KURUKSHETRA UNIVERSITY, KURUKSHETRA

(Established by the State Legislature Act XII of 1956)
('A+' Grade, NAAC Accredited)

Scheme of Examination and Syllabus for

Under-Graduate Programme

Subject: Statistics

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020 w.e.f. 2023-24 (in phased manner)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

(Established by the State Legislature Act XII of 1956)

('A+' Grade, NAAC Accredited

Scheme of Examination for Under-Graduate Programme

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020

w.e.f. 2023-24 (in phased manner)

Subject: Statistics

(First Year)

Remarks	Course Type	Course Code	Nomenclature of Paper	Credits	Contact Hours/ Week	Internal marks	End Term Marks	Total Marks	Duration of Exam
SEMESTER-I									
Scheme A & C	**CC-1/ MCC-1 (4 credit)**	B23-STA-101	Descriptive Statistics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme C only	**MCC-2 (4 credit)**	B23-STA-102	Statistical Methods	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme A,B & D	**CC-M1 (2 credit)**	B23- STA - 103	Introduction to Statistics	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	3 hrs.
Scheme A,B,C & D	**MDC-1 (3 credits)**	B23- STA - 104	Business Statistics	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	3 hrs.
SEMESTER-II									
Scheme A & C	**CC-2/ MCC-3 (4 credit)**	B23- STA - 201	Probability Theory and Distributions	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme C only	**DSEC-1 (4 credit)**	B23- STA - 202	Numerical Analysis	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme A,B & D	**CC-M2 (2 credit)**	B23- STA - 203	Introduction to Operations Research	1	1	10	20	30	3 hrs.
			Practical	1	2	5	15	20	3 hrs.
Scheme A,B,C & D	**MDC-2 (3 credit)**	B23- STA - 204	Vital and Official Statistics	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	3 hrs.
Internship of 4 credits of 4-6 weeks duration after IInd Semester									

(Second Year)

Remarks	Course Type	Course Code	Nomenclature of Paper	Credits	Contact Hours/ Week	Internal marks	End Term Marks	Total Marks	Duration of Exam
SEMESTER-III									
Scheme A,B & C	**CC-3/ MCC-4 (4 credit)**	B23- STA - 301	Applied Statistics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme B and C	**MCC-5 (4 credit)**	B23- STA - 302	Advanced Probability	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme A,B,C & D	**MDC-3 (3 credit)**	B23- STA - 303	Industrial Statistics	2	2	15	35	50	3 hrs.
			Practical	1	2	5	20	25	3 hrs.
SEMESTER-IV									
Scheme A, B & C	**CC-4 MCC-6 (4 credit)**	B23- STA - 401	Statistical Inference	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme B & C	**MCC-7 (4 credit)**	B23- STA - 402	Linear Algebra	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme B & C	**MCC-8 (4 credit)**	B23- STA - 403	Linear Programming	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme B & C	**DSE-1 (4 credit)** Select one option	B23- STA - 404	Demography	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
		OR B23- STA - 405	Statistical Methods in Epidemiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Internship of 4 credits of 4-6 weeks duration after 4th Semester (if not done after second semester)									

(Third Year)

Remarks	Course Type	Course Code	Nomenclature of Paper	Credits	Contact Hours/ Week	Internal marks	End Term Marks	Total Marks	Duration of Exam
SEMESTER-V									
Scheme A, B & C	**CC-5 MCC-9 (4 credit)**	B23- STA - 501	Sample Surveys	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme B & C	**MCC-10 (4 credit)**	B23- STA - 502	Statistical Quality Control and Official Statistics	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme B & C	**DSE-2 (4 credit)** Select one option	B23- STA - 503	Operations Research	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
		OR	Statistical Simulation	3	3	20	50	70	3 hrs.
		B23- STA - 504	Practical	1	2	10	20	30	3 hrs.
Scheme B & C	**DSE-3 (4 credit)** Select one option	B23- STA - 505	Linear Models	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
		OR	Actuarial Statistics	3	3	20	50	70	3 hrs.
		B23- STA - 506	Practical	1	2	10	20	30	3 hrs.
SEMESTER-VI									
Scheme A, B & C	**CC-6 MCC-11 (4 credit)**	B23- STA - 601	Design of Experiments	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme B & C	**MCC-12 (4 credit)**	B23- STA - 602	Advanced Statistical Inference	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Scheme B & C	**DSE-4 (4 credit)** Select one option	B23- STA - 603	Non-parametric Inference	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
		OR	Bayesian Inference	3	3	20	50	70	3 hrs.
		B23- STA - 604	Practical	1	2	10	20	30	3 hrs.
Scheme B & C	**DSE-5 (4 credit)** Select one option	B23- STA - 605	Statistical Data Analysis using Statistical Softwares	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
		OR	Data Analysis using Python	3	3	20	50	70	3 hrs.
		B23- STA - 606	Practical	1	2	10	20	30	3 hrs.

(Fourth Year)

Remarks	Course Type	Course Code	Nomenclature of Paper	Credits	Contact Hours/ Week	Internal marks	End Term Marks	Total Marks	Duration of Exam
SEMESTER-VII (FOR HONOURS/HONOURS WITH RESEARCH IN STATISTICS)									
Same for Honours/ Honours with Research	**CC-H1 (4 credit)**	B23- STA -701	Multivariate Analysis	4	4	30	70	100	3 hrs.
	CC-H2 (4 credit)	B23- STA -702	Stochastic Processes	4	4	30	70	100	3 hrs.
	CC-H3 4 credit	B23- STA -703	Advanced Sampling Techniques and Design of Experiments	4	4	30	70	100	3 hrs.
	DSE-6 (4 credit) Select one	B23- STA -704 OR B23- STA -705	Optimization Techniques	4	4	30	70	100	3 hrs.
			Biostatistics	4	4	30	70	100	3 hrs.
	PC-H1 (4 credit)	B23- STA -706	Practicum Course (Based on B23-STA-701 to B23-STA 704/ B23-STA 705)	4	8	30	70	100	3 hrs.
SEMESTER-VIII (FOR HONOURS IN STATISTICS)									
For Honours in Statistics	**CC-H4 (4 credit)**	B23- STA -801	Reliability Theory	4	4	30	70	100	3 hrs.
	CC-H5 (4 credit)	B23- STA -802	Queueing Theory	4	4	30	70	100	3 hrs.
	CC-H6 (4 credit)	B23- STA -803	Econometrics	4	4	30	70	100	3 hrs.
	DSE-7 (4 credit) Select one option	B23- STA -804 OR B23- STA -805	R and its applications in Statistics	4	4	30	70	100	3 hrs.
			Information Theory						
	PC-H2 (4 credit)	B23- STA -806	Practicum Course (Based on B23-STA-801 to B23-STA 804/ B23-STA 805)	4	8	30	70	100	3 hrs.
SEMESTER-VIII (FOR HONOURS WITH RESEARCH IN STATISTICS)									
Honours with Research in Statistics	**CC-H4 (4 credit)**	B23- STA -801	Reliability Theory	4	4	30	70	100	3 hrs.
	CC-H5 (4 credit)	B23- STA -802	Queueing Theory	4	4	30	70	100	3 hrs.
	Project/Dissertation (12 credit)	B23- STA -807	Project/Dissertation	12	-	-	-	-	-

LIST OF VOC COURSES

Remarks	Course Type	Course Code	Nomenclature of Paper	Credits	Contact Hours/ Week	Internal marks	End Term Marks	Total Marks	Duration of Exam
Semester -III	**VOC-I**	B23- VOC - 121	Working with SPSS	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.
Semester -IV	**VOC-II**	B23- VOC - 121	Data Handling	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	3 hrs.

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	First		
Name of the Course	Descriptive Statistics		
Course Code	B23-STA-101		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-1 MCC-1		
Level of the course	100-199		
Pre-requisite for the course (if any)	Mathematics as a Subject at 4.0 Level (Class XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Tabular and graphical representation of data based on variables. 2. Measures of central tendency and measures of Dispersion. 3. Skewness and Kurtosis, Moments and their use in studying various characteristics of data. Theory of attributes: conditions for the consistency and criteria for the independence of data for attributes. 4. Correlation and regression, its properties and its implementation in real life problems.		
CLO 5 is related to the practical components of the course	5. Problems based on graphically representation of data, determination of Measures of Central Tendency, Measures of Dispersion, Correlation coefficient and Regression lines.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All

the questions will carry equal marks except the compulsory question.		
Unit	**Topics**	**Contact Hours**
I	**Introduction of Statistics**: Origin, development, definition, scope, uses and limitations. **Types of Data**: Qualitative and quantitative data, nominal and ordinal data, time series data, discrete and continuous data, frequency and non-frequency data, Primary and Secondary data. **Presentation of Data**: Frequency distribution and cumulative frequency distribution, diagrammatic and graphical presentation of data, construction of bar, pie diagrams, histograms, frequency polygon, frequency curve and Ogives.	12
II	**Measures of Central Tendency and Location**: Arithmetic mean, median, mode, geometric mean, harmonic mean; partition values-quartiles, Deciles, percentiles and their graphical location along with their properties, applications, merits and demerits. **Measures of Dispersion**: Concept of dispersion, characteristics for an ideal measure of dispersion. Absolute and relative measures based on: range, inter quartile range, quartile deviation, coefficient of quartile deviation, Mean deviation, coefficient of mean deviation, variance, standard deviation (σ), coefficient of variation and properties of these measures, variance of the combined series.	11
III	**Moments:** Moments about mean and about any point and derivation of their relationships, effect of change of origin and scale on moments, Sheppard's correction for moments (without derivation), Pearson's β and γ coefficients. **Skewness and Kurtosis:** Coefficients of Skewness and Kurtosis with their interpretations. **Theory of Attributes**: Symbolic notations, dichotomy of data, class frequencies, order of class frequencies, consistency of data, independence and association of attributes, Yule's coefficient of association and coefficient of colligation and their relationship.	11
IV	**Correlation**: Concept and types of correlation, methods of finding correlation - scatter diagram, Karl Pearson's Coefficient of correlation (r), its properties, Rank correlation along with its merits and demerits, limits of rank correlation coefficient, tied or repeated ranks. (without derivation). **Linear Regression**: Principle of least squares, fitting of straight line, Two lines of regression, regression coefficients, properties of regression coefficients.	11

	Practicum	
	1. To construct frequency distributions using exclusive and inclusive methods 2. Representation of data using Bar and pie diagrams 3. Representation of data using Histogram, Frequency Polygon, Frequency Curve and Ogives. 4. To compute various measures of central tendency and dispersion. 5. To obtain first four moments for the given grouped frequency distribution. 6. To obtain various coefficients of Skewness and Kurtosis. 7. To discuss the association of attributes for a 2x2 contingency table using Yule's coefficient of association and colligation. 8. To compute Karl Pearson's coefficient of correlation for given bivariate frequency distribution. 9. To find Spearman's rank correlation coefficient for given data. 10. To fit the straight line for the given data on pairs of observations.	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory:** 50 marks ➢ **Practicum:** 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Fundamental of Statistics Vol.I	Goon A.M., Gupta M.K., Dasgupta B.	World Press, Calcutta (2016)
2.	Statistics: principles And methods	Johnson R., Bhattacharyya G K	Wiley Publishers (2019)
3.	Basic Statistics	Aggarwal B.L.	New Age, International (2009)
4.	Fundamental of Mathematical Statistics	Gupta S.C.& kapoor V.K.	Sultan Chand & Sons (2020)
5.	Programmed Statistics	Aggarwal B.L.	New Age International (2017)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	First		
Name of the Course	**Statistical Methods**		
Course Code	B23-STA-102		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-2		
Level of the course	100-199		
Pre-requisite for the course (if any)	Mathematics as a Subject at 4.0 Level (Class XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Fundamental concepts of index number. 2. Weighted aggregative methods and Criteria of Good Index Number 3. Principle of least square, curve fitting of different curves. 4. Multivariate Regression analysis, its properties and multiple correlations.		
CLO 5 is related to the practical components of the course	5. Ability to deal with the problems based on Index Number, Regression analysis and Multivariate Data.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Index Number:** Definition, problems involved in the construction of index numbers, calculation of index numbers - simple aggregate method, weighted aggregates method, simple average of price relatives, weighted average of price relatives, link relatives, chain indices, value index numbers, price and quantity index numbers, Interpretation, uses and limitations of index numbers.	12
II	**Weighted aggregative methods:** Laspeyre's, Paasche's, Drobish-Bowley Price Index Number, Marshall-Edgeworth, Walsch and Fisher's 'ideal' index numbers, Kelly's Price Index or Fixed Weight Method. **Criteria of Good Index Number**: Unit test, Time reversal test, factor reversal test, circular test. Errors in measurements of Index number. Base shifting of index numbers.	11
III	**Curve Fitting and Regression analysis**: Principle of least squares, second degree parabola, power curves of the type $Y=aX^b$, exponential curves of the types $Y=ab^X$ and $Y=ae^{bX}$. Angle between two regression lines, standard error of estimate obtained from regression line, correlation coefficient between observed and estimated values.	11
IV	**Multivariate Data**: Plane of regression, properties of residuals, variance of the residual. Multiple and partial correlation for three variables: coefficient of multiple correlation and its properties, coefficient of partial correlation and its properties, multiple correlation in terms of total and partial correlations and coefficient of determination.	11
	Practicum	
	1. To calculate price and quantity index numbers using the formulae given by Laspeyre, and Paasche. 2. To calculate price and quantity index numbers using the formulae given by Marshall- Edgeworth and Fisher. 3. To test the criteria of good index numbers. 4. Find Index number when base is shifted. 5. To fit the second degree curve for the given data. 6. To fit the curve of the type $Y=aX^b$ for the given data on pairs of observations. 7. To fit the exponential curve for the given data. 8. To obtain the regression lines for given data. 9. To compute partial and multiple correlation coefficients for the given tri-variate data. 10. To obtain plain of regression for the given tri - variate data.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 50 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Introduction to Theory of Statistics	Mood A.M., Graybill F.A. & Boes D.C.	McGraw Hill (1974)
2.	Fundamentals of Applied Statistics	Gupta S.C.& Kapoor V.K.	Sultan Chand & Sons (2020)
3.	Introduction to Mathematical Statistics	Kapoor & Sexena.	S.Chand (2010)
4.	Statistical Methods	Snedecor G.W. & Cochran W.G.	Iowa State Uni. Press (1989)
5.	Fundamentals of Mathematical Statistics	Gupta S.C.& Kapoor V.K.	Sultan Chand & Sons (2020)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	First		
Name of the Course	**Introduction to Statistics**		
Course Code	B23-STA-103		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-M1		
Level of the course	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Tabular and graphical representation of data based on variables. 2. Measures of central tendency, measures of Dispersion 3. Moments and their use in studying various characteristics of data, Skewness and Kurtosis. 4. Correlation and regression, its properties and its implementation in real life problems.		
CLO 5 is related to the practical components of the course	5. Problems based on graphically representation of data, determination of Measures of Central Tendency, Measures of Dispersion, Correlation coefficient and Regression lines.		
Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Introduction of Statistics**: Origin, development, definition, scope, uses and limitations. **Presentation of Data**: Qualitative and quantitative data, Frequency distribution and cumulative frequency distribution, diagrammatic and graphical presentation of data, construction of bar, pie diagrams, histograms, frequency polygon, frequency curve and ogives.	4
II	**Measures of Central Tendency**: Arithmetic mean, median, mode, along with their properties, applications, merits and demerits. **Measures of Dispersion**: Concept of dispersion, characteristics for an ideal measure of dispersion. range, inter quartile range, quartile deviation, Mean deviation, variance, standard deviation (σ), coefficient of variation.	4
III	**Moments:** Moments about mean and about any point (without derivation), Pearson's β and γ coefficients. **Skewness and Kurtosis:** Coefficients of Skewness and Kurtosis with their interpretations.	4
IV	**Correlation and regression**: Concept of correlation and regression, Karl Pearson's Coefficient of correlation, Principle of least squares, two lines of regression.	3
	Practicum	
	1. To construct frequency distributions using exclusive and inclusive methods 2. Representation of data using Bar and pie diagrams 3. Representation of data using Histogram, Frequency Polygon, Frequency Curve and Ogives. 4. To compute various measures of central tendency and dispersion. 5. To obtain first four moments for the given grouped frequency distribution. 6. To obtain various coefficients of Skewness and kurtosis. 7. To compute Karl Pearson's coefficient of correlation for given bivariate frequency distribution. 8. To fit the straight line for the given data on pairs of observations.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (10 marks)** • Class Participation: 4 marks • Seminar/presentation/assignment/quiz/class test etc. Nil • Mid-Term Exam: 6 marks ➢ **Practicum (05 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:05 marks • Mid-Term Exam: Nil	**End Term Examination:** **End Term Examination:** ➢ **Theory**: 20marks ➢ **Practicum**: 15 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Fundamental of Statistics Vol.I	Goon A.M., Gupta M.K., Dasgupta B.	World Press, Calcutta (2016)
2.	Statistics: principles and methods	Johnson R., Bhattacharyya G K	Wiley Publishers (2019)
3.	Basic Statistics	Aggarwal B.L.	New Age, International (2009)
4.	Fundamentals of Mathematical Statistics	Gupta S.C.& Kapoor V.K.	Sultan Chand & Sons (2020)
5.	Programmed Statistics	Aggarwal B.L.	New Age International (2017)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	First		
Name of the Course	**Business Statistics**		
Course Code	B23-STA-104		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. The fundamental concepts of Index Numbers. Construction of price, quantity and value Index numbers. 2. Different weighted aggregated methods 3. Criteria of good index number 4. The fundamental concepts of Demand Analysis.		
CLO 5 is related to the practical components of the course	5. To measure price and quantity index number using various index formulae. To check an index number is good or not, and to find equilibrium price, quantity exchanged and elasticity of demand.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks: 75 Internal Assessment Marks: 20 End Term Exam Marks: 55		Time: 3 Hours	
Part B- Contents of the Course			
Instructions for Paper- Setter There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.			

Unit	Topics	Contact Hours
I	**Index Number**: Definition, Characteristics of index numbers, types of index numbers, methods to construct price, quantity and value index numbers. problems involved in the construction of index numbers, methods of constructing index numbers.	09
II	**Weighted aggregative method:** Laspeyre's, Paasche's, Drobish-Bowley Price Index Number, Marshall-Edgeworth, Walsch and Fisher's 'ideal' index numbers, Kelly's Price Index or Fixed Weight Method.	07
III	**Criteria of Good Index Number**: Unit test, Time reversal test, factor reversal test, Circular test, errors in measurements of index numbers, Interpretation, uses and limitations of index numbers.	07
IV	**Demand Analysis**: Introduction to Demand and Supply, Laws of demand and supply, Equilibrium Price, Giffen's paradox, price elasticity of demand along with their interpretations.	07
	Practicum	
	1. To calculate price index numbers using the formulae given by Laspeyre, and Paasche. 2. To calculate price index numbers using the formulae given by Marshall- Edgeworth and Fisher. 3. To compute quantity index number using Laspeyre, Paasche and Fisher index numbers. 4. To test the criteria of good index numbers. 5. To verify Fisher's index satisfying time reversal test 6. To verify Fisher's index satisfying factor reversal test 7. Find the equilibrium price and quantity exchanged from demand and supply curves. 8. To find elasticity of demand for a given demand function.	30
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory (15 marks)** • Class Participation: 04 marks • Seminar/presentation/assignment/quiz/class test etc.:04 marks • Mid-Term Exam: 07 marks ➢ **Practicum (05 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:05 marks • Mid-Term Exam: Nil		**End Term Examination:** **End Term Examination:** ➢ **Theory**: 35 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources			
S. No.	**Title of Book**	**Name of Author**	**Publisher**
1.	Introduction to Mathematical Statistics	Kapoor & Sexena.	S.Chand (2010)
2.	Statistical Methods	Snedecor G.W. & Cochran W.G.	Iowa State Uni. Press (1989)
3.	Fundamentals of Applied Statistics	Gupta S.C.& Kapoor V.K.	Sultan Chand & Sons (2020)
4.	Fundamental of Statistics Vol.II	Goon A.M., Gupta M.K., Dasgupta B.	World Press, Calcutta (2016)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Second		
Name of the Course	**Probability Theory and Distributions**		
Course Code	B23- STA -201		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-2 MCC-3		
Level of the course	100-199		
Pre-requisite for the course (if any)	Mathematics as a Subject at 4.0 Level (Class XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Solve probabilistic problems using fundamental concepts of Probability. 2. Random variables and its probability functions, joint, marginal and conditional probability distribution. 3. Expectation for the random variables with their distributions and properties. Moment generating function, cumulant generating function and characteristic function. 4. Standard probability distributions and their properties.		
CLO 5 is related to the practical components of the course	5. Solve problems based on Probability, p.m.f, p.d.f, probability distributions and fitting of standard distributions.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Concepts in Probability:** Random experiment, trial, sample point, sample space, operation of events, exhaustive, equally likely, mutually exclusive and independent events; Definition of probability-classical, statistical and axiomatic approach. Conditional probability. Addition and Multiplication laws of probability and their extension to n events. Baye's theorem and its applications.	12
II	**Random Variable and Probability Functions:** Definition of random variable, discrete and continuous random variable, probability function, probability mass function and probability density functions, distribution function and its properties.	11
III	**Mathematical Expectation and Generating Functions**: Expectation of single random variables and its properties. Moments and moment generating function, and characteristic function. Uniqueness theorem (without proof) along with application.	11
IV	**Standard probability distributions**: Uniform, Binomial, Poisson, Geometric, Normal and Exponential distributions along with their properties and limiting/approximation cases.	11
	Practicum	
	1. Problem based on probability. 2. Problems based on Bayes' theorem. 3. Problems based on probability mass function. 4. Problems based on probability density function. 5. Application problems based on binomial distribution. 6. Fitting of binomial distributions. 7. Application problems based on Poisson distribution. 8. Fitting of Poisson distributions. 9. Problems based on area property of Normal distribution. 10. Fitting of Normal and Exponential distributions.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 • Seminar/presentation/assignment/quiz/class test etc.:05 • Mid-Term Exam: 10 ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 50 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Fundamentals of Mathematical Statistics	Gupta S.C.& Kapoor V.K.	Sultan Chand & Sons (2014)
2.	Elementary Probability	David S.	Oxford Press (2003)
3.	Introduction to Mathematical Statistics	Hoel P.G.	Asia Pub. House (2018)
4.	New Mathematical Statistics	Bansi Lal& Arora S.	Satya Prakashan (1989)
5.	Introduction to Mathematical Statistics	Kapoor & Sexena.	S.Chand (1960)

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Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Second		
Name of the Course	Numerical Analysis		
Course Code	B23- STA -202		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSEC-1		
Level of the course	100-199		
Pre-requisite for the course (if any)	Mathematics as a Subject at 4.0 Level (Class XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Solution of Equations and Linear System of Algebraic equations 2. Exercise Interpolation and Approximation 3. Numerically differentiation and Integration 4. Initial Value Problems For Ordinary Differential Equations.		
CLO 5 is related to the practical components of the course	5. Roots of the equations using various methods, solving the system of equations, Interpolation, Extrapolations, Numerical differentiation and integration and solve the initial value problem.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Solution of Equations**: introduction of algebraic and transcendental equations, Bisection Method, Method of false position, Newton-Raphson method. **Linear System of Algebraic equations**: Direct methods – Gauss elimination method, Gauss Jordan method. Iterative method – Gauss-Jacobi iteration method, Gauss Seidel Iteration method.	12
II	**Interpolation and Approximation**: Concept of interpolation and extrapolation, difference operators, relation between operators, Lagrange interpolation, Newton divided difference, Newton's Forward Difference Interpolation, Newton's Backward Difference Interpolation.	11
III	**Numerical differentiation**: Introduction, differentiation Using Newton's Forward, Backward and Divided Difference along with their applications. (without derivations) **Numerical integration**: Integration Rules Based on Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ formulae.	11
IV	**Initial Value Problems For Ordinary Differential Equations**: Introduction of ordinary differential equations, difference between initial value and boundary value problems, Picard's method, Euler method, Taylor Series method and Runge-Kutta Methods.	11
	Practicum	
	1. Find the roots of the equation using Bisection Method, Method of false position, and Newton-Raphson method. 2. Solve the system of equations using Gauss-Jacobi iteration method, Gauss Seidel Iteration method. 3. To interpolate the required value for the given data using Newton' s 4. Forward interpolation formula for equal intervals 5. Backward interpolation formula for equal intervals. 6. To interpolate the required value for the given data of using i. Newton's divided difference formula ii. Lagrange's interpolation formula. 7. Find the derivative using Newton's Forward, Backward and Divided Difference. 8. To evaluate the integral of the type $\int_a^b f(x)\,dx$ using 9. Trapezoidal rule, 10. Simpson' s one-third rule 11. Simpson's three- eight rule 12. Solve the initial value problem using Picard's method, Euler method, Taylor Series method.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 50 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Introductory Methods of Numerical Analysis	Sastry S.S.	Prentice Hall (2012)
2.	Computer Based Numerical Algorithms	Krishnamurthy E.V. & Sen S.K.	Affiliated East West Press (2009)
3.	Computer Oriented Numerical Methods	Rajaraman V.	Prentice Hall (2019)
4.	Numerical Methods	Jain M.K., Iyengar S.R.K. & Jain R.K.	New Age (2010) International publishers

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Second		
Name of the Course	**Introduction to Operations Research**		
Course Code	B23-STA-203		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	**CC-M2**		
Level of the course	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 6. Fundamental concepts of Operational Research Techniques 7. Linear Programming Problems and their formulations. 8. Graphical procedure and simplex method, to solve for artificial variables using Big-M & Two-Phase methods. 9. How to minimize cost for any balanced transportation problem using different methods.		
CLO 5 is related to the practical components of the course	10. Formulation of LPP, solution of LPP by using Simplex, Big-M and Two Phase methods. Basic feasible solution of Transportation Problem.		
Credits	Theory	Practical	Total
	1	1	2
Contact Hours	1	2	3
Max. Marks: 50 Internal Assessment Marks: 15 End Term Exam Marks: 35		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Introduction**: Objective of O.R., nature and definitions of O.R., Scope of O.R., Meaning and necessity of O.R. models, classification of O.R. models, Advantages & disadvantages of O.R. models. Steps in model formulation, principles of modeling. Characteristics of a good model.	4
II	**Linear programming problem** (**LPP**): Definition, objective function, constraints, concept of initial basic feasible solution, graphical solution of L.P.P., limitations of graphical method, Simplex method to solve L.P.P. and computation procedure for Simplex method.	4
III	**Artificial variable techniques**: Introduction of artificial variables, Big-M method or M-technique, Two-phase method (only numericals).	4
IV	**Transportation Problem (T.P.):** Basic feasible solution. Different methods to find initial feasible solution: North-West corner rule, Row minima method, column minima method, Matrix minima method (Least cost entry method), Vogel's Approximation method (or Unit cost penalty method).	3
	Practicum	
	9. Mathematical formulation of L.P.P and solving the problem using graphical Method. 10. Solve the problem using Simplex technique. 11. Solving the LPP problems using Big M method. 12. Solving the LPP problems using Two-Phase method. 13. Identifying Special cases by Graphical and Simplex method and interpretation of a. Degenerate solution b. Unbounded solution c. Alternate solution d. Infeasible solution 14. Allocation problem using Transportation model. 15. To find the basic solutions of transportation problem using various methods.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (10 marks)** • Class Participation: 4 marks • Seminar/presentation/assignment/quiz/class test etc.: Nil • Mid-Term Exam: 6 marks ➢ **Practicum (05 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:05 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 20marks ➢ **Practicum**: 15marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Linear Programming	Hadley G.	Narosa (2002)
2.	Operations Research: An Introduction	Taha H.A.	Macmillan Pub. Co. (2019)
3.	Operations Research	Goel B.S. & Mittal S.K.	Pragati Prakashan (2014)
4.	Operations Research	Sharma S.D.	KedarNath& Co.(2017)
5.	Operations Research	Sharma J.K.	Macmillan Pub. (2017)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Second		
Name of the Course	Vital and Official Statistics		
Course Code	B23-STA-204		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course	100-199		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 6. Learn concept of Vital statistics and Indian Official Statistics. 7. Measure different Mortality rates useful to improve the public health. 8. Measure different Fertility rates for efficient and better planning. 9. Measure Population growth for predicting, managing, monitoring the growth of population.		
CLO 5 is related to the practical components of the course	10. Measures of crude death rates, specific death rates, infant mortality rate and standardized death rates. Measures of Crude Birth rate, General Fertility rate, total fertility rate, gross reproduction rate and net reproduction rate along with interpretation.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks: 75 Internal Assessment Marks: 20 End Term Exam Marks: 55		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the

questions will carry equal marks except the compulsory question.		
Unit	**Topics**	**Contact Hours**
I	**Vital Statistics**: Introduction and uses of vital statistics, Methods of obtaining vital statistics, Sources of demographic data-census, register, adhoc survey, hospital records, measurement of population, rate and ratio of vital events. **Indian official statistics:** Introduction. Indian statistical system. Statistical offices at the centre. Statistical offices in the states. Population statistics. Agricultural statistics. Industrial statistics. Trade statistics. Statistics of labour and employment. Statistics of transport and communication. Financial and banking statistics.	08
II	**Measurement of mortality**: crude death rate, specific death rate, infant mortality rate, standardized death rates (direct and indirect methods) along with their merits and demerits.	08
III	**Measurement of fertility** - crude birth rate, general fertility rate, specific fertility rate, Age specific fertility rate, total fertility rate along with their merits and demerits.	07
IV	**Measurement of population growth**: crude rate of natural increase, Pearle's vital index, gross reproduction rate, net reproduction rate with applications.	07
	Practicum	
	1. To calculate the crude death rates 2. To measure specific death rates of given data. 3. To find the infant mortality rate and standardized death rates of the population using Direct Method. 4. To measure the standardized death rates using Indirect Method regarding one of the population as standard population. 5. To calculate the Crude Birth rate, General Fertility rate. 6. To measure the total fertility rate for the given data. 7. To measure the population growth using vital index, gross reproduction rate and net reproduction rate.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (15 marks)** • Class Participation: 04 marks • Seminar/presentation/assignment/quiz/class test etc.: 04 marks • Mid-Term Exam: 07 marks ➢ **Practicum (05 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.: 05 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 35 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of author	Publisher
1.	Fundamentals of Applied Statistics	Gupta, S.C.& Kapoor, V.K.	Sultan Chand & Sons (2020)
2.	Fundamental of Statistics Vol. II	Goon, A.M., Gupta, M.K., Dasgupta, B.	World Press, Calcutta (2016)
3.	Programmed Statistics	Aggarwal B.L.	New Age International (2017)
4.	Applied General Statistics	Croxton, F.E., Cowden, D.J. & Kelin S.	Prentice Hall (1968)
5.	Indian Official Statistical Systems	Saluja, M.R.	Statistical Pub. Society (1972)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Third		
Name of the Course	**Applied Statistics**		
Course Code	B23-STA-301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-3 MCC-4		
Level of the course	200-299		
Pre-requisite for the course (if any)	Mathematics as a Subject at 4.0 Level (Class XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate the knowledge of: 1. Basic concepts of time series data, components of time series data, behavior and identification of the variation due to different components in the data, determination of trend. 2. Measurement of trend using different methods. 3. Seasonal fluctuations via various techniques and De-seasonalisation of data. 4. The Demand analysis, laws of demand and supply along with their price elasticity.		
CLO 5 is related to the practical components of the course	5. Problems based on finding the trend using different methods, fitting the curve, obtaining the seasonal indices, and finding the equilibrium price and quantity exchanged.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Time Series Analysis**: Definition, components of time series-trend, seasonal variations, cyclic variations, irregular component. Analysis of Time series - additive, multiplicative models, and mixed models. Uses of time series. **Determination of trend**: graphic (free hand curve fitting) method, semi-averages method, moving average method along with graphical representation and applications.	12
II	**Measurement of trend**: Method of curve fitting by principle of least squares: fitting of straight line, second degree parabolic trend, exponential curve, second degree curve fitted to logarithms, Growth curves: modified exponential, Grompertz curve along with their fittings.	11
III	**Analysis of Seasonal fluctuations,** construction of seasonal indices using method of simple averages, ratio to trend method and ratio to moving average method, Link relative method. De-seasonalisation of data.	11
IV	**Demand Analysis**: Introduction to Demand and Supply, Laws of demand and supply, Equilibrium Price, Giffen's paradox, price elasticity of demand, Price elasticity of supply along with their interpretations.	11
	Practicum	
	1. To find the trend using free hand curve fitting method. 2. To fit the trend line using method of semi averages. 3. To compute the trends using curve fitting method for given data. 4. Fitting of second degree parabolic trend for given data. 5. To fit the exponential curve by method of selected points. 6. To find the trend by moving average method. 7. To obtain seasonal variation indices using method of simple averages. 8. To obtain seasonal variation indices using ratio to trend and ratio to moving average method. 9. To obtain seasonal variation indices using link relative methods. 10. Find the equilibrium price and quantity exchanged from demand and supply curves.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 50 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of author	Publisher
1.	Fundamentals of Applied Statistics	Gupta, S.C.& Kapoor, V.K.	Sultan Chand & Sons (2020)
2.	Fundamental of Statistics Vol.II	Goon, A.M., Gupta, M.K., Dasgupta, B.	World Press, Calcutta (2016)
3.	Introduction to Mathematical Statistics	Hoel, P.G.	Asia Pub. House (2018)
4.	New Mathematical Statistics	Bansi Lal & Arora, S.	Satya Prakashan (1989)
5.	Introduction to Mathematical Statistics	Kapoor & Sexena.	S.Chand (1960)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Third		
Name of the Course	**Advanced Probability**		
Course Code	B23-STA-302		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-5		
Level of the course	200-299		
Pre-requisite for the course (if any)	Mathematics as a Subject at 4.0 Level (Class XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 6. Some important discrete probability distributions, with their characteristics, and their implementation at realistic models 7. Some important Continuous probability distributions, with their characteristics, and their implementation at realistic models 8. Important limit laws, and central limit theorem for *i.i.d.* variate. 9. Two dimensional random variables along with their properties and bivariate normal distribution.		
CLO 5 is related to the practical components of the course	10. Problems based on theoretical discrete and uniform distributions, estimating and finding lower bound using limit laws, and finding marginal, conditional probabilities for two dimensional random variables along with other applications in probability.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			
Instructions for Paper- Setter There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be			

set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Theoretical Discrete Distributions:** Uniform, Negative Binomial Distribution**,** Geometric Distribution and lack of memory, Hyper geometric Distribution, Multinomial Distribution along with their properties	12
II	**Theoretical Continuous Distributions:** Rectangular Distribution, Gamma Distribution, Log Normal distribution, Beta distribution of first and second kind, Exponential distribution, Logistic and Cauchy distribution.	11
III	**Limit laws**: convergence in probability, Chebyshev's inequality, Weak law of large numbers and their applications, De-Moivre Laplace theorem, Central Limit Theorem (C.L.T.) for *i.i.d.* variates, applications of C.L.T.	11
IV	**Two dimensional random variables:** discrete and continuous type, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., independence of random variables and conditional expectations, Bivariate normal distribution and associated marginal and conditional probability distributions (without derivation).	11
	Practicum	
	1. Problem based on Uniform distribution. 2. Fitting of Negative Binomial Distribution. 3. Estimation using Hyper-geometric model. 4. Problems based on Rectangular and Gamma distributions. 5. Fitting of Exponential distribution. 6. To estimate probability using CLT. 7. To find lower bound using Chebyshev's inequality. 8. To find the joint, marginal and conditional probabilities of given bivariate probability distribution. 9. To check if the two random variables are independent or not. 10. To find the Correlation coefficient of a given bivariate normal distribution.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 50 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Fundamentals of Mathematical Statistics	Gupta S.C.& Kapoor V.K.	Sultan Chand & Sons (2020)
2.	Elementary Probability	David S.	Oxford Press (2003)
3.	Introduction to Mathematical Statistics	Hoel P.G.	Asia Pub. House (2018)
4.	New Mathematical Statistics	Bansi Lal& Arora S.	Satya Prakashan (1989)
5.	Introduction to Mathematical Statistics	Kapoor & Sexena.	S.Chand (1960)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Third		
Name of the Course	**Industrial Statistics**		
Course Code	B23-STA-303		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MDC-3		
Level of the course	200-299		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate the knowledge of: 1. Basic concepts of Statistical Quality Control and its uses in industries. 2. Statistical quality of product using mean and range charts. 3. Statistical quality of attributes using p, d and c charts. 4. Basic sampling methods and acceptance sampling plans.		
CLO 5 is related to the practical components of the course	5. Problems to construct control charts for mean, range to check the quality of product, to construct control charts for number of defectives, defects, and fraction defective, to establish quality standards for future.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks: 75 Internal Assessment Marks: 20 End Term Exam Marks: 55		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Statistical Quality Control (SQC**): Meaning and uses of SQC, Basis of SQC, causes of variations in quality, Benefits of SQC, product and process control. Control, Specification and tolerance limit. Control charts, 3-σ control limits.	7
II	**Control chart for variables**- $\overline{X}$ and R chart, selection of sample or subgroups, construction of control charts, criteria for detection of lack of control in $\overline{X}$ & R Charts, Interpretation of $\overline{X}$ & R charts. Control chart for standard deviation (σ chart), s chart vs R chart.	7
III	**Control charts for attributes**: fraction defective chart, control chart for number of defective, interpretation of 'p' chart and 'd' chart, Revised control limits, Control chart for number of defects, 'c' chart for variable sample size, applications of 'c' chart, natural tolerance and specification limits.	7
IV	**Basic sampling methods**: Basic concepts in sampling. Sampling and Non-sampling errors, advantages of sampling over complete census, Limitation of sampling, Simple random sampling (SRS) with and without replacement (without derivation). **Acceptance Sampling Plan:** Concepts of Acceptable quality level, LTPD, producer's and consumer's risks, Rectifying inspection plans, Average sample number and average amount of total inspection, idea about single sampling plan.	9
	Practicum	
	1. To construct mean and range chart, and comment on the state of control of the process. 2. To construct control chart for fraction defectives and comment on the state of control of the process. 3. To construct 'number of defectives' chart and establish quality standards for future. 4. Construct the control chart using revised control limits. 5. To obtain control limits for number of defects and comment on the state of control plotting the appropriate chart. 6. To obtain control limits for number of defects per unit and comment on the state of control plotting the appropriate chart. 7. Single sample inspection plan: Construction and interpretation of OC .	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (15 marks)** • Class Participation: 04 marks • Seminar/presentation/assignment/quiz/class test etc.:04 marks • Mid-Term Exam: 07 marks ➢ **Practicum (05 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:05 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ Theory: 35 marks ➢ Practicum: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Fundamentals of Applied Statistics	Gupta, S.C.& Kapoor, V.K.	Sultan Chand & Sons (2020)
3.	Fundamental of Calcutta Statistics Vol. II	Goon, A.M., Gupta, M.K., Dasgupta, B.	World Press, (2016)
3.	Programmed Statistics	Aggarwal, B.L.	New Age International (2017)
4.	Statistical Quality Control	Grant, E.L.	McGraw Hill (2017)
5.	Applied General Statistics	Croxton, F.E., Cowden, D.J. & Kelin S.	Prentice Hall (1968)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Fourth		
Name of the Course	Statistical Inference		
Course Code	B23-STA-401		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	CC-4 MCC-6		
Level of the course	200-299		
Pre-requisite for the course (if any)	Mathematics as a Subject at 4.0 Level (Class XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate the knowledge of: 1. Concepts of estimation and basic terminologies; parameter, statistic, standard error, sampling distribution of a statistic, characteristics of a good estimator. 2. Estimate parameters of different distribution using different methods of estimation and know about their properties. 3. Procedure of Statistical hypothesis testing along with related terms, and to test of significance based on Normal distribution. 4. Test of single mean, test of difference of two means, test for sample correlation coefficient, and test for the equality of two population variances.		
CLO 5 is related to the practical components of the course	5. Solving problems based on unbiased, consistent and efficient estimators, to apply Statistical tests of significance for proportion, mean, correlation coefficient, variances, goodness of fit and independence of attributes.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			
Instructions for Paper- Setter There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to			

attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Statistical Estimation**: Basic concept of sampling distribution, Parameter and statistic, Point and interval estimate of a parameter. Properties of a good estimator: Unbiasedness, Efficiency, Consistency and Sufficiency (definition and illustrations), Cramer-Rao Inequality (without proof).	12
II	**Methods of Estimation**: Method of moments, method of maximum likelihood and its properties (without proof). Estimation of parameters of Binomial, Poisson and Normal distributions.	11
III	**Testing of Hypothesis-I**: Statistical Hypothesis:- Simple and composite, test of statistical hypothesis, Null and alternative hypotheses, critical region, types of errors, level of significance, size and power of a test, one tailed and two tailed testing, p-value, Test of significance based on normal distribution (tests for single proportion, difference of two proportions, single mean and difference of two means).	11
IV	**Testing of Hypothesis-II:** Test based on t-distribution, Test of single mean, difference of two means, paired t-test, test for sample correlation coefficient. Tests based on Chi-square distribution and test based on F-distribution for the equality of two population variances.	11
Practicum		
	1. Problems based on unbiased estimators 2. Problems based on consistent estimators and efficient estimators. 3. To apply large sample test of significance for single proportion and difference of two proportions. 4. To apply large sample test of significance for single mean and to obtained confidence interval. 5. To apply large sample test of significance for difference between two means. 6. To apply t-test for testing single mean and difference between means. 7. To apply paired t-test for difference between two means. 8. To apply test of significance of sample correlation coefficient. 9. To apply Chi- square test for goodness of fit and independence of attributes. 10. To apply F-test for testing difference of two variances.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 50 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	A First Course on Parametric Inference	Kale, B.K.	Narosa (2005)
2.	Introduction to Theory of Statistics	Mood, A.M., Graybill F.A. & Boes, D.C.	McGraw Hill (2017)
3.	Mathematical Statistics With Applications	Freund, J.E.	Prentice Hall (2013)
4.	Fundamentals of Mathematical Statistics	Gupta, S.C. & Kapoor, V.K.	Sultan Chand & Sons (2014)
5.	An Introduction to Probability Theory and Mathematical Statistics	Rohatgi, V.K.	John Wiley (1988)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Fourth		
Name of the Course	**Linear Algebra**		
Course Code	B23- STA -402		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-7		
Level of the course	200-299		
Pre-requisite for the course (if any)	Mathematics as a Subject at 4.0 Level (Class XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 6. Basic concepts of matrices, Sylvester's Law, echelon form which is useful in various Statistics courses. 7. Vector spaces, Spanning Sets, Basis, and dimensions. 8. Linear transformation and algebra of linear transformation. 9. Inverse of matrices using Cayley Hamilton theorem, Eigen values and Eigen vectors of linear transformations and characteristic & minimal polynomial of a linear transformation.		
CLO 5 is related to the practical components of the course	10. Problems based on matrices, vector spaces, consistency and solutions of equations, row reduced echelon form, Eigen values and Eigen vectors and finding inverse using Cayley Hamilton theorem which has application in major courses of statistics.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Matrices**: Determinant and trace, Rank of a matrix, Row rank and column rank of a matrix, ranks of the product of two matrices, Sylvester's Law, consistency and solution of a system of linear equations, elementary matrices and echelon form.	12
II	**Vector spaces**: definition and examples of vector spaces, Subspace and Null space, Linear span and Spanning Sets, Linearly Independent and dependent subsets of a vector space, Basis and Dimension.	11
III	**Linear Transformation-I**: Linear transformation, Algebra of Linear Transformation, Singular and non-singular linear transformations, Matrix of a linear transformation, Rank and Nullity Theorem.	11
IV	**Linear Transformation-II:** Characteristic polynomial of a linear transformation, Minimal Polynomial of a linear transformation, Cayley Hamilton Theorem, diagonalization, Eigen values and Eigen vectors of linear transformations.	11
	Practicum	
	11. To find the rank and nullity of given matrix. 12. To discuss the consistency of given system of equations and find the solution. 13. To reduce the matrix to row reduced echelon form. 14. To check whether the given vectors are linearly independent or not. 15. To find the characteristic polynomial and minimal polynomial of the matrix formed by linear transformation with respect to the standard basis. 16. To find the Eigen values and Eigen vectors of the given matrices. 17. To find the inverse of matrix using Cayley Hamilton theorem**.** 18. To find a matrix P such that $P^{-1}AP$ is diagonal.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 50 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Linear Algebra	Rao. A.R., Sankaran, P. B.	Hindustan Book Agency (2002)
2.	Linear Algebra	Sahai V. & Bist V..	Narosa (2002)
3.	Linear Algebra	Hadley, G	Addison-Wesley- Publishing Company(2002)
4.	Matrix and Linear Algebra	Datta,K.B.	Prentice-Hall of India Pvt.Ltd (2004)
5.	Matrices with Applications in Statistics	Franklin A. Graybill	Wadsworth International Group (1983)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Fourth		
Name of the Course	Linear Programming		
Course Code	B23- STA -403		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	MCC-8		
Level of the course	200-299		
Pre-requisite for the course (if any)	Mathematics as a Subject at 4.0 Level (Class XII)		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Linear Programming Problems and their formulations, Graphical procedure and simplex method 2. Artificial variables using Big-M & Two-Phase methods, Duality & situations where duality is fruitful 3. Optimum solution of transportation problem using different methods. 4. Assignment problem and its solution by using Hungarian method.		
CLO 5 is related to the practical components of the course	5. Based on Mathematical formulation of L.P.P, and solve using graphical Method, and Simplex technique, using Big M method and Two-Phase method. To solve Transportation problem, optimal solutions, and assignment problem.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			
Instructions for Paper- Setter There will be nine questions in all. Question No.1 will be compulsory covering whole of the			

syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.		
Unit	**Topics**	**Contact Hours**
I	**Introduction:** Elementary theory of convex sets, definition of general linear programming problems (LPP), Requirements, Assumptions, Applications of LPP, Canonical and Standard forms of Linear Programming, Concept of initial basic feasible solution, graphical solution of L.P.P., limitations of graphical method, Simplex method to solve L.P.P., computation procedure for Simplex method.	12
II	**Artificial variable techniques**: Introduction of artificial variables, Big-M method or M-technique, Two-phase method. **Duality in Linear Programming**; Concept and applications of Duality in L.P.P., Rules of forming dual and dual simplex method.	11
III	**Transportation Problem** (T.P.): Formulation, Basic feasible solution. Different methods to find initial feasible solution: North-West corner rule, Row minima method, column minima method, Matrix minima method (Least cost entry method), Vogel's Approximation method (or Unit cost penalty method). UV-method (MODI method) for finding the optimum solution of T.P.	11
IV	**Assignment problem**: Introduction of assignment problem, Mathematical representation, comparison with the transportation model, Solution of the assignment Models, Hungarian Method along with its flowchart.	11
	Practicum	
	1. Mathematical formulation of L.P.P and solving the problem using graphical Method. 2. Solving the problem using Simplex technique. 3. Solving the LPP problems using Big M method. 4. Solving the LPP problems using Two-Phase method. 5. Identifying Special cases by Graphical and Simplex method and interpretation of a. Degenerate solution b. Unbounded solution c. Alternate solution d. Infeasible solution 6. Allocation problem using Transportation model. 7. To find the optimal solutions of transportation problem using UV method. 8. To solve the assignment problem using Hungarian Method.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory:** 50 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Linear Programming	Hadley ,G.	Narosa (2002)
2.	Operations Research: An Introduction	Taha, H.A.	Macmillan Pub. Co. (2019)
3.	Operations Research	Goel, B.S. & Mittal, S.K.	Pragati Prakashan (2014)
4.	Operations Research	Sharma, S.D.	KedarNath & Co. (2017)
5.	Operations Research	Sharma, J.K.	Macmillan Pub. (2017)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Fourth		
Name of the Course	**Demography**		
Course Code	B23- STA -404		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-1		
Level of the course	200-299		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Concept of Vital statistics and measurement of mortality. 2. Basic concepts of Life tables and its main features, assumptions, descriptions and construction of a life tables along with its uses. 3. Abridged life table and measurement of fertility. 4. Measures of population growth and Graduation of mortality rates.		
CLO 5 is related to the practical components of the course	5. Measures of crude death rates, specific death rates, infant mortality rate and standardized death rates. To complete the incomplete life table. Measures of Crude Birth rate, General Fertility rate, total fertility rate, gross reproduction rate and net reproduction rate along with interpretation.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Vital Statistics**: Introduction and uses of vital statistics, Methods of obtaining vital statistics, Sources of demographic data-census, measurement of population, rate and ratio of vital events. **Measurement of mortality**: crude death rate, specific death rate, infant mortality rate, standardized death rates (direct and indirect methods) along with their merits and demerits.	12
II	**Life Tables**: Introduction and terminology of life tables, expectation of life, central mortality rate, force of mortality, complete life tables and its main features, assumptions, descriptions and construction of life tables, uses of life tables, stationary and stable population.	11
III	**Abridged life table**: introduction, difference between complete and abridged life tables, Reed & Merrell's method for construction of abridged life table. **Measurement of fertility** - crude birth rate, general fertility rate, specific fertility rate, Age specific fertility rate, total fertility rate along with their merits and demerits.	11
IV	**Measurement of population growth**: crude rate of natural increase, Pearle's vital index, gross reproduction rate, net reproduction rate with applications. **Graduation of mortality rates**: Makehams and Gompertz graduation formula.	11
	Practicum	
	1. To calculate the crude death rates 2. To measure specific death rates of given data. 3. To find the infant mortality rate and standardized death rates of the population using Direct Method. 4. To measure the standardized death rates using Indirect Method regarding one of the population as standard population. 5. To complete the given incomplete life table by computing various elements of life table. 6. To calculate the Crude Birth rate, General Fertility rate. 7. To measure the total fertility rate for the given data. 8. To measure the population growth using vital index, gross reproduction rate and net reproduction rate.	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory**: 50 marks ➢ **Practicum**: 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Fundamentals of Applied Statistics	Gupta, S.C.& Kapoor, V.K.	Sultan Chand & Sons (2020)
4.	Fundamental of Statistics Vol. II	Goon, A.M., Gupta, M.K., Dasgupta, B.	World Press, Calcutta (2016)
3.	Programmed Statistics	Aggarwal, B.L.	New Age International (2017)
4.	Applied General Statistics	Croxton, F.E., Cowden, D.J. & Kelin, S.	Prentice Hall (1968)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Fourth		
Name of the Course	**Statistical Methods in Epidemiology**		
Course Code	B23- STA -405		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	DSE-1		
Level of the course	200-299		
Pre-requisite for the course (if any)	N.A.		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Basic principles and concepts of epidemiology and statistics. 2. Proficiency in descriptive statistics, including measures of central tendency and dispersion, graphical representation of epidemiology data and Interpret measures of association. 3. Various statistical tests appropriate for epidemiological data analysis. 4. Regression analysis techniques, including simple and multiple linear regression and logistic regression in epidemiology.		
CLO 5 is related to the practical components of the course	5. Hypothesis testing and statistical inference techniques to analyze epidemiological data, evaluate associations, compare groups, and draw conclusions based on statistical evidence to generate reliable insights for public health research and decision-making.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the

questions will carry equal marks except the compulsory question.		
Unit	**Topics**	**Contact Hours**
I	**Introduction to Epidemiology**: Basic concepts and principles, historical development, and key measures of disease occurrence and association. **Study Designs in Epidemiology**: Cohort studies, case-control studies, cross-sectional studies, and experimental designs. Introduction to randomized controlled trials (RCTs) and their statistical analysis.	12
II	**Descriptive Epidemiology**: Calculation and interpretation of disease rates, prevalence, incidence, and standardization techniques. **Measures of Association**: Relative risk, odds ratio, attributable risk, population-attributable risk, and their interpretation in epidemiological studies.	11
III	**Understanding sources of bias** in epidemiological studies, such as selection bias, information bias, and confounding. **Statistical Analysis of Epidemiological Data:** Application of statistical techniques to epidemiological data, including chi-square test, t-tests and analysis of variance (ANOVA).	11
IV	**Regression Analysis in Epidemiology**: Simple and multiple linear regression models for continuous outcomes, logistic regression for binary outcomes, and interpretation of regression coefficients. **Critical Appraisal of Epidemiological Studies**: Evaluation of study quality, assessing validity and reliability, and interpretation of epidemiological literature.	11
	Practicum	
	1. See patterns and distributions of epidemiological data through descriptive statistics and visualizations. 2. Compute key epidemiological measures to assess disease burden and impact. 3. Perform hypothesis tests to compare means between two or more groups in epidemiological data, assessing differences in health outcomes or exposure variables. 4. Conduct hypothesis tests to assess the presence of associations between two variables, such as exposure and outcome, in epidemiological data. 5. Apply the chi-square test to evaluate the independence of two categorical variables in epidemiological data, examining the	30

	presence of associations. 6. Perform a paired t-test to evaluate differences in means between two related measurements, such as pre- and post-intervention data in a cohort study. 7. Conduct a goodness-of-fit test to assess how well observed data fit an expected distribution or theoretical model in epidemiological research. 8. Analyze the relationship between exposure variables and disease outcomes. 9. Explore the relationship between multiple risk factors and outcomes. 10. Analyze epidemiological data with categorical outcomes to assess associations and evaluate the impact of risk factors.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory:** 50 marks ➢ **Practicum:** 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher
1.	Statistical Methods for Epidemiology	Koepsell, T.D and Weiss, N.S	Oxford University Press (2003)
2.	Introduction to Epidemiology	& Merrill, R.M	Jones & Bartlett Learning (2017).
3.	Principles of Biostatistics	Marcello Pagano and Kimberlee Gauvreau	Cengage Learning (2018)
4.	Statistical Methods in Epidemiology	Elwood, J.M	Oxford University Press (2018)
5.	Applied Epidemiology: Theory to Practice	Brownson, J.C, Petitti,D.B and Kathleen N.	Oxford University Press, (2018)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Third		
Name of the Course	Working with SPSS		
Course Code	**B23-VOC-121**		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC-I		
Level of the course	200-299		
Pre-requisite for the course (if any)	N.A.		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Basic concepts and features of SPSS software. 2. Descriptive Statistics and data visualization using SPSS. 3. Correlation, Regression and Data Manipulation Techniques 4. Hypothesis testing and inferential statistics using SPSS.		
CLO 5 is related to the practical components of the course	5. Interpretation and presentation the results of statistical analyses using SPSS.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Introduction of SPSS:** Overview of SPSS software and its interface, Data types and variable properties in SPSS, Data entry and importing data into SPSS. Data Cleaning and Manipulation: Identifying and handling missing data, Data transformation and recoding, Merging and splitting datasets in SPSS.	12
II	**Descriptive Statistics and Data Visualization**: Calculating and interpreting measures of central tendency and dispersion, Creating charts and graphs in SPSS, Exploratory data analysis using SPSS.	11
III	**Correlation and Regression Analysis**: Understanding correlation and regression analysis. Performing bivariate and multiple regression in SPSS. Interpreting regression output and assessing model fit. **Data Manipulation Techniques:** Creating and computing new variables in SPSS, Subsetting and filtering data in SPSS.	11
IV	**Inferential Statistics** :Introduction to hypothesis testing, Conducting t-tests and analysis of variance (ANOVA) in SPSS. Chi-square tests for categorical data.	11
	Practicum	
	1. Data Entry and Cleaning: Importing data from various file formats (e.g., Excel, CSV) into SPSS. Performing data validation and cleaning tasks, such as identifying and handling missing values and outliers. 2. Descriptive Statistics and Data Visualization: Calculating descriptive statistics (mean, median, standard deviation) for variables. Creating various charts and graphs (e.g., bar charts, scatter plots) to visualize data distributions and relationships. 3. Hypothesis Testing: Conducting t-tests or chi-square tests to compare groups or assess relationships between variables. Interpreting statistical output and drawing conclusions from hypothesis tests. 4. Correlation and Regression Analysis: Performing correlation analysis to examine the strength and direction of relationships between variables. Conducting simple or multiple regression analysis to predict an outcome variable based on predictor	30

	variables. 5. Data Manipulation: Creating new variables using transformations, recoding, or computing functions in SPSS. 6. Reporting and Presenting Results: Summarizing and reporting the results of statistical analyses using SPSS. Creating tables and figures for research reports or presentations. 7. Real-World Application Project: Applying SPSS techniques to a real-world dataset from a specific domain (e.g., social sciences, business, healthcare). Conducting data analysis, interpreting the results, and presenting the findings in a report.	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	**End Term Examination:** ➢ **Theory:** 50 marks ➢ **Practicum:** 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher & Year
2.	Discovering Statistics Using IBM SPSS Statistics	Field,A., Miles J. and Field Z.	SAGE Publications Ltd (2017)
2.	SPSS Survival Manual:	Pallant, J.	Allen &Unwin (2021)
3.	A Beginner's Guide to SPSS for Windows	Einspruch,E.L	SAGE Publications (2020)
4.	SPSS for Psychologists: A Guide to Data Analysis Using SPSS for Windows	Brace,N. Kemp, R. and Snelgar, R.	Palgrave Macmillan (2016)

Session: 2023-24			
Part A - Introduction			
Subject	Statistics		
Semester	Fourth		
Name of the Course	Data Handling		
Course Code	B23-VOC-221		
Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/VAC)	VOC-II		
Level of the course	200-299		
Pre-requisite for the course (if any)	N.A.		
Course Learning Outcomes (CLO):	After completing this course, the learner will demonstrate knowledge of: 1. Basic concepts and features of Data and its visualization 2. Exploratory Data Analysis**,** Correlation, and Regression 3. Hypothesis testing and inferential statistics. 4. Statistical test based on sampling distributions.		
CLO 5 is related to the practical components of the course	5. Graphically representation of data, Measures of Central Tendency, Measures of Dispersion, Correlation coefficient, Regression lines and Statistical hypothesis tests.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks: 100 Internal Assessment Marks: 30 End Term Exam Marks: 70		Time: 3 Hours	
Part B- Contents of the Course			

Instructions for Paper- Setter

There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 4 to 5 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. All the questions will carry equal marks except the compulsory question.

Unit	Topics	Contact Hours
I	**Types of Data**: Source and collection of Data, Qualitative and quantitative data, nominal and ordinal data, time series data, discrete and continuous data, frequency and non-frequency data, Primary and Secondary data. **Data visualization techniques**: Frequency distribution and cumulative frequency distribution, diagrammatic and graphical presentation of data, construction of bar, pie diagrams, histograms, frequency polygon, frequency curve and Ogives.	12
II	**Exploratory Data Analysis:** Measures of Central Tendency: Arithmetic mean, median, mode, along with their applications. Measures of Dispersion: Concept of dispersion, characteristics for an ideal measure of dispersion. range, inter quartile range, quartile deviation, Mean deviation, variance, standard deviation (σ), coefficient of variation. **Correlation and regression**: Concept of correlation and regression, Karl Pearson's Coefficient of correlation, Principle of least squares, two lines of regression	11
III	**Statistical Analysis** Statistical Hypothesis:- Simple and composite, test of statistical hypothesis, Null and alternative hypotheses, critical region, types of errors, level of significance, size and power of a test, one tailed and two tailed testing, p-value. Testing of significance based on normal distribution (tests for single proportion, difference of two proportions, single mean and difference of two means).	11
IV	**Tests based on sampling distributions**: Test based on t-distribution, Test of single mean, difference of two means, paired t-test, test for sample correlation coefficient. Testing of independence of attributes using Chi-square distribution and test based on F-distribution for the equality of two population variances.	11
	Practicum	
	1. Representation of data using Bar, Pie Chart, Histogram, Frequency Polygon, Frequency Curve and Ogives. 2. To compute various measures of central tendency and dispersion. 3. To compute Karl Pearson's coefficient of correlation for given bivariate frequency distribution. 4. To fit the straight line for the given data on pairs of	30

	observations. 5. To apply large sample test of significance for single proportion and difference of two proportions. 6. To apply large sample test of significance for single mean and to obtained confidence interval. 7. To apply large sample test of significance for difference between two means. 8. To apply t -test for testing single mean and difference between means. 9. To apply paired t-test for difference between two means. 10. To apply test of significance of sample correlation coefficient. 11. To apply Chi- square test for independence of attributes. 12. To apply F-test for testing difference of two variances.	

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory (20 marks)** • Class Participation: 05 marks • Seminar/presentation/assignment/quiz/class test etc.:05 marks • Mid-Term Exam: 10 marks ➢ **Practicum (10 marks)** • Class Participation: Nil • Seminar/Demonstration/Viva-voce/Lab records etc.:10 marks • Mid-Term Exam: Nil	➢ **Theory:** 50 marks ➢ **Practicum:** 20 marks

Part C-Learning Resources

S. No.	Title of Book	Name of Author	Publisher & Year
1.	A First Course on Parametric Inference	Kale B.K.	Narosa (2005)
2.	Introduction to Theory of Statistics	Mood A.M., Graybill F.A. & Boes D.C.	McGraw Hill (2017)
3.	Mathematical Statistics With Applications	Freund's J.E.	Prentice Hall (2013)
4.	Fundamentals of Mathematical Statistics	Gupta S.C. & Kapoor V.K.	Sultan chand & Sons (2014)
5.	An Introduction to Probability Theory and Mathematical Statistics.	Rohatgi V.K.	John Wiley (1988)