

Department of **Statistics**

H.N.B. Garhwal University, Srinagar Garhwal
(Uttarakhand)
(A Central University)

P G Syllabus Under NEP Framework

STATISTICS SYLLABUS



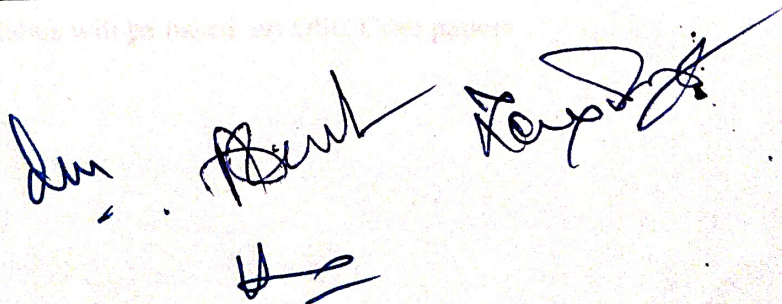
Academic Session 2025-26 Onwards

P.G First Year - First Semester (For Two Year P.G. Programme)

3-year bachelor's degree (120 credits), and candidates who have met the entrance requirements, including specified levels of attainment, in the programme admission regulations.						
Entry requirement	Semester	Course category	Course title	Credits		Total Credit
				T	P	
I	DSC CORE		Core-1	5		5
			Measure Theory and Probability	5		5
			Core-2	5		5
			Matrices	5		5
	DSE (Any one)		Core-3	5		5
			Real Analysis and Complex Analysis			
DSE (Any one)		DSC Practical*		3	3	
		Elective	4	2	6	
		1. Research methodology and project work				
Total			2. Survival analysis			
			3. Distribution Theory			
				19	5	24

P.G First Year - Second Semester (For Two Year P.G. Programme)

Semester	Course category	Course title	Credits		Total Credit
			T	P	
II	DSC (Core)	Core-1 Sample Surveys	5		5
		Core-2 Statistical Inference	5		5
		Core-3 Linear Algebra	5		5
		DSC Practical*		3	3
	DSE (Any one)	Elective	4	2	6
		1. Statistical process and Quality control 2. Bio- statistics 3. Design and Analysis of Experiment			
Total			19	5	24



P.G Second Year - Third Semester (For Two Year P.G. Programme)

Entry requirement	4-year bachelor's degree (160credits), and candidates who have met the entrance requirements, including specified levels of attainment, in the programme admission regulations Or P.G. First year with 40 credits				
Semester	Course category	Course title	Credits		Total Credit
			T	P	
III	DSC (Core)	Core-1 Multivariate Analysis and Curve Fitting	5		5
		Core-2 Advanced Operations Research I	5		5
		Core-3 Statistical Computing	5		5
		DSC Practical*		3	3
	DSE (Any one)	Elective 1. Advanced Statistical Analysis Using SPSS 2. Economic Statistics and Demography 3. Nonparametric and Semi parametric methods	4	2	6
Total			19	5	24

P.G Second Year - Fourth Semester (For Two Year P.G. Programme)

Semester	Course category	Course title	Credits		Total Credit
			T	P	
IV	DSC (Core)	Core-1 Econometrics	5		5
		Core-2 Advanced Operations Research II	5		5
		Core-3 Official Statistics	5		5
		DSC Practical*		3	3
	DSE (Any one)	Elective 1. Dissertation 2. Data analysis using R 3. Data analysis using STATA	4	2	6
Total			19	5	24

1. (*) - DSC practical syllabus will be based on DSC Core papers

P.G First Year- First Semester (For Two Year P.G. Programme)

Subject: STATISTICS		
Course Title: Measure Theory and Probability		
Credits:	T-5	DSC: Core I
Course Outcome: The aim of the course is to pay a special attention to applications of measure theory in the probability theory and the Central Limit Theorem with their applications. To understand the concepts of random variables, sigma-fields generated by random variables, probability distributions and independence of random variables related to measurable functions. To gain the ability to understand the concepts of measurable functions, sequence of random variables, convergence, modes of convergence. To learn the concepts of weak and strong laws of large numbers and central limit theorem.		
Syllabus		
Measure and integration: Classes of sets, field, sigma fields, minimal sigma fields, Borel sigma fields, Limsup and liminf of a sets, Measure, Probability measure, properties of a measure, Lebesgue and Lebesgue- Steljes measures, measurable functions. Probability : Baye's theorem. Random variable. Marginal and conditional distributions, Expectation. Tehebycheffs inequality and improvements on it, convergence in probability. The weak law of large numbers Bernoulli's theorem. Convergence in distribution continuity theorem. Khinchin's theorem. Strong law of large numbers Kologorov's theorem, Borel zero-one law, Borel-Cantelli lemma. Central limit theorem-Lindberg-Levy's and liapouneff forms.		
Books Recommended:		
Goon Gupta and Das Gupta: An outline of Statistical theory, World Press Calcutta, Vol. 1. 6 2. Rohtagi, V.K. and Saleh A.K. (2005): Probability Theory, John Wiley. 3. B.R. Bhat(1985): Modern Probability Theory. 4. Basu, A.K. (2001): Probability and Measure theory, Narosa Pub.		

Subject: STATISTICS		
Course Title: Matrices		
Credits:	T-5	DSC: Core II
Course Outcome: To acquire the knowledge of Matrices, determinants and their operations and their properties, solutions and applications.		
Syllabus Different type of matrices, algebra of matrices, row and column spaces of a matrix, elementary matrices, determinant, singular and non-singular matrices, adjoin of matrix, rank and inverse of matrix, portioned matrices and Kroneker product. Canonical form, Hermit canonical form, diagonal form, triangular form, Jordan form, quadratic form, generalized inverse, Moore-Penrose generalized inverse, idempotent matrices. Characteristic roots and vectors, algebraic multiplicity of characteristic roots, Caley- Hamilton theorem, spectral decomposition of real symmetric matrix. Positive, semi positive , negative and semi negative definite matrices, similar matrices Derivative of determinant.		
Books Recommended: 1. Biswas, S, (1984): Topics in Algebra of matrices, Academic Publications. 2. Shanti Narain: A text books of matrices, S. Chand and Company (Pvt.) Ltd. 3. Frank Ayres, JR: Schaum's outline series Theory and problems. 4. A.I. Kostrikin, Introduction to Algebra, Springer Verlag, 1984. S. H. Friedberg, A. L. Insel and L. E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi, 2004. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.		

Subject: STATISTICS		
Course Title: Real analysis and Complex Analysis		
Credits:	T-5	DSC: Core III
Course Outcome: The main objective of this course is to introduce students with the knowledge of real field and complex field with their properties and relativity between complex plane and real line. These properties and relations provide grounds for Probability Theory and help in theoretical research in Statistics.		
Syllabus		
Real Analysis: Continuity and discontinuity of functions, Differentiability, Røll's theorem, Mean Value theorem, Non differentiable functions, Riemann integration, Fundamental theorem of integral calculus, convergence of integrals and uniform Convergence. Complex Analysis: Analytic functions, Conformal representation, complex integration, Cauchy's Theorem, Morea's Theorem, Taylor's and Laurent's Series, Zero's and Poles of Functions, theory of Residues and Its application to Contour integration.		
Books Recommended:		
1. Apostol, T.M. (1975). Mathematical Analysis, Addison- Wesley. 2. Bartle, R.G. (1976). Elements of Real Analysis, John Wiley & Sons. 3. Berbarian, S.K. (1998). Fundamentals of Real Analysis, Springer-Verlag. 4. Conway, J.B. (1978). Functions of one Complex Variable, Springer-Verlag. 5. Priestley, H.A. (1985). Complex Analysis, Clarenton Press Oxford. 6. Rudin, W. (1985). Principles of Mathematical Analysis, McGraw Hill.		

Subject: STATISTICS**Course Title: Research Methodology and project work I****Credits:****T-4/P-2****DSE: Elective I****Course Outcome:**

A solid foundation in Statistical Theory and Methodology will be able to communicate the major tenets of statistics, explain their work orally and identify areas of future research areas.

Syllabus

Meaning of Research – Objective of Research – Approach to research – significance of research – type of research – research in Social Sciences – facts, theories and concepts in Social Science research – research design – features of a good research design. Research problem – Identifying the research problem – formulation of research problem concept of hypothesis – role and formulation of hypothesis – scientific method of research
– Nature of scientific research – stages of scientific method.
Logic and scientific method – Deductive and inductive methods – the Case study method merits and demerits of Case study methods – survey methods – merits and demerits of
Survey methods – types of survey – selecting the survey method – sample surveys different types – merits and demerits.
Schedule and questionnaire – Principle underlying the construction of questionnaire measurement and scaling techniques – processing and analysis of data.
Interpretation and report writing – Steps – bibliography, quality of a good research report.

Books Recommended:

Kothari, C.R. (1985): Research Methodology: Methods and Techniques, Wiley Eastern. Garg. B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Vol 2, Ess Publication.
Wadehra, B.L.2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Subject: STATISTICS

Course Title: **Survival Analysis**

Credits:

T-4/P-2

DSE: Elective II

Course Outcome:

To improve the basic fundamentals and the analytical approach of Survival Analysis.

Syllabus

Concept of time, order and random censoring, likelihood in the distributions – exponential, gamma, Weibull, lognormal, Pareto, Linear failure rate, inference for these distribution.

Life tables, failure rate, mean residual life and their elementary classes and their properties.

Estimation of survival function – actuarial estimator, Kaplan – Meier estimator, estimation under the assumption of IFR/DFR, tests of exponentially against non-parametric classes, total time on test.

Two sample problem – Gehan test, log rank test.

Semi-parametric regression for failure rate – Cox's proportional hazards model with one and several covariates. rank test for the regression coefficient.

Competing risk model, parametric and non-parametric inference for this model. Multiple decrement life table.

Books Recommended:

1. Barlow, R.E. and Proschan, F. (1985): Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston.
2. Lawless, J.F. (1982): Statistical Models and Methods of Life Time Data; John Wiley.
3. Nelson, W. (1982): Applied life Data Analysis; John Wiley.
4. Zacks, S.: Reliability Theory; Springer
5. Bain, L. J. and Engelhardt (1991): Statistical Analysis of Reliability and Life Testing Models; Marcel Dekker.

Course Title: Distribution Theory		
Credits:	T-4/P-2	DSE: Elective III
Course Outcome: To provide the knowledge of discrete distributions, continuous distributions, discuss the appropriate distribution with their properties and application of to solve problems, knowledge of sampling distributions and order statistics.		
Syllabus Univariate Discrete distributions; properties and applications of Uniform Discrete, Binomial, Poisson, Hypergeometric, Geometric Negative Binomial distribution and Multinomial distribution. Univariate continuous Distribution; statement, derivation of properties and applications of Normal, Beta, Gamma, Cauchy, Exponential Sampling distribution from Binomial, Poisson, Exponential and Normal populations, Bivariate distributions; bivariate normal. Distribution of functions of random variables. Large sample tests. Derivation and properties of chi-square, t and F distribution and their inter relationship. Test of significance based on chi-square, t. and F distribution. Order statistics, their distributions and properties, joint and marginal distributions of order statistics, extreme values and their asymptotic distributions (statement only) with applications.		
Books Recommended: 1. Rao, C.R. (1973): Linear Statistical Inference and its Application, Wiley Eastern. 2. Kendall, M.G., Stuart, A: The Advanced Theory of Statistics: Distribution Theory. Vol. 1. 3. Johnson and Kotz: Continuous Univariate Distribution, Vol. 1 and Vol. 2, Wiley. 4. Dudwicz, E.J. and Mishra, S.N. (1988): Modern Mathematics Statistics, Wiley. International students edition.		

Signature

U

P.G First Year- Second Semester (For Two Year P.G. Programme)

Subject: STATISTICS

Course Title: **Sample Surveys**

Credits:

T-5

DSC: **Core I**

Course Outcome:

The main objective of this course is to learn techniques in survey sampling with practical applications in daily life which would be beneficial for the students to their further research.

Syllabus

Basic Principles: Census and sample surveys, advantages and disadvantages of sample surveys. Basic principles in sampling, survey enquiries, choice of sampling units, problems of sample size, Bias in selection and estimation, simple random sampling, sampling from finite populations with and without replacement, sampling of attributes, unbiased estimates of population total, mean and estimation of their variances.

Stratified Sampling: Reason for stratification, choice of strata, choice of sampling unit, stratified random sampling, estimation of population mean and its variance, choice of sample sizes in different strata, variances of estimates with different allocation, effects of deviation from optimum allocation, estimation of the gain in precision due to stratification, cost function, construction of strata.

Systematic Sampling: Estimation of sample mean and its variance, comparison of systematic sampling with simple random and stratified sampling.

Ratio and Regression Estimation: Ratio and regression methods of estimation, variances of the estimates, optimum property of ratio estimates, comparison among ratio and regression and simple and biased estimates.

Cluster Sampling: Estimates of mean and its variance for equal and unequal clusters, efficiency in terms of intra-class correlation, optimum unit of sampling, sampling with replacement, estimation of mean and variance.

Double Sampling: Multistage sampling with special reference to two stage design, Non-sampling errors, problems of non-response, errors of measurements, Interpenetrating sub sampling. Randomized response techniques. Pilot survey.

PPS Sampling schemes, sampling techniques with varying probabilities for simple random sampling. Horvitz Thompson Estimators, Mid Zuno Sen Sampling Scheme.

Books Recommended:

1. Cochran W.G.: Sampling Techniques, Wiley Eastern Ltd., New Delhi.
2. Des Raj and Chandhok (1998): Sampling Theory, Narosa Publishing House.
3. Mukhopadhyay Parimal: Theory and Methods of Survey Sampling-Prentice Hall of India Ltd.
4. Kish L: Survey Sampling.

[Handwritten signatures and marks]

Subject: STATISTICS

Course Title: Statistical Inference

Credits:

T- 5

DSC: Core II

Course Outcome:

To make aware the students about parametric, non-parametric and sequential estimation (point, as well as, interval) and testing (simple, as well as, composite hypotheses) procedures. To apply various estimation techniques and testing procedures to deal with real life problems. To understand consistency, CAN estimator, MLE. Understand UMPU tests UMVU estimators.

Syllabus

Problem of point estimation: Unbiasedness, Consistency, Sufficiency, Efficiency, Complete statistics, Complete Sufficient statistics. Factorization theorem, Exponential family of distributions and its properties, Minimum-variance unbiased estimators, Rao-Blackwell theorem. Lehmann Scheffe's theorem, Cramer-Rao Inequality. Method of estimation- Method of Maximum Likelihood and its properties. Interval estimation, Interval Estimation: Confidence Region, shortest confidence intervals, General method of finding confidence interval. Method of obtaining confidence intervals based on small and large samples, Relationship with the testing of hypothesis. Testing of hypothesis: Basic concept, Simple and composite hypothesis, Two types of error, power of the test, Neyman-Pearson lemma and its generalization, Types A, A1 critical regions, Construction of most powerful test, Uniformly most powerful tests, Uniformly most powerful Unbiased test using N P lemma, likelihood ratio test and its properties. General decision problem: Basic concept of loss function, risk function, Minimax and Bays rule.

Books Recommended:

1. Lehmann, E.L.(1986): Theory of Point Estimation, Student Edition.
2. Zacks, S. (1971): Theory of Statistical Inference, Wiley, New York.
3. Rao, C.R. (1973): Linear Statistical Inference and its applications, 2nd edition, John Wiley and sons.
4. Kale, B.K. (1999): A First course on Parametric Inference, Narosa Publishing House.
5. Goon, A.M., M.K. Gupta, & B. Das Gupta: Outline of Statistics, Vol-II.

Subject: STATISTICS

Course Title: **Linear Algebra**

Credits:

T- 5

DSC: **Core III**

Course Outcome:

The main objective of this paper is to allow students to manipulate and understand multi-dimensional space.

Syllabus

Vector Space, subspace,

Linear dependence and independence, maximal linearly independent subset,

Basis and dimension of vector space, finite dimensional vector spaces, Example of vector spaces over real and complex variable.

Linear transformation, algebra of linear transformation,

Null space and ranges, rank and nullity of linear transformation, Rank nullity theorem,

Eigenvalues and eigenvectors for Linear Transformations, Matrix representation of linear transformation.

Vector spaces with an inner product,

Gram-Schmidt orthogonalization process, orthonormal projection of a vector.

Books Recommended:

1. Biswas, S, (1984): Topics in Algebra of matrices, Academic Publications.
2. Shanti Narain: A text books of matrices, S. Chand and Company (Pvt) Ltd.
3. Stephen H. Friedberg, Arnold J. Insel Lawrence E. Spence: Liner Algebra, Pearson Education Limited.
4. Kenneth Hoffman and Ray Kunje: Linear Algebra, Prentice-Hall Inc.

Subject: STATISTICS

Course Title: Statistical process and Quality Control

Credits:

T-4/P-2

DSE: Elective I

Course Outcome:

Familiarity with different aspects of Statistical Quality Control in manufacturing units, Ability to understand the concept of Sampling Inspection plans for products, Knowledge of Statistical tools to be applied in Educational Statistics, Familiarity with various scaling procedures, Knowledge to understand the concept of statistical quality control and different, control charts for variables and attributes.

Syllabus

Statistical Quality Control, Process and Product Control, General Theory of Control Charts, Different Types of Control Charts for Variables and Attributes Modified Control Charts. Sampling inspection by attributes- Single and Double sampling plans, producer's and Consumer's risk, OC, ASN, AOQL and LTPD of sampling plans. SPRT

Books Recommended:

1. Montgomery D.C.: Introduction to Statistical Quality Control.
2. Wetherill, G.B. and Brown, D. W.: Statistical Quality Control: Theory. and Practice.
3. Burr, I.W.: Statistical Quality Control Methods.
4. Croxton F.E. and Cowden D.J.: Applied General Statistics
5. Goon, A.M., Gupta, M.K. and Dasgupta, B.: Fundamentals of Statistics, Vol. II
6. Kapoor, V.K. and Gupta, S.C.: Fundamentals of Applied Statistics
7. Garrett H.L.: Statistics in psychology and education.
8. Grant, E.L.: Statistical Quality Control
9. Edwards, A.L.: Attitude Scale Construction Techniques.

Subject: STATISTICS

Course Title: **Bio Statistics**

Credits:

T-4/P-2

DSE: Elective II

Course Outcome:

To provide the basic knowledge of Bio Statistics, biological assays, Response surfaces, clinical trials, Analysis of categorical outcomes and DNA sequences.

Syllabus

Type of biological assays: direct assays, indirect assays, parallel line assays. Incomplete block designs for bio assays.

Response surfaces: Linear Response surface designs, second order response surface designs, variance of estimated response.

Introduction to clinical trials: the need of clinical trials, bias and random error in clinical studies, overview of phase 1-4 trials.

Analysis of categorical outcomes from phase I-III Trials, analysis of survival data from clinical trials. Analysis of One DNA sequence: Shotgun Sequencing, Modeling signals in DNA.

Analysis of multiple DNA or Protein Sequences: Alignment Algorithms for Two sequences, Protein sequences and Substitution Matrices.

Books Recommended:

1. Z. Govindarajulu(2000): Statistical technique in Bioassay, S. Kargar.
2. 2. Das, M.N. and Giri, N. (1975): Design and Analysis of experiments, New age international.
3. S. Piantadosi (1997): Clinical trials. A methodological perspective. Wiley & sons.
4. J.L. Fleiss (1989): The design and analysis of clinical experiments, Wiley & sons.

Subject: STATISTICS		
Course Title: Design and Analysis of Experiment		
Credits:	T-4/P-2	DSE: Elective III
Course Outcome: This course provides to the students the ability to understand the design and conduct experiments, as well as to analyze data and interpret the results.		
Syllabus		
Analysis of Variance for one-way, two-way with one/m observation per cell for fixed, mixed and random effects models, Tuckey's test for non- additivity. General theory of analysis of experimental designs; completely randomized design, Randomized block design and Latin square design, Missing plot techniques in RBD and LSD.		
Analysis of covariance for CRD and RBD. Split plot and strip plot designs. Complete and		
Partial confounding. General factorial experiments: Definition, Estimation of factor's effect. Analysis of the factorial experiments using CRD and RBD.		
Balanced Incomplete Block Designs: Balanced Incomplete Block Design with and without recovery of inter information.		
Books Recommended:		
9. Raghava Rao D. (1971) : Construction and Combinatorial problems in Design of experiment. Wiley		
10. Aloke Dey (1986) : Theory of Block Designs, Wiley Eastern.		
11. Das, M.N. & Giri, N.(1979): Design and Analysis of experiments, Wiley Eastern.		
12. Giri, N. (1986) : Analysis of Variance, South Asian Publishers.		
13. Rao, C.R. and Kleffe, J.(1988) : Estimation of Variance Components and applications, North Holland.		
14. Searle, S.R., Casella, G. and McCulloch, C.E. (1992) : Variance Components, Wiley.		
15. Nigam, Puri & Gupta (1987-88) : Characterisation and Analysis of Block Design, Wiley Eastern.		
16. V.K. Gupta & A.K. Nigam (1978-79) : Handbook an analysis of Agriculture Experiment, IASRI Publication.		

[Handwritten signatures and initials]