NOTIFICATION
(25/Sep/Adp./76)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the syllabi and courses of studies for **Post Graduate Programme** in **Statistics** under **NEP-2020** as per details given below:-

Two Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Statistics	Semester-I	December 2025, 2026 and 2027
	Semester-II	May 2026, 2027 and 2028
	Semester-III	December 2026, 2027 and 2028
	Semester-IV	May 2027, 2028 and 2029

One Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Statistics	Semester-I	December 2026, 2027 and 2028
	Semester-II	May 2027, 2028 and 2029

The Syllabi of the courses are also available on the University website: www.jammuuniversity.ac.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/25/ 9599-9621
Dated: 10/9/25

Copy for information and necessary action to:

1. Dean, Faculty of **Mathematical Science**
2. Director/Convener, Board of Studies in **Statistics**
3. Director, Centre for IT Enabled services and Management, University of Jammu for information and for uploading on University Website.
4. All members of the Board of Studies
5. Joint Registrar (Evaluation/P.G. Exam.)
6. Programmer, Computer Section, Examination Wing

Joint Registrar (Academic)

Syllabi Framework for PG Programme Statistics (2 Year) under NEP 2020,   Programme Code PGFMS005

S. No	Course No.	Course Title	No. of Credit	Credit Level	Credit Points	Course Type Core/Elective/ Any Other	Marks Theory	Marks Practical	Nature of Course Global	National	Regional	Skill	SAWAYAM /MOOC	Vocation Course	Research Project/Summer Internship/ Dissertation
1.	P2STTC101	Probability and Distribution Theory	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-
2.	P2STTC102	Real Analysis and Measure Theory	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-
3.	P2STTC103	Sample Survey and Sampling Designs	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-
4.	P2STTC104	Linear Algebra	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-
5.	P2STPC105	Computing with MATLAB	04	6.5	26	Core	-	100	✓	-	-	✓	-	-	-

Sr. No.	Course Code	Course Title	Credits												
6.	P2STPC106	Statistical Computing with Excel	04	6.5	26	Core	-	100	✓	-	-	✓	-	-	-
7.	P2STPC107	Scientific Publishing using Latex	01	6.5	6.5	Core	-	25	✓	-	-	✓	-	-	-
8.	P2STPC108	Seminar	01	6.5	6.5	Core	-	25	✓	-	-	✓	-	-	-
9.	P2STTE109*	Basic Statistics	NC	6.5	6.5		100	-	✓	-	-	-	-	-	-
10	P2STTC201	Advanced Probability Theory	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-
11	P2STTC202	Linear Models and Regression Analysis	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-
12	P2STTC203	Advanced Statistical Inference-I	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-
13	P2STTC204	Advanced Multivariate Analysis	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-

#	Code	Course	Credits			Type									
14	P2STPC205	Data Analytics with Python	04	6.5	26	Core	100	-	✓	-	✓	-	-	-	-
15	P2STPC206	Computational Statistics with SPSS	04	6.5	26	Core	100	-	✓	-	✓	-	-	-	-
16	P2STPC207	Seminar	01	6.5	6.5	Core	25	-	✓	-	✓	-	-	-	-
17	P2STPC208	Communication Skills	01	6.5	6.5	Core	25	-	✓	-	✓	-	-	-	-
18	P2STVC251	Advanced Data Analytics with SPSS	04	6.5	26	VOC	-	100	-	-	-	-	✓	-	-
19	P2STTC301	Advanced Design of Experiments	04	6.5	26	Core	-	100	✓	-	-	-	-	-	-
20	P2STTC302	Artificial Intelligence and Machine Learning	04	6.5	26	Core	-	100	✓	-	-	-	-	-	-
21	P2STTC303	Statistical Modelling and Computing	04	6.5	26	Core	-	100	✓	-	-	-	-	-	-

No.	Course Code	Course Title	Credits			Core/Elective									
22	P2STRC304	Internship/Survey/Industrial Training	01	6.5	6.5	Core	-	25	✓	-	-	✓	-	-	Summer Internship
23	P2STPC305	Computing with R	04	6.5	26	Core	-	100	✓	-	-	✓	-	-	
24	P2STPC306	Advanced Data Analytics with SPSS	04	6.5	26	Core	-	100	✓	-	-	✓	-	-	
25	P2STPC307	Seminar	01	6.5	6.5	Core	-	25	✓	-	-	✓	-	-	
26	P2STTE308	Advanced Statistical Inference-II	04	6.5	26	Elective	100	-	✓	-	-	-	-	-	
27	P2STTE309	Information Theory	04	6.5	26	Elective	100	-	✓	-	-	-	-	-	
28	P2STTE310	Advanced Sampling Techniques	04	6.5	26	Elective	100	-	✓	-	-	-	-	-	
29	P2STTE311	Advanced Biostatistics	04	6.5	26	Elective	100	-	✓	-	-	-	-	-	

#	Code	Course	Credits		Marks	Type									
30	P2STTE312	Advanced Reliability Theory	04	6.5	26	Elective	100	-	✓	-	-	-	-	-	-
31	P2STTE313	Advanced Bayesian and Sequential Inference	04	6.5	26	Elective	100	-	✓	-	-	-	-	-	-
32	P2STMO351	MOOC/SWAYAM	04	6.5	26	Core	100						✓		
33	P2STTC401	Stochastic Processes	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-
34	P2STTC402	Optimization Techniques for Decision Making	04	6.5	26	Core	100	-	✓	-	-	-	-	-	-
35	P2STRC403	Research	16	6.5	104	Research	-	400	✓	✓	✓	✓	✓	-	Research

Course Structure for PG Programme in Statistics- Two Years (NEP 2020)

Programme code – PGFMS005

Semester –I

Course Code	Course Title	Credit Hour	Contact Hours per week L-Tu-P
P2STTC101	Probability and Distribution Theory	04	4-1-0
P2STTC102	Real Analysis and Measure Theory	04	4-1-0
P2STTC103	Sample Survey and Sampling Designs	04	4-1-0
P2STTC104	Linear Algebra	04	4-1-0
P2STPC105	Computing with MATLAB	04	0-0-4
P2STPC106	Computational Statistics with Excel	04	0-0-4
P2STPC107	Scientific Publishing using Latex	01	0-1-2
P2STPC108	Seminar	01	0-1-0
P2STTE109*	Basic Statistics	NC	4-1-0
	Total Credits	26	

* Non-Credit Course meant for those students who have not studied Statistics at UG Level.

Semester–II

Course Code	Course Title	Credit Hours	Contact Hours per week L-Tu-P
P2STTC201	Advanced Probability Theory	04	4-1-0
P2STTC202	Linear Models and Regression Analysis	04	4-1-0
P2STTC203	Advanced Statistical Inference-I	04	4-1-0
P2STTC204	Advanced Multivariate Analysis	04	4-1-0
P2STPC205	Data Analytics with Python	04	0-0-4
P2STPC206	Computational Statistics with SPSS	04	0-0-4
P2STPC207	Seminar	01	0-1-0
P2STPC208	Communication Skills	01	0-0-2
	Total Credits	26	
EXIT OPTION VOCATIONAL COURSES			
P2STV251	Advanced Data Analytics with Statistical Softwares	04	0-0-4

Semester – III

Course Code	Course Title	Credit Hours	Contact Hours per week L-Tu-P
P2STTC301	Advanced Design of Experiments	04	4-1-0
P2STTC302	Artificial Intelligence and Machine Learning	04	4-0-1
P2STTC303	Statistical Modelling and Computing	04	4-0-1
P2STRC304	Internship/Survey/Industrial Training	01	0-0-1
P2STPC305	Computing with R	04	0-0-4
P2STPC306	Advanced Data Analytics with SPSS	04	0-0-4
P2STPC307	Seminar	01	0-1-0
Any One of the following Elective Courses (From courses ending with TE308 to 313)			
P2STTE308	Advanced Statistical Inference-II	04	4-1-0
P2STTE309	Information Theory	04	4-1-0
P2STTE310	Advanced Sampling Techniques	04	4-1-0
P2STTE311	Advanced Biostatistics	04	4-1-0
P2STTE312	Advanced Reliability Theory	04	4-1-0
P2STTE313	Advanced Bayesian and Sequential Inference	04	4-1-0
P2STMO351	MOOC/SWAYAM	04	**4-0-0**
Total Credits		30	

Semester–IV

Course Code	Course Title	Credit Hours	Contact Hours per week L-Tu-P
P2STTC401	Stochastic Processes	04	4-1-0
P2STTC402	Optimization Techniques for Decision Making	04	4-1-0
P2STRC403	Research	16	0-0-16
Total Credits		24	

L – Number of Lecture, Tu – Number of Tutorials, P – Number of Practical hours.

SEMESTER-WISE CREDITS EARNED BY STUDENT

Semester	Credit Hours
Semester -1	26
Semester -2	26
Semester-3	30
Semester-4	24
Total Credits Earned	106

SCHEME OF EXAMINATIONS FOR THEORY COURSES OF 04 CREDITS

	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II**.

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 from each unit) of 03 marks each. (10*3=30 marks)

Section-B will have 04 questions of 15 marks each to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks)

In major test there should not be a gap of more than two days in between two tests.

SCHEME OF EXAMINATIONS FOR SEMINAR COURSES

The seminar presentation shall carry 25 marks and distribution of marks shall be as under:

Presentation	Contents	Domain Knowledge	Total
05	10	10	25

Evaluation Criteria: Each student will be allotted a mentor under whose guidance

student will prepare the Seminar.

Each Seminar presentation will be of **duration 45-60 minutes**. Evaluation of the seminar will be done by the DAC members on the above parameters. There will be no external examination/viva-voce examination. The schedule of the Seminar will be issued by the Head of the Department.

SCHEME OF EXAMINATION FOR PRACTICAL COURSES OF 04 CREDITS

Each practical Internal and External paper shall carry **50 marks** and will be of **04 hours** and distribution of marks shall be as under:

Component	Marks	Remarks
Internal	25	After 60 days on completion of 50 % of syllabus **Written Exam: 20 Marks (Attempt two Practical of 10 Marks each out of three Practicals)** **Viva Voce :05 Marks**
External	75	On completion of entire syllabus **Written Exam: 40 Marks (two Practicals each of 20 Marks out of three Practicals)** **Case Study Report :10** **Viva Voce :25 Marks**
Total	100	

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance of the students.

SCHEME OF EXAMINATION FOR PRACTICAL COURSES OF 01 CREDIT

Each practical paper shall have the following distribution of marks and will be of **03 Hours**:

Component	Marks	Remarks
Internal	10	After 60 days on completion of 50 % of syllabus **Written Exam: 10 Marks (Attempt two Questions of 05 Marks Each out of Three asked questions from Module-1)**

External	15	On completion of entire syllabus **Written Exam: 10 Marks (Attempt two questions of 05 Marks Each out of Three Questions from Module-2)** **Viva Voce :05 Marks**
Total	25	

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department and the concerned teacher who shall evaluate/assess final practical performance of the students.

SCHEME OF EXAMINATION FOR SUMMER INTERNSHIP / SURVEY / INDUSTRIAL TRAINING

The internship shall be under a departmental teacher who will be designated as Internship Supervisor. After completion of summer internship students will have to produce a report related to the work carried out duly signed by the internship supervisor and Head of the department.

The Board of Examiners consisting of Head of the Department, one teacher of concerned department, and internship supervisor shall evaluate/assess performance of the students.

The work will be assessed on the following components:

Contents of the Report	Seminar Presentation	Domain Knowledge	Total
10	05	10	25

Note: The minimum passing criteria for the summer internship is 40%.

SCHEME OF EXAMINATION FOR RESEARCH

External Research examination shall be conducted by Board of Examiners consisting of Head of the Department, concern teacher and one outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess dissertation of the students.

The research work will be assessed on the following components:

Content Quality of Report/Dissertation	Seminar Presentation	Domain Knowledge	Total
150	100	150	400

Course Structure for PG Programme in Statistics- Two Years (NEP 2020)

Programme code – PGFMS005

Semester –I

Course Code	Course Title	Credit Hour
P2STTC101	Probability and Distribution Theory	04
P2STTC102	Real Analysis and Measure Theory	04
P2STTC103	Sample Survey and Sampling Designs	04
P2STTC104	Linear Algebra	04
P2STPC105	Computing with MATLAB	04
P2STPC106	Computational Statistics with Excel	04
P2STPC107	Scientific Publishing using Latex	01
P2STPC108	Seminar	01
P2STTE109*	Basic Statistics	NC
Total Credits		26

* Non-Credit Course meant for those students who have not studied Statistics at UG Level.

Semester–II

Course Code	Course Title	Credit Hours
P2STTC201	Advanced Probability Theory	04
P2STTC202	Linear Models and Regression Analysis	04
P2STTC203	Advanced Statistical Inference-I	04
P2STTC204	Advanced Multivariate Analysis	04
P2STPC205	Data Analytics with Python	04
P2STPC206	Computational Statistics with SPSS	04

P2STPC207	Seminar	01
P2STPC208	Communication Skills	01
	Total Credits	26

VOCATIONAL COURSES

P2STVC251	Advanced Data Analytics with Statistical Softwares	04

Semester – III

Course Code	Course Title	Credit Hours
P2STTC301	Advanced Design of Experiments	04
P2STTC302	Artificial Intelligence and Machine Learning	04
P2STTC303	Statistical Modelling and Computing	04
P2STRC304	Internship/Survey/Industrial Training	01
P2STPC305	Computing with R	04
P2STPC306	Advanced Data Analytics with SPSS	04
P2STPC307	Seminar	01

Any One of the following Elective Courses (From courses ending with TE308 to 313)

P2STTE308	Advanced Statistical Inference-II	04
P2STTE309	Information Theory	04
P2STTE310	Advanced Sampling Techniques	04
P2STTE311	Advanced Biostatistics	04
P2STTE312	Advanced Reliability Theory	04
P2STTE313	Advanced Bayesian and Sequential Inference	04
P2STMO351	MOOC/SWAYAM	04
	Total Credits	30

Semester–IV

Course Code	Course Title	Credit Hours
P2STTC401	Stochastic Processes	04
P2STTC402	Optimization Techniques for Decision Making	04
P2STRC403	Research	16
Total Credits		24

L – Number of Lecture, Tu – Number of Tutorials, P – Number of Practical hours.

SEMESTER-WISE CREDITS EARNED BY STUDENT

Semester	Credit Hours
Semester -1	26
Semester -2	26
Semester-3	30
Semester-4	24
Total Credits Earned	106

SCHEME OF EXAMINATIONS FOR THEORY COURSES OF 04 CREDITS

	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 from each unit) of 03 marks each. (10*3=30 marks)

Section-B will have 04 questions of 15 marks each to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks)

In major test there should not be a gap of more than two days in between two tests.

SCHEME OF EXAMINATIONS FOR SEMINAR COURSES

The seminar presentation shall carry 25 marks and distribution of marks shall be as under:

Presentation	Contents	Domain Knowledge	Total
05	10	10	25

Evaluation Criteria: Each student will be allotted a mentor under whose guidance student will prepare the Seminar.

Each Seminar presentation will be of **duration 45-60 minutes**. Evaluation of the seminar will be done by the DAC members on the above parameters. There will be no external examination/viva-voce examination. The schedule of the Seminar will be issued by the Head of the Department.

SCHEME OF EXAMINATION FOR PRACTICAL COURSES OF 04 CREDITS

Each practical Internal and External paper shall carry **50 marks** and will be of **04 hours** and distribution of marks shall be as under:

Component	Marks	Remarks
Internal	25	After 60 days on completion of 50 % of syllabus **Written Exam: 20 Marks (Attempt two Practical of 10 Marks each out of three Practicals)** **Viva Voce :05 Marks**
External	75	On completion of entire syllabus **Written Exam: 40 Marks (two Practicals each of 20 Marks out of three Practicals)**

		Case Study Report :10 Viva Voce :25 Marks
Total	100	

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance of the students.

SCHEME OF EXAMINATION FOR PRACTICAL COURSES OF 01 CREDIT

Each practical paper shall have the following distribution of marks and will be of **03 Hours**:

Component	Marks	Remarks
Internal	10	After 60 days on completion of 50 % of syllabus **Written Exam: 10 Marks (Attempt two Questions of 05 Marks Each out of Three asked questions from Module-1)**
External	15	On completion of entire syllabus **Written Exam: 10 Marks (Attempt two questions of 05 Marks Each out of Three Questions from Module-2)** **Viva Voce :05 Marks**
Total	25	

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department and the concerned teacher who shall evaluate/assess final practical performance of the students.

SCHEME OF EXAMINATION FOR SUMMER INTERNSHIP / SURVEY / INDUSTRIAL TRAINING

The internship shall be under a departmental teacher who will be designated as Internship Supervisor. After completion of summer internship students will have to produce a report related to the work carried out duly signed by the internship supervisor and Head of the department.

The Board of Examiners consisting of Head of the Department, one teacher of concerned department, and internship supervisor shall evaluate/assess performance of the students.

The work will be assessed on the following components:

Contents of the Report	Seminar Presentation	Domain Knowledge	Total
10	05	10	25

Note: The minimum passing criteria for the summer internship is 40%.

SCHEME OF EXAMINATION FOR RESEARCH

External Research examination shall be conducted by Board of Examiners consisting of Head of the Department, concern teacher and one outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess dissertation of the students.

The research work will be assessed on the following components:

Content Quality of Report/Dissertation	Seminar Presentation	Domain Knowledge	Total
150	100	150	400

Department of Statistics, University of Jammu

Course Structure for PG Programme in Statistics- Two Years (NEP 2020)

Programme code – PGFMS005

Semester –I

Course Code	Course Title	Credit Hour	Contact Hours per week L-Tu-P
P2STTC101	Probability and Distribution Theory	04	4-1-0
P2STTC102	Real Analysis and Measure Theory	04	4-1-0
P2STTC103	Sample Survey and Sampling Designs	04	4-1-0
P2STTC104	Linear Algebra	04	4-1-0
P2STPC105	Computing with MATLAB	04	0-0-4
P2STPC106	Computational Statistics with Excel	04	0-0-4
P2STPC107	Scientific Publishing using Latex	01	0-1-2
P2STPC108	Seminar	01	0-1-0
P2STTE109*	Basic Statistics	NC	4-1-0
Total Credit		26	

* Non-Credit Course meant for those students who have not studied Statistics at UG Level.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STTC101
Credit Hours :04
Duration of Examination: 3 Hrs

Title: Probability and Distribution Theory
Maximum Marks:100
Minor Test -I: 20
Minor Test -II: 20
Major Test   60

Course Outcomes:

- **CO1**: Demonstrate an understanding of random variables, basic distribution theory, and fundamental probability concepts, including joint, marginal, and conditional distributions.

- **CO2**: Apply standard discrete and continuous distributions to statistical modelling and problem-solving in various practical contexts.

- **CO3**: Analyse order statistics, special probability distributions, and their applications in data interpretation and decision-making.

- **CO4**: Utilize concepts of conditional expectation, variance, correlation, and regression for statistical inference and predictive modelling.

- **CO5**: Examine advanced distribution models, including compound, truncated, and mixture distributions, along with key sampling distributions used in hypothesis testing.

Unit-I

Review of random variable and basic distribution theory. Joint, marginal and conditional p.m.fs. and p.d.fs, Functions of random variables and their distribution (One and two dimensional), Standard discrete distributions viz., Binomial, Poisson, Rectangular, Negative Binomial, Geometric and Hyper Geometric.

Unit II

Standard continuous distributions viz., Normal, Uniform, Cauchy, Beta, Gamma, Log normal, Exponential, Bivariate normal, Bivariate Exponential (Laplace); Order statistics and their distribution, Joint and marginal distributions of order statistics, Distribution of median and range.

Unit III

Introduction to special distributions: Degenerate, Two-point, negative Hypergeometric, Multinomial, Pareto, Logistic, Weibull and Rayleigh distributions. Conditional expectation & conditional variance, Simple, partial and multiple correlations, linear and multiple regression (in terms of conditional expectation).

Unit IV

Compound, truncated and mixture distributions, Sampling distributions, Central and Non-central Chi- square, t-and F- distributions and their properties.

Course No.: P2STTC101   Title: Probability and Distribution Theory
Credit Hours :4   Maximum Marks:100
Duration of Examination: 3 Hrs   Minor Test -I: 20
                                      Minor Test -II: 20
                                      Major Test   : 60
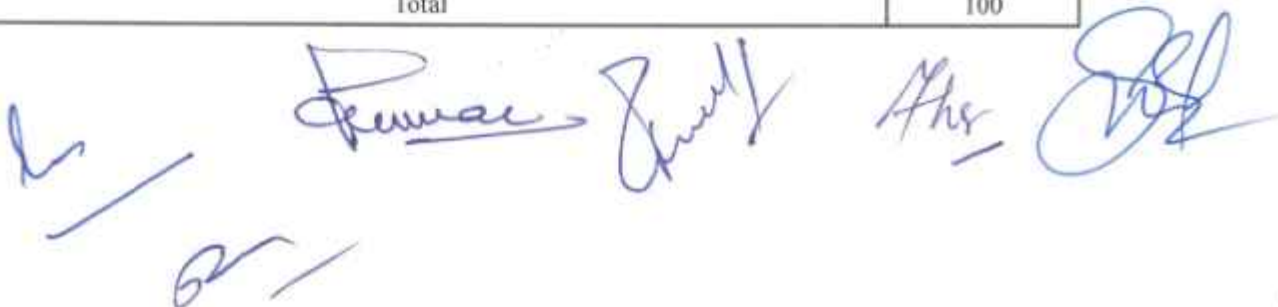
Books Recommended:

1.	Fisz, M. (2012)	Probability Theory and Mathematical Statistics, John Wiley & Sons
2.	Johnson, N.L. and Kotz, S. and Balakrishnan, N (1995)	Continuous Univariate Distributions, Vol 1 and Vol 2, John Wiley & Sons
3.	Johnson, N.L., Kemp, A.W. and Kotz, S. (2005)	Univariate Discrete Distributions, John Wiley & Sons
4.	Kendall, M.G., Stuart, A. (2001)	The Advanced theory of Statistics: Distribution Theory Vol 1, John Wiley & Sons
5.	Rohatgi, V. K. (1993)	An introduction of Probability Theory and Mathematical Statistics, John Wiley & Sons
6.	Rohatgi, V.K. & Ehsanes Saleh, A.K. (2014)	An Introduction to Probability Theory and Mathematical Statistics, Wiley Series.
7.	Thomopoulos, N. T. (2017)	Probability Distributions: With Truncated, Log and Bivariate Extensions

SCHEME OF EXAMINATIONS

Scheme of Examination:

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STTC101   Title: Probability and Distribution Theory
Credit Hours :4   Maximum Marks:100
Duration of Examination: 3 Hrs   Minor Test -I: 20
                                             Minor Test -II: 20
                                             Major Test :   60

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions of 15 marks each to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks).

 In major test there should not be a gap of more than two days in between two tests.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STTC102   Title: Real Analysis and Measure Theory
Credits Hours:04   Maximum Marks:100
Duration of Examination: 3 Hrs   Minor Test -I : 20
                                             Minor Test -II : 20
                                             Major Test   : 60

Course Outcomes:

- **CO1:** Develop a fundamental understanding of the real number system, Euclidean space, and key concepts in metric spaces, including limit points, open and closed sets, and compactness.

- **CO2:** Analyse sequences and series through concepts of limit superior, limit inferior, convergence tests, and uniform convergence, applying key theorems like Stone-Weierstrass.

- **CO3:** Explore measure theory, including sigma-fields, probability measures, and the continuity theorem of measure, to establish a strong foundation in advanced mathematical analysis.

- **CO4:** Understand Lebesgue and Lebesgue-Stieltjes measure, signed measures, and measurable functions, along with integration techniques and theorems related to convergence.

- **CO5:** Apply advanced mathematical tools such as the Radon-Nikodym theorem, product measures, and Fubini's theorem to practical problems in analysis and probability.

Unit- I

Introduction to Real number system, introduction to n-dimensional Euclidean space: Limit Points of a set, open sets, closed sets etc. (will be developed through general metric space and R^n will be considered as a special case, Compact sets, Bolzano-Weirsstrass theorem, Heine-Borel Theorem.

Unit -II
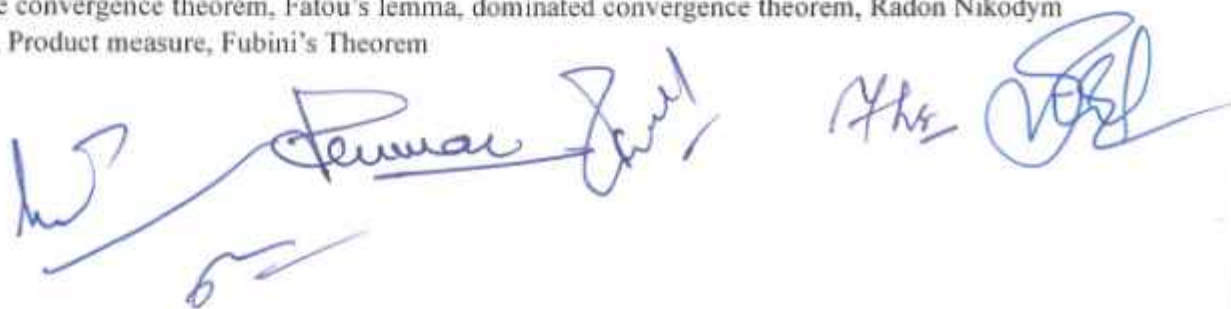
Limit superior, limit inferior and limit of a sequence, their convergence, Cauchy sequence, Convergence of series, tests for convergence for series, Uniform convergence of sequences and series, Stone-Weirsstrass theorem (Statement Only).

Unit- III

Fields, sigma minimal sigma field, sigma-field generated by a class of subsets, Borel fields. Sequence of sets, limsup and liminf of sequence of sets, Measure, probability measure, properties of a measure, Continuity theorem of measure.

Unit- IV

Idea of Lebesgue and Lebesgue-Steiltjes measure, Signed measure, Jordan-Hahn decomposition theorem. Measurable functions, integration of a measurable function with respect to a measure, Monotone convergence theorem, Fatou's lemma, dominated convergence theorem, Radon Nikodym Theorem, Product measure, Fubini's Theorem

Course No.: P2STTC102
Credits Hours:04
Duration of Examination: 3 Hrs

Title: Real Analysis and Measure Theory
Maximum Marks:100
Minor Test -I : 20
Minor Test -II : 20
Major Test   : 60

Books Recommended

1.	Apostol, T.M. (2002)	Mathematical Analysis, Narosa, Indian Edition.
2.	Bartle, R.G. and Sherbat (2007)	Elements of Real Analysis (Wiley)
3.	Courant, R. and John, F. (1974)	Introduction to Calculus and Analysis (Vol I and II), Wiley
4.	Ghorpade, S.R. and BV Limaye (2006)	A Course in Calculus and Real Analysis, Springer
5.	Goldberg, R. R. (1970)	Methods of Real Analysis, Oxford and IBH Publisher
6.	Kumar, Ajit and Kumaresan, S (2015)	A Basic Course in Real Analysis, CRC Press
7.	Malik S. C. & Arora S. (2008)	Mathematical Analysis-New Age International Publications Wiley Eastern Limited 4th edition.
8.	Royden, H.L. (1988)	Real Analysis, MacMillan
9.	Rudin, W. (2013)	Principles of Mathematical Analysis, McGraw.
10.	Torence, Tao (2006)	Analysis I, Hindustan Book Agency, India.

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Course No.: P2STTC102   Title: **Real Analysis and Measure Theory**
Credits Hours:04   Maximum Marks:100
Duration of Examination: 3 Hrs   Minor Test -I : 20
     Minor Test -II : 20
     Major Test   : 60

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions of 15 marks each to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks).

In major test there should not be a gap of more than two days in between two tests.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STTC103
Credits Hours:04
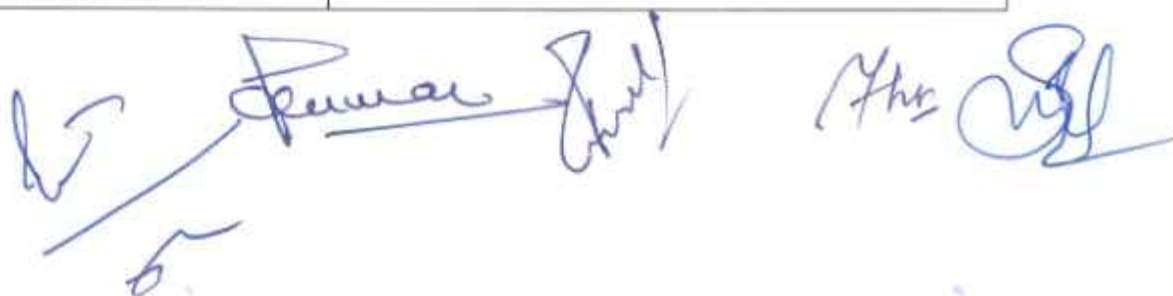Duration of Examination: 3 Hrs

Title: **Sample Survey and Sampling Designs**
Maximum Marks:100
    Minor Test -I: 20
    Minor Test -II: 20
    Major Test   : 60

Course Outcomes:

- **CO1**: Demonstrate an understanding of various sampling techniques, including simple random sampling (SRS), stratified sampling, and post-stratification, along with their relative precision and applications.

- **CO2**: Apply systematic sampling and probability proportional to size (PPS) methods for estimating mean and variance, and evaluate the efficiency of different sampling strategies.

- **CO3**: Utilize ratio, difference, and regression estimators in statistical inference, comparing their efficiency with standard sampling techniques, and explore cluster and double-phase sampling.

- **CO4**: Analyse advanced sampling methods, including two-stage and successive sampling, identifying sources of non-sampling errors and applying appropriate estimation techniques.

- **CO5**: Understand randomized response techniques for handling sensitive characteristics and apply estimators such as Hansen-Hurwitz and Warner-Simmons methods in data collection.

Unit- I
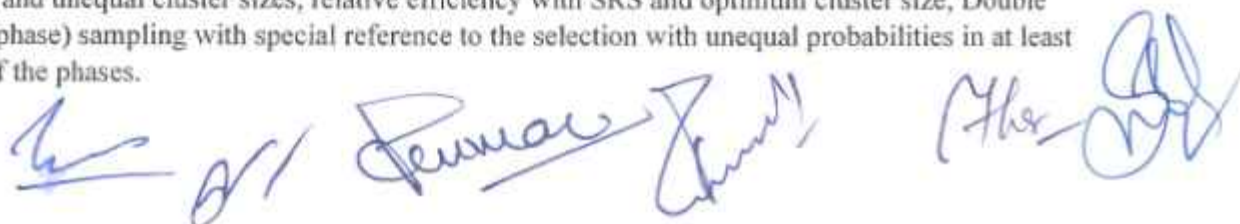
Review of SRS WR and WOR, Estimation of sample size, Stratified random sampling, different methods of allocation, relative precision of stratified random sampling with S.R.S., formation and construction of strata and Post Stratification.

Unit-II

Systematic sampling, estimation of mean and sampling variance, comparison of systematic sampling with stratified and S.R.S., Varying probability sampling methods of selecting sample with P.P.S, P.P.S. sampling W.R., efficiency of P.P.S. sampling. PPS WOR, H.T. estimator, Des Raj Sampling strategy, Murthy estimator, Sen-Midzuno method.

Unit-III

Ratio estimator, bias and mean square error, estimation of variance, comparison with SRS, ratio estimator in stratified sampling, unbiased type ratio estimators Difference estimator, regression estimator, comparison of regression estimator with SRS and ratio estimator, Cluster sampling with equal and unequal cluster sizes, relative efficiency with SRS and optimum cluster size, Double (two-phase) sampling with special reference to the selection with unequal probabilities in at least one of the phases.

Course No.: P2STTC103
Credits Hours:04
Duration of Examination: 3 Hrs

Title: Sample Survey and Sampling Designs
Maximum Marks:100
    Minor Test -I: 20
    Minor Test -II: 20
    Major Test   : 60

Unit-IV

Two stage sampling with equal and unequal s.s.u's, estimation of mean and sampling variance. Successive sampling, sampling on two occasions. Kinds of non-sampling errors with special reference to non-response problems. Hansen and Hurwitz estimator for population mean. Concept of randomized response and some well-known randomized response techniques for sensitive characteristics. Warner's and Simmons' randomized response techniques for one qualitative sensitive characteristic.

Books Recommended:

1.	Arijit Chaudhuri (2014)	Modern Survey Sampling, CRC Press
2.	Cochran, W.G. (2013)	Sampling techniques, Wiley & Sons
3.	Des Raj (1999)	Sampling Theory, Create Space Publishers, USA.
4.	Mukhopadhayay, P. (2014)	Theory and methods of survey sampling, PHI Learning.
5.	Murthy, M.N. (1967)	Sampling Theory and Methods, Statistical PublishingSociety, Calcutta.
6.	Sampath,S. (2005)	Sampling Theory & Methods, Alpha Science India Ltd.
7.	Singh, S (2003)	Advanced Sampling Theory with Applications: How Michael' selected' Amy Volume I, Springer
8.	Singh,D. and F.S Chaudhary (2002)	Theory and Analysis of sample Survey Designs, New age, International Publications.
9.	Sukhatme,P.V.,Sukhatme, B.V., Sukhatme, S. and Asok, C.	Sampling Theory of Surveys with Applications, Iowa State University Press and Indian Society of Agricultural Statistics.
10.	Chaudhuri, A. and R. Mukherjee (1988)	Randomised response: theory and techniques, New York, Marcel Deckker Inc.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STTC103   Title: Sample Survey and Sampling Designs
Credits Hours:04   Maximum Marks:100
Duration of Examination: 3 Hrs   Minor Test -I: 20
                                                Minor Test -II: 20
                                                Major Test   : 60

SCHEME OF EXAMINATIONS

Scheme of Examination:

	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
MINOR TEST 1 (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions of 15 marks each to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks).

In major test there should not be a gap of more than two days in between two tests.

Course No.: P2STTC104
Credits Hours:04
Duration of Examination: 3 Hrs

Title: Linear Algebra
Maximum Marks:100
Minor Test -I: 20
Minor Test -II: 20
Major Test   : 60

Course Outcomes:

- **CO1**: Understand the concepts of vector spaces, inner products, basis, dimension, and linear transformations, including their applications in real and complex fields.

- **CO2**: Apply matrix algebra, including elementary matrices, rank, inverse, null space, and generalized inverses, to solve mathematical problems.

- **CO3**: Analyse real quadratic forms, classification techniques, characteristic roots and vectors, and key theorems like Cayley-Hamilton for matrix computations.

- **CO4**: Explore spectral decomposition, singular value decomposition, and reduction techniques for symmetric matrices to enhance problem-solving skills in linear algebra.

- **CO5**: Develop mathematical reasoning and computational proficiency in vector and matrix theories for applications in advanced mathematical and engineering domains.

Unit -I

Vector spaces with an inner product, sub spaces, linear dependence and independence, basis and dimension of a vector space, finite dimensional vector spaces, linear transformations, completion theorem, examples of vector spaces over real and complex fields, Gram-Schmidt Orthogonalization process.

Unit- II

Algebra of matrices, elementary matrices, row and column spaces of a matrix, rank and inverse of a matrix, null space and nullity, partitioned matrices, Kronecker product, Hermite canonical form, generalized inverse, Moore Penrose generalized inverse, left weak and right weak g-inverses, Idempotent matrices, solution of matrix equations.

Unit- III

Real quadratic forms, reduction and classification of quadratic forms, index and signature, triangular reduction of a positive definite matrix, characteristic roots and vectors, Cayley-Hamilton theorem, similar matrices, Hermitian quadratic forms.

Unit -IV

Algebraic and geometric multiplicity of a characteristic root, spectral decomposition of a real symmetric matrices, reduction of a pair of real symmetric matrices, singular values and singular value decomposition.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STTC104   Title: Linear Algebra
Credits Hours:04   Maximum Marks:100
Duration of Examination: 3 Hrs   Minor Test -I: 20
             Minor Test -II: 20
             Major Test : 60

Books Recommended:

1.	Bellman, R. (1997)	Introduction to matrix Analysis, McGraw Hill.
2.	Biswas, S. (2012)	Topics in Algebra of matrices Academic publications.
3.	DeFranza,J.and Gagliardi,D.(2017)	Introduction to Linear Algebra and Applicatins, Tata McGraw Hill
4.	Dutta, K. B. (2014)	Matrix and Linear Algebra, PHI Learning
5.	Graybill, F.A. (2001)	Matrices with applications in Statistics, Cengage Learning.
6.	Hadley, G. (2006)	Linear Algebra, Narosa Publishing House.
7.	Halmos, P.R. (1958)	Finite Dimensional Vector Spaces, Springer.
8.	Harville,D.A.(2001)	Matrix Algebra from a Statistician's Perspective, Springer
9.	Searle, S.R. (1982)	Matrix Algebra Useful for Statistics, John Wiley & Sons.

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STTC104   Title: Linear Algebra
Credits Hours:04   Maximum Marks:100
Duration of Examination: 3 Hrs   Minor Test -I: 20
                                                  Minor Test -II: 20
                                                  Major Test   : 60

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions of 15 marks each to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks).

In major test there should not be a gap of more than two days in between two tests.

Course No.: P2STPC105
Credit Hours :04
Duration of Examination: 04 Hrs

Title: Computing with MatLab
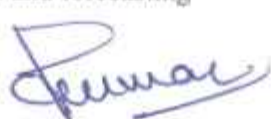Maximum Marks: 100
Internal : 50
External : 50

Course Outcomes:

- **CO1**: Develop proficiency in MATLAB programming, utilizing variables, operators, control structures, and functions for mathematical computations and matrix operations.
- **CO2**: Apply data visualization techniques in MATLAB, including various plotting methods such as histograms, box plots, scatter plots, and probability plots for analytical interpretation.
- **CO3**: Implement numerical methods for integration, root extraction, and random number generation, alongside simulation exercises for probabilistic modelling.
- **CO4**: Perform statistical analysis using MATLAB, including fitting probability distributions, testing goodness of fit, and executing Principal Component Analysis (PCA) and regression methods.
- **CO5**: Conduct parametric tests such as Z-test, t-test, Chi-square test, and explore their applications in hypothesis testing and statistical inference.

There shall be at least twenty computing exercises on Statistical Computing and analysis of statistical data using MatLab software.

Module -I

Programming in MatLab: Variables, Operators, Selection statements, Loop statement, Functions, Computation of Determinants of matrix, Inverses of a matrix by partitioning, Rank of a matrix, Solutions of matrix equations, Characteristic roots and vectors of a matrix, Covariance and Correlation Matrices.

Plot function in MatLab, Histograms, Box Plot, Simple and Clustered Bar Chart, Line Charts, Scatter plot, Probability plots and Q-Q Plot and their interpretation through some case studies. Violin Plots, Candle Bar Charts, Heat Plots, Population Pyramid, Error-bar plots, Weibull Plots and their interpretation through some case studies.

Module -II

Numerical Integration, Root extraction using different methods, Random number generation from different distributions, Simple exercise on simulation

Fitting of probability distributions and testing the goodness of fit, Principal Component Analysis (PCA), Linear Regression Analysis.

Performing basic parametric tests- Z-test for proportions (one sample and two sample), t-test (single mean, independent samples, paired sample), Chi square test for independence of attributes.

Course No.: P2STPC105   Title: Computing with MatLab
Credit Hours :04   Maximum Marks: 100
Duration of Examination: 04 Hrs   Internal : 50
     External : 50

Books Recommended:
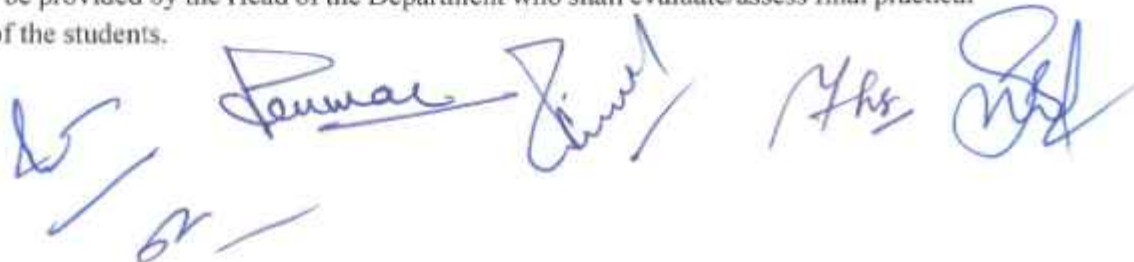
1.	Bruce L.L. and Hanselman D. C. (1996).	Mastering Matlab 7, Pearson Education India, India
2.	Gilat A. (2004)	Matlab: An Introduction with Applications, 4th Edition, Wiley India Pvt. Ltd., New Delhi
3.	Stephen J. Chapman (2024)	MATLAB Programming for Engineers , Cengage Learning

SCHEME OF EXAMINATIONS

Each practical Internal and External paper shall carry **50 marks** and will be of **04 hours** and distribution
of marks shall be as under:

Component	Marks	Remarks
Internal	25	After 60 days on completion of 50 % of syllabus **Written Exam: 20 Marks (Attempt two Practical of 10 Marks Each out of three Practicals)** **Viva Voce :05 Marks**
External	75	On completion of entire syllabus Written Exam: 40 Marks (two Practicals each of 20 Marks out of three Practicals) Case study report: 10 Viva Voce: 25 Marks
Total	100	

External Practical examination shall be conducted by Board of Examiners consisting of Head of
the Department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out
of the panel to be provided by the Head of the Department who shall evaluate/assess final practical
performance of the students.

Course No.: P2STPC106
Credit Hours :04
Duration of Examination: 4 Hrs

Title: Computational Statistics
 with Excel
Maximum Marks:100
Internal : 50
External : 50

Course Outcomes:

- **CO1**: Develop proficiency in MS Excel, including interface navigation, data entry, formatting, and fundamental functions for efficient data handling.
- **CO2**: Apply data management techniques such as sorting, filtering, conditional formatting, and error checking for effective data cleaning and organization.
- **CO3**: Utilize Excel's statistical functions to perform descriptive analysis, probability distribution modelling, regression analysis, and correlation studies.
- **CO4**: Create and interpret data visualizations using charts, pivot tables, dashboards, and advanced plotting methods to enhance statistical reporting.
- **CO5**: Implement Excel-based statistical modelling, hypothesis testing, automation through VBA macros, and real-world applications across industries.

Module-1

1. **Introduction to MS Excel**
    - Interface and navigation
    - Data entry and formatting
    - Basic formulas and functions
2. **Data Management & Cleaning**
    - Sorting and filtering data
    - Conditional formatting
    - Data validation and error checking
3. **Statistical Functions in Excel**
    - Descriptive statistics (mean, median, mode, standard deviation)
    - Probability distributions
    - Regression analysis and correlation
4. **Data Visualization**
    - Creating and customizing charts (histograms, scatter plots, box plots)
    - Pivot tables and pivot charts
    - Dashboard creation for statistical reporting
5. **Advanced Excel Functions**
    - Lookup functions (VLOOKUP, HLOOKUP, INDEX-MATCH)
    - Logical functions (IF, AND, OR)
    - Array formulas and dynamic ranges

Module-2

6. **Excel for Statistical Modeling**
    - Hypothesis testing (t-tests, chi-square tests)
    - ANOVA and variance analysis
    - Time series analysis and forecasting

Course No.: P2STPC106
Credit Hours :04
Duration of Examination: 4 Hrs

Title: Computational Statistics
with Excel
Maximum Marks:100
Internal : 50
External : 50

7. **Excel Macros & Automation**
   - Introduction to VBA (Visual Basic for Applications)
   - Writing simple macros for repetitive tasks
   - Automating statistical computations
8. **Case Studies & Applications**
   - Real-world statistical problems solved using Excel
   - Industry applications in finance, healthcare, and research
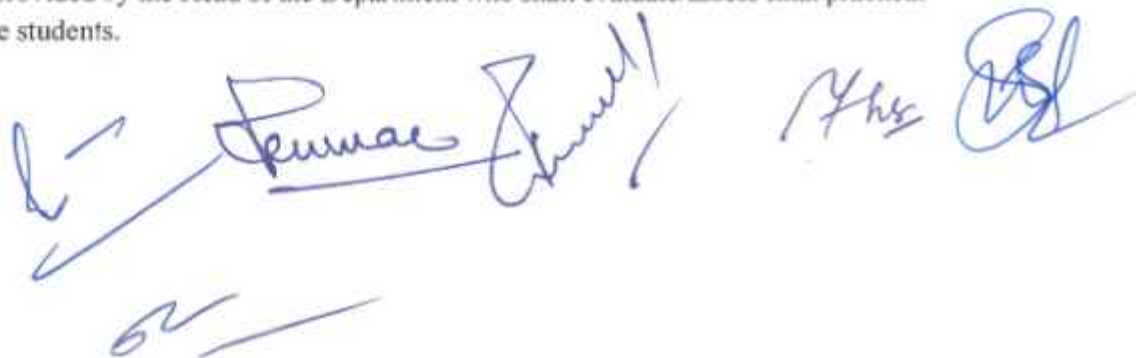
SCHEME OF EXAMINATIONS

Each practical Internal and External paper shall carry **50 marks** and will be of **04 hours** and distribution
of marks shall be as under:

Component	Marks	Remarks
Internal	25	After 60 days on completion of 50 % of syllabus **Written Exam: 20 Marks (Attempt two Practical of 10 Marks Each out of three Practicals)** **Viva Voce :05 Marks**
External	75	On completion of entire syllabus **Written Exam: 40 Marks (two Practicals each of 20 Marks out of three Practicals)** **Case study report: 10** **Viva Voce: 25 Marks**
Total	100	

External Practical examination shall be conducted by Board of Examiners consisting of Head of
the Department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out
of the panel to be provided by the Head of the Department who shall evaluate/assess final practical
performance of the students.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STPC107
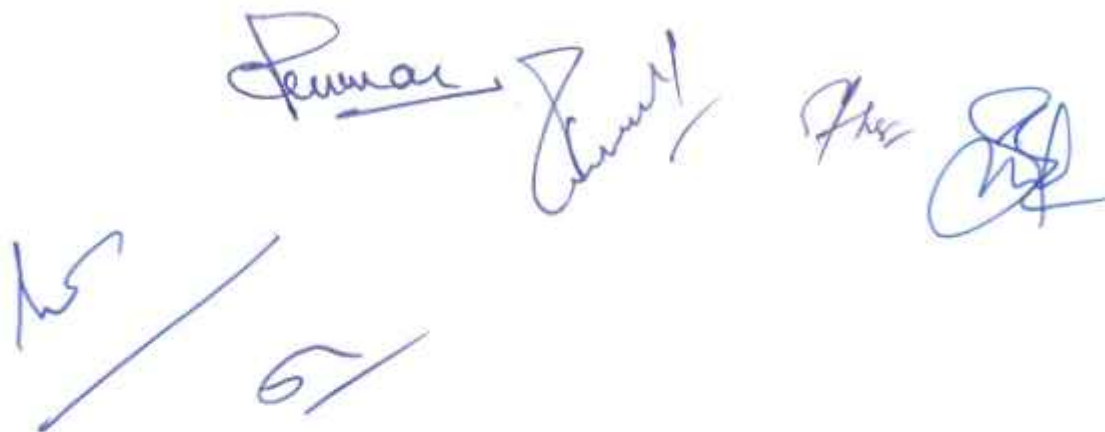Credits Hours:01
Duration of Examination: 3 Hrs

Title: Scientific Publishing using Latex
Maximum Marks: 25
Internal: 10
External: 15

Module - 1

Installation of Kile and MikeTeX. Class and packages. Latex programming and commands, sample packages. Error messages, Some sample errors, list of LaTeX error messages. Fonts, symbols, indenting, paragraphs, line spacing, word spacing, titles and subtitles. Document class, page style, parts of the documents, table of contents. Command names and arguments, environments, declarations. Theorem like declarations, comments within text.

Module - 2

Mathematical environments, math mode, mathematical symbols. Graphic package, multivalued functions, drawing matrices. Tables, tables with captions. References to figures and tables in text. Picture environments. Extended pictures, other drawing packages. Preparing book, project report in LaTeX, LaTeX Beamer for Technical Presentations.

Books Recommended

1.	Kopka, H., Daly, P. W. (2003)	Guide to LaTeX. United Kingdom: Pearson Education
2.	Kottwitz, S. (2021)	LaTeX Beginner's Guide: Create Visually Appealing Texts, Articles, and Books for Business and Science Using LaTeX. United Kingdom: Packt Publishing.
3.	Lamport (1994)	Latex: A Document Preparation System, 2/E. India: Pearson Education.

SCHEME OF EXAMINATION

Each practical paper shall have the following distribution of marks and will be of **03 Hours**:

Component	Marks	Remarks
Internal	10	After 60 days on completion of 50 % of syllabus **Written Exam: 10 Marks (Attempt two Questions of 05 Marks Each out of Three asked questions from Module-1)**
External	15	On completion of entire syllabus **Written Exam: 10 Marks (Attempt two questions of 05 Marks Each out of Three Questions from Module-2)** **Viva Voce :05 Marks**
Total	25	

Course No.: P2STPC107   Title: Scientific Publishing using Latex
Credits Hours:01   Maximum Marks: 25
Duration of Examination: 3 Hrs   Internal: 10
                                         External: 15

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department and the concerned teacher who shall evaluate/assess final practical performance of the students.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STTC108   Title: Seminar
Credits Hours :01   Maximum Marks:25
Duration of Examination: 1 Hour

Course Learning Outcomes (CLO)

After completing this course, the learner will be able to:

1: To enhance the critical thinking and communication skills of students, enabling them to effectively evaluate, synthesize, and apply information in academic and professional contexts for decision makings.

2: To enhance the research acumen and statistical as well as interpretation skills of students, enabling them to effectively apply statistical tools in academic and professional contexts.

SCHEME OF EXAMINATION

The seminar presentation shall carry 25 marks and distribution of marks shall be as under:

Presentation	Contents	Domain Knowledge	Total
05	10	10	25

Evaluation Criteria: Each student will be allotted a mentor under whose guidance student will prepare the Seminar.

Each Seminar presentation will be of **duration 45-60 minutes**. Evaluation of the seminar will be done by the DAC members on the above parameters. There will be no external examination/viva-voce examination. The schedule of the Seminar will be issued by the Head of the Department.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-I examinations to be held in Dec-2025,2026 and 2027

Course No.: P2STTE109   Title: Basic Statistics
Credits Hours: Non-Credit   Maximum Marks:100
Duration of Examination: 3 Hrs Minor Test -I: 20
                               Minor Test -II: 20
                               Major Test: 60

Course Outcomes:

- **CO1:** Understand fundamental statistical concepts, including measures of central tendency, dispersion, probability laws, and random variables, applying Bayes' theorem in problem-solving.

- **CO2:** Analyze statistical relationships using expectation, moment generating functions, correlation, regression analysis, and curve fitting methods for data interpretation.

- **CO3:** Apply hypothesis testing techniques, including significance levels, power of tests, NP Lemma, and estimation methods for effective statistical inference.

- **CO4:** Explore classification models, analysis of variance, and experimental design principles to enhance statistical modeling and decision-making.

- **CO5:** Develop an understanding of official statistics, including data compilation, dissemination, and the roles of National Statistical Organizations and Commissions in policymaking.

Unit I

Measures of Central Tendency, Measures of Dispersion, Classical and axiomatic definitions of Probability. Additive and multiplicative laws of probability, Conditional probability, Bayes' theorem and applications. Discrete and continuous random variables. Distribution function and their properties.

Unit II

Expectation, Moment Generating Function, Correlation: Simple, Partial and multiple correlation, Intraclass correlation, Correlation ratio, Regression lines, regression coefficients and their properties. Principle of least squares and fitting of a straight line. Bivariate and multivariate data, Association and Contingency, Curve fitting and Orthogonal Polynomials.

Unit III
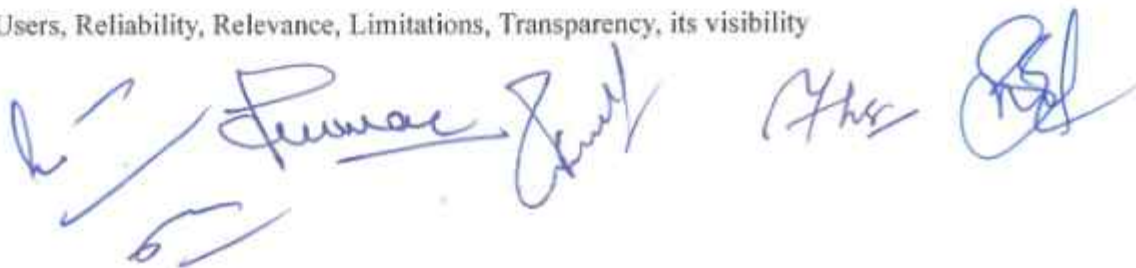
Testing of Hypothesis: Statistical hypothesis, Null and alternative hypothesis, simple and composite hypothesis, two types of error, Critical region, Different types of critical regions and similar regions, power of test, level of significance. Best Critical Region, NP Lemma, its applications, Properties of good estimator and methods of estimation.

Unit IV

One way and two-way classifications, fixed, random and mixed effects models. Analysis of variance (two- way classification only), Design of experiment

Official Statistics:

(a) Need, Uses, Users, Reliability, Relevance, Limitations, Transparency, its visibility

Course No.: P2STTE109
Credits Hours: Non-Credit
Duration of Examination: 3 Hrs

Title: Basic Statistics
Maximum Marks:100
Minor Test -I: 20
Minor Test -II: 20
Major Test: 60

(b)Compilation, Collection, Processing, Analysis and Dissemination.
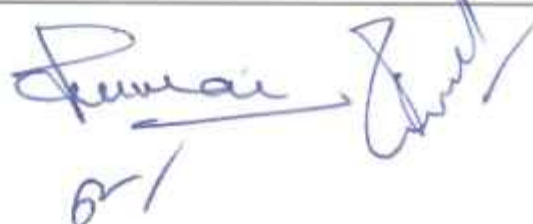
National Statistical Organization: Vision and Mission, NSSO and CSO, roles and responsibilities, important activities, Publications etc.

National Statistical Commission: Need, Constitution, its role, functions etc, Legal Acts/ Provisions/ Support for Official Statistics; Important Acts.

Books Recommended:

1.	Das,M.N. and Giri,N. (1987)	Design and Analysis of Experiments, New Age International Publication
2.	Goon,A.M.,Gupta M.K. and Dasgupta,B(2013)	Fundamentals of Statistics, World Press
3.	Gupta,S.C. and Kapoor V.K.(2017)	Fundamentals of Applied Statistics, S Chand publication
4.	Gupta,S.C. and Kapoor V.K.(2017)	Fundamentals of Mathematical Statistics, S Chand publication
5.	Hogg ,R. and Craig,A (2012)	Introduction to Mathematical Statistics, Pearson
6.	Mood,A.M., Graybill,F. and Boes,D.(2017)	Introduction to Theory of Statistics, McGraw Hill
7.	Rohtagi,V.K. and Saleh A.K.M.E. (2015)	An Introduction to Probability and Statistics, Wiley
8.	Schiller,J. Srinivasan, A. R.and Spiegel, M. (2012)	Outline of Probability and Statistics, Mc Graw Hill
9.	Yule G.U. (2019)	An introduction to the theory of Statistics, Wiley–Blackwell

Course No.: P2STTE109   Title: Basic Statistics

Credits Hours: NC   Maximum Marks:100

Duration of Examination: 3 Hrs   Minor Test -I: 20

Minor Test -II: 20

Major Test: 60

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions of 15 marks each to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks).

In major test there should not be a gap of more than two days in between two tests.

Department of Statistics, University of Jammu

Course Structure for PG Programme in Statistics- Two Years (NEP 2020)

Programme code – PGFMS005

Semester–II

Course Code	Course Title	Credit Hours	Contact Hours per week L-Tu-P
P2STTC201	Advanced Probability Theory	04	4-1-0
P2STTC202	Linear Models and Regression Analysis	04	4-1-0
P2STTC203	Advanced Statistical Inference-I	04	4-1-0
P2STTC204	Advanced Multivariate Analysis	04	4-1-0
P2STPC205	Data Analytics with Python	04	0-0-4
P2STPC206	Computational Statistics with SPSS	04	0-0-4
P2STPC207	Seminar	01	0-1-0
P2STPC208	Communication Skills	01	0-0-2
Total Credits		26	

EXIT OPTION VOCATIONAL COURSES			
P2STVC251	Advanced Data Analytics with Statistical Softwares	04	0-0-4

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STTC201
Credit Hours : 04
Duration of Examination: 3 Hrs

Title: Advanced Probability Theory
Maximum Marks:100
    Minor Test -I: 20
    Minor Test -II: 20
    Major Test :   60

Course Outcomes:

- **CO1**: Develop a strong foundation in probability and measure theory, including key inequalities and fundamental properties of characteristic functions.

- **CO2**: Analyse various modes of convergence for sequences of random variables and understand their interrelationships with practical illustrations.

- **CO3**: Apply key probability lemmas and laws, including Borel-Cantelli and Kolmogorov's Zero-One laws, to understand the behaviour of large sequences of random variables.

- **CO4**: Explore limiting distributions, Levy's continuity theorem, and central limit theorems to assess asymptotic behaviour in probability theory.

- **CO5**: Examine advanced probability concepts such as martingale convergence and tail events, gaining insights into stochastic processes.

UNIT-I

Recap of Basic Concepts of Probability and Measure Theory, Chebyshev's, Markov, Holder, Minkowski, Jensen and Lyapunov inequalities, Characteristic function and its properties, Parseval relation, Uniqueness theorem, Inversion theorem.

UNIT-II

Convergence of sequence of random variables, almost sure convergence, convergence in mean, convergence in probability, convergence in distribution, and their relationships with illustrations.

UNIT- III

Borel-Cantelli Lemma, Zero-One Laws of Borel and Kolmogorov, Kolmogorov's inequality, weak law and strong law of large numbers of sequences of r.v.'s with illustrations, three series criteria.

UNIT- IV

Limiting and asymptotic distributions, Levy's continuity theorem, continuity correction, Central Limit Theorems of Lindeberg-Levy, Lyapunov and Lindberg-Feller with suitable illustrations, Martingale convergence, tail events.

Books Recommended:

1.	Basu, A.K. (2012)	Measure theory and Probability, PHI, India
2.	Bhat, B. R. (2014)	Modern Probability Theory, New Age International Private Limited, India
3.	Billinsley, P. (1986)	Probability and Measure, Wiley, USA
4.	Chung, K. L. (2001)	A Course in Probability Theory, Academic Press, USA

5.	Dudley, R.M. (2002)	Real Analysis and Probability, Cambridge University Press, UK
6.	Feller, W. (1998)	Introduction to Probability and its Application Vol. II, Wiley Eastern, USA
7.	Kingman, J.F.C. and Taylor, S.J.(1966)	Introduction to measure and probability, Cambridge University Press, UK
8.	Robert , Ash (1972)	Real Analysis and Probability, Academic Press, USA
9.	Rohtagi, V. K. and Saleh A.K.M.E. (2015)	An Introduction to Probability and Statistics, Wiley, USA

SCHEME OF EXAMINATION

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test
The Major test will comprise of **two sections**, Section-A and Section-B.
Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).
Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks).
In major test there should not be a gap of more than two days in between two tests.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy
(NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STTC202
Credit Hours :04
Duration of Examination: 3 Hrs

Title: Linear Models and Regression Analysis
Maximum Marks:100
    Minor Test -I : 20
    Minor Test -II : 20
    Major Test   : 60

Course Outcomes:

- **CO1**: Understand the Gauss-Markov setup, least squares estimation, and properties of estimation spaces, including variance and covariance analysis.

- **CO2**: Apply hypothesis testing techniques for linear parametric functions, confidence intervals, analysis of variance, and multiple variance comparison tests.

- **CO3**: Develop proficiency in regression modelling, including simple, multiple, logistic, and polynomial regression, along with diagnostic tools for model validation.

- **CO4**: Explore generalized linear models (GLMs) and link functions, understanding their applications in statistical modelling and inference.

- **CO5**: Analyse non-linear models, large sample tests, model selection criteria (AIC and BIC), and techniques for goodness-of-fit assessment

UNIT- I

Gauss-Markov set-up, Normal equations and Direct Least squares estimates, Error and estimation spaces, variances and covariances of least squares estimates, estimation of error variance, least squares estimate with exact restriction on parameters.

UNIT -II

Simultaneous Estimates of linear Parametric functions, Tests of hypothesis for one and more than one linear parametric functions, confidence intervals and regions, Analysis of Variance, Multiple variance comparison test(s), simultaneous confidence intervals.

UNIT -III

Introduction to One-way and two ways random effects linear models and estimation of variance components, Simple linear Regression, multiple, logistic and polynomial regression, orthogonal polynomials, reparameterization of linear models. Residuals and their plots as tests for departure from assumptions such as fitness of the model, normality, homogeneity of variances and detection of Outliers, Remedies.

UNIT -IV

Fundamental concept of generalized linear model (GLM), exponential family of random variables. Link functions such as Logit, Probit, binomial, inverse Gaussian, gamma. Introduction to non-linear models; least squares in non-linear case, transformation of the model. Large sample tests about parameters, goodness of fit, analysis of deviance. Variable selection: AIC and BIC.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.:
P2STTC202 Credit
Hours :04
Duration of Examination: 3 Hrs

Title: Linear Models and Regression Analysis
Maximum Marks:100
 Minor Test -I : 20
 Minor Test -II : 20
 Major Test : 60

Books Recommended:

1.	Cook, R.D. and Weisber, S. (1982)	Residual and Influence in Regression, Chapman and Hall, USA.
2.	Draper, N.R. and Smith, H. (1998)	Applied Regression Analysis 3ᵈ Ed. Wiley, USA.
3.	Graybill, F.A. (2000)	Theory and Application of the Linear Models, Cengage Learning Models, Boston
4.	Gunst, R.F. and Mason,R.L.(1980)	Regression Analysis and its Application-A Data Oriented Approach, Marcel and Dekker, New York.
5.	Hosmer Jr, D. W.,Lemeshow S., & Sturdivant, R. X.(2013).	Applied logistic regression (Vol. 398). John Wiley & Sons, New Jersy.
6.	Montgomery, D.C. and E.A. Peck (2021)	Introduction to Linear Regression Analysis, John Wiley &sons, New Jersy.
7.	Rao, C.R. (2002)	Linear Statistical Inference and its Applications, Wiley, USA.
8.	Weisber, S. (1995)	Applied Linear Regression, Wiley Eastern, USA.

SCHEME OF EXAMINATION

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.:
P2STTC202 Credit
Hours :04
Duration of Examination: 3 Hrs

Title: Linear Models and Regression Analysis
Maximum Marks:100
   Minor Test -I : 20
   Minor Test -II : 20
   Major Test   : 60

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks) .

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks).

In major test there should not be a gap of more than two days in between two tests.

Course No.: P2STTC203
Credit Hours :04
Duration of Examination: 3 Hrs

Title: Advanced Statistical Inference-I
Maximum Marks : 100
    Minor Test -I : 20
    Minor Test -II : 20
    Major Test :   60

Course Outcomes:

- CO1: Apply advanced hypothesis testing techniques, including the Neyman-Pearson Lemma, UMPU tests, and likelihood ratio tests for statistical inference.

- CO2: Utilize estimation methods such as MVUE, Cramer-Rao Inequality, and Maximum Likelihood Estimation (MLE) for parameter estimation and model evaluation.

- CO3: Analyse confidence intervals, tolerance intervals, and statistical decision rules, incorporating Bayes and minimax estimators for optimal decision-making.

- CO4: Perform non-parametric inference using goodness-of-fit tests, rank-based tests, and bootstrapping methods for robust statistical analysis.

- CO5: Understand key asymptotic properties, empirical distribution functions, and order statistics to enhance statistical modelling and inference techniques.

Unit-I

Review of Neyman-Pearson Lemma and its generalization. Unbiasedness in hypothesis testing, UMPU tests for one and two-sided hypothesis – in case of exponential families, similar tests and tests of Neyman structure and its relation to bounded completeness, Concept and applications of Wald's SPRT and Likelihood ratio tests.

Unit-II
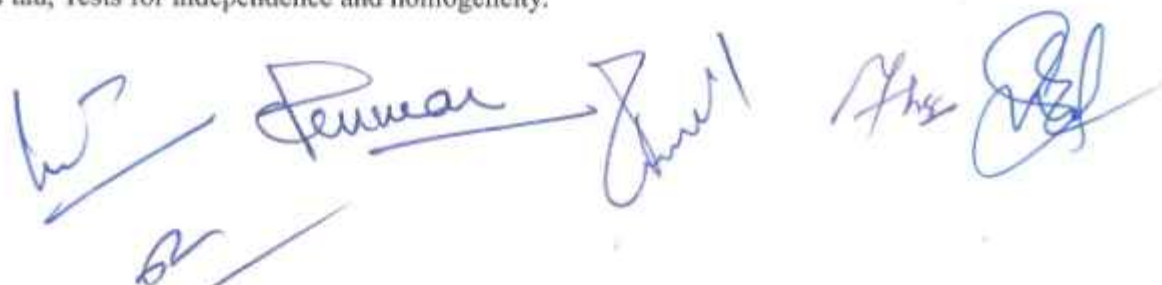
MVUE and Review of methods to obtain MVUE viz., Cramer-Rao Inequality, Chapman-Robbins-Kiefer Inequality, Rao-Blackwellization and Lehmann-Scheffe. Review of moment, percentile and maximum likelihood estimation, MLE for Censored and truncated distribution, Cramer-Huzurbazar theorem, solution of likelihood equation by method of scoring, Introduction to Sequential Estimation and Sequential Cramer –Rao inequality.

Unit-III

Coverage probabilities and confidence intervals, tolerance intervals, empirical distribution function and its properties, asymptotic distributions of order-statistics, bounds on expected values. Concept of Shortest Expected length Confidence Intervals based on Pivots.
Statistical Decision Problem: non –randomized and randomized decision rules, loss functions, risk function, admissibility, Bayes rule, minimax rule, least favourable distribution, priori and posterior distributions, admissible, Bayes and minimax estimators with illustrations.

Unit-IV

Non-parametric inference: Goodness of fit tests- Chi square test and Kolmogorov Smirnov test for one and two sample problems, Sign test, Signed rank test, Wald-Wolfowitz run test, Median test, Man-Whitney U-test, Kruskal-Wallis Test, Bootstrapping confidence intervals, P-P Plot and Q-Q plot, Kendall's tau, Tests for independence and homogeneity.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STTC203　　　　　　　Title: Advanced Statistical Inference-I
Credit Hours :04　　　　　　　　　　Maximum Marks : 100
Duration of Examination: 3 Hrs　　　　　Minor Test -I :　20
　　　　　　　　　　　　　　　　　　　Minor Test -II : 20
　　　　　　　　　　　　　　　　　　　Major Test :　　60

Books Recommended:

1.	Ferguson, T.S. (1967)	Mathematical Statistics: A Decision Theoretic Approach, John Wiley, USA.
2.	Gibbons, D. & Chakraborty, S. (2011)	Non-parametric Statistical Inference, Chapman and Hall, USA.
3.	Goon, A.M., Gupta, M.K. & Das Gupta, B. (2003)	An outline of Statistical Theory, World Press Pvt. Ltd., India.
4.	Kale, B.K. (2007)	Parametric Inference, Alpha science Int. Ltd., UK
5.	Lehman, E.L. (1998)	Theory of Point Estimation, Springer, London.
6.	Lehman, E.L. (1998)	Testing Statistical Hypothesis, Springer, London.
7.	Rajagopalan, M and Dhanavanthan, P. (2012)	Statistical Inference, PHI, India.
8.	Randles, H.R. & Wolfe, D.A. (1991)	Introduction to the Theory of Nonparametric Statistics, Krieger Publishing Company, USA
9.	Rohatgi, V.K. (1997)	Statistical Inference, Wiley, USA.
10.	Rohatgi, V.K. (1998)	An Introduction to Probability Theory and Mathematical Statistics, Wiley, USA.
11.	Zacks, S. (1981)	Theory of Statistical Inference, John Wiley, USA.
12.	Conover, W.J. (1999)	Practical Non-Parametric Statistics, John Wiley & Sons, New Jersy.

SCHEME OF EXAMINATION

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:
Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to

Course No.: P2STTC203
Credit Hours :04
Duration of Examination: 3 Hrs

Title: Advanced Statistical Inference-I
Maximum Marks : 100
Minor Test -I :   20
Minor Test -II : 20
Major Test :   60

answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks) .

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

 In major test there should not be a gap of more than two days in between two tests.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STTC204
Credit Hours :04
Duration of Examination: 3 Hrs

Title: Advanced Multivariate Analysis
Maximum Marks   : 100
   Minor Test -I: 20
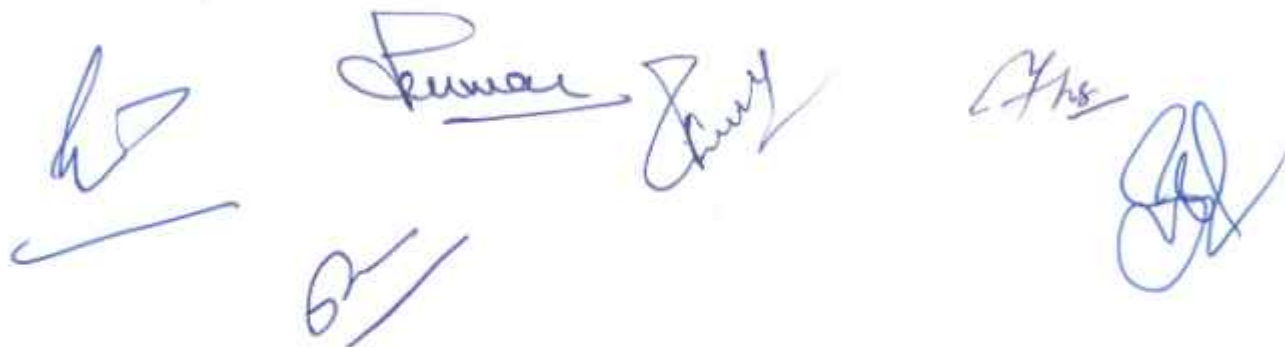   Minor Test -II: 20
   Major Test: 60

Course Outcomes:

- **CO1**: Understand the properties and characterization of the multivariate normal distribution, including marginal and conditional distributions and maximum likelihood estimation.

- **CO2**: Apply statistical methods such as Hotelling's T^2 statistic, Mahalanobis D^2 statistic, and Wishart matrix for hypothesis testing and data analysis in multivariate settings.

- **CO3**: Analyse correlation and regression coefficients, sampling distributions, classification methods, and decision rules for multivariate statistical inference.

- **CO4**: Utilize dimension reduction techniques, including principal component analysis, canonical correlations, and factor analysis for complex data interpretation.

- **CO5**: Develop proficiency in classification models, discriminant analysis, and clustering methods for effective multivariate data segmentation

UNIT- I

Multivariate normal distribution, its properties and characterization, marginal and conditional distributions, distribution of linear combinations of normal variates. Maximum likelihood estimators of parameters. Distribution of Quadratic forms. Likelihood ratio Test for mean vectors, Comparing several mean vectors and variance co-variance matrix.

UNIT- II

Hotelling's T^2 statistic-its distribution and application in testing of mean vector for one and more multivariate normal populations, Mahalanobis D^2 statistic and its applications. Wishart matrix- its distribution, characteristic function and properties, Wilk's Distribution, density function of Wilk's statistic;

UNIT- III

Null and non-null distribution of sample correlation coefficient, Distribution of sample regression coefficients, sampling distribution of multiple correlation coefficient. Application in testing and interval estimation. Testing independence of sets of variates, testing equality of covariance matrices and means. Classification problem-standards of good classification, procedures of classification into one of two populations with known probability distributions, classification into one of two known multivariate normal populations, classification into one of several populations; Bayes solution, Fisher's discriminant function

UNIT-IV

Principal component analysis; canonical variables and canonical correlations, factor analysis and cluster analysis.

Course No.: P2STTC204
Credit Hours :04
Duration of Examination: 3 Hrs

Title: Advanced Multivariate Analysis
Maximum Marks   : 100
    Minor Test -I: 20
    Minor Test -II: 20
    Major Test: 60

Books Recommended:

1.	Anderson, T.W. (2003)	An introduction to Multivariate Statistical Analysis, Wiley, USA.
2.	Hardle, W. & Simar, L. (2012)	Applied Multivariate Statistical Analysis, Springer International Ltd., London.
3.	Jobson, D.B. (1997)	Applied Multivariate Analysis, Springer, London.
4.	Johnson, R.A. & Wichern D.W. (2012)	Applied Multivariate Statistical Analysis, PHI, India.
5.	Morrison, D.F. (2003)	Multivariate Analysis, McGraw Hill, New York.
6.	Searle, S.R., Casella, G. & McCulloch, C.E. (1992)	Variance Components, Wiley, USA.
7.	Srivastava, M.S. & Khatri, C.G. (1983)	An introduction to multivariate statjstics, Elsevier North Holland, New York

SCHEME OF EXAMINATION

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STTC204

Title: Advanced Multivariate Analysis

Credit Hours :04

Maximum Marks   : 100

Duration of Examination: 3 Hrs

Minor Test -I: 20

Minor Test -II: 20

Major Test: 60

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks) .

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

 In major test there should not be a gap of more than two days in between two tests.

Course No.: P2STPC205	**Title: Data Analytics with Python**
Credit Hours :04	**Maximum Marks:100**
Duration of Examination: 4 Hrs	**Internal: 50**
	External: 50

Course Outcome (C.O):

After completion of this course the students will be able to

1. Define python environment Understand

2. Explain python programming language Evaluate

3. Develop a scientific computing environment using python Evaluate

4. Identify the use of python software to meet the given scientific objective

Module I:

Introduction: The Process of Computational Problem Solving, Python Programming Language, Python Data Types: Expressions, Variables and Assignments, Strings, List, Objects and Classes, Python Standard Library, Imperative Programming: Python programs, Execution Control Structures, User-Defined functions, Python Variables and Assignments, Parameter Passing. Text Files: Strings, Formatted Output, Files, Errors and Exception Handling, Execution and Control Structures: if Statement, for Loop, Two Dimensional lists,
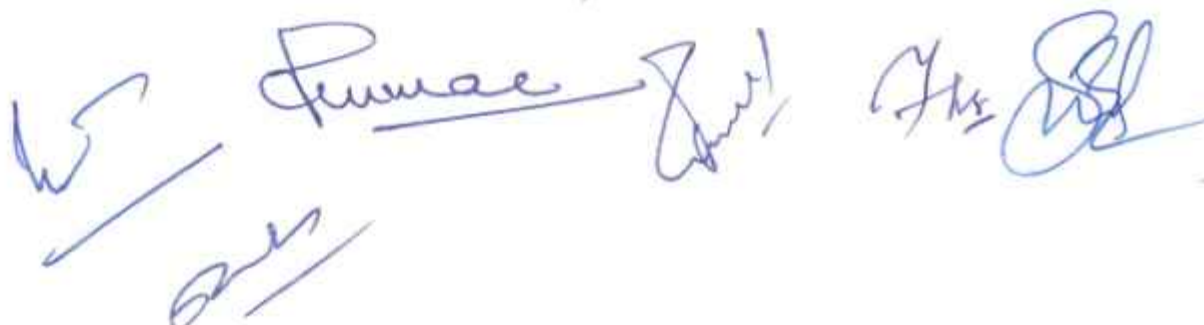
while Loop, More Loop Patterns, Additional Iteration Control Statements, Containers and Randomness: Dictionaries, Other Built-in Container Types, Character Encoding and Strings, Module random, Set Data Type.

Module II:

Lists: Basic Operations, Iteration, Indexing, Slicing and Matrixes; Dictionaries: Basic dictionary operations; Tuples and Files; Functions: Definition, Call, Arguments, Scope rules and Name resolution; Modules: Module Coding Basics.

References

1.	Charles Dierbach. (2012).	Introduction to computer science using Python a computational problem-solving focus, John-Wiley & Sons.
2.	Perkovie, L. (2011).	Introduction to computing using python: An Application development focus. Wiley Publishing.
3.	McKinney, W. (2012).	Python for data analysis: Data wrangling with Pandas, NumPy, and I Python. "O Reilly Media, Inc."

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STPC205   Title: Data Analytics with Python
Credit Hours :04   Maximum Marks:100
Duration of Examination: 4 Hrs   Internal: 50
    External: 50

SCHEME OF EXAMINATION

Each practical Internal and External paper shall carry **50 marks** and will be of **04 hours** and distribution

of marks shall be as under:

Component	Marks	Remarks
Internal	25	After 60 days on completion of 50 % of syllabus **Written Exam: 20 Marks (Attempt two Practical of 10 Marks Each out of three Practicals)** **Viva Voce :05 Marks**
External	75	On completion of entire syllabus Written Exam: 40 Marks (two Practicals each of 20 Marks out of three Practicals) Case study report: 10 Viva Voce: 25 Marks
Total	100	

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance of the students.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STPC206   Title: Statistical Computing with SPSS
Credits Hours:04   Maximum Marks:100
Duration of Examination: 4 Hrs   Internal: 50
      External: 50

Course Outcomes:

- **CO1:** Develop proficiency in SPSS, including data entry, coding, recoding, and pre-processing techniques for efficient data management.

- **CO2:** Utilize data visualization tools in SPSS, such as histograms, box plots, scatter plots, and map plots, for insightful statistical interpretations.

- **CO3:** Apply descriptive statistical methods, including measures of central tendency, correlation analysis, and regression modelling, for data-driven decision-making.

- **CO4:** Perform parametric and non-parametric hypothesis tests using SPSS, including t-tests, ANOVA, Chi-square tests, and rank-based tests for statistical inference.

- **CO5:** Assess survey data reliability and validity through Likert scale analysis, questionnaire testing, and advanced statistical modelling techniques.

There shall be at least twenty computing exercises covering the applications of Statistical Software's and computing tools.

Practical

The SPSS Environment

- Getting Started, the SPSS data Editor, Data View and Variable View
- Arranging the variable view to input primary data, Data Entry, Text Entry
- Coding and Decoding of data, Recoding into same and different variable.

Pre-processing and tabulation of Data

Data Visualisation:

- Histograms, Box Plot, Simple and Clustered Bar Chart, Line Charts, Scatter plot, Probability plots and Q-Q Plot and their interpretation through some case studies.
- Map plots, Population Pyramid, Error-bar plots, Weibull Plots and their interpretation through some case studies.

Descriptive Statistics

- Computation of frequencies, cross-tabulation, measures of central tendency, dispersion, skewness and kurtosis, analysis of grouped frequency distributions and their interpretation through some case studies
- Computation of correlation coefficient (Pearson, Spearman, Kendall, Biserial and Point-biserial correlation), correlation matrix, partial correlation
- Simple Linear Regression, Non-linear regression involving two variables, Multiple Regression, Checking the assumptions of regression, use of dummy variables in regression.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy
(NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STPC206   Title: Statistical Computing with SPSS

Credits Hours:04   Maximum Marks:100

Duration of Examination: 4 Hrs   Internal: 50

                                             External: 50

Parametric and Non-parametric Tests in SPSS

- Performing basic parametric tests in SPSS- Z-test for proportions (one sample and two sample), t-test (single mean, independent samples, paired sample), Levine test, Chi square test for independence of attributes and Goodness-of-fit
- ANOVA-one way, two-way (with single and multiple number of observations per cell), Latin Square Design experiment.
- Basic non-parametric tests: Wilcoxon Signed Rank Test, Mann-Whitney U Test, Wilcoxon Matched Pair Signed Rank Test, Median test, run test (one sample, two samples), Wald-Wolfowitz Run Test, Kolmogorov-Smirnov (one sample and two sample tests),
- Kruskal-Wallis One-way ANOVA, Binomial test, McNemar's Test, Cochran's Q Test, Kendall's Coefficient of Concordance.
- Collection and analysis of Likert Scale type data.
- Testing Reliability and Validity of the Questionnaire

Course No.: P2STPC206   Title: Statistical Computing with SPSS
Credits Hours:04   Maximum Marks:100
Duration of Examination: 4 Hrs   Internal: 50
                                             External: 50
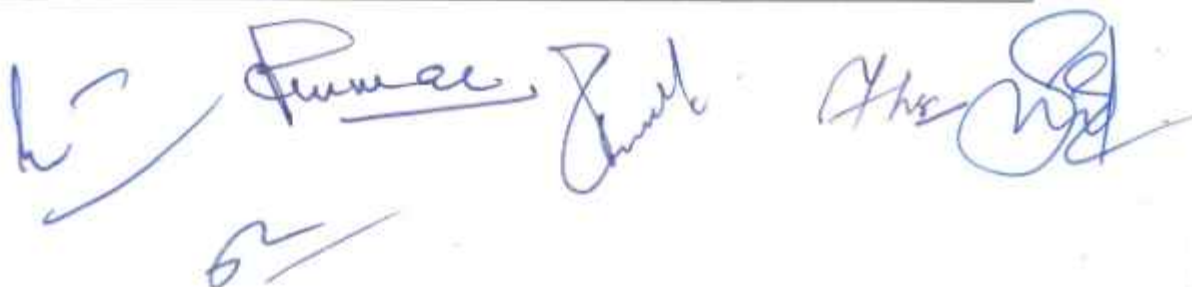
Books Recommended

1	Carver RH. and Nash JG. (2012)	Doing Data Analysis in SPSS: Version 18.0, Cengage Learning.
2.	Field A. (2024)	Discovering Statistics Using SPSS, Sage Publications.
3.	Ho, Robert (2006)	Handbook of Univariate and Multivariate Data Analysis and Interpretation with SPSS, Chapman and Hall/CRC Press, London.
4.	Landu, S. and Everitt, BS. (2004)	A Handbook of Statistical Analysis in SPSS, Chapman and Hall/CRC Press, London.
5.	Schmidt W (2019)	IBM SPSS: Comprehensive Beginners Guide to Learn Statistics Using IBM SPSS from A to Z, Independently Published.

SCHEME OF EXAMINATION

Each practical Internal and External paper shall carry **50 marks** and will be of **04 hours** and distribution of marks shall be as under:

Component	Marks	Remarks
Internal	25	After 60 days on completion of 50 % of syllabus **Written Exam: 20 Marks (Attempt two Practical of 10 Marks Each out of three Practicals)** **Viva Voce :05 Marks**
External	75	On completion of entire syllabus **Written Exam: 40 Marks (two Practicals each of 20 Marks out of three Practicals)** **Case study report: 10** **Viva Voce: 25 Marks**
Total	100	

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STPC206	Title: Statistical Computing with SPSS
Credits Hours:04	Maximum Marks:100
Duration of Examination: 4 Hrs	Internal: 50
	External: 50

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance of the students.

Course No.: P2STPC207
Credit Hours :01
Duration of Examination: 1 Hour

Title: Seminar
Maximum Marks:25

Course Learning Outcomes (CLO)

After completing this course, the learner will be able to:

1: To enhance the critical thinking and communication skills of students, enabling them to effectively evaluate, synthesize, and apply information in academic and professional contexts for decision making.

2: To enhance the research acumen and statistical as well as interpretation skills of students, enabling them to effectively apply statistical tools in academic and professional contexts.

SCHEME OF EXAMINATIONS

The seminar presentation shall carry 25 marks and distribution of marks shall be as under:

Presentation	Contents	Domain Knowledge	Total
05	10	10	25

Evaluation Criteria: Each student will be allotted a mentor under whose guidance student will prepare the Seminar.

Each Seminar presentation will be of **duration 45-60 minutes**. Evaluation of the seminar will be done by the DAC members on the above parameters. There will be no external examination/viva-voce examination. The schedule of the Seminar will be issued by the Head of the Department.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STPC208
Credit Hours :01
Duration of Examination: 3 Hrs

Title: Communication Skills
Maximum Marks: 25
Internal: 10
External: 15

Course Outcomes:

- CO1: Understand the fundamentals of communication, including its process, types, professional relevance, and barriers to effective communication.

- CO2: Develop oral communication skills, including listening techniques, paralinguistic features, and proficiency in group discussions, debates, interviews, and public speaking.

- CO3: Enhance reading skills through various reading strategies such as skimming, scanning, and intensive/extensive reading for effective information processing.

- CO4: Apply written communication techniques in academic and professional contexts, including business letters, reports, emails, and research papers.

- CO5: Develop soft skills such as body language awareness, presentation skills, and interpersonal communication for professional and personal effectiveness

Module-1

Fundamentals of Communication: Definition, Process, Importance of Communication, Types of Communication, Purpose of Professional Communication. Barriers to Communication.

Oral Communication: Listening Skill - Effective Listening, Intensive Listening vs Extensive listening, Techniques of Effective Listening, Listening and Note Taking.

Speaking Skills: Paralinguistic features - Rate, Pauses, Volume, Pitch/Intonation/Voice Modulation, Pronunciation and Articulation. Group Discussions, Debates, Interviews, Public Speaking.

Readings Skills - Effective Reading, Types of Reading (Skimming, Scanning, Extensive Reading, Intensive Reading).

Module-2

Written communication: Academic Writing; Critical Thinking; Technical Writing vs Creative Writing - Paragraph Writing (structure, construction, coherence and cohesion), Business Letters (Acknowledgement letter, Appreciation letter, Order letter), Business Reports, Research Papers, Advertising, Notices, Emails, Resume writing, Cover Letter.

Soft Skills: Body Language – Personal Appearance, Gesture, posture, facial expression, eye contact; Proxemics/ Space Distance; Presentation Skills.

Books Recommended:

1.	Banerjee Meera & Mohan Krishna (1990)	Developing Communication Skills, Macmillan Publications, UK.
2.	Chaturvedi, P.D. (2013)	Business Communication, Pearson Publications, London.
3.	M.J. Mathew (2005)	Business Communication, RBSA Publications, India.
4.	Taylor Shirley (2005)	Communication for Business, Pearson Publications, London.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-2 examinations to be held in May-2026,2027 and 2028

Course No.: P2STPC208
Credit Hours :01
Duration of Examination: 3 Hrs

Title: Communication Skills
Maximum Marks: 25
Internal: 10
External: 15

SCHEME OF EXAMINATION

Each practical paper shall have the following distribution of marks and will be of **03 Hours**:

Component	Marks	Remarks
Internal	10	After 60 days on completion of 50 % of syllabus **Written Exam: 10 Marks (Attempt two Questions of 05 Marks Each out of Three asked questions from Module-1)**
External	15	On completion of entire syllabus **Written Exam: 10 Marks (Attempt two questions of 05 Marks Each out of Three Questions from Module-2)** **Viva Voce :05 Marks**
Total	25	

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department and the concerned teacher who shall evaluate/assess final practical performance of the students.

Course No.:P2STVC251
Credit Hours :01
Duration of Examination: 3 Hrs

Title: Advanced Data Analytics with Statistical Softwares

Maximum Marks: 25
Internal: 10
External: 15

Course Outcomes:

- **CO1**: Develop proficiency in data management, organization, cleaning, and visualization techniques for effective statistical analysis.
- **CO2**: Utilize advanced regression models, non-parametric statistical methods, and predictive analytics to enhance data-driven decision-making.
- **CO3**: Explore time series analysis, forecasting techniques, and survival models such as Cox regression and Kalman filters for practical applications.
- **CO4**: Implement statistical techniques in real-world scenarios, including direct marketing case studies, ensuring practical proficiency in analytical methodologies.

Module 1: Advanced Statistical Methods and Applications

1. **Advanced Regression and Models**
   - Loglinear Models
   - Repeated Measures ANOVA
   - Non-linear Regression
   - Optimal Scaling
2. **Classification and Predictive Analytics**
   - Hierarchical Cluster Classification
   - Cluster Silhouettes
   - Receiver Operating Characteristic (ROC) Curve Analysis
3. **Time Series and Forecasting Techniques**
   - Seasonal Decomposition
   - Spectral Analysis
   - Sequence Charts

Module 2: Case Study

SCHEME OF EXAMINATION FOR VOCATIONAL COURSE

The incumbent shall undertake a case study using the advance statistical tools and techniques under the supervision of a departmental teacher who will be designated as Vocational Course Supervisor. After completion of coursework the student will have to produce a report related to the case study carried out duly signed by the vocational supervisor and Head of the department.

The Board of Examiners consisting of Head of the Department, one teacher of concerned department, and vocational supervisor shall evaluate/assess performance of the students.

The work will be assessed on the following components:

Contents of the Report	Seminar Presentation	Domain Knowledge	Total
40	20	40	100

Department of Statistics, University of Jammu

Course Structure for PG Programme in Statistics- Two Years (NEP 2020)

Programme code – PGFMS005

Semester-III

Course Code	Course Title	Credit Hours	Contact Hours per week L-Tu-P
P2STTC301	Advanced Design of Experiments	04	4-1-0
P2STTC302	Artificial Intelligence and Machine Learning	04	4-0-1
P2STTC303	Statistical Modelling and Computing	04	4-0-1
P2STRC304	Internship/Survey/Industrial Training	01	0-0-1
P2STPC305	Computing with R	04	0-0-4
P2STPC306	Advanced Data Analytics with SPSS	04	0-0-4
P2STPC307	Seminar	01	0-1-0
Any One of the following Elective Courses (From courses ending with TE308 to 313)			
P2STTE308	Advanced Statistical Inference-II	04	4-1-0
P2STTE309	Information Theory	04	4-1-0
P2STTE310	Advanced Sampling Techniques	04	4-1-0
P2STTE311	Advanced Biostatistics	04	4-1-0
P2STTE312	Advanced Reliability Theory	04	4-1-0
P2STTE313	Advanced Bayesian and Sequential Inference	04	4-1-0
P2STMO351	MOOC/SWAYAM	04	4-0-0
Total Credits		30	

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTC301   Title: Advanced Design of Experiments
Credit Hours: 04   Maximum Marks: 100
Duration of examination: 3 hours   Minor Test-I: 20
                                            Minor Test-II:20
                                            Major Test: 60

Course Outcomes:

- **CO1**: Understand key estimation techniques, hypothesis testing methods, and fixed, random, and mixed effects models, along with the principles of the Gauss-Markov theorem.
- **CO2**: Apply factorial experiment designs, missing plot techniques, confounding methods, and advanced block designs to optimize experimental analysis.
- **CO3**: Develop expertise in constructing and analysing balanced and partially balanced incomplete block designs, nested block designs, lattice designs, and Youden Square designs.
- **CO4**: Utilize response surface designs for optimization, perform covariance analysis, and address non-orthogonal data challenges in experimental setups.
- **CO5**: Implement robust statistical techniques for handling missing observations and enhancing the validity and reliability of experimental results.

Unit-I

Review of best point estimates/interval estimates of estimable linear parametric functions, estimability of linear parametric functions, and testing of linear hypothesis, Fixed, random and mixed effects linear models, Gauss-Markov theorem. Introduction to Design of Experiments: General Block Design and its information matrix (C), Criteria for connectedness, balance and orthogonality, intrablock analysis (Estimability). Optimality criteria, Robustness of Design against loss of data, Concept of Rotatable Design.

Unit-II

Review of RBD and LSD, Missing plot techniques in RBD and LSD, Symmetrical Factorial experiments with factors at two and three levels (2^n, 3^2, 3^3), Fractional replications,Regular and irregular fractions , Confounding-Total and Partial in factorial experiments, Split plot Design, Strip plot design.

Unit-III

Balanced incomplete block designs, partially balanced incomplete block design,m-associate PBIB design, methods of constructions and their analysis, Nested Block Design ,Lattice design and Youden Square Design, Geberalized Youden Design,Pseudo-Youden Design.

Unit-IV

Response Surface Design-symmetrical and asymmetrical factorials,Response Optimization and slope estimation, Analysis of Covariance in RBD, LSD and CRD, Analysis of Covariance in Non-orthogonal Data in two-way classification, Covariance and Analysis of experiments with missing observation(s).

Course No: P2STTC301
Credit Hours: 04
Duration of examination: 3 hours

Title: Advanced Design of Experiments
Maximum Marks: 100
Minor Test-I: 20
Minor Test-II:20
Major Test: 60

Books Recommended:

1.	Aloke Dey (1987)	Theory of Block Designs, Wiley-Blackwell
2.	Anderson, V.L. & McLean, R.A. (2019)	Design of Experiments: A Realistic Approach, CRC Press
3.	Angela, D., Voss D. & Draguljić, D. (2017)	Design and Analysis of Experiments, Springer
4.	Chakrabarty, M.C.(1962)	Mathematics of Design and analysis of experiments
5.	Cochran, W.G.& Cox, G.M.	Design of Experiments, John Wiley & Sons
6.	Das, M.N. & Giri N.C.(2024)	Design and Analysis of Experiment, New Age Publishers
7.	Joshi, D.D. (2003)	Linear Estimation and Design of Experiments, New Age International Publishers
8.	Kempthorne, O. (2008)	Design and Analysis of Experiments, Wiley
9.	Montgomery,C.D. (2019)	Design and Analysis of Experiments, Wiley, New York
10.	Nigam, A. K., Puri, P.D. & Gupta, V.K. (1988)	Characterizations and Analysis of Block Designs, Wiley– Blackwell
11.	Searle, S.R., Casella, G. & Culloch, C.E. (1992)	Variance Components, Wiley

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Course No: P2STTC301
Credit Hours: 04
Duration of examination: 3 hours

Title: Advanced Design of Experiments
Maximum Marks: 100
Minor Test-I: 20
Minor Test-II:20
Major Test: 60

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

In major test there should not be a gap of more than two days in between two tests.

Course No: P2STTC302   Title: Artificial Intelligence and Machine Learning

Credits Hour:04

Duration of exination: 3 hours

Maximum Marks: 100

     Minor Test-I   :20

     Minor Test-II :20
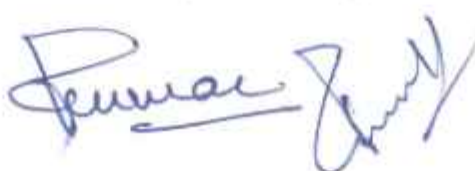
     Major Test   :60

Course Outcomes:

- **CO1**: Understand the foundation, history, and applications of artificial intelligence, along with key search techniques such as depth-first and breadth-first search.
- **CO2**: Apply heuristic search methods, including generate-and-test, hill climbing, constraint satisfaction, and simulated annealing, for problem-solving in AI.
- **CO3**: Develop knowledge of machine learning fundamentals, differentiating between AI and ML, and utilizing key concepts like training, validation, and data preprocessing.
- **CO4**: Implement supervised learning algorithms, including decision trees, Naïve Bayesian classifiers, neural networks, support vector machines, and k-nearest neighbour methods for classification tasks.
- **CO5**: Utilize advanced machine learning techniques such as case-based reasoning, random forest algorithms, and optimization methods for AI-driven decision-making.

Unit- 1

Artificial Intelligence, Foundation and History of AI, Applications of AI, AI Representation, Future of AI, Issues in Design of Search Programs - Blind Search or Depth First Search, Breadth First Search, Logic Programming.

Unit-II

Heuristic Search, Heuristic Search Methods - Generate and Test, Hill Climbing Problem, reduction–constraint satisfaction - Means-end analysis., Simulated Annealing.

Unit-III

Introduction: Basic definitions – Learning - Machine Learning vs AI - Machine Learning – features – samples – labels - Real-world applications and problems – hypothesis test - approaches of machine learning model - Data preprocessing. Representation of formal ML model: The statistical learning framework – training - testing – validation - cross validation - parametric and non-parametric methods

Unit-IV

Supervised learning Algorithms: Introduction-Approaches for classification-Decision Tree classification algorithm-Tree Pruning-Rule based Classification-IF-THEN rules classification Naïve Bayesian classification, Neural Network classification, classification by Back propagation algorithm. Support Vector Machine (SVM)-Lazy learners; k-Nearest Neighbor(k-NN) Algorithm-Case Based reasoning (CRR)-Random Forest Algorithm.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTC302

Title: Artificial Intelligence and Machine Learning

Credits Hour:04

Duration of exination: 3 hours

Maximum Marks: 100

Minor Test-I :20
Minor Test-II :20
Major Test   :60

Books Recommended:

1.	Alpaydin, E. (2014)	Introduction to Machine Learning, third edition, MIT Press
2.	Ela Kumar (2008)	Artificial Intelligence, I.K. International Publishing House Pvt. Ltd., New Delhi
3.	Dinesh Kumar, U. and Pradhan, M. (2019)	Machine learning using Python, Wiley
4.	Hastie,T.,Tibshirani R. and Friedman J. 2017	The Elements of Statistical Learning: Data Mining, Inference, and Prediction,2nd Edition Springer
5.	Motwani, B (2020)	Data Analytics using Python, Wiley
7.	Rich,E. and Knight K. (2010)	Artificial Intelligence, 3rd Edition, Tata McGraw-Hill
8.	Srinivasaraghavan, A. & Joseph, V. (2019)	Machine Learning, Wiley

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTC302   Title: **Artificial Intelligence and Machine Learning**

Credits Hour:04

Duration of exination: 3 hours

Maximum Marks: 100
    Minor Test-I   :20
    Minor Test-II :20
    Major Test   :60

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

In major test there should not be a gap of more than two days in between two tests.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTC303   Title: Statistical Modelling and Computing

Credits Hour:04   Maximum Marks: 100
Duration of examination: 3 hours   Minor Test-I : 20
                                         Minor Test-II : 20
                                         Major Test   : 60

Course Outcomes:

- **CO1**: Understand the fundamentals of simulation, including discrete and continuous systems, event scheduling, and real-world applications in problem-solving.
- **CO2**: Apply random number generation techniques, analyse queuing models, and assess performance measures for different stochastic processes.
- **CO3**: Utilize advanced sampling techniques such as importance sampling, Monte Carlo methods, bootstrap, jackknife, and permutation tests for statistical inference.
- **CO4**: Implement missing value imputation techniques, including single and multiple imputation methods, for handling incomplete datasets.
- **CO5**: Apply the EM algorithm in various contexts, including mixture models and stochastic processes, for efficient data estimation and analysis

Unit-I

Simulation: Definition, areas of application, System: discrete and continuous Systems, Model of System, Steps in a simulation study. General principles of discrete event–Simulation, Event scheduling/time advance algorithms, World views, Simulation examples: single channel queues newspaper selling problem, reliability problem, Lead-time demand.

Unit-II
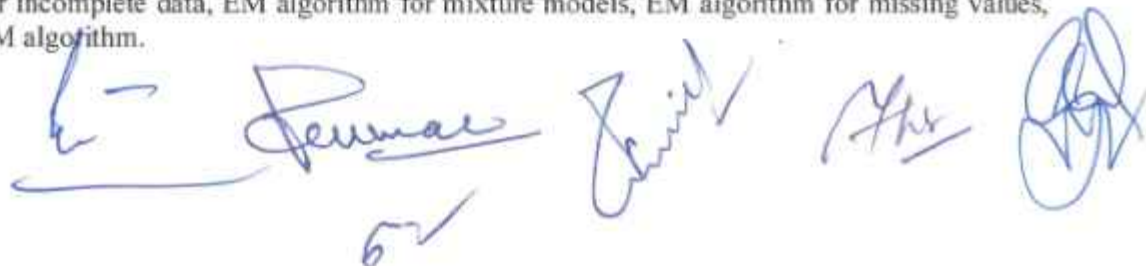
Random number generation, Properties of random numbers, Techniques of generation of pseudo–random numbers, Test for random numbers, Random variate generation: Inverse transform technique, Convolution method, Acceptance–rejection technique. Queuing Models, Long run measures of performance of models $M/M/1/N/\infty$, $M/M/C/\infty/\infty$, $M/M/C/K/K$, $M/G/1$.

Unit-III

Accept-Rejection Sampling, Importance Sampling, Markov Chain and Monte Carlo, Metropolis-Hastings, Hamiltonial Monte Carlo. esampling Techniques: Re sampling paradigms, bias-variance trade-off. Bootstrap methods, estimation of sampling distribution, confidence interval, variance stabilizing transformation. Jackknife and cross-validation. Jackknife in sample surveys. Jackknife in regression under heteroscedasticity. Permutation tests.

Unit-IV

Missing Values and Imputations Techniques: Missing values and types of missingness, imputations methods for missing values, single and multiple imputations. EM Algorithm and Applications: EM algorithm for incomplete data, EM algorithm for mixture models, EM algorithm for missing values, stochastic EM algorithm.

Course No: P2STTC303   Title: Statistical Modelling and Computing

Credits Hour:04

Duration of examination: 3 hours

Maximum Marks: 100

Minor Test-I : 20

Minor Test-II : 20

Major Test : 60

Books Recommended:

1.	Good, P. I. (2005)	Resampling Methods: A Practical Guide to Data Analysis. BirkhauserBosel.
2.	Law A. M. (2015)	Simulation Modeling and Analysis, Fifth edition, McGraw Hill New York
3.	McLachlan, G.J. and Krishnan, T. (2008)	The EM Algorithms and Extensions. Wiley.
4.	Robinson S (2014)	Simulation, The Practice of Model Development and Use, Red Globe Press; Second edition
5.	Shao J. and Tu, D. (1995)	The Jackknife and the Bootstrap. Springer Verlag.
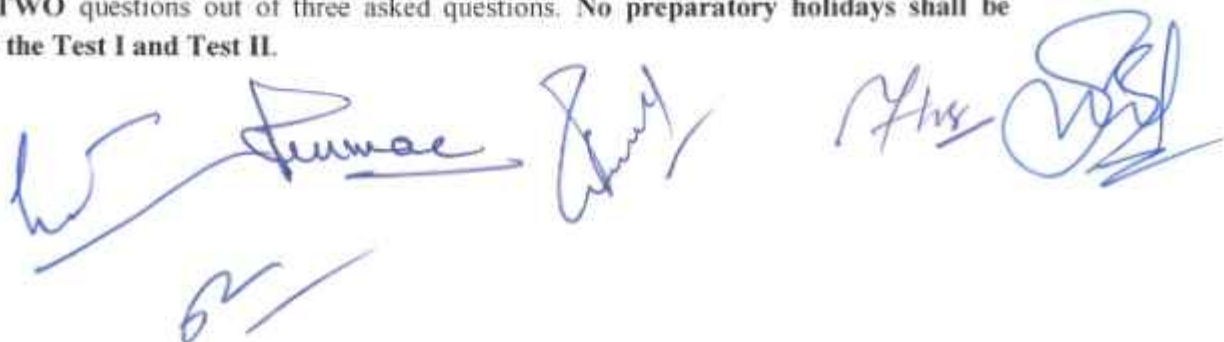
SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/he performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTC303	**Title: Statistical Modelling and Computing**
Credits Hour:04	**Maximum Marks: 100**
Duration of examination: 3 hours	**Minor Test-I : 20**
	Minor Test-II : 20
	Major Test : 60

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

 In major test there should not be a gap of more than two days in between two tests.

Course No: P2STRC304

Credit Hours :01

Title: Internship/Survey/Industrial training

Maximum Marks: 25

Course Outcomes:

It shall be a short-term internship/Project of 15 days duration at the end of Semester 2nd during the summer vacations. Students will go for a job/professional training in a suitable organization or hands-on training or activity-based course at university level in order to gain work experience.

All students will undergo internships/ Apprenticeships/project in a firm, industry, or organization or labs with faculty or researchers in their field or other HEIs/research institutions during the summer break. Students will be provided with opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a wide variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Community engagement and service: The curricular component of 'community engagement and service' seeks to expose students to the socio-economic issues in society so that the theoretical learning can be supplemented by actual life experiences to generate solutions to real-life problems. This will be part of summer term activity.

Field-based learning/minor project: The filed-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development. Students will be given opportunities to gain a first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process. They would have the opportunity to gain an understanding of the complex socio-economic problems in the community, and innovative practices required to generate solutions to the identified problems. This will be a summer term internship cum project.

SCHEME OF EXAMINATION

The internship shall be under a departmental teacher who will be designated as Internship Supervisor. After completion of summer internship students will have to produce a report related to the work carried out duly signed by the internship supervisor and Head of the department.

The Board of Examiners consisting of Head of the Department, one teacher of concerned department, and internship supervisor shall evaluate/assess performance of the students.

The work will be assessed on the following components:

Contents of the Report	Seminar Presentation	Domain Knowledge	Total
10	05	10	25

Note: The minimum passing criteria for the summer internship is 40%.

Course No: P2STPC305   Title: Computing with R
Credit Hours: 04   Maximum Marks: 100
Duration of examination: 4 hours   Internal :50
     External :50

Course Outcomes: To make students acquaint with the software R and to do practicals using this software. There shall be at least twenty computing exercises on the computation work and Statistical Analysis.

Module-1

a) **Tests of significance based on t-distribution.**
  (i) Testing the significance of the mean of a random sample from a normal population.
  (ii) Testing the significance of difference between two sample means.
  (iii) Testing the significance of an observed correlation coefficient.
  (iv) Testing the significance of an observed partial correlation coefficient.
  (v) Testing the significance of an observed regression coefficient.

b) **Tests based on F-distribution.**
  (i) Testing the significance of the ratio of two independent estimates of the population variance.
  (ii) Testing the homogeneity of means (Analysis of variance).

c) **Testing the significance of the difference between two independent correlation coefficients.**

d) **Testing the significance for**
  (i) a single proportion
  (ii) difference of proportions for large samples.

e) **Testing the significance of the difference between means of two large samples.**

f) **Testing the significance of difference between standard deviations of two large samples.**

g) **Data Visualization tools through R packages**

h) **Linear and Multiple Regression analysis**

i) **Logistics ,Probit Regression Analysis**

Module-2

j) **Understanding Bayesian Inference:**
  (i) Prior, Likelihood, and Posterior
  (ii) MCMC Sampling
  (iii) Hierarchical Models, Regression Models, Model Comparison, Posterior Predictive
  (iv) Checks and Convergence Diagnostics

k) **Numerical algorithms such as direct search, grid search, interpolation search, gradient search, Bisection and Newton-Raphson methods**

l) **Case Studies and Real-world Applications**
  Direct Marketing /Research related Case Studies

Course No: P2STPC305
Credit Hours: 04
Duration of examination: 4 hours

Title: Computing with R
Maximum Marks: 100
Internal :50
External :50

Books Recommended

1.	Braun, W. J. and Murdoch, D. J. (2007)	A First Course on Statistical Programming with R, Cambridge University Press.
2.	Gardener M. (2010)	Beginning R : The Statistical Programming Language, Wiley India Pvt. Ltd., New Delhi.
3.	Jared P. Lander(2018)	R for Everyone. Advanced Analytics and Graphics
4.	Mailund, T. (2017)	Beginning Data Science in R: Data Analysis, Visualization, and Modelling for the Data Scientist..
5.	Schmuller, J. (2017)	Statistical Analysis with R For Dummies John Wiley & Sons.
6.	Teetor, Paul (2011)	R Cookbook, O'Really.

SCHEME OF EXAMINATION

Each practical Internal and External paper shall carry **50 marks** and will be of **04 hours** and distribution of marks shall be as under:

Component	Marks	Remarks
Internal	25	After 60 days on completion of 50 % of syllabus **Written Exam: 20 Marks (Attempt two Practical of 10 Marks Each out of three Practicals)** **Viva Voce :05 Marks**
External	75	On completion of entire syllabus **Written Exam: 40 Marks (two Practicals each of 20 Marks out of three Practicals)** **Case study report: 10** **Viva Voce: 25 Marks**
Total	100	

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance of the students.

Course No: P2STPC306   Title: Advanced Data Analytics with SPSS
Credit Hours :04   Maximum Marks: 100
Duration of examination: 4 hours   Internal   : 50
                                              External   : 50

Course Outcomes:

- **CO1**: Develop proficiency in data management, organization, cleaning, and visualization techniques for effective statistical analysis.
- **CO2**: Apply ANOVA and experimental design principles, including Latin Square Design, factorial experiments, and randomized block designs, for analysing data structures.
- **CO3**: Utilize advanced regression models, non-parametric statistical methods, and predictive analytics to enhance data-driven decision-making.
- **CO4**: Explore time series analysis, forecasting techniques, and survival models such as Cox regression and Kalman filters for practical applications.
- **CO5**: Implement statistical techniques in real-world scenarios, including direct marketing case studies, ensuring practical proficiency in analytical methodologies.

Module 1: Data Management, Presentation, and Statistical Analyses

1. **Data Management and Presentation**
   - Problems based on data organization, cleaning, and visualization techniques.
2. **Analysis of Variance (ANOVA)**
   - One-way ANOVA
   - Two-way ANOVA (multiple but equal, multiple but unequal)
   - Randomized Block Design (RBD)
3. **Experimental Designs**
   - Latin Square Design
   - Factorial Experiments
   - Missing and Mixed-up plot in RBD
4. **Non-parametric Statistical Methods**
- Kruskal-Wallis one-way analysis of variance by ranks
- Kolmogorov-Smirnov one-sample and two-sample tests

Module 2: Advanced Statistical Methods and Applications

1. **Advanced Regression and Models**
   - Loglinear Models
   - Repeated Measures ANOVA
   - Non-linear Regression
   - Optimal Scaling
2. **Classification and Predictive Analytics**
   - Hierarchical Cluster Classification
   - Cluster Silhouettes
   - Receiver Operating Characteristic (ROC) Curve Analysis
3. **Time Series and Forecasting Techniques**
   - Seasonal Decomposition
   - Spectral Analysis
   - Sequence Charts

Course No: P2STPC306

Credit Hours :04

Duration of examination: 4 hours

Title: Advanced Data Analytics with SPSS

Maximum Marks: 100

Internal : 50

External : 50

4. **Survival Analysis and Specialized Methods**
   - Life Tables
   - Cox Regression
   - Kalman Filter
5. **Case Studies and Real-world Applications**
   - Direct Marketing Case Studies

Books Recommended :

1.	Carver RH. and Nash JG. (2024)	Doing Data Analysis in SPSS: Version 29, Cengage Learning.
2.	Cleophas TJ and Zwinderman AH (2012)	SPSS for Starters and Second Levelers (Second Edition), Springer, Singapore.
3.	Field A. (2023)	Discovering Statistics Using SPSS, Sage Publications.
4.	Ho, Robert (2006)	Handbook of Univariate and Multivariate Data Analysis and Interpretation with SPSS, Chapman and Hall/CRC Press, London.
5.	Landu, S. and Everitt, BS. (2004)	A Handbook of Statistical Analysis in SPSS, Chapman and Hall/CRC Press, London.
6.	Schmidt W (2019)	IBM SPSS: Comprehensive Beginners Guide to Learn Statistics Using IBM SPSS from A to Z, Independently Published.

SCHEME OF EXAMINATION

Each practical Internal and External paper shall carry **50 marks** and will be of **04 hours** and distribution of marks shall be as under:

Component	Marks	Remarks
Internal	25	After 60 days on completion of 50 % of syllabus **Written Exam: 20 Marks (Attempt two Practical of 10 Marks Each out of three Practicals)** **Viva Voce :05 Marks**
External	75	On completion of entire syllabus **Written Exam: 40 Marks (two Practicals each of 20 Marks out of three Practicals)** **Case study report: 10** **Viva Voce: 25 Marks**
Total	100	

Course No: P2STPC306   **Title: Advanced Data Analytics with SPSS**

Credit Hours :04   **Maximum Marks: 100**

Duration of examination: 4 hours   **Internal : 50**

      External : 50

External Practical examination shall be conducted by Board of Examiners consisting of Head of the Department, concerned teacher and outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess final practical performance of the students.

Course No.: P2STPC307   Title: Seminar
Credit Hours :01   Maximum Marks:25
Duration of Examination: 1 Hour

Course Learning Outcomes (CLO)

After completing this course, the learner will be able to:

1: To enhance the critical thinking and communication skills of students, enabling them to effectively evaluate, synthesize, and apply information in academic and professional contexts for decision making.

2: To enhance the research acumen and statistical as well as interpretation skills of students, enabling them to effectively apply statistical tools in academic and professional contexts.

SCHEME OF EXAMINATIONS

The seminar presentation shall carry 25 marks and distribution of marks shall be as under:

Presentation	Contents	Domain Knowledge	Total
05	10	10	25

Evaluation Criteria: Each student will be allotted a mentor under whose guidance student will prepare the Seminar.

Each Seminar presentation will be of **duration 45-60 minutes**. Evaluation of the seminar will be done by the DAC members on the above parameters. There will be no external examination/viva-voce examination. The schedule of the Seminar will be issued by the Head of the Department.

Course No: P2STTE308   Title: Advanced Statistical Inference-II

Credits Hour: 04   **Maximum Marks: 100**
Duration of examination: 3 hours   **Minor Test-I: 20**
                                              Minor Test-II :20
                                              Major Test : 60

Course Outcomes:

- **CO1**: Understand the fundamentals of non-parametric and distribution-free methods, including key single-sample and two-sample tests for statistical inference.
- **CO2**: Apply general linear rank statistics, various distributional properties, and advanced non-parametric test procedures for effective data analysis.
- **CO3**: Assess efficiency and asymptotic properties of statistical tests, explore U-statistics, and analyse measures of association such as Kendall's Tau and Spearman's Rank Correlation.
- **CO4**: Perform statistical tests for multiple-sample problems, including Kruskal-Wallis and Jonckheere-Terpstra tests, enhancing non-parametric inference capabilities.
- **CO5**: Utilize advanced statistical techniques such as jack knifing, bootstrapping, and bias reduction methods for robust data-driven decision-making.

Unit-I

Concept of Non parametric and distribution free methods, Review of Single Sample Problems for Location and standard non parametric tests, Two sample problems, Mann-Whitney-Wilcoxon test, Wilcoxon test, Run Test and Median Test. Tests of Goodness of fit viz., Chi square, Empirical distribution function and Kolmogorov Smirnov test.

Unit-II

General linear rank statistic, Its Distributional Properties, Statement and applications of Terry Hoefling, Vander Warden test Statistic, Mood Statistic, Freund-Ansari-Bradley-David-Barton statistics, Siegel-Tukey Statistic, Klotz-Normal Score Test, Percentile modified Rank test and Sukhatme test.
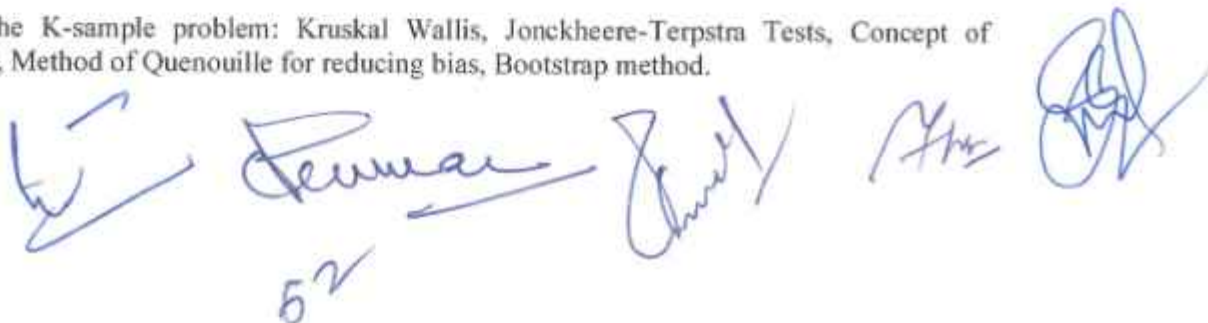
Unit-III

Efficiency of tests, asymptotic relative efficiencies Hoefling's, U-Statistics, Asymptotic distribution of U-Statistics, Measures of Association for Bivariate samples/population: Kendall's Tau

coefficient and its sample estimate, Spearman's rank Correlation Coefficient. Spearman's R test against trend and relations between R and T, E(R), Kendall's Tau and Pearsons R, Measure of Association related to R for paired samples.

Unit-IV

Tests for the K-sample problem: Kruskal Wallis, Jonckheere-Terpstra Tests, Concept of Jackknifing, Method of Quenouille for reducing bias, Bootstrap method.

Course No: P2STTE308   Title: Advanced Statistical Inference-II

Credits Hour: 04   Maximum Marks: 100
Duration of examination: 3 hours   Minor Test-I: 20
                                            Minor Test-II :20
                                            Major Test : 60

Books Recommended:

1.	Conover, W.J. (2017)	Practical Nonparametric Statistics, Wiley
2.	David, H.A. & Nagaraja, H.N. (2003)	Order Statistics, John Wiley & sons
3.	Davison, A. C. & Hinkley, D.V. (1997)	Bootstrap Methods and their application, Cambridge University Press
4.	Fraser, D.A.S. (1996)	Non-parametric Methods in Statistics, Wiley
5.	George Casella & Roger Berger (2024)	Statistical Inference (2nd Edition), Chapman & Hall/CRC
6.	Ghosh, J.K. (2003)	Bayesian Non-parametric, Springer
7.	Gibbons, J.D. (2020)	Non-parametric Statistical Inference, Chapman and Hall/CRC Press
8.	Govindarajulu Z. (2007)	Nonparametric Inference, World Scientific
9.	Hajek, J. & Sidak, Z. (1967)	Theory of Rank Tests, Academic Press.
10.	Puri, M.L. (2007)	Nonparametric Techniques in Statistical Inference, Cambridge University Press
11.	Rohatgi, V. K. (1998)	An Introduction to Probability Theory & Mathematical Statistics, John Wiley & Sons
12.	Tiku, M. L.,Tan W.Y. & Balakrishnan, N.(1986)	Robust Inference, Marcel and Dekker

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTE308   Title: Advanced Statistical Inference-II

Credits Hour: 04   Maximum Marks: 100

Duration of examination: 3 hours   Minor Test-I: 20

Minor Test-II :20

Major Test : 60

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

In major test there should not be a gap of more than two days in between two tests.

Course No: P2STTE309

Title: Information Theory

Credits Hour:04

Maximum Marks:100

Duration of Examination: 3 Hrs.

Minor Test -I: 20

Minor Test -II: 20

Major Test: 60

Course Outcomes:

- **CO1**: Understand the Bayesian framework, including Bayes' theorem, types of priors, and methods for obtaining prior distributions in statistical inference.
- **CO2**: Apply Bayesian interval estimation techniques, including credible intervals and highest posterior density regions, while comparing classical confidence intervals.
- **CO3**: Perform Bayesian hypothesis testing using prior and posterior odds, Bayes factor, Bayesian Information Criterion (BIC), and computational methods.
- **CO4**: Explore concepts of censoring, truncation, and sequential tests, including Wald's SPRT, optimality properties, and large sample properties of estimators.
- **CO5**: Utilize likelihood ratio tests, Rao's score test, and asymptotic efficiency methods for hypothesis testing and statistical decision-making.

Unit I

Foundations of Information Theory, Concept of Entropy and Information Measures, Formal Requirements of Average Uncertainty, Shannon's Measure of Information and Its Properties, Joint and Conditional Entropy, Relative Entropy and Mutual Information, Uniqueness of the Entropy Function Modern Additions: Rényi Entropy and its Applications, Quantum Entropy in Quantum Information Theory, Differential Privacy and Information Theoretic Security.

Unit II

Data Encoding and Compression Techniques, Elements of Encoding, Redundancy, and Efficiency,Binary Codes and Shannon-Fano Encoding, Necessary and Sufficient Conditions for Noiseless Coding,Average Length of Encoded Messages, Kraft Inequality, McMillan Inequality, Optimal Codes and Huffman Code,Modern Additions: Arithmetic Coding for Efficient Data Compression, Adaptive Huffman Coding for Dynamic Encoding, Deep Learning-Based Compression Methods.

Unit III

Advanced Entropy and Optimization Principles, Differential Entropy, Joint and Conditional Differential Entropy, Properties of Differential and Relative Entropy, Relationship of Differential Entropy to Discrete Entropy, Entropy Bound on Discrete Entropy.

Modern Additions: Entropy Optimization in Machine Learning and Neural Networks, Maximum Entropy Principle and MaxEnt Formalism in AI Models, Entropy in Reinforcement Learning for Policy Optimization.

Course No: P2STTE309   Title: Information Theory

Credits Hour:04   Maximum Marks:100

Duration of Examination: 3 Hrs.   Minor Test -I: 20

              Minor Test -II: 20
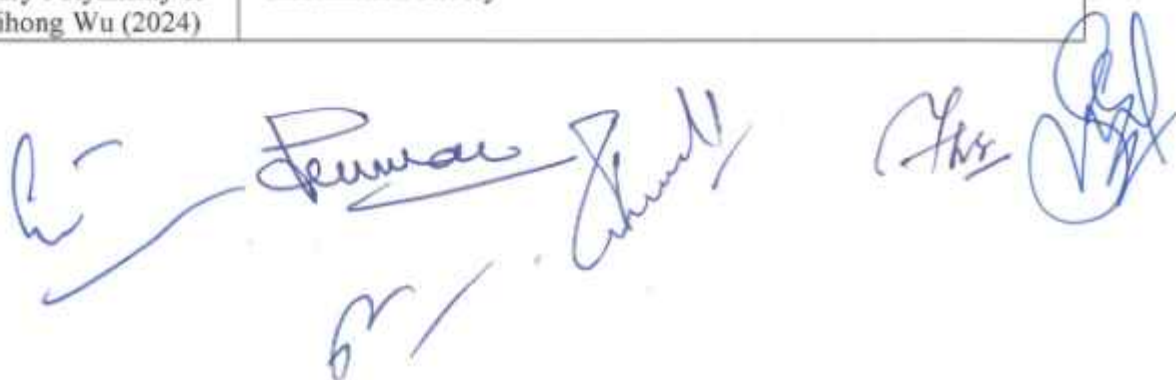
              Major Test: 60

Unit IV

Information Transmission and Coding Theory, Channel Capacity and Symmetric Channels, Binary Symmetric Channel and Binary Erasure Channel, Properties of Channel Capacity, Joint AEP Theorem, Channel Coding Theorem (Statement Only),Fano's Inequality and Converse to the Coding Theorem ,Hamming Codes

Modern Additions' (Low-Density Parity Check) and Turbo Codes, Error-Correcting Codes in Quantum Computing, Network Coding and Distributed Storage Systems.

Books Recommended:

1.	Dehmer, M. and Frank E. S. (2009)	Information Theory and Statistical Learning, Springer
2.	Gray, R.M. (2011)	Entropy and Information Theory 2nd edition. Springer
3.	Kapur,J.N. and Kesavan .K(1992)	Entropy Optimization Principles with Applications, Academic Press, New York.
4.	Reza, F.M. (2007)	An Introduction to Information Theory, Dover Publications.
5.	Robert Ash (1965)	Information Theory, Dover Publications
6.	Shannon, C.E. (1948)	The mathematical theory of communication. Bell Syst.Tech. J, Vol. 27, pp. 379-423 and pp 623-656.
7.	Thomas T. M. and Cover (2006)	Elements of Information Theory. Wiley, New York.
8.	Vander, L. (1997)	Information Theory, Cambridge University Press.
9.	Yury Polyanskiy & Yihong Wu (2024)	Information Theory

Course No: P2STTE309

Credits Hour:04

Duration of Examination: 3 Hrs.

Title: Information Theory

Maximum Marks:100

Minor Test -I: 20

Minor Test -II: 20

Major Test: 60

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

 In major test there should not be a gap of more than two days in between two tests.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTE310

Credit Hours :04

Duration of Examination: 3 Hrs

Title: Advanced Sampling Techniques

Maximum Marks:100

Minor Test -I: 20

Minor Test -II: 20

Major Test: 60

Course Outcomes:

- **CO1**: Understand optimal stratification techniques, including dynamic and data-driven methods, post-stratification refinements, and Bayesian approaches for improved sampling strategies.
- **CO2**: Apply advanced systematic sampling methods, including variance estimation refinements, probability proportional to size (PPS) techniques, and specialized estimators for survey sampling.
- **CO3**: Utilize regression and ratio estimators, calibration methods, and hierarchical models for small area estimation, incorporating machine learning techniques for enhanced statistical inference.
- **CO4**: Develop expertise in cluster and two-stage sampling optimization, efficiency improvements, and variance estimation refinements for real-world applications.
- **CO5**: Implement adaptive and responsive sampling techniques, successive sampling strategies, and real-time data collection methods to enhance data-driven decision-making.

Unit I

Optimal stratification techniques: dynamic stratification, data-driven methods, post-stratification refinements: handling missing data, nonresponse adjustments, Controlled sampling: adaptive and real-time sampling strategies, Bayesian approaches to stratified sampling.
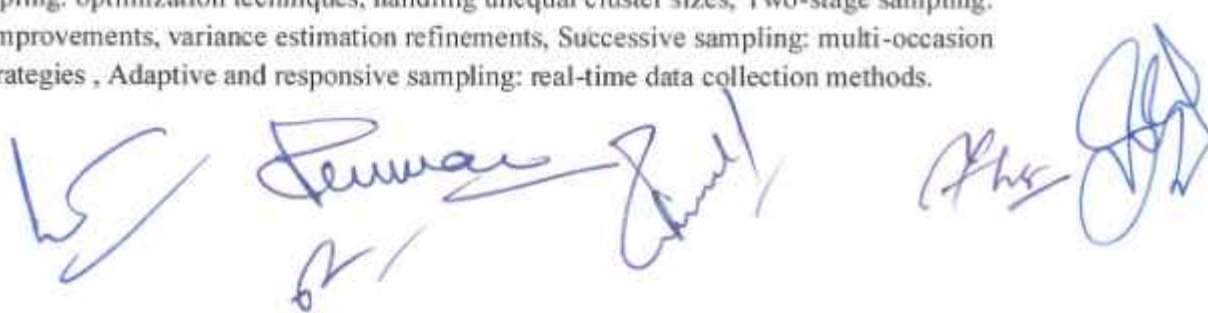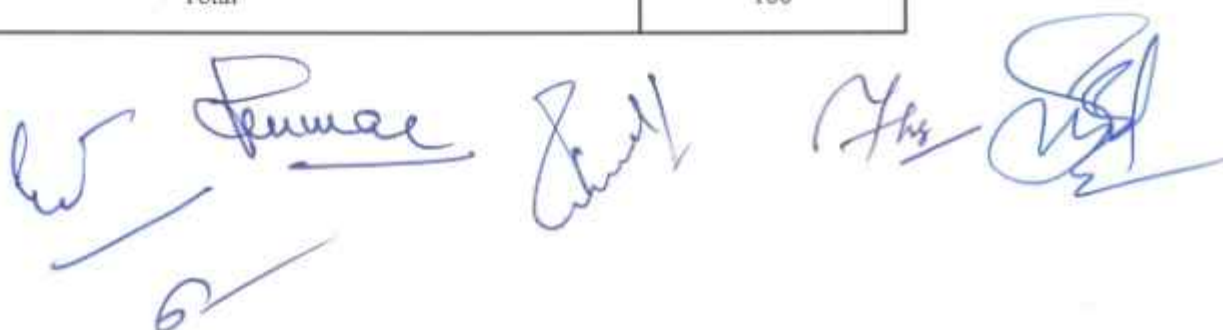
Unit II

Systematic sampling: variance estimation refinements, efficiency improvements, Probability proportional to size (PPS) sampling: enhanced selection methods, PPS WOR refinements, Advanced estimators: Horvitz-Thompson estimator, Des Raj strategy, Murthy estimator, Sen-Midzuno method: modifications for real-world applications.

Unit III

Ratio and regression estimators: bias reduction techniques, robust variance estimation, Calibration estimators: applications in survey sampling, Small area estimation: hierarchical models, empirical Bayes methods, Machine learning approaches to sampling and estimation.

Unit IV

Cluster sampling: optimization techniques, handling unequal cluster sizes, Two-stage sampling: efficiency improvements, variance estimation refinements, Successive sampling: multi-occasion sampling strategies , Adaptive and responsive sampling: real-time data collection methods.

Course No: P2STTE310 **Title: Advanced Sampling Techniques**

Credit Hours :04 **Maximum Marks:100**

Duration of Examination: 3 Hrs **Minor Test -I: 20**

Minor Test -II: 20

Major Test: 60

Books Recommended:

1.	Chaudhuri , Arijit (2014)	Modern Survey Sampling, CRC Press
2.	Cochran, W.G. (2013)	Sampling techniques, Wiley & Sons
3.	Des Raj (1999)	Sampling Theory, Create Space Publishers, USA.
4.	Mukhopadhayay, P. (2014)	Theory and methods of survey sampling, PHI Learning.
5.	Murthy, M.N. (1967)	Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
6.	Pfeffermann, D., Rao, C.R. (2009)	Handbook of Statistics: Sample Surveys ,Vol 29B, Elsevier (North Holland)
7.	Sampath, S. (2005)	Sampling Theory & Methods, Alpha Science India Ltd.
8.	Särndal, C.E., Swensson, B., Wretman, J.H (1992)	Model Assisted Survey Sampling, Springer-Verlag
9.	Singh, S (2003)	Advanced Sampling Theory with Applications: How Michael' selected' Amy Volume 1, Springer
10.	Thompson, S.K. (2012)	Sampling, John Wiley & Sons

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTE310

Credit Hours :04

Duration of Examination: 3 Hrs

Title: Advanced Sampling Techniques

Maximum Marks:100

Minor Test -I: 20

Minor Test -II: 20

Major Test: 60

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

In major test there should not be a gap of more than two days in between two tests.

Course No: P2STTE311	**Title: Advanced Biostatistics**
Credits Hour :04	**Maximum Marks:100**
Duration of Examination: 3 Hrs.	**Minor Test -I : 20**
	Minor Test -II : 20
	Major Test: 60

Course Outcomes:

- **CO1:** Understand fundamental genetic concepts, including Mendel's laws, Hardy-Weinberg equilibrium, allele frequency distribution, and evolutionary forces such as natural selection and genetic drift.
- **CO2:** Apply principles of clinical trial design, including various phases, comparative trial methodologies, and sample size determination for effective biomedical research.
- **CO3:** Analyse survival distributions, hazard functions, and goodness-of-fit tests for modelling biological data related to survival time and failure rates.
- **CO4:** Develop expertise in censoring techniques, survival time estimation, and stochastic epidemic models for analysing real-world biological datasets.
- **CO5:** Utilize statistical techniques for biomedical applications, improving data-driven decision-making in genetics, clinical trials, and epidemiology.

UNIT-I

Basic biological concepts in genetics, Mendel's law, Hardy- Weinberg equilibrium, random mating, distribution of allele frequency (dominant/co-dominant cases), Approach to equilibrium for X-linked genes, natural selection, mutation, and genetic drift, equilibrium when both natural selection and mutation are operative.
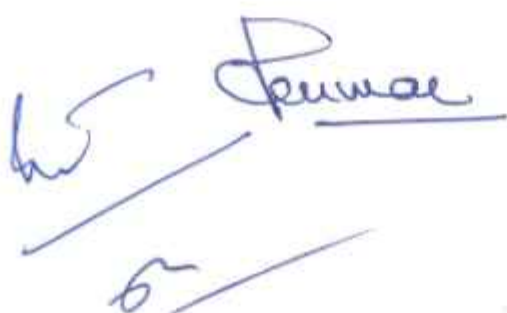
UNIT-II

Planning and design of clinical trials, Phase I, II, and III trials. Consideration in planning a clinical trial, designs for comparative trials. Sample size determination in fixed sample designs.

UNIT-III

Functions of survival time, survival distributions and their applications viz. Exponential, Gamma, Weibull, Rayleigh, lognormal, death density function for a distribution having bath-tub shape hazard function. Tests of goodness of fit for survival distributions (WE test for exponential distribution, W-test for lognormal distribution, Chi-square test for uncensored observations).

UNIT-IV

Type I, Type II and progressive or random censoring with biological examples, Estimation of mean survival time and variance of the estimator for type I and type II censored data with numerical examples. Idea of Stochastic epidemic models: Simple epidemic models (by use of random variable technique).

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTE311

Credits Hour :04

Duration of Examination: 3 Hrs.

Title: Advanced Biostatistics

Maximum Marks:100

Minor Test -I : 20

Minor Test -II : 20

Major Test: 60

Books Recommended:

1.	B. Santhosh Kumar (2024)	Recent Advances in Biostatistics.
2.	Biswas, S. (1995)	Applied Stochastic Processes. A Biostatistical and Population Oriented Approach, Wiley Eastern Ltd.
3.	Cox, D.R. & Oakes, D. 1984)	Analysis of Survival Data, Chapman and Hall.
4.	Ewens, & Grant, (2010)	Statistical methods in Bio informatics.: An Introduction, Springer.
5.	Ewens, W. J. (1979)	Mathematics of Population Genetics, Springer Verlag.
6.	Friedman, L. M., David L., & Christobher G. (2015)	Fundamentals of Clinical Trials, Springer
7.	Lee, Elisa, T. (1992)	Statistical Methods for Survival Data Analysis, John Wiley

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

Course No: P2STTE311   Title: Advanced Biostatistics

Credits Hour :04   Maximum Marks:100

Duration of Examination: 3 Hrs.   Minor Test -I : 20

Minor Test -II : 20

Major Test: 60

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks).

 In major test there should not be a gap of more than two days in between two tests.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTE312

Credits Hour:04

Duration of Examination: 3 Hrs.

Title: Advanced Reliability Theory

Maximum Marks:100

Minor Test -I: 20

Minor Test -II: 20

Major Test: 60

Course Outcomes:

- **CO1**: Understand reliability functions, failure time distributions, and system structures, including series, parallel, and k-out-of-n configurations for reliability assessment.

- **CO2**: Apply Laplace transforms and Markov models to derive reliability and availability measures, optimizing system performance through redundancy and preventive maintenance.

- **CO3**: Analyse stochastic processes, including Markov chains, Poisson processes, birth-death processes, and renewal models, for probabilistic system modelling.

- **CO4**: Develop expertise in queuing models for reliability analysis, including M/M/1 and M/M/S models, loss systems, bulk arrival/service systems, and Poisson input models.

- **CO5**: Utilize advanced statistical and probabilistic techniques for system reliability evaluation, predictive modelling, and real-world applications.
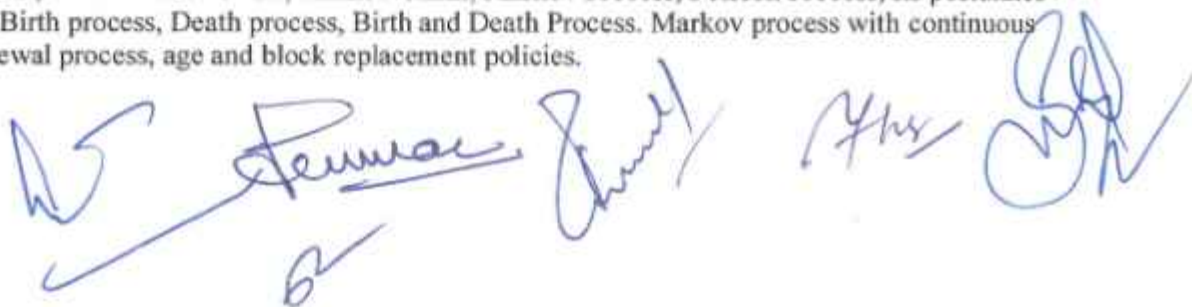
UNIT-I

Reliability functions, Pointwise and steady state Availability, Interval Reliability, Mean Time to System Failure, Mean sojourn time, Failure, Typos of Failure, Failure rate and Various failure time distribution such as Exponential, Gamma, Rayliegh, Lognormal, Weibull; Various System structures such as series, parallel, k out of n system structure, structure function.

UNIT-II

Laplace and Laplace Steiljes transform their important properties and applications. Derivation of reliability and availability using Markov Models, Methods of improving reliability, redundancy, optimization, preventive maintenance, Reliability estimation in case of exponential, Gamma and Weibull distribution.

UNIT-III

Stochastic Process, Classification of SP, Markov Chain, Markov Process, Poisson Process, Its postulates and properties, Birth process, Death process, Birth and Death Process. Markov process with continuous state space, renewal process, age and block replacement policies.

Course No: P2STTE312

Credits Hour:04

Duration of Examination: 3 Hrs.

Title: Advanced Reliability Theory

Maximum Marks:100

Minor Test -I: 20

Minor Test -II: 20
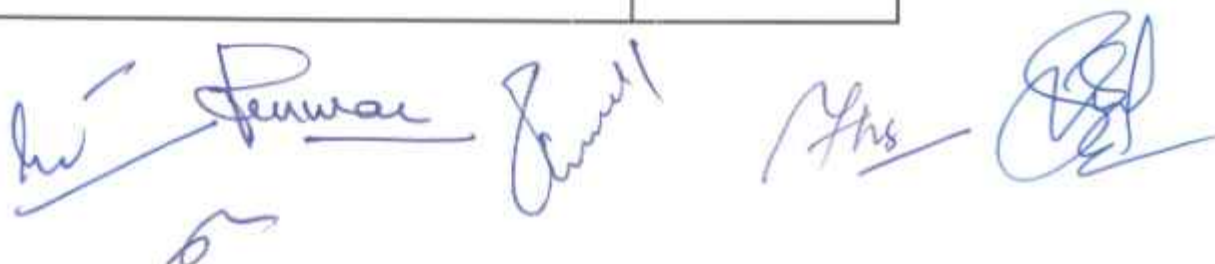
Major Test: 60

UNIT-IV

Stochastic Process in queuing and reliability, M/M/1 model, Steady state and transient behavior, Queues with limited waiting space i.e. M/M/S model, loss system model, Bulk arrival system and bulk service system, Queues with Poisson input WG/I model.

Books Recommended:

1.	R. E. Barlow and F. Proschan, John Wiley & Sons, New York	Mathematical theory of Reliability (1965)
2.	Reliability k. E Barlow and F. Proschan, Holt, and Life Testing: Rinehard and Winston, Inc., New York.	Statistical theory of Reliability and Life (1975)
3.	B. V. Gnedenko, Belyayvev and Solovyev, Academic Press.	Mathematical Models of Reliability (1977)
4.	L J Bain, Marcell Dekker, New York.	Statistical analysis of Reliability and Life testing models (1978)
5.	J Medhi, New Age International Private Ltd., New Delhi., SM Ross, Wiley, New York, NU Prabhu, McMillan	Stochastic Process (1982)
6.	Balagurusamy Tata McGraw Hill	Reliability Engineering (1984)
7.	SK Sinha Wiley Eastern Ltd.	Reliability and Life Testing (1986)
8.	Recent Advances in Reliability and Maintenance Modeling	Hiroyuki Okamura, Shinji Inoue, Xiao Xiao (2024)

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

Course No: P2STTE312   Title: Advanced Reliability Theory
Credits Hour:04   Maximum Marks:100
Duration of Examination: 3 Hrs.   Minor Test -I: 20
                              Minor Test -II: 20
                              Major Test: 60

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of **THREE questions** (05 marks each). Students are required to answer **TWO** questions. **No preparatory holidays shall be provided for the Test I and Test II**.

*Those candidates who have **appeared** in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.*

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

 In major test there should not be a gap of more than two days in between two tests.

Course No: P2STTE313   Title: Advanced Bayesian and Sequential Inference

Credit Hours :04   Maximum Marks: 100
Duration of examination: 3 hours   Minor Test-I   : 20
                                        Minor Test-II   : 20
                                        Major Test   : 60

Course Outcomes:

- **CO1**: Understand the Bayesian framework, including Bayes' theorem, types of priors, and methods for obtaining prior distributions in statistical inference.
- **CO2**: Apply Bayesian interval estimation techniques, including credible intervals and highest posterior density regions, while comparing classical confidence intervals.
- **CO3**: Perform Bayesian hypothesis testing using prior and posterior odds, Bayes factor, Bayesian Information Criterion (BIC), and computational methods.
- **CO4**: Explore concepts of censoring, truncation, and sequential tests, including Wald's SPRT, optimality properties, and large sample properties of estimators.
- **CO5**: Utilize likelihood ratio tests, Rao's score test, and asymptotic efficiency methods for hypothesis testing and statistical decision-making.

Unit-I

An outline of Bayesian framework, Bayes Theorem, Types of priors, Conjugate prior, proper and improper prior, subjective prior etc., Methods of obtaining priors. Types of loss functions, Squared error loss function, Absolute error loss, 0-1 loss, Asymmetric loss functions such as LINEX and Entropy loss functions, Mixture of loss functions.

Unit-II

Bayesian Interval Estimation: Credible Intervals, Highest Posterior Density Regions, Interpretation of the Confidence Coefficient of an Interval & its Comparison with the Coefficient of Classical Confidence Intervals.

Unit-III

Bayesian Hypothesis testing: Specification of the Appropriate Form of the Prior Distribution for a Bayesian Testing of Hypothesis Problem, Prior Odds, Posterior Odds, Bayes Factor, Bayesian Information Criterion(BIC).

Bayesian computations: Analytic approximation, convergence and diagnostic issues. Concept of Censoring, types of censoring, Type-I censoring, Type-II censoring, Progressive censoring, Concept of Truncation.

Unit-IV

Stopping variables, Sequential Tests, Wald's equation for ASN, Walds SPRT and its properties – fundamental identity, OC and ASN Functions, Optimality of SPRT (under usual approximation). Consistency and Asymptotic Efficiency of Estimators, Maximum Likelihood estimators and their Large sample properties. Asymptotic distributions and properties of Likelihood ratio tests, Rao's score test and Wald's tests in the simple hypothesis case. Introduction to Sequential Tests for Composite Hypothesis.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-3 examinations to be held in Dec-2026,2027 and 2028

Course No: P2STTE313   Title: Advanced Bayesian and Sequential Inference

Credit Hours :04
Duration of examination: 3 hours

Maximum Marks: 100
Minor Test-I   : 20
Minor Test-II : 20
Major Test   : 60

Books Recommended:

1.	A. Wald(2017)	Sequential Analysis
2.	Albert, J. (2009)	Bayesian Computation with R, Springer
3.	B.K.Ghosh(1971)	Sequential Tests of Statistical Hypotheses
4.	Berger, J. O.(1985)	Statistical Decision Theory and Bayesian Analysis, Springer Verlag
5.	Box, G.P. and Tiao, G. C.(1992)	Bayesian Inference in Statistical Analysis, Addison-Wesley.
6.	Gelman, A., Carlin, J.B., and Rubin, D.B. (2021)	Bayesian Data Analysis, Electronic Edition.
7.	Gemerman, D.(2006)	Markov Chain Monte Carlo: Stochastic Simulation for Bayesian Inference, Chapman Hall.
8.	Robert, C.P. and Casella, G.(2004)	Monte Carlo Statistical Methods, Springer Verlag.
9.	Turkman, M. A. A., Paulino, C. D. and Muller, P. (2019)	Computational Bayesian Statistics: An Introduction, CUP

SCHEME OF EXAMINATIONS

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

Course No: P2STTE313   **Title: Advanced Bayesian and Sequential Inference**

Credit Hours :04   **Maximum Marks: 100**
Duration of examination: 3 hours   Minor Test-I   :20
                              Minor Test-II :20
                              Major Test   :60

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

In major test there should not be a gap of more than two days in between two tests.

Department of Statistics, University of Jammu

Course Structure for PG Programme in Statistics- Two Years (NEP 2020)

Programme code – PGFMS005

Semester–IV

Course Code	Course Title	Credit Hours	Contact Hours per week L–Tu–P
P2STTC401	Stochastic Processes	04	4-1-0
P2STTC402	Optimization Techniques for Decision Making	04	4-1-0
P2STRC403	Research	16	0-0-16
Total		24	

Course No: P2STTC401

Credit Hours:04

Duration of examination: 3 hours

Title: Stochastic Processes

Maximum Marks: 100

Minor Test-I : 20

Minor Test-II :20

Major Test : 60

Course Outcomes

- **CO1**: Understand fundamental concepts of stochastic processes, including classification, Markov chains, transition probabilities, and applications such as random walks and gambler's ruin problems.

- **CO2**: Analyse continuous-time Markov processes, Poisson processes, and Brownian motion, applying them to real-world scenarios such as queues and storage systems.

- **CO3**: Explore renewal processes, stationary processes, and time-series models, including moving average and autoregressive methods, for predictive analysis.

- **CO4**: Examine branching processes, extinction probabilities, and martingale properties to model population dynamics and evolutionary behaviour.

- **CO5**: Apply key stochastic modelling techniques for statistical analysis and decision-making in diverse fields, including finance, engineering, and biological sciences.

Unit-I

Introduction to stochastic processes (SP's), Classification of SP's according to state space and time domain, Countable state Markov Chains (MC's), Chapman-Kolmogorov equations; solidarity theorem, calculation of n- step transition probability and its limit, Stationary distribution, Classification of states; transient MC, Random Walk and gambler's ruin problem.

Unit-II

Discrete state space continuous time MC's, Kolomogorav-Feller differential equations, Poisson Process and its properties, Birth and Death processes, Non-homogeneous Poisson Process, Cluster Poisson Process Applications to queues and storage problems, Brownian motion process, Black Scholes formula, Wiener process as a limit of random walk, first passage time and other problems.

Unit-III

Renewal process, Modified Renewal Process, Equilibrium Renewal Process; Elementary renewal theorem and applications, CLT for renewal process, statement and uses of key renewal theorem, study of residual and excess lifetimes lifetime process, stationary process, weakly stationary and strongly stationary process, white-noise process, Moving average process, Auto-regressive Processes.

Unit-IV

Galton-Watson branching process, probability of ultimate extinction, distribution of populations size, Martingale and its properties.

Course No: P2STTC401

Credit Hours:04

Duration of examination: 3 hours

Title: Stochastic Processes

Maximum Marks: 100

Minor Test-I : 20

Minor Test-II :20

Major Test : 60

Books Recommended:

1.	Basu, A.K. (2007)	Introduction to Stochastic Process, Alpha Science International Ltd.
2.	Bhat, B.R. (2020)	Stochastic Models: Analysis And Applications, New Age International Pvt. Ltd.
3.	Ciprian Tudor (2023)	Non-Gaussian Self Similar Stochastic Processes, Springer
4.	Dharmaraja, S., Arunachalam, V. & Castaneda, L.B. (2012)	Introduction to Probability and Stochastic Processes with Applications, Wiley
5.	Feller, W. (1968)	An Introduction to Probability Theory and Its Applications, John Wiley
6.	Karlin, S. & Taylor H.M. (1975)	A First Course in Stochastic Process, Vol. I Academic Press
7.	Maksym Luz, Mikhail Moklyachuk (2024)	Non-Stationary Stochastic Processes Estimation, De Gruyter
8.	Medhi, J. (2019)	Stochastic Processes, New Age International Pvt. Ltd.
9.	Papoulis, A. & Pillai, S.U. (2008)	Probability, Random Variables, and Stochastic Processes, Tata Mcgraw Hill
10.	Parzen, E. (1999)	Stochastic Processes, Siam
11.	Ross, S. M. (1996)	Stochastic Process, John Wiley & Sons
12.	Ross, S.M. (2009)	Introduction to Probability Models, Academic Press

SCHEME OF EXAMINATION

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-4 examinations to be held in May-2027,2028 and 2029

Course No: P2STTC401

Credit Hours:04

Duration of examination: 3 hours

Title: Stochastic Processes

Maximum Marks: 100
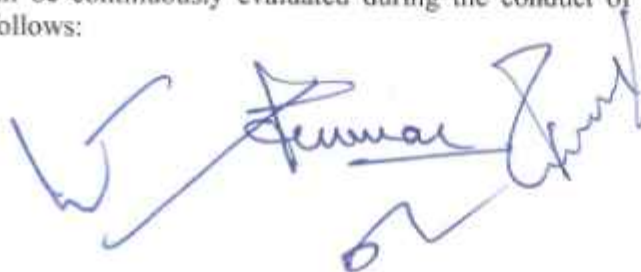
Minor Test-1 : 20
Minor Test-II :20
Major Test : 60

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .

In major test there should not be a gap of more than two days in between two tests.

Course No: P2STTC402   Title: Optimization Techniques for Decision Making

Credit Hours:04

Duration of examination: 3 hours

Maximum Marks: 100

Minor Test-I   : 20
Minor Test-II : 20
Major Test   : 60

Course Outcomes:

- **CO1**: Understand the formulation of linear programming problems (LPP), convex sets, graphical solutions, and advanced optimization techniques such as genetic algorithms and simulated annealing.
- **CO2**: Apply duality principles in LPP, including fundamental theorems, Markov Decision Processes, and sensitivity analysis for model robustness.
- **CO3**: Solve transportation and assignment problems using methods such as stepping-stone, MODI's method, Hungarian method, and explore AI-driven approaches in routing and optimization.
- **CO4**: Develop expertise in game theory concepts, including minimax strategies, Nash equilibrium, and applications of AI in decision-making models.
- **CO5**: Utilize job sequencing techniques, heuristic methods for large-scale optimization, CPM, PERT, and AI-powered project scheduling for efficient resource allocation and industrial process optimization.

Unit-I

Linear programming problem, formulation of LPP, Convex sets, Concept of Separating and supporting Hyperplanes, Half-space, Convex Polyhedron, Graphical method for solving LPP's,

Theorems: Reduction of FS to BFS, Replacement of a Basis Vector, Improved BFS, Condition of Optimality, Extreme Point and BFS relation.

Simplex method for solving LPP, two phase method (Artificial Variable Technique), Big-M-Method and degeneracy in LPP and its resolution, Genetic algorithms, simulated annealing, and evolutionary strategies for solving complex LP problems.
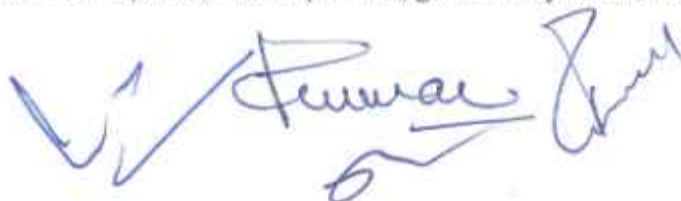
Unit-II

Duality in LPP, Correspondence between dual and primal, theorems on duality, Fundamental duality theorem, Basic duality theorem, existence theorem, complementarity theorem, Solution of primal from duality, Markov Decision Processes (MDP) in duality

Revised Simplex Method, Formulation of LPP in standard form, Application of computation procedure for standard form, Sensitivity analysis, AI-driven approaches for model robustness and parameter adjustments.

Unit-III

Transportation problem (TP), formulation of TP, FS, BFS and optimum solution, existence of FS, optimal solution method, Stepping-stone method, Methods for finding BFS, U-V (MODI's) method for finding optimal solution, unbalance transportation problem, assignment problems, fundamental theorems of assignment problems, Hungarian method for assignment problems, Routing problems, Applications of machine learning in vehicle routing.

Theory of games, rectangular games Minimax (Maximin) Criterion and optimal strategy, Minimax-Maximin principle mixed strategy, Games and their solutions through different methods including LPP, Minimax theorem, Nash equilibrium computation, game theory in AI-driven decision-making.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-4 examinations to be held in May-2027,2028 and 2029

Course No: P2STTC402   **Title: Optimization Techniques for Decision Making**

Credit Hours:04   **Maximum Marks: 100**

Duration of examination: 3 hours

Minor Test-I	: 20
Minor Test-II	: 20
Major Test	: 60

Unit-IV

Job sequencing, solutions of sequencing problems, processing n-jobs through two- machines, Johnson's algorithm for n-jobs for 2- machines, processing 2-jobs through n-machines graphical method, processing n-jobs through m-machines, Travelling Salesman Problem. AI-driven heuristic methods for large-scale optimization, genetic algorithms in TSP.

CPM and PERT, Determination of critical path's, applications of CPM,PERT, AI-driven project scheduling and resource allocation, Neural network-based scheduling, predictive modeling in industrial process optimization, AI-powered decision support systems, automated scheduling solutions, and predictive analytics for supply chain optimization.

Books Recommended:

1.	El-Ghazali Talbi (2024)	*Metaheuristics: From Design to Implementation* (covers genetic algorithms, simulated annealing, and evolutionary strategies)
2.	Harris, C.M. & Gross, D. (2018)	Fundamentals of Queueing Theory, Wiley
3.	Imhade P. Okokpujie, Lagouge K. Tartibu (2023)	Modern Optimization Techniques for Advanced Machining, Springer publisher.
4.	Kanti Swarup, Gupta, P.K. and Manmohan (2014)	Operations Research, Sultan Chand & Sons
5.	Konstantinos Gkoumas (2021)	Machine Learning for Transportation Planning and Traffic Modeling, Springer
6.	Martin L. Puterman (1994)	Markov Decision Processes: Discrete Stochastic Dynamic Programming, Wiley-Interscience
7.	Michael L. Pinedo (2012)	Scheduling: Theory, Algorithms, and Systems, Springer
8.	Noam Nisan, Tim Roughgarden, Eva Tardos, Vijay Vazirani (2007)	Algorithmic Game Theory, Cambridge University Press
9.	Rao, S.S. (1984)	Optimization: Theory and applications, John Wiley
10	Santosh Kumar Das, Massimiliano Giacalone (2023)	Fuzzy Optimization Techniques in the Areas of Science and Management, CRC Press
11	Taha, H.A. (2016)	Operations Research, Pearson Education India
12	Yongsheng Ma (2013)	Neural Networks for Optimization and Scheduling, Springer

Course No: P2STTC402

Title: Optimization Techniques for Decision Making

Credit Hours:04

Maximum Marks: 100

Duration of examination: 3 hours

Minor Test-I   : 20
Minor Test-II : 20
Major Test   : 60

SCHEME OF EXAMINATION

	Syllabus to be covered in the examination	Time allotted for the examination	%Weightage (Marks)
MINOR TEST I (after 30 days)	25%	1 hour	20
MINOR TEST II (after 60days)	26 to 50%	1 hour	20
Major Test (after 90 days)	100%	3 hours	60
Total			100

The student shall be continuously evaluated during the conduct of each course based on his/her performance as follows:

Minor Test I and Minor Test II

The Subjective Tests of Minor Test I and Minor Test II would consist of 10 **compulsory MCQ** of one mark each and THREE **subjective type questions** (05 marks each). Students are required to answer any **TWO** questions out of three asked questions. **No preparatory holidays shall be provided for the Test I and Test II.**

Those candidates who have appeared in Minor Test I and II and failed to get the minimum required marks i.e. 14 out of 40 will be eligible to re-appear in the Test I and Test II only once.

Major Test

The Major test will comprise of **two sections**, Section-A and Section-B.

Section-A will have **one compulsory question** comprising of 10 parts (minimum 02 questions from each unit) of 03 marks each. (10*3=30 marks).

Section-B will have 04 questions each of 15 marks to be set from the last two units (02 from each unit). In Section B students are required to attempt 01 question from each unit. (15*2=30 marks) .
In major test there should not be a gap of more than two days in between two tests.

Syllabus for Two Years PG Programme in Statistics as per National Education Policy (NEP) 2020 for Semester-4 examinations to be held in May-2027,2028 and 2029

Course No: P2STRC403

Credit Hours:16

Title: Research

Maximum Marks: 400

Course Outcomes:

Upon successful completion of this 16-credit postgraduate-level research course, students will:

- Develop advanced proficiency in research methodologies, enabling them to design and execute impactful studies.
- Critically evaluate scholarly literature to identify gaps and formulate innovative research questions.
- Master data collection techniques and analytical tools, applying both quantitative and qualitative approaches.
- Demonstrate the ability to independently plan and conduct a comprehensive research project or dissertation.
- Exhibit strong academic writing and oral communication skills to effectively present findings.
- Uphold ethical standards and integrity in all aspects of research and scholarly reporting.
- Contribute novel insights to their field, showcasing originality and rigor in their dissertation work.

Every student shall undertake the research under a departmental teacher who will be designated as Research Supervisor. After completion of research work students will have to produce a report in the form of dissertation/technical report related to the work carried out and duly signed by the research supervisor and Head of the department.

SCHEME OF EXAMINATION

External Research examination shall be conducted by Board of Examiners consisting of Head of the Department, concern teacher and one outside expert to be appointed by the Vice-Chancellor out of the panel to be provided by the Head of the Department who shall evaluate/assess dissertation of the students.

The research work will be assessed on the following components:

Content Quality of Report/Dissertation	Seminar Presentation	Domain Knowledge	Total
150	100	150	400