Edition, Book World Publications, Dhaka
2. Das M. N. & Giri N. C., (2017), Design and Analysis of Experiments, 3rd Edition, New Age International, Delhi
3. Sahai H. & Ageel, M. I., (2000), The Analysis of Variance: Fixed. Random and Mixed Models, MA: Birkhauser, Boston
4. Cochran W. G. & Cox D. R., Experimental Design, 2nd Edition, John Wiley & Sons, NY
5. Federer W. T., Experimental Design: Theory and Application, Oxford & IBH Publishing Company, NY
6. Gomez K. A. & Gomez A. A., Statistical Procedures for Agricultural Research, 2nd Edition, Wiley, NY

7. Kempthrone O., The Design and Analysis of Experiment, Reprint Edition, Wiley, NY
8. Winer B. J., Statistical Principles in Experimental Design, 2nd Ed., McGraw Hill Company, Ltd
9. Yates F., Design and Analysis of Factorial Experiments, Harpenden Herts, England

Course Code: STA 0542 4156	**Credit: 1.5**	**Year: 4th**	**Semester: 1st**
Course Title: Design & Analysis of Experiments – II Lab		**Course Status:** Lab	

Rationale of the Course: Solving the problems on advanced design of experiments.

Course Objectives: The objectives of the course are

- Make the students able to conduct confounded factorial design of experiments,
- Assist the students to perform incomplete block design of experiments,
- Help the students able to analyze asymmetric factorial designs,
- Make the students capable to perform analysis of covariance.

Course Contents

Total, partial and simultaneous confounding, fractionally replicated factorial experiment, intra block and inter block analysis of BIBD, analysis of split-plot design, split-split plot design, strip- plot design and nested design, analysis of covariance.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Apply the confounded factorial experiment and advanced experimental designs;
CO2	Analyze data on experiments with incomplete blocks;
CO3	Analyze asymmetrical experiments;
CO4	Fit ANCOVA models.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong **2: Moderate** **1: Weak**

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3		2		
CO2	3	3		2	2	
CO3	3	3		2		
CO4	2	3		2	2	

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	
CO 4	Lecture using board/ assignment	

Main Texts

1. Montogomery D. C., (2020), Design and Analysis of Experiments, 10th Edition, Wiley, NY
2. Lawson, J. (2015), Design and Analysis of Experiments with R, Chapman and Hall/CRC

Reference Books

1. Bhuyan M. R., Fundamentals of Experimental Design, 2nd Edition, Book World Publications, Dhaka
2. Gomez K. A. & Gomez A. A., Statistical Procedures for Agricultural Research, 2nd Edition, Wiley, NY
3. Kempthrone O., The Design and Analysis of Experiment, Reprint Edition, Wiley, NY

Course Code: STA 0542 4157	**Credit:** 3.0	**Year: 4th**	**Semester: 1st**
Course Title: Sampling Techniques – II		**Course Status: Theory**	

Rationale of the Course: In this course, advanced sampling techniques for sample surveys are introduced. It includes non-sampling errors, two-stage sampling, multistage sampling, methods for calculating variance in complex surveys, and sampling of unequal clusters. Thus, students can acquire knowledge to design and implement complex sample surveys.

Course Objectives: The objectives of the course are

- Acquaint students with the concepts and solid knowledge of cluster sampling, multistage sampling, double sampling, and sampling on two or more occasions,
- Make students understand of sampling and non-sampling errors and consequences of such errors,
- Foster the analytical and critical thinking ability to outline and carry out various complex surveys,
- Familiarize with large-scale surveys used in Bangladesh.

Course Contents

Introduction: Sampling with unequal probability, Horvitz-Thompson estimator and its standard error. Brewer and Durbin's methods of selection of sample of size 2. Raj, Murthy, Rao-Hartley and Cochran and Samford's methods of selection. PPS systematic selection. Estimation and standard errors. **Multi-stage sampling:** Two and three stage sampling – equal and unequal clusters. Selection of units with equal and unequal probability with or without replacement. Self-weighting estimates. **Double sampling with PPS selection:** Double sampling for stratification, ratio, regression and difference estimations, repetitive surveys. Sampling on two or more occasions. **Sampling errors and non-sampling errors:** Different methods of estimating non-sampling errors. Nonresponse, interviewer`s bias, interpenetrating subsamples. Familiarity with recent sample surveys in Bangladesh.
Large-scale surveys – DHS, HIES and SVRS.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Distinguish between sampling with equal and unequal probability;
CO2	Describe cluster sampling, multistage sampling, double sampling, and sampling on two or more occasions
CO3	Differentiate between sampling and non-sampling errors;
CO4	Produce appropriate estimation of population means, and totals along with their standard errors under various sampling techniques;
CO5	Design appropriate sample surveys in various social, economic, agricultural, industrial, and health sectors and thier implementation.

Mapping Course Learning Outcomes (COs)with the POs
3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	2				
CO2	2	2	2			
CO3	2			2		
CO4	3	2		2		
CO5		3	3	2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ tutorial	Quiz/ Midterm Examination 1 Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 4	Lecture using board/ projectors	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Cochran W. G., (1977), Sampling Techniques, 3rd Edition, John Wiley, NY

2. Lohr S. L., (2010), Sampling: Design and Analysis, 2nd Edition, MPS Limited, A Macmillan Company, USA

Reference Books

1. Raj D., (1968), Sampling Theory, Tata McGraw Hill, Delhi
2. Islam M. N., (2005), An Introduction to Sampling Methods, 1st Edition, Book World, Dhaka.
3. Kish L., (1968), Survey Sampling, Wiley, 1st Edition, NY
4. Latest Reports of BDHS, HIES, SVRS
5. Singh D., & Chaudhary F. S., (1986), Theory and Analysis of Sample Survey Designs, John Wiley & Sons
6. Sukhatme P. V., (1984), Sampling Theories and Surveys with Applications, 3rd Edition, Iowa State University Press, USA
7. United Nations Handbook on Surveys

Course Code: STA 0542 4158	**Credit: 1.5**	**Year: 4th**	**Semester: 1st**
Course Title: Sampling Techniques – II Lab		**Course Status:** Lab	

Rationale of the Course: Apply acquired knowledge to complex sample surveys.

Course Objectives: The objectives of the course are

- Help the students to draw sample using double sampling, two-stage sampling and PPS sampling,
- Make the students able to estimate population totals, population means and standard errors under double sampling, two-stage sampling and PPS sampling.

Course Content: Estimates and standard errors of estimates for sample selected with unequal probabilities, Two or more stage sampling (equal and unequal size clusters), PPS sampling, double sampling, self-weighting estimates.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Perform complex sampling designs;
CO2	Compute population totals, population means and standard errors under double sampling, two-stage sampling and PPS sampling;
CO3	Find self-weighting estimates.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	3	1	2		
CO2	3	2	1	1		
CO3	2			2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	

Main Texts

1. Cochran W. G., (1977), Sampling Techniques, 3rd Edition, John Wiley, NY
2. Lohr S. L., (2010), Sampling: Design and Analysis, 2nd Edition, MPS Limited, A Macmillan Company, USA

Reference Books

1. Raj D., (1968), Sampling Theory, Tata McGraw Hill, Delhi
2. Islam M. N., (2005), An Introduction to Sampling Methods, 1st Edition, Book World, Dhaka.
3. Kish L., (1968), Survey Sampling, Wiley, 1st Edition, NY
4. Latest Reports of BDHS, HIES, SVRS
5. Singh D., & Chaudhary F. S., (1986), Theory and Analysis of Sample Survey Designs, John Wiley & Sons
6. Sukhatme P. V., (1984), Sampling Theories and Surveys with Applications, 3rd Edition, Iowa State University Press, USA

7. United Nations Handbook on Surveys

Course Code: STA 0542 4150	**Credit:** 1.0	**Year: 4th**	**Semester: 1st**
Course Title: Presentation & Viva-voce		**Course Status:** Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		3		3	
CO2	3				3	
CO3	3				3	3
CO4	2				3	3
CO5	1		3		3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 2		
CO 3		
CO 4		
CO 5		

Fourth Year Second Semester Course Details

Course Code: STA 0542 4251	**Credit:** 3.0	**Year: 4th**	**Semester: 2nd**
Course Title: Multivariate Analysis		**Course Status: Theory**	

Rationale of the Course: Due to the complexity of most events in the real world, an investigator must gather and analyze observations on numerous variables as opposed to single variable. Data analysts' need for statistical methods to extract information from multiple dimensions data thus becomes critical and essential. Multivariate techniques based on normal theory are the main topic of this course. It equips students with the practical skills necessary to assess data and find solutions to issues

involving measurements of more than one variable each with n subjects. Therefore, students can acquire knowledge of the analysis and interpretation of multivariate techniques.

Course Objectives: The objectives of the course are

- To facilitate necessary knowledge about multivariate theory,
- To provide knowledge of statistical inference about multivariate means including hypothesis testing, confidence ellipsoid calculation and different types of confidence intervals estimation.

Course Contents

Non-central distributions: Non-central χ^2, non-central t and non-central F distributions and their properties. **Distribution of quadratic forms:** Distribution of general quadratic form, properties, expected values, moment and moment generating function, Cochrans' theorem. **Multivariate normal distribution:** Derivation of multivariate normal distribution, marginal, conditional, moments, moment generating functions, and characteristic function. Properties of multivariate normal distribution. **Multivariate sampling distributions:** Hotelling's T^2 distribution, Mahalanobis D^2 distribution, Wishart distribution. Tests for covariance and correlation patterns and multivariate normality. Simulation of multivariate normal variate. **Multivariate linear models:** Multivariate linear regression, MANOVA, MANCOVA, covariance selection, conditional Gaussian distribution and conditional independence graph.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Explain the properties of non-central distributions (non-central χ^2, t, and F distributions);
CO2	Apply the distribution of quadratic forms, including expected values and moment generating functions;
CO3	Analyze the derivation and properties of the multivariate normal distribution, including marginal and conditional distributions;
CO4	Evaluate multivariate sampling distributions and tests for covariance, correlation patterns, and multivariate normality;
CO5	Design multivariate linear models, including multivariate linear regression, MANOVA, and MANCOVA.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3			2		
CO2	3			2		
CO3	3			2		
CO4	3			2		
CO5	3			2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 3	Lecture using board/ projectors	Quiz/ Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ tutorial	Quiz/ Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Johnson R. A. & Wichern D. W., (2015), Applied Multivariate Statistical Analysis, 6th Edition, Pearson Prentice Hall, NJ
2. Rencher A. C., Christensen F., (2012), Methods of Multivariate Analysis, 3rd Edition, John Wiley & Sons Inc, NY

Reference Books

1. Anderson T. W., An Introduction to Multivariate Analysis, Wiley and Sons, NY
2. Graybill F. A., An Introduction to Linear Statistical Models, Vol-1, 2nd Edition, McGraw Hill, NY
3. Cox & Hinkley, Theoretical Statistics, Chapman and Hall, UK

Course Code: STA 0542 4252	**Credit: 1.5**	**Year: 4th**	**Semester: 2nd**
Course Title: Multivariate Analysis Lab		**Course Status:** Lab	

Rationale of the Course: Apply acquired knowledge of the analysis and interpretation of real-life multivariate data.

Course Objectives: The objectives of the course are

- To facilitate necessary skills to draw multivariate random samples,
- To acquaint students with the hypothesis testing of multivariate means,
- To develop the ability to apply multivariate linear regression model and test for goodness of fit.

Course Contents

Multivariate Normal Distribution: Simulation of multivariate normal variate. **Multivariate Sampling Distributions:** Tests of mean vectors by Hotelling's T^2 and Mahalanobis D^2; Tests for covariance and correlation patterns and multivariate normality. **Multivariate Linear Models**: Estimation of multivariate linear regression and construction of MANOVA.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Simulate multivariate normal variates;
CO2	Interpret tests of mean vectors using Hotelling's T^2 and Mahalanobis D^2;
CO3	Estimate parameters in multivariate linear regression models;
CO4	Perform MANOVA;
CO5	Assess multivariate normality through covariance and correlation patterns.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	2		3	2	
CO2	3	2		2		
CO3	3	3		2		
CO4	3	2		2		2
CO5	3	2		2		2

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	
CO4	Lecture using board/ assignment	
CO5	Lecture using board/ assignment	

Main Text

- Johnson R. A. & Wichern D. W., (2015), Applied Multivariate Statistical Analysis, 6th Edition, Pearson Prentice Hall, NJ

Reference Books

1. Rencher A. C., Christensen F., (2012), Methods of Multivariate Analysis, 3rd Edition, John Wiley & Sons Inc, NY

Graybill F. A., An Introduction to Linear Statistical Models, Vol-1, 2nd Edition, McGraw Hill, NY

Course Code: STA 0542 4253	**Credit:** 3.0	**Year: 4th**	**Semester: 2nd**
Course Title: Biostatistics and Epidemiology		**Course Status: Theory**	

Rationale of the Course: This course is designed to study survival data and its application with the help of parametric, semi-parametric and non-parametric methods. Moreover, this course also includes epidemiological concept with various models

such as logistic, Poisson regression models and linear mixed models. Thus, this course will help students to acquire knowledge to analyze data produced in biological sciences.

Course Objectives: The objectives of the course are

- Acquaint students with the concepts of Biostatistics and Epidemiology,
- Help students conceptualize basic theories in lifetime distributions, estimation of survival functions, concepts of incomplete data and estimation of survival probabilities,
- Provide students with the tools and strategies of epidemiological investigation studies.

Course Contents

Basic quantities: Concept of survival data, application and challenges of survival data in different fields, history of survival analysis and its progress, censoring: type – I, type – II and random censoring, truncation, lifetime distribution, survival function, hazard function, interrelationships, mean residual life function, median life time. **Nonparametric methods:** Kaplan–Meier (product-limit), Nelson–Aalen estimators, Life-table (or actuarial) method, Log-rank and Wilcoxon test, estimation of survival function, hazard function; reduced sample method, estimation and standard error. **Parametric and semi-parametric methods:** Construction of likelihood function for censored and complete data, inference procedure for exponential and Weibull distributions under complete and censored data. Basic concept of Cox proportional hazard model. **Epidemiologic concept:** Overview of important historical development of epidemiology, basic terminology and principles used in epidemiology. Sources of data of community health: census, vital statistics and morbidity data. Study designs**:** case-control, cohort, prospective, retrospective, longitudinal studies. Basic concept of causal inference. **Measure of effect and measures of association:** Incidence, prevalence, sensitivity and specificity. ROC curve. Effect measure, measures of association, standard measures, prevalence ratio, relative risk, attributable risk, odds ratio, standard errors of estimates for different types studies. **Models:** Correlated proportion, McNemar test, logistic and Poisson regression models, correlated data, basic concepts of linear mixed models.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain basic concepts of Biostatistics and Epidemiology;
CO2	Describe methods and analytical tools for survival data;
CO3	Illustrate several epidemiological studies with layouts;
CO4	Analyze survival data in different fields, especially medical and engineering sectors;
CO5	Analyze data produced in life sciences and epidemiological studies.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3				
CO2	3	2	3			
CO3		3	3			
CO4		2	3	2		
CO5		2	3	2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 3	Lecture using board/ tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group)

		Semester-end examination

Main Texts

1. Kleinbaum D. G., *et al* (1982), Epidemiologic Research: Principles and Quantitative Methods, John Wiley & Sons, USA
2. Rothman K. J., (2012), Epidemiology: An Introduction, 2nd Edition, Oxford University Press, UK
3. Klein J. P. & Moeschberger M. L., (2003), Survival Analysis – Techniques for Censored and Truncated data, 2nd Edition, Springer-Verlang, New York

Reference Books

4. Woodward M., (2013). Epidemiology: study design and data analysis. CRC press.
5. Bonita R. *et al*, (2006), Basic Epidemiology, WHO
6. Collett D., (2023), Modelling Survival Data in Medical Research, 4th Edition, Chapman and Hall, Florida
7. Cox D. R. & Oakes D., (1984), Analysis of Survival Data, Reprint Edition, Chapman & Hall/CRC Press, NY
8. Elandt-Jhonson R. C. & Jhonson N. L., (1999), Survival Models and Data Analysis, Wiley Inter Science, USA
1. Lawless J. F., (2002), Statistical Models and Methods for Lifetime Data, 2nd Edition, John Wiley & Sons, USA
9. Kalbfleisch J. D. & Prentice R. L., (2011), The Statistical Analysis of Failure Time Data, 2nd Edition, John Wiley & Sons, USA
10. Kleinbaum D. G. & Klein M., (2005), Survival Analysis: A Self-Learning Text, 3rd Edition, Springer-Verlang, NewYork
11. Rothman K. J. & Greenland S., (2012), Modern Epidemiology, 3rd Edition, Lippincott Williams and Wilkins, USA
12. Verbeke G. & Molenberghs G., (2000), Linear Mixed Models for Longitudinal Data, Springer-Verlag, NewYork

Course Code: STA 0542 4254	**Credit: 1.5**	**Year: 4th**	**Semester: 2nd**
Course Title: Biostatistics and Epidemiology Lab		**Course Status:** Lab	

Rationale of the Course: Apply acquired knowledge to analyze data produced in life sciences and epidemiological studies.

Course Objectives: The objectives of the course are

- Help students apply lifetime distributions, estimate survival functions and calculate survival probabilities,
- Provide students necessary skills to estimate various epidemiological measures.

Course Contents

Estimation of survival probabilities using non-parametric methods for complete and censored cases. Identification of parametric models for survival data, estimation of parameters and hypothesis testing for exponential and Weibull distribution with complete and censored samples. Computation of incidence, prevalence, sensitivity and specificity. Measures of association, estimation of relative risk, attributable risk and odds ratio. Computation of standard errors of estimates for different types of epidemiological studies. Application of correlated proportion, McNemar test, logistic regression model and linear mixed models.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Analyze survival data using computer software;
CO2	Analyze epidemiological data with proper interpretation;
CO3	Apply epidemiological measures as well as linear mixed models for correlated data.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1		2	3	3	2	
CO2		2	3	3	2	
CO3		3	3	3	2	

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ assignment	Quiz/ assignment/presentation (individual/group), semester end examination
CO 2	Lecture using board/ assignment	
CO 3	Lecture using board/ assignment	

Main Texts

1. Klein J. P. & Moeschberger M. L., (1997), Survival Analysis – Techniques for Censored and Truncated data, Springer-Verlang, New York
2. Lawless J. F., (2002), Statistical Models and Methods for Lifetime Data, 2nd Edition, John Wiley & Sons, USA
3. Rothman K. J., (2012), Epidemiology: An Introduction, 2nd Edition, Oxford University Press, UK

Reference Books

1. Bonita R. *et al.*, (2006), Basic Epidemiology, WHO
2. Collett D., (2023), Modelling Survival Data in Medical Research, 4th Edition, Chapman and Hall, Florida
3. Cox D. R. & Oakes D., (1984), Analysis of Survival Data, Reprint Edition, Chapman & Hall/CRC Press, NY
4. Elandt-Jhonson R. C. & Jhonson N. L., (1999), Survival Models and Data Analysis, Wiley Inter Science, USA
5. Kalbfleisch J. D. & Prentice R. L., (2011), The Statistical Analysis of Failure Time Data, 2nd Edition, John Wiley & Sons, USA
6. Kleinbaum D. G., *et al.*, (1982), Epidemiologic Research: Principles and Quantitative Methods, John Wiley & Sons, USA
7. Kleinbaum D. G. & Klein M., (2005), Survival Analysis: A Self-Learning Text, 3rd Edition, Springer-Verlang, NewYork
8. Pocock S. J., (1985), Clinical Trials: A Practical Approach, Wiley, NY
9. Rothman K. J. & Greenland S., (2012), Modern Epidemiology, 3rd Edition, Lippincott Williams and Wilkins, USA
10. Verbeke G. & Molenberghs G., (2000)LinearMixedModelsforLongitudinalData,Springer-Verlag,NewYork

Course Code: STA 0542 4255	**Credit:** 2.0	**Year:** 4th	**Semester:** 2nd
Course Title: Generalized Linear Models		**Course Status: Theory**	

Rationale of the Course:
In this course, many statistical models for the analysis of quantitative and qualitative data of the kinds typically found in research are covered. In particular, students acquire knowledge on models those follows exponential family of distributions.

Course Objectives: The objectives of the course are

- To acquaint students with the concepts of model fitting and adequacy checking,
- To facilitate necessary knowledge on sampling distribution of score statistics, maximum likelihood estimators, deviance, and likelihood ratio statistics,
- To provide knowledge of exponential family of distributions, general and generalized linear models, and various link functions,
- To foster the analytical and critical thinking ability for analyzing data that come from normal as well as other distributions.

Course Contents

Introduction: Introduction to the concepts of modeling. **Model fitting:** Examples, some principles of statistical modeling (exploratory data analysis), model formulation, parameter estimation, residuals and model checking), estimation and tests based on specific problems. Sampling distribution for score statistics, MLEs, deviance; log-likelihood ratio statistic. **Exponential family**: Bernoulli, binomial, Poisson, exponential, gamma, normal, *etc*. Properties of distributions in the exponential family, expected value, variance, expected value and variance of score statistic, examples for various distributions. Components of generalized linear models – random, systematic and link functions, Poisson regression. Maximum likelihood estimation using chain rules, random component, mean and variance of the outcome variable, variance function, dispersion parameter, applications. **Systematic component and link function:** Identity link, logit link, log link, parameter estimation. Score function and information matrix, estimation using the method of scoring, iteratively reweighted least squares. **Inference procedures:** Deviance for

logit, identity, log link functions, scaled deviance, sampling distributions, hypothesis testing. Generalized Pearson chi-square statistic, residuals for GLM, Pearson residual, Anscombe residuals. Logit link function, iteratively reweighted least squares, tests; nominal and ordinal logistic regression. **Goodness of fit tests**: Hosmer-Lemeshow test, pseudo-R square, AIC and BIC. **Quasi-likelihood**: Construction of quasi-likelihood for correlated outcomes, parameter estimation, variance-covariance of estimators, estimation of variance function. Quasi-likelihood estimating equations, comparison between likelihood and quasi-likelihood methods. **Modeling for repeated measure data:** GEE for repeated measures data, repeated measures models for normal data (e.g. Linear Mixed Effect Models), repeated measures models for non-normal data (e.g. Generalized Linear Mixed Effect Models), working correlation matrix, robust variance estimation or information sandwich estimator, hypothesis testing.

Course Learning Outcomes (COs): By the end of the course, students will be expected to -

CO1	Derive sampling distributions of score statistics, MLEs, deviance, log-likelihood ratio statistics;
CO2	Compare and contrast between general and generalized linear models;
CO3	Carry out tests of hypotheses related to GLMs;
CO4	Fit GLMs along with model diagnostics;
CO5	Discriminate quasi-likelihood and likelihood function along with its application for fitting models.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	2		2	2	
CO2	3	2		2	2	
CO3	3	3				
CO4	3	2		2	2	
CO5	3	2		2		

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ tutorial	Quiz/ Midterm Examination 1; Semester-end examination
CO 2	Lecture using board/ projectors	Quiz/ Semester-end examination
CO 3	Lecture using board/ tutorial	Quiz/ Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Midterm Examination 2; Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Text

- Dobson A. J. & Barnett A. G., (2008), An Introduction to Generalized Linear Models, 3rd Edition, Chapman and Hall, Florida

Reference Books

1. Agresti A., Categorical Data Analysis, 3rd Edition, Wiley, NY
2. Hosmer D. W., & Lemeshow S., Applied Logistic Regression, 2nd Edition, Wiley, NY
3. McCullagh P. & Nelder J. A., Generalized Linear Models, 2nd Edition, Chapman and Hall, UK
4. Molenberghs G. & Verbeke G., (2005), Models for Discrete Longitudinal Data, Springer
5. Verbeke G. & Molenberghs G., (2000), Linear Mixed Models for Longitudinal Data, Springer

Course Code: STA 0542 4261	**Credit:** 2.0	**Year: 4th**	**Semester: 2nd**
Course Title: Introduction to Data Science		**Course Status: Theory**	

Rationale of the Course: The main computational principles, methods, and procedures for organizing, storing, and evaluating massive amounts of data of diverse kinds and frequencies will be covered in this course. In particular, this course will provide how statistical models can be used in computer systems to examine large data sets and enable computers to carry out activities that are beyond the scope of traditional computer science approaches. Therefore, this course needs a basic understanding of computer programming.

Course Objectives: The objectives of the course are

- To familiarize students with data Science including its features and difficulties, and to provide them with the necessary tools for organizing and interpreting data.
- To assist students in comprehending the uses of Big data in various areas.
- To prepare the students in dealing with big data in real life.

Course Contents

Data Science Basics: Data, information, and knowledge. Concept of data science. Data science objectives, data science process and data science tasks. Importance and applications of data science. Data science tools, techniques and best practice. Skills for data science. Data science methodology. Ethics, bias and privacy in data science. Related to other fields- data science and statistics, data science and mathematics, data science and business analytics, health and biomedical data science, data science and information science. Data science career.

Data, Sources, Generation and Storage: Data attributes, data-storage formats, data sources, data generation, data management techniques for data collection and storage, data cloud services. Data supply chain.

Dataset Preprocessing and Data Preparation: Data cleaning, feature encoding, missing value processing, data formatting, data reduction, data transformation, data normalization, data integration, data discretization, outlier detection. Exploratory data analysis and data visualization.

Concepts of Predictive Modelling and Machine Learning: Supervised learning, unsupervised learning, semi-supervised learning and reinforcement learning.

Regression- linear and logistic regression. Classification- K-nearest neighbors, decision tree, random forest, support vector machine and naive Bayes classifiers. Artificial neural networks. Cluster analysis. Feature selection and model evaluation. Ensemble learning. Association-rule mining. Deep learning. Natural Language Processing.

Big Data Analysis: Characteristics of Big Data. Types of Big Data. Big Data analysis problems. Big Data analytics techniques. Big Data analytics platforms. Big Data analytics architecture. Tools and systems for Big Data analytics. Active challenges of Big Data analysis.

Data Science Project: Hands-on Data Science Project with R, Python and SQL. Individual/group project designed by the course teacher which can be counted as the class evaluation/assignments.

Course Learning Outcomes (COs): By the end of the course, students will be expected to –

CO1	Explain basic data science tools and techniques;
CO2	Design various statistical machine learning algorithms in real-world applications;
CO3	Handle big data;
CO4	Work on different areas of data science projects using statistical softwares in real life.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3			3	3	3
CO2	3			3	3	3
CO3	3			3	3	3
CO4	3			3	3	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO1	Lecture using board/ projectors	Quiz/ Midterm Examination 1; Semester-end examination
CO2	Lecture using board/ projectors	Quiz; Semester-end examination
CO3	Lecture using board/ projectors	Quiz/ Midterm Examination 2; Semester-end examination
CO4	Statistical Softwares/ projectors	Individual/group Project

Text Books

1. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier.
2. Ou, G., Zhu, Z., Dong, B., & Weinan, E. (2023). Introduction to Data Science. World Scientific.

Reference Books

1. Shah, C. (2020). A hands-on introduction to data science. Cambridge University Press.
2. Wagh, S. J., Bhende, M. S., & Thakare, A. D. (2021). Fundamentals of data science. Chapman and Hall/CRC Press.
3. Burns, S. (2019). Fundamentals of Data Science: Take the First Step to Become a Data Scientist.

Course Code: STA 0542 4257	**Credit:** 2.0	**Year: 4th**	**Semester: 2nd**
Course Title: Research Methodology		**Course Status: Theory**	

Rationale of the Course: To find answers and learn new things is the goal of research. The main instrument employed in almost every branch of science to extend the boundaries of understanding is research. The theoretical foundations of conducting research, from problem formulation to report writing, are included in the research technique component. Students will acquire in depth knowledge of research methodology for the purposes of describing an event, discovering the relationship between phenomena, or making predictions about future events.

Course Objectives: The objectives of the course are

- Acquaint students with basic concepts of research and its methodologies,
- Provide knowledge of selecting and defining appropriate research problems,
- Facilitate necessary knowledge on writing research proposal, research report and thesis,
- Enhancing the skills on conducting research project in a group.

Course Contents

Elements of research: Concepts, definitions and scope of research. Research question, target population and study population. Research methods and methodology, research ethics, desirable qualities of research, research question, research objectives, research hypotheses, operational definition. **Research ideas:** Role of literature review. Inductive approach, deductive approach, complementary of inductive and deductive approach, wheel of science. **Research approaches and types**: Quantitative and qualitative approaches of research. Idea about various types of research under quantitative approaches according to different criteria. **Qualitative approaches**: Focus group discussion (FGD), in-depth interview (IDI), key informant interview (KII) and their guidelines and checklist. **Research process**: Conceptual, empirical and analytical phases of research. Problem identification, literature review, setting objectives and hypothesis, selection of research design and sample design, data gathering, data processing and analysis, and report writing. **Detailed study of important research designs**: Exploratory studies – secondary data analysis, experience survey, pilot study, case study, focus group discussion. Descriptive studies – cross-sectional, longitudinal, trend, panel study, baseline study, impact assessment, feasibility study designs. Causal studies – comparative, case-control, cohort. **Experimental studies**: Concepts of randomization, grouping, matching, advantages and disadvantages over non-experimental designs, validity in experimentation. Study on experimental research designs – pre-experimental, true-experimental and quasi-experimental. **Sample design**: Choice of correct sampling methods and sample size determination. **Data gathering**: Quantitative data collection techniques – interview method, mail method, telephone surveys; qualitative methods of data collection

observation, in-depth interviews, case studies, focus group discussions. Key informant interview, participatory rural appraisal. **Questionnaire design and construction**: Types of questions, framing of questions, sequencing questions, construction of a model questionnaire, question wording, guidelines for avoiding poor question wording. **Idea about planning and implementation of a research study**: Time and financial budgeting, logistics of data collection, recruitment and training of the enumerators, field work supervision and quality control of data. **Data processing and analysis**: Editing, coding, data entry, validation check, imputation of variables, tabulation plan, data analysis. **Reliability and validity in measurements**: Initiation of model building, measurement error, test for sound measurement, reliability and its measurements, validity and its types, measurements of validity; stability of the model over the population, construction of measurements scales. **Report writing:** Types of reports, design and structure of reports, introductory section, main body, concluding section, tables and graphical presentations, references and bibliography. **Research proposal**: Request for proposal, term of reference, components of a proposal, evaluation of proposal.

Course Learning Outcomes (COs): By the end of the course, students will be expected to **–**

CO1	Define research question, research process, different types of studies, sampling design, questionnaire, ethical issues;
CO2	Extract relevant informations from the literature to develop methodological aspetcs for a research question;
CO3	Create a good research proposal;
CO4	Conduct research project independently along with report writing
CO5	Collaborate a research to benefit the stakeholders.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3				
CO2		3		2	2	
CO3		2		3	3	
CO4		2		2	3	2
CO5			3		2	2

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1	Lecture using board/ tutorial	Quiz/ Midterm Examination 1 Semester-end examination
CO 2	Lecture using board/ tutorial	Quiz/ Semester-end examination
CO 3	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ tutorial	Quiz/ Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Main Texts

1. Kothari C. R., (2013), Research Methodology - Methods and Techniques, 3rd Edition, New Age, New Delhi
2. Trochim W. M. K., Research Methods – Knowledge Base, https://www.socialresearchmethods.net/kb/
3. Akand M. A. S., (2019), Research Methodology – A Complete Direction for Learners, 2nd Edition, Akanda & Sons, Academic Publishers, Dhaka

Reference Books

1. Islam M. N., An Introduction to Research Methods, Mullick & Brothers, Dhaka
2. Malhotra N. K., Marketing Research – An Applied Orientation, 5th Edition, Prentice Hall of India, New Delhi

3. Palys T., Research Decisions – Quantitative and Qualitative Perspectives, 2nd Edition, International Thomson Publishing

Course Code: STA 0542 4258	**Credit: 3.0**	**Year: 4th**	**Semester: 2nd**
Course Title: Research Project		**Course Status:** Capstone	

Rationale of the Course: Traditional theory and lab courses cannot fully provide a student the in-depth knowledge and skills required to be a subject expert. In order to learn the application of a study subject as an expert in solving real-life problem and to acquire transferable and professional skills, it is essential for an undergraduate student to undertake research projects.

Course Objectives: The objectives of the course are

- To facilitate necessary skills about hands-on experience of conducting a research project,
- To foster the analytical and critical thinking ability to apply statistical methods appropriately.

Course Contents

Students will be in consultation with assigned teachers to select project topics.

Evaluation: Every student will have to submit research report using LaTeX to the department through assigned teachers. The reports will be examined by the assigned teachers against 30% marks, by another examiner against 30% marks. The oral presentation of reports for examinations by the examination committee will carry another 40% marks. Results will be processed by the examination committee.

Reference Books

Recommended readings and books referred by the supervisors of the research project.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Write an appropriate research proposal including design a research project;
CO2	Develop suitable questionnaire for collecting necessary primary data;
CO3	Perform data cleaning and management;
CO4	Apply analytical tools, write a research report and disseminate research findings by an effective oral presentation.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3		2	3	2
CO2	2	3	2	2	2	
CO3		2		3	2	
CO4		3		3	3	3

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Project	Semester-end examination
CO 2	Project	Semester-end examination
CO 3	Project	Semester-end examination
CO 4	Project	Semester-end examination
CO 5	Project	Semester-end examination

Optional Course Details

Course Code: STA 0542 4259	**Credit:** 4.0	**Year: 4th**	**Semester: 2nd**
Course Title: Comprehensive		**Course Status:** Optional/Elective	

Rationale of the Course: It is essential for the students to bear always the fundamental concepts to handle the academic problems in any situation. Therefore, this course is designed as an additional option in the final semester with a view to revive foundation of the students on basic statistical tools and techniques for collecting and analyzing data, and interpretation of the findings.

Course Objectives: The objectives of the course are

- Make the students capable to understand the statistical tools and techniques for data collection and analysis,
- Assist the students to apply statistical techniques in real field.

Course Content

Introductory Concepts: Population, Parameter, Sample, Statistic, Estimator, Estimate, Variable, Attribute, Measurements Scales, Data, Meaning of Statistics, Descriptive Statistics, Inferential Statistics. **Collection of data:** Primary data, Secondary data, **Presentation of data:** Statistical table, Chart, Frequency distribution. **Averages / Measures of central tendency:** Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode. Merits and Limitations. **Dispersion:** Meaning, Absolute and relative measures: Range, Mean deviation, Standard deviation, Coefficient of variation. **Shape characteristics of distribution**: Skewness and Kurtosis. **Probability**: Sets and their properties, Random Experiment, Sample space, Event, Classical and Statistical definitions of probability, Additive and multiplicative laws of probability, Conditional probability, Baye's theorem. Problems. **Concept of random variable:** Probability distribution, Probability function, Distribution function, Mathematical expectation and variance. Problems. Discrete and continuous probability distributions: Bernoulli, Binomial, Poisson, Negative binomial, Geometric, Hyper geometric, Normal, Gamma, Exponential. Problems. **Sampling distribution**: Concepts, Methods of finding sampling distribution of statistic. t-statistic, F-statistic, χ^2Statistic and their distributions. Applications. **Point estimations and interval estimation**: Methods of obtaining point estimator, Properties of a good point estimator. Maximum likelihood estimator, moment estimator, Bayes estimator. **Test of hypothesis:** Concept, Null and alternative hypotheses, Type I error, Type II error, Critical region, Level of significance (α) and p-value, Test statistics, Some parametric and non-parametric tests. **Sample Survey:** Census, Sampling, sampling error and non-sampling error, Probability sampling and non-probability sampling. Simple random sampling (SRS), Methods of drawing sample under SRS, Problem. **Experimental design:** Treatment, Block, Experimental unit, Experimental error. Principles of design, Analysis of variance, Completely randomized design, Randomized block design and Latin squares design.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Gather widespread knowledge on descriptive statistical tools, probability, probability distributions, and sampling distributions;
CO2	Layout experimental design, select appropriate sampling techniques and determination of sample size in real situation;
CO3	Estimate the parameters using point estimation along with construction of interval estimation;
CO4	Develop a regression model including its prediction;
CO5	Perform parametric and non-parametric tests of hypotheses.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3		2		
CO2	3	3		2		
CO3	3	3				
CO4	3	3		2		
CO5	3	3				

Mapping Course Learning Outcomes (COs)with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CO 1	Lecture using board/ projectors	Quiz/ Midterm Examination 1 Semester-end examination
CO 2	Lecture using board/ tutorial	Quiz/ Semester-end examination
CO 3	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination
CO 4	Lecture using board/ assignment	Assignment/ Presentation (Individual/group)

		Midterm Examination 2 Semester-end examination
CO 5	Lecture using board/ assignment	Assignment/ Presentation (Individual/group) Semester-end examination

Reference Books

1. Gupta S. C. & Kapoor V. K., (2000), Fundamentals of Mathematical Statistics, 10th Revised Edition, Sultan Chand and Sons, New Delhi, India
2. Islam M. N., (2006), Introduction to Statistics and Probability, 3rd Edition, Book World, Dhaka
3. Mostafa, M. G., (1989), Methods of Statistics, Karim press and publication, Dhaka Bangladesh
4. Ross S. M., (2010), Introductory Statistics, 3rd Edition, Academic Press, USA
5. Ross S. M., (2018), A First Course in Probability, 9th Edition, Academic Press, NY
6. Roy M. K., (2011), Fundamentals of Probability and Probability Distributions, 8th Edition, ROMAX Publications, Chittagong

Course Code: STA 0542 4250	**Credit:** 1.0	**Year: 4th**	**Semester: 2nd**
Course Title: Presentation & Viva-voce		**Course Status:** Lab	

Rationale of the Course: Presentation and verbal communication skills are essentials for the students to pursue further higher education and build future career. Therefore, students should get the opportunity to communicate their learning through presentation and viva-voce in order to develop confidence and to have deep understating on the core courses.

Course Objectives: The objectives of the course are

- Help students gain confidence in their own ability to present and explain the basic concepts of the courses,
- Provide the knowledge of oral communication and presentation skills that are essential for later professional career.

Course Contents: Comprehensive contents of all the underlying courses of the semester.

Reference Books

- Reference books referred for all the underlying courses of the semester.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Explain key concepts of the core courses both visually and verbally to the experts in the pertinent subject area;
CO2	Communicate their learning effectively and appropriately to formal audiences;
CO3	Interpret the findings of data analysis;
CO4	Exhibit good performance in professional oral examinations and job interviews;
CO5	Conduct academic and professional discussion.

Mapping Course Learning Outcomes (COs)with the POs

3: Strong 2: Moderate 1: Weak

Course Learning Outcomes (CO)	Fundamental Skill		Social Skill	Thinking Skill	Personal Skill	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		3		3	
CO2	3		3		3	
CO3	3				3	3
CO4	2				3	3
CO5	1		3		3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	Teaching-Learning Strategy	Assessment Strategy
CO 1		
CO 2		

CO 3	Self-learning using reference book/lecture notes/research articles/other online materials/group study	Semester-end oral examination
CO 4		
CO 5		

Part D

20. Grading/Evaluation: According to the ordinance of the university

1) **Grading Scale** and
2) **Grades:**

Letter Grade and corresponding Grade-Point for a course will be awarded from the roundup marks of individual courses as follows:

Numerical Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	C-	2.00
Less than 40%	F	0.00

3) **Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)**

GPA:

Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses completed by a student in a semester.

CGPA:

Cumulative Grade Point Average (CGPA) of major and second major degrees will be calculated separately by the weighted average of all courses of the previous semesters along with that of the current/present semester. For the calculation of the final CGPA of clearing graduates, if the third digit after the decimal point is nonzero then its

previous, that is, the second digit will be incremented by one. A student, if applicable, will also receive a separate CGPA for her/his Second Major courses.

F Grades:

A student will be given an "F" grade if s/he fails or remains absent in the final examination of a registered course. If a student obtains an "F" grade, her/his grade will not be counted for GPA and s/he will have to repeat the course. An "F" grade will be in her/his record, and s/he will not be eligible for distinction, award, and scholarship of the university.

4) **Course Improvement**

A student will be allowed only once to improve maximum of 2 (two) theory courses for which s/he has obtained a B- grade or less in the previous level by registering in the semesters of the immediate next level. Such course grade improvement opportunity shall be given only for 100- 300 level courses. If the course grade does not improve then the previous course grade will sustain in grade count. In the case of the course grade improvement, this will be cited/noted in the concerned transcripts beside the grade count as "Improvement."

5) **Incomplete courses**

If a student has an incomplete course(s), s/he has to register such an incomplete course(s) from preceding semesters before registering courses from current or successive semesters. If an incomplete course is not available or offered in the running semesters, the student shall take such course(s) when it is available or offered.

6) **Course Withdrawal**

A student can withdraw a course by a written application to the Controller of Examinations through the Head of the discipline two weeks before the examination start. The Controller of Examinations will send the revised registration list to the disciplines before the commencement of semester final examination. There will be no record of the course in transcript if the course is withdrawn.

7) **Repetition**

If a student has to repeat a failed or incomplete course and that course is not available/offered any more, the discipline may allow him/her to take an equivalent

course from the current curriculum. For clearing graduates, if any incomplete course is not available/offered in the running semester, the discipline may suggest a suitable/equivalent course to complete the credit requirement so required for the degree.

8) Break in study:

In very special cases, if a student does not register and remains absent continuously for 2-4 (two to four) semesters within her/his 12/14 semesters of 4/5 years' program, then s/he may apply for readmission as an irregular student. Her/his application will be considered only once provided that s/he has already completed 80% or more of the credits for which s/he was supposed to register and sit in the examination before the beginning of her/his break of study. The concerned discipline will analyze the application and send its well-judged recommendation to the Dean within the 1st month of the running semester. The Academic council, based on the recommendation of the discipline and the opinion of the Dean, may allow the applicant for admission as an irregular student. Such student has to complete the required credits within her/his remaining number of semesters. In the certificate, grade sheet and transcript of all irregular students, the word "irregular" will be mentioned.