B.Sc. Semester – III

Subject: STATISTICS
Discipline Specific Course (DSC)

The course STATISTICS in III semester has two papers (Theory Paper –I for 04 credits & Practical Paper -II for 2 credits) for 06 credits: Both the papers are compulsory. Details of the courses are as under.

Course No.-3 (Theory): 21BSC3C3STS1L

Year	II	**Course Code:** 21BSC3C3STS1L	**Credits**	04
Sem.	III	**Course Title: Calculus and Probability Distributions**	**Hours**	56
Course Pre-requisites, if any		NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60	Duration of ESA:.02 hrs.	

Course Outcome (CO):

After completion of course (Theory), students will be able to:

CO 1 Judge continuity of a function, find integrations and solve problems of differentiability.

CO 2 Solve problems of various analytical environments using different distributions and their properties.

CO 3 Find sampling distributions of functions of random variables and explore their applications.

Syllabus- Course 3 (Theory): **21BSC3C3STS1L** : Title- Calculus and Probability Distributions	**Total Hrs: 56**
Unit-I : Calculus of one and more variables	**15 hrs**
Review of calculus of one variable: continuity, differentiability, mean value theorem and Taylor series expansion. Functions of several variables: Continuity, directional derivatives, differentials of functions of several variables, the gradient vector. The mean value theorem, a sufficient condition for the existence of the differential, partial derivatives of higher order and Taylor's formula. Applications of partial differentiation, Jacobians. Riemann integrals, integration by parts, mean value theorem. Multiple integrals and evaluation of multiple integrals by repeated integration, Mean-value theorem for multiple integrals. Sequences and Series of real numbers. convergence of sequences and series, tests for convergence of series. (Only results and applications)	
Unit-II Distribution of Random Variables (Two-dimensional)	**12 hrs**
Two dimensional random variables: Joint distribution, Marginal distribution and Conditional distributions of random variables, conditional expectation, covariance,	

correlation and moments.	
Distribution of functions of random variables using m.g.f. and distribution function. Transformation of variable technique (one and two variables).	
Chebyshev's inequality- proof and its use in approximating probabilities; Statements of Weak Law of Large Numbers; Convergence in law and Central Limit theorems – De-Moivre. (Some simple examples)	
Unit-III Probability Distributions-II	**16 hrs**
Discrete distributions: Rectangular, Geometric, Negative Binomial, Hypergeometric, Multinomial- definition through probability mass function, mean, variance, moments, p.g.f., m.g.f., other properties and applications.	
Continuous distributions: Uniform, Gamma, Exponential, Beta (type 1 and type 2), Cauchy, Weibull– definition through probability density function, mean, variance, moments, m.g.f., other properties and applications.	
Bivariate normal distribution- definition through probability density function, marginal and conditional distribution.	
Unit-IV Sampling Distributions and Simulation	**13 hrs**
Definitions of random sample, parameter and statistic, sampling distribution of sample mean, standard error of sample mean, sampling distribution of sample variance, standard error of sample variance.	
Exact sampling distributions: Chi square distribution- mean, variance, moments, mode, additive property. Student's and Fisher's t-distribution- mean, variance, moments and limiting form of t distribution. Snedecor's F-distribution: mean, variance and mode. Distribution of $1/F$. Relationship between t, F and χ^2 distributions.	
Introduction to simulation. Generation of random observations from Uniform, Exponential, Normal, Binomial, Poisson distributions using inverse-method and R-codes.	

Books recommended.

1. Andre I Khuri (2003). Advanced Calculus with Applications in Statistics, Second Edition, John Wiley & Sons.
2. Ghorpade, S. R. and Limaye, B. V. (2006). A Course in Calculus and Real Analysis, Springer
3. Gupta S.C. and V.K. Kapoor (2020), Fundamental of Mathematical Statistics, Sultan Chand and Co. 12th Edition.
4. Hogg, R. V. McKean J. W. and Craig, A. T. (2012), Introduction to Mathematical Statistics, Pearson 7th Edition.
5. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009), Probability and Statistical Inference,10th Edition, Pearson Education, New Delhi.
6. Jay Kerns, G. (2010). Introduction to Probability and Statistics using R. 1st Edition, Springer.
7. Rohatgi, V.K. and A.K. Md. Ehsanes Saleh. (2002). An Introduction to Probability Theory and Mathematical Statistics, New York, John Wiley.
8. Ross, S. M. (2014). Introduction to Probability Models. 11th Edition, Elsevier science.

9. Ross, S. M. (2012). Simulation. Academic Press.
10. Shanthi Narayana (2000), Integral Calculus, S. Chand & Co. Ltd.
11. Shanti Narayana (2000). Differential Calculus, S. Chand & Co. Ltd.
12. Verzani, J. (2002). Simple R - Using R for Introductory Statistics.

<div align="center">Course No.-03 (Practical): 21BSC3C3STS1P</div>

Year	II	Course Code: 21BSC3C3STS1P		Credits	02
Sem.	III	**Course Title:** **Practical**		**Hours**	52
Course Pre-requisites, if any		NA			
Formative Assessment Marks: 25		Summative Assessment Marks: 25		Duration of ESA:.03 hrs.	

Course Outcome (CO):

After completion of course (Practical), students will be able to gain:

CO 1   Practical knowledge of handling various types of R-functions for calculus and probability distributions.

CO 2   Practical knowledge of carrying out numerical analysis.

CO 3   The knowledge of simulating random observations from various probability distributions using R.

List of the Experiments for 52 hrs / Semesters

Note: The first practical assignment is on R-programming. Practical assignments 2 to 10 have to be first solved manually (using scientific calculators) and executed using R-programming.

1. Demonstration of R functions for calculus, distribution of random variables, probability distributions, sampling distributions, simulation.

2. Numerical differentiation and integration.

3. Bivariate Probability Distributions - Marginal and Conditional distributions,

4. Bivariate Probability Distributions - Conditional Mean, Conditional Variance, Correlation.

5. Applications of Chebyshev's inequality (For standard distributions such as Normal, Exponential, Gamma).

6. Applications of discrete probability distributions - Negative – Binomial, Geometric, Hyper geometric and discrete uniform, multinomial distributions.

7. Applications of continuous probability distributions - Exponential, Gamma, Cauchy, Weibull distributions.

8. Fitting of discrete and continuous distributions.

9. Generating random sample from discrete distributions.

10. Generating random sample from continuous distributions.

General instructions:

Computation of all the practicals manually and using Excel

Scheme of Practical Examination (distribution of marks): 25 marks for Semester end examination

Students have to attempt 3 practical questions out of four practical questions given, each carrying 7 marks.

1. **7 Marks**

2. **7 Marks**

3. **7 Marks**

4. **Viva 2 Marks**

5. **Journal 2 Marks**

   Total 25 marks

Note: Same Scheme may be used for IA(Formative Assessment) examination

Books recommended.

1. Andre I Khuri (2003). Advanced Calculus with Applications in Statistics, Second Edition, John Wiley & Sons.

2. Ghorpade, S. R. and Limaye, B. V. (2006). A Course in Calculus and Real Analysis, Springer

3. Gupta S.C. and V.K. Kapoor (2020), Fundamental of Mathematical Statistics, Sultan Chand and Co. 12th Edition.

4. Hogg, R. V. McKean J. W. and Craig, A. T. (2012), Introduction to Mathematical Statistics, Pearson 7th Edition.

5. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009), Probability and Statistical Inference,10th Edition, Pearson Education, New Delhi.

6. Jay Kerns, G. (2010). Introduction to Probability and Statistics using R. 1st Edition, Springer.

7. Rohatgi, V.K. and A.K. Md. Ehsanes Saleh. (2002). An Introduction to Probability Theory and Mathematical Statistics, New York, John Wiley.

8. Ross, S. M. (2012). Simulation. Academic Press.

9. Verzani, J. (2002). Simple R - Using R for Introductory Statistics.

B.Sc. Semester – III (OEC)

Subject: POPULATION STUDIES
(OEC for other students)

Year	II	**Course Code:** 21BSC303STS3		**Credits**	03
Sem.	III	**Course Title:** POPULATION STUDIES		**Hours**	42
Course Pre-requisites, if any			NA		
Formative Assessment Marks: 40		Summative Assessment Marks: 60		Duration of ESA:.02 hrs.	

After completion of course, students will be able to:

CO 1 : Study the concepts of Vital Statistics, sources of data, different measures of Fertility, Mortality and migration.

CO 2 : Understand the Growth rates- GRR and NRR and their interpretations.

Syllabus- OEC: 21BSC303STS3: Title- POPULATION STUDIES	Total Hrs: 42
Unit-I Introduction and Sources of Population Data	**14 hrs**
History, definition, nature and scope of population Studies. Sources of population data – salient features of Census, Civil Registration System, National Sample Surveys, Demographic Surveys, relative merits and demerits of these sources. Coverage and content errors. Use of balancing equations, Chandrasekar-Deming formula to check completeness of vital registration data, use of Whipple's, Myer's and UN indices.	
Unit-II Fertility, Mortality	**14 hrs**
Basic concepts and terms used in the study of fertility. Measures of fertility- Crude Birth Rate (CBR), General Fertility Rate (GFR), Age Specific Fertility Rate (ASFR), Total Fertility Rate (TFR), Birth order statistics, Child Women ratio. Measures of reproduction- Gross Reproduction Rate (GRR)and Net Reproduction rate(NRR). Measurement of population growth rate- simple growth rate and compound growth. Basic concepts and terms used in the study of mortality. Measures of mortality- Crude Death Rate (CDR), Age Specific Death Rate (ASDR), Direct and Indirect Standardized Death rates, Infant Mortality Rate (IMR), Under-five mortality Rate, Neo-natal mortality rate, Post-natal mortality rate; Maternal Mortality Rate (MMR).	
Unit-III Life tables and Population change	**14 hrs**
Life tables: Components of a life table, force of mortality and expectation of life table, types of life tables. Construction of life tables using Reed-Merrell's method, Greville's method. Uses of life tables.	

Basic concepts and definition of population change, migration. Types of migration-internal and international, factors affecting migration. Rates and ratios of Migration-Indirect measures of net-internal migration, national growth rate method, residual method, push-pull factors Population estimates and projections.

Books recommended.

1. Barclay, G, W(1968). Techniques of Population Analysis, John Wiley and Sons, Incs. New York/London.
2. Keyfitz, H (1968). Introduction to the Mathematics of Population. Addison-Wesley Publishing Co.
3. Pathak, K.B and Ram, F (1991).Techniques of Demographic Analysis, Himalaya Publishing House.
4. Ramakumar. R (1986). Technical Demography, Wiley Eastern Ltd.
5. Srinivasan. K (1998). Basic Demographic Techniques and Applications, Sage Publication, New Delhi.
6. Wunsch G.J. & M.G. Tarmota(1978). Introduction to Demographic Analysis, Plenum Press, N.Y.

Details of Formative assessment (IA) for DSCC theory/OEC: 40% weight age for total marks

Type of Assessment	Weight age	Duration	Commencement
Written test-1	10%	1 hr	8th Week
Written test-2	10%	1 hr	12th Week
Seminar	10%	10 minutes	--
Case study / Assignment / Field work / Project work/ Activity	10%	------	--
Total	40% of the maximum marks allotted for the paper		