



# स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड - ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'B++' grade

Fax : (02462) 215572

Academic-1 (BOS) Section

website: srtmun.ac.in

Phone: (02462)215542

E-mail: bos@srtmun.ac.in

विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण-२०२० नुसार पदवी तृतीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६-२७ पासून लागू करण्याबाबत.

## परिपत्रक

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २२ एप्रिल २०२६ रोजी संपन्न झालेल्या मा.विद्यापरिषद बैठकीतील विषय क्र.०८/६४-२०२६ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण-२०२० नुसार पदवी तृतीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६-२७ पासून लागू करण्यास मा.विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी.एस्सी. तृतीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६-२७ पासून लागू करण्यात येत आहे.

01	B.Sc. III Year Botany	10	B.Sc. III Year Biochemistry
02	B.Sc. III Year Chemistry	11	B.Sc. III Year Agriculture Microbiology
03	B.Sc. III Year Mathematics	12	B.Sc. III Year Electronics
04	B.Sc. III Year Zoology	13	B.Sc. III Year Seed Technology
05	B.Sc. III Year Microbiology	14	B.Sc. III Year Horticulture
06	B.Sc. III Year Geology	15	B.Sc. III Year Analytical Chemistry
07	B.Sc. III Year Environment & Earth Science	16	B.Sc. III Year Agrochemical & Fertilizers
08	B.Sc. III Year Statistics	17	B.Sc. III Year Industrial Chemistry
09	B.Sc. III Year Dairy Science	18	B.Sc. III Year Industrial Microbiology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या [www.srtmun.ac.in](http://www.srtmun.ac.in) या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

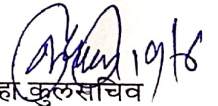
'ज्ञानतीर्थ' परिसर,

विष्णुपुरी, नांदेड - ४३१ ६०६.

जा.क्र.:शे-१ / परिपत्रक / पदवी / बीएस्सी / २०२६-२७ / 60

दिनांक : १९.०६.२०२६



  
सहा कुलसचिव

शैक्षणिक (१-अभ्यासमंडळे) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :-

- १) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
- २) मा. प्र.कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ
- ३) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
- ४) मा. संचालक, परिक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
- ५) मा. प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.



**SWAMI RAMANAND TEERTHMARATHWADA  
UNIVERSITY, NANDED - 431 606 (MS)**



**(Credit Framework and Structure of Four Year UG Program with  
Multiple Entry and Exit Option as per NEP-2020)**

**UNDERGRADUATE PROGRAMME OF  
SCIENCE & TECHNOLOGY**

Major in **STATISTICS** and Minor in **DSM** (Subject)

**Under the Faculty of Science & Technology**

*(Revised as per the Govt. of Maharashtra circular dt. 13<sup>th</sup> March 2024)*

**W.E.F. AY-2026-27**



## Preamble:

The education in India, in general, is expanding manifolds. It is the challenge to ensure its quality to stakeholders to meet this challenge. The issue of quality needs to be addressed and taken forward in a systematic manner. For this we statisticians tried to modify our subject curriculum according to National Education Policy (NEP) 2020 to explore future brightness of stakeholders.

As I am Chairman, Board of Studies in Statistics, Swami Ramanand Teerth Marathwada University, Nanded, happy to state here that we all members made a curriculum and finalized it. The Program Educational Objectives were finalized for undergraduate programs in Statistics. I am thankful to our Dean of Science and Technology Dean Dr. M. K. Patil who has given us this opportunity.

The Program Educational Objectives finalized for undergraduate program in Statistics are listed below:

### Program Educational Objectives (PEO):

**PEO1:** Students should be able to understand the fundamentals of statistical techniques and implement them.

**PEO2:** To develop a statistical view for better understanding and analytic ability.

**PEO3:** The ability to bring together and flexibly apply it to characterize, analyze and solve a wide range of problems with statistical models.

**PEO4:** The ability to communicate effectively in terms of technical and non-technical audiences.

### Program Outcomes (PO):

**PO1:** Have fundamental knowledge and understanding of statistical theory at an applied level in the subject.

**PO2:** Acquire the strong foundation of statistical concepts which will benefit them to become good academicians.

**PO3:** Use acquired statistical tools and techniques to address various real-life problems.

**PO4:** Gain the knowledge of software which has the wide range of opportunities in the various sectors viz., IT sector Quality control in industries, Business, Government and private sector etc.

**PO5:** Qualify various National / State level competitive exams viz. ISS, DSO, GATE, MPSC, UPSC, Banking etc.

### Program Specific Outcomes (PSO):

On successful completion of the program students will able to:

**PSO1:** Understand and implement statistical models.

**PSO2:** Handle and analyse databases with computer skills.

**PSO3:** Describe complex statistical ideas to non-statisticians and can make practical suggestions for improvement.

**PSO4:** Get a wide range of statistical skills in problem-solving.

### Course Outcomes (for all courses):

The course outcomes are the statement that describes the knowledge & abilities developed in the student by the end of course (subject) teaching. The focus is on development of abilities rather than mere content. There are 4 course outcomes of all courses defined here. These are to be written in the specific terms and not in general. In addition to Program Educational Objectives, for each course of undergraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome-based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stakeholders.

**Chairman,**

**Board of Studies of the Statistics**

**Swami Ramanand Teerth Marathwada University, Nanded.**



**Details of the Board of Studies Members in the subject  
STATISTICS under the faculty of Science & Technology of  
S.R.T.M. University, Nanded**

<i>Sr. No</i>	<i>Name of the Member</i>	<i>Designation</i>	<i>Address</i>	<i>Contact No.</i>
1.	Dr. A. A. Muley	Chairman	School of Mathematical Sciences, S.R. T. M. University, Nanded	7276114558
2.	Dr. S. V. Kawale	Member	Dr. B. A. M. University, Chhatrapati Sambhajinagar	9421303727
3.	Dr. V. S. Jadhav	Member	Sanjeevaneer College, Chapoli	9604421675
4.	Dr. M. R. Fegade	Member	Digambarrao Bindu College, Bhokar	9922675834
5	Mr. D. N. Shinde	Invitee Member	DSM College, Parbhani	8668799217
6.	Mr. Namdev Ambhure	UG MPUA u/s 40(2)(d)(E) Invitee Member & PG Student	School of Mathematical Sciences, SRTM University, Nanded	8552827030
7.	Ms. Vibhute Vaishnavi Chandrakant	UG MPUA u/s 40(2)(d)(E) UG & PG Student	Yeshwant College, Nanded	9356238834



**B.A. / B.Sc. Third Year (SEMESTER-V) (Level 5.5)**

**Teaching Scheme**

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ Week)	
			Theory	Practical	Total	Theory	Practical
<b>Major</b>	SSTACT1301	Sampling Techniques	03	--	<b>12</b>	03	--
	SSTACT1302	Linear Programming	03	--		03	--
	SSTACT1303	Statistics Everywhere (IKS)	02	--		02	--
	SSTACP1301	Practical VII	--	02		--	04
	SSTACP1302	Practical VIII	--	02		--	04
<b>Major (Elective)</b> <b>(Select any one)</b>	SSTAET1301	Linear Statistical Models	02	--	<b>02</b>	02	--
	SSTAEP1301	Practical-I	--	02	<b>02</b>	--	04
	SSTAET1302	Statistical Quality Control	02	--	<b>02</b>	02	--
	SSTAEP1302	Practical-II	--	02	<b>02</b>	--	04
<b>Skill Based Course</b>	SSTAVC1301	Statistical Analysis Using Advanced Excel	--	02	<b>02</b>	--	04
<b>Field Project</b>	SSTAEP1301	Field Project	--	04	<b>04</b>	--	08
<b>Total Credits</b>			<b>10</b>	<b>12</b>	<b>22</b>	<b>10</b>	<b>24</b>



## B.A. / B.Sc. Third Year (SEMESTER-V)(Level 5.5)

### Examination Scheme

[40% Continuous Assessment (CA) and 60% End Semester Assessment (ESA)](For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject (1)	Course Code (2)	Course Name (3)	Theory						Practical		Total Col (6+7+8+9) / Col (10+11) (12)
			Continuous Assessment (CA)					ESA	CA (10)	ESA (11)	
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Assignment, Presentation, Viva, Quiz, Open Book, etc. (7)	Attendance (8)	Total (9)			
<b>Major</b>	SSTACT1301	Sampling Techniques	15	15	15	9	6	45	--	--	75
	SSTACT1302	Linear Programming	15	15	15	9	6	45	--	--	75
	SSTACT1303	Statistics Everywhere (IKS)	10	10	10	6	4	30	--	--	50
	SSTACP1301	Practical VII	10	10	10	6	4	--	20	30	50
	SSTACP1302	Practical VIII	10	10	10	6	4	--	20	30	50
<b>Major (Elective)</b>	SSTAET1301	Linear Statistical Models	10	10	10	6	4	30	--	--	50
	SSTAEP1301	Practical-I	10	10	10	6	4	--	20	30	50
	SSTAET1302	Statistical Quality Control	10	10	10	6	4	30	--	--	50
	SSTAEP1302	Practical-II	10	10	10	6	4	--	20	30	50
<b>Skill Based Course</b> (related to Major)	SSTAVC1301	Statistical Analysis Using Advanced Excel	10	10	10	6	4	--	20	30	50
<b>Field Project</b>	SSTAFP1301	Field Project	20	20	20	12	8	--	40	60	100



## B.A. / B.Sc. Third Year (SEMESTER-VI)(Level 5.5)

### Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
<b>Major</b>	SSTACT1351	Design of Experiments	03	--	<b>12</b>	03	--
	SSTACT1352	Operations Research	03	--		03	--
	SSTACT1353	Demography	02	--		02	--
	SSTACP1351	Practical IX	--	02		--	04
	SSTACP1352	Practical X	--	02		--	04
<b>Major (Elective)</b>	SSTAET1351	Introduction to Stochastic Process	02	--	<b>02</b>	02	--
	SSTAEP1351	Practical-III	--	02	<b>02</b>	--	04
	SSTAET1352	Introductory Clinical Trials	02	--	<b>02</b>	02	--
	SSTAEP1352	Practical-IV	--	02	<b>02</b>	--	04
<b>Skill Based Course</b>	SSTAVC1351	Data Analysis using SPSS Software	--	02	<b>02</b>	--	04
<b>OJT</b>	SSTAOJ1351	OJT (On the Job Training)	--	04	<b>04</b>	--	08
<b>Total Credits</b>			<b>10</b>	<b>12</b>	<b>22</b>	<b>10</b>	<b>24</b>



## B.A. / B.Sc. Third Year (SEMESTER-VI)(Level 5.5)

### Examination Scheme

***[40% Continuous Assessment (CA) and 60% End Semester Assessment (ESA)](For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)***

Subject (1)	Course Code (2)	Course Name (3)	Theory						Practical		Total Col (6+7+8+9) / Col (10+11)  (12)
			Continuous Assessment (CA)					ESA	CA (10)	ESA (11)	
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Assignment, Presentation, Viva, Quiz, Open Book, etc. (7)	Attendance (8)	Total (9)			
<b>Major</b>	SSTACT1351	Design of Experiments	15	15	15	9	6	45	--	--	75
	SSTACT1352	Operations Research	15	15	15	9	6	45	--	--	75
	SSTACT1353	Demography	10	10	10	6	4	30	--	--	50
	SSTACP1351	Practical IX	10	10	10	6	4	--	20	30	50
	SSTACP1352	Practical X	10	10	10	6	4	--	20	30	50
<b>Major (Elective)</b>	SSTAET1351	Introduction to Stochastic Process	10	10	10	6	4	30	--	--	50
	SSTAEP1351	Practical-III	10	10	10	6	4	--	20	30	50
	SSTAET1352	Introductory Clinical Trials	10	10	10	6	4	30	--	--	50
	SSTAEP1352	Practical-IV	10	10	10	6	4	--	20	30	50
<b>Skill Based Course</b>	SSTAVC1351	Data Analysis using SPSS Software	10	10	10	6	4	--	20	30	50
<b>OJT</b>	SSTAOJ1351	OJT (On the Job Training)	20	20	20	12	8	--	40	60	100



**B.A. / B.Sc. Third Year (SEMESTER-V) (Level 5.5)**

**Teaching Scheme**

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ Week)	
			Theory	Practical	Total	Theory	Practical
<b>Major</b>	SSTACT1301	Sampling Techniques	03	--	<b>12</b>	03	--
	SSTACT1302	Linear Programming	03	--		03	--
	SSTACT1303	Statistics Everywhere (IKS)	02	--		02	--
	SSTACP1301	Practical VII	--	02		--	04
	SSTACP1302	Practical VIII	--	02		--	04
<b>Major (Elective)</b> <b>(Select any one)</b>	SSTAET1301	Linear Statistical Models	02	--	<b>02</b>	02	--
	SSTAEP1301	Practical-I	--	02	<b>02</b>	--	04
	SSTAET1302	Statistical Quality Control	02	--	<b>02</b>	02	--
	SSTAEP1302	Practical-II	--	02	<b>02</b>	--	04
<b>Skill Based Course</b>	SSTAVC1301	Statistical Analysis Using Advanced Excel	--	02	<b>02</b>	--	04
<b>Field Project</b>	SSTAEP1301	Field Project	--	04	<b>04</b>	--	08
<b>Total Credits</b>			<b>10</b>	<b>12</b>	<b>22</b>	<b>10</b>	<b>24</b>



**B.A. / B.Sc. Third Year (SEMESTER-V)**  
**DSC-13: SAMPLING TECHNIQUES**  
 (Maximum No. of Periods 45)

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSC	Semester: V
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTACT1301</b>	Course Title: <b>Sampling Techniques</b>		
<b>Course Objectives:</b> The course objectives are: <ul style="list-style-type: none"> <li>• To understand concept of survey sampling.</li> <li>• To understand and implement Simple Random sampling.</li> <li>• To understand and implement Stratified Random Sampling</li> <li>• To understand and implement Systematic Sampling.</li> </ul> <b>Course Outcomes(CO's):</b> At the end of the course the student should be able to: <p>CO1: Evaluate different sampling techniques including random, non-random, purposive, quota, snowball, and mixed sampling.</p> <p>CO2: Apply simple random sampling methods with and without replacement.</p> <p>CO3: Understand the concept and need for stratification in heterogeneous populations.</p> <p>CO4: Identify conditions where systematic sampling is more efficient than SRS.</p>			
Credits: 03	DSC-13		
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0			

Module No.	Unit No.	Topic	No. of Lectures
<b>1.0</b>	<b>1</b>	<b>Sample Survey</b>	<b>12</b>
	<b>1.1</b>	Concepts of population, sample, sampling unit, sampling frame, Parameters and statistics.	
	<b>1.2</b>	sampling Distribution, Principal steps in Sample Survey, Principles of Sample Survey.	
	<b>1.3</b>	Sampling and non-sampling errors, advantages of sampling over complete census, Limitations of sampling.	
	<b>1.4</b>	Types of sampling, Probability Sampling and Non-Probability sampling Methods: Purposive Sampling, Snow ball Sampling, Quota Sampling, Mixed Sampling.	
<b>2.0</b>	<b>2</b>	<b>Simple Random Sampling</b>	<b>10</b>
	<b>2.1</b>	Simple random sampling with and without replacement, probability of selecting any specified unit in the sample.	
	<b>2.2</b>	selection of simple random sample, lottery system and random numbers method, Drawing a simple random sample from a population with given frequency distribution.	



	2.3	Notations and terminology, Estimation of population mean, population mean square and variance of sample mean.,	
	2.4	Merits and demerits simple random sampling, Simple Random sampling of attributes, Determination of sample size.	
<b>3.0</b>	<b>3</b>	<b>Stratified Random Sampling</b>	
	3.1	Concept of Stratification Sampling from heterogeneous population, principal advantages of stratified random sampling.	<b>13</b>
	3.2	Estimation of population mean and its variance, Allocation of sample size, Proportional Allocation, Neyman Allocation.	
	3.3	Comparison of stratified random sampling with random sampling without stratification, Proportional allocation Vs simple random sampling, Neyman's allocation Vs Proportional allocation.	
	3.4	Neyman's allocation Vs simple random sampling, Efficiency of stratified random sampling over simple random sampling, Gain in precision due to Stratifications.	
<b>4.0</b>	<b>4</b>	<b>Systematic and Cluster Sampling</b>	
	4.1	Introduction of Systematic sampling, sampling interval,	<b>10</b>
	4.2	Variance of Estimated means, relation between Systematic sampling and Simple Random sampling, Condition for systematic sampling to be better than SRS,	
	4.3	relation between Systematic sampling and Stratified Random sampling, Merits and Demerits of Systematic sampling.	
	4.4	Circular Systematic sampling, Cluster Sampling, Multistage Sampling.	
		<b>Total No. of Lectures =</b>	<b>45</b>

#### Text Books:

1) Fundamentals of applied statistics-S. C. Gupta and V. K. Kapoor (Sultan Chand and Sons)

#### Reference Books:

- 1) Murty M. N. (1967): Sampling Theory and Methods, Statistical publishing Society Calcutta.
- 2) Sukatme B.V. (1984): Sampling Theory and Applications, Indian Society of Agricultural Statistics.
- 3) Desraj (2000): Sample survey theory Narosa publishing House.
- 4) Raosaheb Latpate, Jayant Kshirsagar, Vinod Kumar Gupta, and Girish Chandra (2021): Advanced Sampling Methods (Springer).
- 5) Singh D and Chaudhri F. S.: Theory and analysis of Sample Survey Design



SSTACT1302

**B.A. / B.Sc. Third Year (SEMESTER-V)**  
**DSC-14: LINEAR PROGRAMMING**  
 (Maximum No. of Periods 45)

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSC	Semester: V
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: SSTACT1302	Course Title: <b>Linear Programming</b>		
<p><b>Course Objectives:</b></p> <ul style="list-style-type: none"> <li>To introduce the fundamental concepts, scope, and applications of Operations Research in decision-making.</li> <li>To develop the ability to formulate real-world problems into mathematical models, especially Linear Programming Problem (LPP).</li> <li>To understand and apply graphical and simplex methods for solving optimization problems.</li> <li>To provide knowledge of special optimization techniques such as transportation and assignment models.</li> </ul> <p><b>Course Outcomes (CO's):</b> After completion of the course students will able to:</p> <ul style="list-style-type: none"> <li><b>CO1:</b> Understand the basic concepts, scope, phases, and limitations of Operations Research and apply them in decision-making problems.</li> <li><b>CO2:</b> Formulate real-life problems as Linear Programming Problem models and identify feasible and optimal solutions.</li> <li><b>CO3:</b> Analyse and solve Transportation Problem using methods such as North-West Corner Rule, Least Cost Method, and VAM, and test optimality</li> <li><b>CO4:</b> Apply techniques to solve Assignment Problem using the Hungarian method and handle unbalanced cases.</li> </ul>			
Credits: 3	DSC-14		
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0			

Module No.	Unit No.	Topic	No. of Lectures
<b>1.0</b>	<b>1</b>	<b>Basics of Operations Research</b>	<b>12</b>
	<b>1.1</b>	Introduction, Scope, Definition of operations research, Objectives of operations research	
	<b>1.2</b>	Phases of operations research, Scope of operations research, Limitations of operations research	
	<b>1.3</b>	Linear Programming Problem: Introduction, General Linear Programming problems, Mathematical Formulation of L.P.P., Basic solution.	
	<b>1.4</b>	Non degenerate and Degenerate Basic solution, convex set and theorems on it, Numerical Problems.	



<b>2.0</b>	<b>2</b>	<b>Solution of Linear Programming Problem</b>	
	<b>2.1</b>	Solution of L.P.P. by Graphical Method, Slack, Surplus and Artificial variables, Some definitions and Notations.	<b>13</b>
	<b>2.2</b>	Fundamental Theorems of L.P.P (statement only), Basic Feasible Solution from feasible solution, Simplex method of L.P.P,	
	<b>2.3</b>	Degeneracy in Linear Programming Problem, Big-M method,	
	<b>2.4</b>	Two Phase Method, Numerical problems	
<b>3.0</b>	<b>3</b>	<b>Transportation Problem</b>	
	<b>3.1</b>	Introduction, Mathematical Formulation of Transportation Problem, balanced and unbalance Transportation Problem	<b>10</b>
	<b>3.2</b>	Solution of Transportation problem, Initial Feasible Solution, North-West Corner rule method, Lowest-cost entry method	
	<b>3.3</b>	Vogel's Approximation Method (VAM), Optimality test, Computational procedure of Optimality test(Modified Distribution method)	
	<b>3.4</b>	Resolving Degeneracy in Transportation problem, Numerical Problems.	
<b>4.0</b>	<b>4</b>	<b>Assignment Problem</b>	
	<b>4.1</b>	Introduction, Assignment problem, Mathematical Formulation of an Assignment problem	<b>10</b>
	<b>4.2</b>	Difference between Transportation Problem and Assignment Problem,	
	<b>4.3</b>	Unbalanced Assignment Problem	
	<b>4.4</b>	Method for solving a minimal Assignment problem (Hungarian Method), Numerical problems.	
		<b>Total No. of Lectures =</b>	<b>45</b>

#### Text Books:

1. Dr.R. K. Gupta:Linear Programming (Krishna Publication Media (P) Ltd Meerut,Tenth Edition.
2. Kanti Swarup, P. K. Gupta, Man Mohan: Operations Research (Sultan Chand & Sons) Ninth Edition.

#### Reference Books:

- 1) Gass E.: Linear Programming Method and Application. Narosa publishing House New Delhi.
- 2) Gupta R.K.: Operations Research (Krishana Prakashan Media(P) Ltd., Meerut)
- 3) Sharma.S.D.Operations Research. (Kedarnath Ramnath and Co. Meerut)
- 4) Sharma Manju: Linear Programming (Ramprasad and Sons Agra)



**B.A. / B.Sc. Third Year (SEMESTER-V)**  
**SSTACT1303 DSC-15: STATISTICS EVERYWHERE**  
**(INDIAN KNOWLEDGE SYSTEM)**  
**(Maximum No. of Periods 30)**

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSC	Semester: V
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTACT1303</b>		Course Title: <b>Statistics Everywhere-IKS</b>	
<p><b>Course Objectives:</b> The course objectives are:</p> <ul style="list-style-type: none"> <li>• To introduce the fundamental concepts and importance of Statistical Quality Control in maintaining product and process quality. To develop the ability to construct and interpret control charts for variables and attributes. To provide knowledge of sampling inspection methods and quality standards. To familiarize students with modern quality improvement approaches such as Six Sigma and Total Quality Management.</li> </ul> <p><b>Course Outcomes (CO's):</b> At the end of the course the student should be able to:</p> <ul style="list-style-type: none"> <li>• <b>CO1:</b> Understand the concepts of quality, process control, and causes of variation in Statistical Quality Control.</li> <li>• <b>CO2:</b> Construct and interpret control charts for variables such as X-bar, R-chart, and sigma chart to monitor process performance.</li> <li>• <b>CO3:</b> Apply acceptance sampling techniques, including single and double sampling plans, and evaluate quality using AQL, LTPD, and OC curves.</li> <li>• <b>CO4:</b> Understand and apply modern quality improvement tools such as Six Sigma, Total Quality Management, and Taguchi methods.</li> </ul>			
Credits: 2	DSC-15		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 2-0-0			

Module No.	Unit No.	Topic	No. of Lectures
<b>1.0</b>	<b>1</b>	<b>Foundations of Statistical Thought in Indian Knowledge Systems</b>	<b>7</b>
	<b>1.1</b>	Indian Knowledge Systems (IKS): Understanding IKS as an interwoven part of Indian culture, philosophy, and practice.	



	1.2	Ancient Indian Texts and Data Collection: Arthashastra (Kautilya): Economic and demographic data collection, quantitative methods in governance and taxation Rigveda and Mahabharata: Early applications of probability and statistics in rituals and games of chance. Jain Mathematics: Permutations, combinations, and early probabilistic reasoning.	
	1.3	Mathematical Contributions to Statistics: Aryabhata's early probability concepts in planetary motion models. Bhaskaracharya's statistical insights in algebra and combinatorial mathematics. Kerala School of Mathematics (Madhava): Contributions to series expansions and statistical applications.	
	1.4	Ethics in Ancient Indian Statistics: Role of data integrity in ancient census and economic surveys. Ethical considerations in taxation records and trade assessments	
<b>2.0</b>	<b>2</b>	<b>Core Statistical Concepts in Indian Context</b>	
	2.1	Descriptive Statistics: Measures of central tendency and dispersion used in Vedic land measurements and trade. Concept of skewness and kurtosis in ancient economic planning.	
	2.2	Probability and Sampling: Ancient probability applications in dice games and gambling (e.g., Mahabharata). Sampling techniques in revenue collection and population estimation from Mauryan era.	<b>8</b>
	2.3	Data Visualization and Measurement: Use of geometric techniques in astronomy and land surveys.	
	2.4	Influence of Vedic mathematics on early data tabulation.	
<b>3.0</b>	<b>3</b>	<b>Applications of Statistics in Indian Society</b>	
	3.1	Agriculture & Environmental Statistics: Ancient rainfall prediction models and monsoon cycle calculations	
	3.2	Statistical analysis of crop yield and soil quality in traditional farming.	<b>7</b>
	3.3	Healthcare & Ayurveda: Use of statistical inference in Ayurvedic formulations and Siddha medicine	
	3.4	Traditional public health surveys and their role in early epidemic control.	
<b>4.0</b>	<b>4</b>	<b>Economic, Social and Modern Indian Statistical Systems</b>	
	4.1	Statistical tools for studying caste, gender, and rural-urban disparities.	
	4.2	Use of statistical surveys in ancient and medieval Indian economic planning.	<b>8</b>
	4.3	Evolution of census operations in India (1872–present)	
	4.4	Role of NSSO, RBI, and SEBI in contemporary Indian statistics	
		<b>Total No. of Lectures =</b>	<b>30</b>



### Text Books:

1. Datta, B., & Singh, A. N. (1962). History of Hindu Mathematics: A Sourcebook. Asia Publishing House.
2. Plofker, K. (2009). Mathematics in India. Princeton University Press.
3. J. K. Ghosh, P. Maiti, T. J. Rao, and B. K. Sinha. (1999). Evolution of Statistics in India. International Statistical Review, ISI.
4. Singh, A.K. & Kapoor, K. (2021). Indian Knowledge Systems - Vol 1 & 2.
5. Mahalanobis, P.C. (1944). On large-scale sample surveys. Philosophical Transactions of the Royal Society B, 231(584), 329-451.
6. Srinivasan, T.N. (1994). Data Base for Development Analysis: An Overview. Journal of Development Economics, 44(1), 3-27.

### Reference Books:

1. Indian Knowledge Systems - Vol 1 & 2, Avadhesh K. Singh, Kapil Kapoor (2021)
2. Weighted Arithmetic Mean in Ancient India by Amartya Kumar Dutta, Bhavana Oct., 2017.
3. Official Statistics in India: The past and the present. T.J. Rao. Journal of Official Statistics vol. 26, no.2,2010.
4. Probability in Ancient India. C. K. Raju, Handbook of Philosophy of Statistics, edited by Paul Thagard Dov M. Gabbay and John Woods, handbook of Philosophy of Science, Elsevier, 2011.
5. Kautilya's Arthashastra: The Origin of Statistical Economics During -4ce By Balbir S. Sihag
6. Jrsa, Vol. 2, No. 1, June-2013, Pp 1-14 ISSN: 2278-4845
7. Statistics for everyone, Anil Gore, Sharayu Paranjpe, Madhav Kulkarni, SIPF Academy, Nashik, second edition, 2012
8. Basu, D. (1980). Statistical Information and Likelihood. Sankhya: The Indian Journal of Statistics.
9. Rao, C.R. (1992). R.A. Fisher: The Founder of Modern Statistics. Statistical Science, 7(1), 34-48.
10. Stigler, S.M. (1999). Statistics on the Table: The History of Statistical Concepts and Methods. Harvard University Press.
11. Sarukkai, S. (2005). Indian Philosophy and Philosophy of Science. Project of History of Indian Science, Philosophy and Culture. Centre for Studies in Civilizations.
12. Yadav, R.S. (2018). Ancient Indian Mathematics: Vedic, Post-Vedic and Modern Era. Journal of Applied Science and Computations, 5(10), 1320-1326.
13. Prasad, S. (2020). Digital Transformation of Official Statistics in India: Challenges and Opportunities. Journal of the Indian Society of Agricultural Statistics, 74(2), 97-104.



**B.A. / B.Sc. Third Year (SEMESTER-V)**  
**SSTACP1301 DSC-16: PRACTICAL -VII (Practical Based on Theory DSC-13)**  
**(Maximum No. of Periods 60)**

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSC	Semester: V
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTACP1301</b>		Course Title: <b>Practical –VII</b> (Practical Based on Theory DSC-13)	
<b>Course Objectives:</b>			
<ul style="list-style-type: none"> <li>• Learn to apply various sampling techniques.</li> </ul>			
<b>Course Outcomes:</b> After completion of the course students will able to:			
<ul style="list-style-type: none"> <li>• <b>CO1:</b> Compute SRSWR, SRSWOR techniques.</li> <li>• <b>CO2:</b> Compute stratified sampling techniques.</li> <li>• <b>CO3:</b> Compute systematic sampling techniques.</li> <li>• <b>CO4:</b> Compute sample size determination and efficiency.</li> </ul>			
Credits: 2		DSC-16	
Max. Marks: 50		Min. Passing Marks:20	
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4			

<b>Practical-VII (Practical Based on Theory DSC-13)</b>		
Sr. No.	Title of Experiments	No. of Experiments
1	Drawing Simple Random Sample with Replacement (SRSWR)	1
2	Drawing Simple Random Sample Without Replacement (SRSWOR)	1
3	Simple Random Sampling for Attributes	1
4	Estimation of Population Mean using SRS	1
5	Estimation of Variance using SRS	1
6	Estimation of population mean and variance Using Neyman allocations in Stratified Random Sampling	1
7	Estimation of population mean and variance Using Optimum allocations in Stratified Random Sampling	1
8	Estimation of gain in precision due to Stratification	1
9	Determination of sample size in Stratified sampling	1
10	Estimation of population mean in Systematic sampling	1
11	Estimation of population variance in Systematic sampling	1
12	Efficiency of sampling methods.	1



**B.A. / B.Sc. Third Year (SEMESTER-V)**  
**SSTACP1302 DSC-17: PRACTICAL -VIII (Practical Based on Theory DSC-14)**  
**(Maximum No. of Periods 60)**

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSC	Semester: V
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTACP1302</b>		Course Title: <b>Practical -VIII</b> (Practical based on Theory DSC-13)	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>• Learn to formulate real life problems into LPP form and find their solutions.</li> </ul> <b>Course Outcomes:</b> After completion of the course students will able to: <ul style="list-style-type: none"> <li>• <b>CO1:</b> Construct and apply Linear programming problem</li> <li>• <b>CO2:</b> Optimize graphical solutions.</li> <li>• <b>CO3:</b> Solve transportation problem.</li> <li>• <b>CO4:</b> Deal with assignment problem.</li> </ul>			
Credits: 2		DSC-17	
Max. Marks: 50		Min. Passing Marks:20	
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4			

<b>Practical-VIII (Practical Based on Theory DSC-14)</b>		
Sr. No.	Title of Experiments	No. of Experiments
1	Formulation of Linear Programming Problem 1	1
2	Solution of L.P.P. by Graphical method	1
3	Basic feasible solution of L.P.P.	1
4	Solution of L.P.P. by Simplex method	1
5	Solution of L.P.P. by Big-M method	1
6	Solution of L.P.P. by Two-Phase Method	1
7	North-West Corner Rule method	1
8	Matrix Minima Method	1
9	Vogel's Approximation Method (VAM)	1
10	Optimality test	1
11	Assignment Problem	1



SSTAET1301

**B.A. / B.Sc. Third Year (SEMESTER-V)**  
**DSE-01: LINEAR STATISTICAL MODELS**  
 (Maximum No. of Periods 30)

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSE	Semester: V
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTAET1301</b>	Course Title: <b>Linear Statistical Models</b>		
<b>Course Objectives:</b> The course objectives are following: <ul style="list-style-type: none"> <li>• To introduce the fundamentals of Regression Analysis and its applications in data modelling.</li> <li>• To develop skills in formulating and solving Simple Linear Regression and Multiple Linear Regression models.</li> <li>• To enable statistical inference using hypothesis testing, confidence intervals, and ANOVA.</li> <li>• To understand model adequacy and issues like Multicollinearity in regression analysis.</li> </ul> <b>Course Outcomes(CO's):</b> At the end of the course the student should be able to: <ul style="list-style-type: none"> <li>• <b>CO1:</b> Apply regression techniques to model and analyse relationships between variables.</li> <li>• <b>CO2:</b> Perform hypothesis testing and construct confidence/prediction intervals.</li> <li>• <b>CO3:</b> Develop and interpret multiple regression models for real-world problems.</li> <li>• <b>CO4:</b> Evaluate model performance and diagnose issues such as multicollinearity.</li> </ul>			
Credits: 2	DSE-1		
Max. Marks: 50	Min. Passing Marks: 20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 2-0-0			

Module No.	Unit No.	Topic	No. of Lectures
<b>1.0</b>	<b>1</b>	<b>Simple Linear Regression Models</b>	<b>7</b>
	<b>1.1</b>	Simple Linear Regression, Least-Squares Estimation of the Parameters	
	<b>1.2</b>	Estimation of $\beta_0$ and $\beta_1$ , Properties of the Least-Squares Estimators and the Fitted Regression Model	
	<b>1.3</b>	Estimation of $\sigma^2$ , Alternate Form of the model, Hypothesis Testing on the Slope and Intercept	
	<b>1.4</b>	Use of $t$ Tests, Testing Significance of Regression, Analysis of Variance	
<b>2.0</b>	<b>2</b>	<b>Interval Estimation in Simple Linear Regression</b>	<b>8</b>
	<b>2.1</b>	Interval Estimation in Simple Linear Regression, Confidence Intervals on $\beta_0, \beta_1$ and $\sigma^2$	



	<b>2.2</b>	Interval Estimation of the Mean Response, Prediction of New Observations	
	<b>2.3</b>	Coefficient of Determination, Regression Through the Origin	
	<b>2.4</b>	Estimation by Maximum Likelihood	
<b>3.0</b>	<b>3</b>	<b>Multiple Regression Models</b>	
	<b>3.1</b>	Multiple Regression Model, Estimation of the Model Parameters	
	<b>3.2</b>	Least-Squares Estimation of the Regression Coefficients, Geometrical Interpretation of Least Squares	
	<b>3.3</b>	Properties of the Least-Squares Estimators, Estimation of $\sigma^2$ , Inadequacy of Scatter Diagrams, Maximum-Likelihood Estimation	<b>7</b>
	<b>3.4</b>	Hypothesis Testing in Multiple Linear Regression, Test for Significance of Regression, Testing the General Linear Hypothesis	
<b>4.0</b>	<b>4</b>	<b>C. I. in Multiple Regression</b>	
	<b>4.1</b>	Confidence Intervals on the Regression Coefficients, CI Estimation of the Mean Response	
	<b>4.2</b>	Simultaneous Confidence Intervals on Regression Coefficients	<b>8</b>
	<b>4.3</b>	Prediction of New Observations	
	<b>4.4</b>	Hidden Extrapolation in Multiple Regression, Standardized Regression Coefficients	
		<b>Total No. of Lectures =</b>	<b>30</b>

#### Text Books:

- 1) Montgomery D.C., Peck, E.A. and Vining G.G.(2003). Introduction to Linear Regression Analysis, 3<sup>rd</sup> Ed. Wiley.

#### Reference Books:

- 1) Joshi D.D. (1987) Linear Estimation and design and analysis of experiments, Wiley Eastern.
- 2) Giri N. (1986) Analysis of variance, South Asia Publishers.
- 3) Rao. C.R. (2002) Linear Statistical Inference and its Applications, 2nd Ed. Wiley.



**B.A. / B.Sc. Third Year (SEMESTER-V)**  
**SSTAEP1301 DSE-02: PRACTICAL--I (Practical Based on Theory DSE-1)**  
**(Maximum No. of Periods 60)**

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSE	Semester: V
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTAEP1301</b>		Course Title: <b>Practical -I</b> (Practical based on Theory DSE-01)	
<b>Course Objectives:</b>			
<ul style="list-style-type: none"> <li>• Students should able to test the properties of the regression model on real life datasets.</li> </ul>			
<b>Course Outcomes:</b> After completion of the course students will able to:			
<ul style="list-style-type: none"> <li>• <b>CO1:</b> Apply regression techniques to model and analyse relationships.</li> <li>• <b>CO2:</b> Perform hypothesis testing and compute confidence/prediction intervals.</li> <li>• <b>CO3:</b> Interpret multiple regression models for real-world problems.</li> <li>• <b>CO4:</b> Predict future observations.</li> </ul>			
Credits: 2		DSE-02	
Max. Marks: 50		Min. Passing Marks:20	
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4			

<b>Practical-I (Practical Based on Theory DSE-01)</b>		
Sr. No.	Title of Experiments	No. of Experiments
1	Fit a simple linear regression model using least squares method	1
2	Estimate and interpret regression coefficients ( $\beta_0, \beta_1$ )	1
3	Perform t-test for slope ( $\beta_1$ ) and intercept ( $\beta_0$ )	1
4	Construct ANOVA table and test overall significance (F-test)	1
5	Construct confidence intervals for $\beta_0$ and $\beta_1$	1
6	Find confidence interval for mean response at a given x	1
7	Compute prediction interval for a new observation	1
8	Calculate coefficient of determination ( $R^2$ ) and fit regression through origin	1
9	Fit a multiple linear regression model	1
10	Estimate regression coefficients using least squares method	1
11	Perform t-tests for individual regression coefficients	1
12	Test overall significance of regression using F-test	1
13	Construct confidence intervals for regression coefficients	1
14	Estimate confidence interval for mean response and prediction interval	1
15	Compute standardized regression coefficients and identify hidden extrapolation	1



SSTAET1302

**B.A. / B.Sc. Third Year (SEMESTER-V)  
DSE-03: STATISTICAL QUALITY CONTROL  
(Maximum No. of Periods 30)**

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSE	Semester: V
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTAET1302</b>	Course Title: <b>Statistical Quality Control</b>		
<p><b>Course Objectives:</b> The course objectives are:</p> <ul style="list-style-type: none"> <li>To introduce the fundamental concepts and importance of Statistical Quality Control in maintaining product and process quality. To develop the ability to construct and interpret control charts for variables and attributes. To provide knowledge of sampling inspection methods and quality standards. To familiarize students with modern quality improvement approaches such as Six Sigma and Total Quality Management.</li> </ul> <p><b>Course Outcomes (CO's):</b> At the end of the course the student should be able to:</p> <ul style="list-style-type: none"> <li><b>CO1:</b> Understand the concepts of quality, process control, and causes of variation in Statistical Quality Control.</li> <li><b>CO2:</b> Construct and interpret control charts for variables such as X-bar, R-chart, and sigma chart to monitor process performance.</li> <li><b>CO3:</b> Apply acceptance sampling techniques, including single and double sampling plans, and evaluate quality using AQL, LTPD, and OC curves.</li> <li><b>CO4:</b> Understand and apply modern quality improvement tools such as Six Sigma, Total Quality Management, and Taguchi methods.</li> </ul>			
Credits: 2	DSE-03		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 2-0-0			

Module No.	Unit No.	Topic	No. of Lectures
<b>1.0</b>	<b>1</b>	<b>Introduction to Statistical Quality Control</b>	<b>7</b>
	<b>1.1</b>	Introduction, Meaning and purpose SQC, Quality of product	
	<b>1.2</b>	Process Control, Product control, Assignable causes, Chance causes, Uses of SQC	
	<b>1.3</b>	Control Charts, 3-sigma control limits, Specification limits	
	<b>1.4</b>	Natural tolerance process. Seven process control tools	
<b>2.0</b>	<b>2</b>	<b>Control Charts for Variables</b>	<b>8</b>
	<b>2.1</b>	X-bar Chart, Numerical examples	



	2.2	R - Chart, Sigma chart, Numerical examples	
	2.3	Construction, Working revision	
	2.4	Interpretation of X-bar, R and Sigma charts.	
<b>3.0</b>	<b>3</b>	<b>Control Chart for Attributes</b>	
	3.1	Defects, Defectives, Fraction defective, Control chart for fraction defective (p-chart)	<b>7</b>
	3.2	Control chart for number of defectives (d-chart)	
	3.3	Interpretation of charts, Control chart for number of defects per unit(C-chart)	
	3.4	Application of C-chart, Limitations of C-chart	
<b>4.0</b>	<b>4</b>	<b>Acceptance Sampling Plan</b>	
	4.1	Acceptance Sampling for Attributes with rectification, Acceptance Quality level (AQL)	<b>8</b>
	4.2	Lot tolerance proportion defectives (LTPD), Consumer's risk, Producers risk, O.C. Curve, Average Outgoing Quality Limit (AOQL) for Single Sampling Plan	
	4.3	Introduction to Double Sampling Plan, Comparison between Single Sampling Plan and Double Sampling Plan	
	4.4	Concept of Six Sigma, Total Quality Management, Taguchi's Method	
		<b>Total No. of Lectures =</b>	<b>30</b>

**Text Books:**

1. Statistical Quality Control, M. Mahajan, Revised Edition, (2021), Dhanpat Rai & Co., Delhi.
2. S.C. Gupta V.K. Kapoor, Fundamentals of Applied Statistics (Sultan Chand and Sons, New Delhi)

**Reference Books:**

1. Montgomery D.C. -Introduction to Statistical Quality Control, 6<sup>th</sup> Edition (2009), John Wiley & Sons, Inc.



SSTAEP1302

**B.A. / B.Sc. Third Year (SEMESTER-V)**  
**DSE-04: PRACTICAL -II (Practical Based on Theory DSE-03)**  
**(Maximum No. of Periods 60)**

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSE	Semester: V
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTAEP1302</b>		Course Title: <b>Practical -II</b> (Practical based on Theory DSE-03)	
<b>Course Objectives:</b> <ul style="list-style-type: none"> <li>To construct and interpret control charts for variables and attributes. To provide knowledge of sampling inspection methods and quality standards.</li> </ul> <b>Course Outcomes (CO's):</b> At the end of the course the student should be able to: <ul style="list-style-type: none"> <li><b>CO1:</b> Apply concepts of quality, process control, and causes of variation in Statistical Quality Control.</li> <li><b>CO2:</b> Apply to Construct and interpret control charts for variables such as X-bar, R-chart, and sigma chart to monitor process performance.</li> <li><b>CO3:</b> Apply acceptance sampling techniques, including single and double sampling plans, and evaluate quality using AQL, LTPD, and OC curves.</li> <li><b>CO4:</b> Understand and apply modern quality improvement tools such as Six Sigma, Total Quality Management, and Taguchi methods.</li> </ul>			
Credits: 2	DSE-04		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4			

<b>Practical-II (Practical Based on Theory DSE-03)</b>		
<b>Sr. No.</b>	<b>Title of Experiments</b>	<b>No. of Experiments</b>
1	Study of basic concepts of SQC: process control, product control, assignable and chance causes	1
2	Determination of 3-sigma control limits and comparison with specification limits	1
3	Study and application of seven basic quality control tools (check sheet, histogram, etc.)	1
4	Estimation of natural tolerance limits of a process	1
5	Construction of $\bar{X}$ (mean) control chart with numerical example	1
6	Construction of R (range) control chart	1
7	Construction of $\sigma$ (standard deviation) control chart	1
8	Interpretation of $\bar{X}$ , R and $\sigma$ control charts and identification of out-of-control points	1
9	Construction of p-chart (fraction defective)	1
10	Construction of d-chart (number of defectives)	1
11	Construction and application of c-chart (number of defects per unit)	1



12	Interpretation and comparison of attribute control charts (p, d, c charts)	1
13	Design of single sampling plan with given AQL and LTPD	1
14	Construction and interpretation of Operating Characteristic (OC) curve and AOQL	1
15	Study of double sampling plan and comparison with single sampling plan	1

**B.A. / B.Sc. Third Year (SEMESTER-V)**  
**SSTAVC1301 VSC-03: STATISTICAL ANALYSIS USING ADVANCED EXCEL**  
**(Maximum No. of Periods - 60)**

<b>Programme: Degree Course in Statistics</b> <b>Class: B.A./B.Sc. III</b>	<b>Year: Third Level 5.5</b>	<b>Course Type: VSC</b>	<b>Semester: V</b>
<b>Prerequisites: --</b>			
<b>Course Code: SSTAVC1301</b>	<b>Course Title: Statistical Analysis Using Advanced Excel</b>		
<p><b>Course prerequisite:</b> This course requires basics of descriptive and inferential statistics knowledge.</p> <p><b>Course Objectives:</b></p> <ul style="list-style-type: none"> <li>To understand spreadsheet concepts and advanced features of Microsoft Excel.</li> <li>To develop skills in data organization, sorting, filtering, and analysis using Excel tools.</li> <li>To perform data analysis using features like Pivot Tables, Goal Seek, and Analysis Tool Package.</li> <li>To build customized Excel applications and automate tasks.</li> </ul> <p><b>Course Outcomes:</b> After completion of the course students will able to:</p> <ul style="list-style-type: none"> <li><b>CO1:</b> Create and manage Excel lists and datasets effectively.</li> <li><b>CO2:</b> Perform data analysis using Goal Seek, Pivot Tables, and Analysis Tool Package.</li> <li><b>CO3:</b> Use file dialog boxes and file system objects for file handling.</li> <li><b>CO4:</b> Develop integrated Excel applications and interact across applications.</li> </ul>			
Credits: 2	VSC		
<b>Max. Marks: 50</b>	<b>Min. Passing Marks:20</b>		
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4</b>			

Module No.	Unit No.	Topics	No. of Lectures
1.0		<b>Introductions to Excel</b>	15
	1.1	Introduction, Using Excel lists, Creating a List, Sorting	
	1.2	To perform a Simple Sort, To Sort by Multiple Columns	
	1.3	Adding Data Using the Data Form, Finding Records Using Criteria, Filtering Data	
	1.4	AutoFilter, Advanced Filters, Special Features for Filtered Lists	



<b>2.0</b>		<b>Basic Operations</b>	
	<b>2.1</b>	Total Row, Subtotals	<b>15</b>
	<b>2.2</b>	Managing Windows, Multiple Windows Splitting Windows, Freezing Panes	
	<b>2.3</b>	Linking Data, Analysis tool pack, Analysis by goal seek, Analysis by pivot tables	
	<b>2.4</b>	Object-orientated programming, Working across applications	
<b>3.0</b>		<b>Built in Functions</b>	
	<b>3.1</b>	File System Objects Using built-in file dialog boxes, Macro security, Protecting applications	<b>15</b>
	<b>3.2</b>	ActiveX controls, Class modules, good programming techniques, customizing menus and toolbars debugging	
	<b>3.3</b>	Handling errors, recording macros, running macros, writing macros	
	<b>3.4</b>	Selecting cells and ranges, Talking to your user, variables, Subroutines, Arguments and functions	
<b>4.0</b>		<b>Loops and Logic</b>	
	<b>4.1</b>	Loops and logic, Debugging, Handling errors, Event-handling	<b>15</b>
	<b>4.2</b>	The Visual Basic rabbit-hole, Looping over collections	
	<b>4.3</b>	Creating forms, Using forms, Advanced form controls Programming menus and toolbars	
	<b>4.4</b>	Working across applications, Crib sheet	
		<b>Total</b>	<b>60</b>

**References:**

- 1) Learn Excel 2016 Expert Skills with The Smart Method: Courseware Tutorial teaching Advanced Techniques, Mike Smart
- 2) Advance Excel 2016 Training Guide by Rita Arora
- 3) Microsoft Excel Data Analysis and Business Modelling, Wayne Winston.
- 4) Six Sigma Statistics with EXCEL and MINITAB, Issa Bass



SSTAFP1301

**B.A. / B.Sc. Third Year (SEMESTER-V)  
FIELD PROJECT  
(Maximum No. of Periods - 120)**

<b>Programme: Degree Course in Statistics</b> <b>Class: B.A./B.Sc. III</b>	<b>Year: Third Level 5.5</b>	<b>Course Type SFP</b>	<b>Semester: V</b>
<b>Prerequisites: --</b>			
<b>Course Code: SSTAFP1301</b>		<b>Course Title: Field Project</b>	
<p><b>Course prerequisite:</b> This course requires basics of descriptive and inferential statistics knowledge.</p> <p><b>Course Objectives:</b></p> <ul style="list-style-type: none"> <li>To learn data collection, tabulation, analysis and interoperation of data using field project study.</li> </ul> <p><b>Course Outcomes:</b> After completion of the course students will able to:</p> <ul style="list-style-type: none"> <li><b>CO1:</b> State aims and objectives, hypotheses of a study. Collect data analysis through different ways.</li> <li><b>CO2:</b> Tabulate and transform data in summarization form.</li> <li><b>CO3:</b> Apply various statistical tools on data collected from field project study.</li> <li><b>CO4:</b> Interpret the result and compile concise report.</li> </ul>			
Credits: 4		SFP	
<b>Max. Marks: 100</b>		<b>Min. Passing Marks:40</b>	
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-8</b>			

Report should include:

- Title page
- Certificate / declaration
- Acknowledgement
- Objectives
- Methodology (survey / observation / activity)
- Data collected
- Analysis/ Tables / graphs
- Findings
- Community impact / suggestions
- Conclusion
- Appendix / Annexure/ Photos / attendance / questionnaire (if applicable)



## B.A. / B.Sc. Third Year (SEMESTER-VI) (Level 5.5)

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
<b>Major</b>	SSTACT1351	Design of Experiments	03	--	<b>12</b>	03	--
	SSTACT1352	Operations Research	03	--		03	--
	SSTACT1353	Demography	02	--		02	--
	SSTACP1351	Practical IX	--	02		--	04
	SSTACP1352	Practical X	--	02		--	04
<b>Major (Elective)</b>	SSTAET1351	Introduction to Stochastic Process	02	--	<b>02</b>	02	--
	SSTAEP1351	Practical-III	--	02	<b>02</b>	--	04
	SSTAET1352	Introductory Clinical Trials	02	--	<b>02</b>	02	--
	SSTAEP1352	Practical-IV	--	02	<b>02</b>	--	04
<b>Skill Based Course</b>	SSTAVC1351	Data Analysis using SPSS Software	--	02	<b>02</b>	--	04
<b>OJT</b>	SSTAOJ1351	OJT (On the Job Training)	--	04	<b>04</b>	--	08
<b>Total Credits</b>			<b>10</b>	<b>12</b>	<b>22</b>	<b>10</b>	<b>24</b>



**B.A. / B.Sc. Third Year (SEMESTER-VI)**  
**SSTACT1351 DSC-18: Design of Experiments**  
**(Maximum no. of periods 45)**

<b>Programme: Degree Course in Statistics</b> <b>Class: B.A./B.Sc. III</b>	<b>Year: Third Level 5.5</b>	<b>Course Type DSC</b>	<b>Semester: VI</b>
<b>Prerequisites: —</b>			
<b>Course Code: SSTACT1351</b>		<b>Course Title: Design of Experiments</b>	
<p><b>Course Objectives:</b> The Learning Objectives of this course are as follows:</p> <ul style="list-style-type: none"> <li>• Develop a strong foundation in Analysis of Variance (ANOVA) for analysing variability in data and testing statistical hypotheses.</li> <li>• Introduce the fundamental principles of Design of Experiments (DOE), including randomization, replication, and local control, for planning efficient experiments.</li> <li>• Enable students to apply and compare different experimental designs such as Completely Randomized Design (CRD), Randomized Block Design (RBD), and Latin Square Design (LSD).</li> <li>• Provide knowledge of factorial experiments to study the effects of multiple factors and their interactions simultaneously.</li> </ul> <p>Course Outcomes: After completion of the course students will able to:</p> <ul style="list-style-type: none"> <li>• <b>CO1:</b> Understand the concept and applications of ANOVA in data analysis.</li> <li>• <b>CO2:</b> Analyse data using Completely Randomized Design (CRD).</li> <li>• <b>CO3:</b> Analyse data using LSD and construct corresponding ANOVA tables.</li> <li>• <b>CO4:</b> Understand the concept and importance of factorial experiments.</li> </ul>			
<b>Credits: 3</b>		<b>DSC-18</b>	
<b>Max. Marks: 75</b>		<b>Min. Passing Marks:30</b>	
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0</b>			

Module No.	Unit No.	Topic	No. of Lectures
<b>1.0</b>		<b>Analysis of Variance</b>	<b>10</b>
	<b>1.1</b>	Introduction, One-way, Two-way classification with one observation per cell	
	<b>1.2</b>	Analysis of two-way classified data with one observation per cell	
	<b>1.3</b>	Mathematical Model, ANOVA table	
	<b>1.4</b>	Degrees of freedom, Hypotheses to be tested.	
<b>2.0</b>		<b>Design of Experiments</b>	



Module No.	Unit No.	Topic	No. of Lectures
	2.1	Introduction, Notation and terminology, Principles of an Experimental Design, Replication, Randomization, Local control, size of plot	13
	2.2	Analysis of Completely Randomized Design (CRD), Mathematical Model and parameter estimation.	
	2.3	Randomized Block Design (RBD), Mathematical Model and parameter estimation, Statistical analysis of RBD for one observation per experimental unit,	
	2.4	Comparison of CRD with RBD in terms of efficiency, Missing value in RBD	
<b>3.0</b>	<b>Latin Square Design</b>		12
	3.1	Latin Square Design, Mathematical Model and parameter estimation, Analysis of Latin Square Design.	
	3.2	Advantages and disadvantages of Latin Square Design	
	3.3	efficiency of LSD compared with CRD and RBD	
	3.4	Missing value in LSD	
<b>4.0</b>	<b>Factorial Experiments</b>		10
	4.1	Factorial Experiment purpose, need	
	4.2	Advantages of factorial Experiments	
	4.3	Analysis of $2^2$ and $2^3$ Factorial Experiments	
	4.4	Yates correction method of computing factorial effect total, ANOVA table.	
		<b>Total</b>	<b>45</b>

**Text Books:**

1. Fundamentals of applied statistics-S. C. Gupta, V. K. Kapoor (Sultan Chandand Sons)

**Reference Books: -**

- 1) Das.M. N. and Giri (1986): Design and Analysis of Experiments, Springer, Verlag
- 2) Oscar Kempthorne: The Design and analysis of Experiments, Wiley
- 3) Singh D. and Chaudhri F.S.: Theory and Analysis of Sample Survey Design.



SSTACT1352

**B.A. / B.Sc. Third Year (SEMESTER-VI)**  
**DSC-19: Operations Research**  
**(Maximum no. of periods 45)**

<b>Programme: Degree Course in Statistics</b> <b>Class: B.A./B.Sc. III</b>	<b>Year: Third Level 5.5</b>	<b>Course Type DSC</b>	<b>Semester: VI</b>
<b>Prerequisites: —</b>			
<b>Course Code: SSTACT1352</b>		<b>Course Title: Operations Research</b>	
<p><b>Course Objectives:</b> The Learning Objectives of this course are as follows:</p> <ul style="list-style-type: none"> <li>To learn fundamental concepts of Operations Research techniques.</li> <li>To develop analytical skills to solve sequencing and scheduling problems.</li> <li>To provide understanding of queuing models.</li> <li>To equip students with decision-making tools using game theory and enable students to apply network analysis techniques.</li> </ul> <p><b>Course Outcomes:</b> After completion of the course students will able to:</p> <ul style="list-style-type: none"> <li><b>CO1:</b> Understand the concept and assumptions of sequencing problems.</li> <li><b>CO2:</b> Analyze different queue disciplines and probability distributions.</li> <li><b>CO3:</b> Construct and analyze payoff matrices and strategies.</li> <li><b>CO4:</b> Understand network components and construct project networks.</li> </ul>			
<b>Credits: 3</b>		<b>DSC-19</b>	
<b>Max. Marks: 75</b>		<b>Min. Passing Marks:30</b>	
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0</b>			
<b>Module No.</b>	<b>Unit No.</b>	<b>Topic</b>	<b>No. of Lectures</b>
<b>1.0</b>		<b>Sequencing Problem</b>	<b>10</b>
	<b>1.1</b>	Introduction, Sequencing problem, General Assumptions	
	<b>1.2</b>	Sequencing Decision problem for n-jobs on two Machines	
	<b>1.3</b>	Travelling Salesmen problem	
	<b>1.4</b>	Solution of Travelling salesmen problem	
<b>2.0</b>		<b>Queuing Theory</b>	<b>13</b>
	<b>2.1</b>	Concept of Queue, Introduction to Queuing Theory	
	<b>2.2</b>	Queue discipline, Inter time arrival distribution	
	<b>2.3</b>	Service time distribution, Waiting time, Queue length	
	<b>2.4</b>	Busy and ideal period, M/M/1 Queue Model	



3.0	Game Theory		
	3.1	Introduction, Competitive game, Finite and Infinite Game, Zero-sum game, Two Person Game Zero-sum game,	12
	3.2	Payoff Matrix, Strategy, Solution of a game, Value of a game, Saddle point	
	3.3	Solution of a rectangular game with Saddle point, Solution of 2 x 2 game without Saddle point	
	3.4	Dominance Property, Graphical Method for the, Solution of 2 x n and m x 2 games.	
4.0	Network Analysis		
	4.1	Introduction, Network and basic components, Activity, Event, Logical sequencing	10
	4.2	Rules for network construction, Critical path analysis Forward pass calculation, Backward pass calculation	
	4.3	Critical path, Float of an activity and Event	
	4.4	Probability consideration in PERT, Distinguish between PERT and CPM	
<b>Total</b>			<b>45</b>

**Text Books:**

1) Kanti Swarup, P.K.Gupta, Man Mohan: -Operations Research (Sultan Chand&Sons) Ninth Edition.

**Reference Books:**

- 1) Gass E.: Linear Programming Method and Application. Narosa publishing House New Delhi.
- 2) Dr.R.K.Gupta - Operations Research (Krishana Prakashan Media(P) Ltd .11- Shivaji Road Meerut)
- 3) Sharma S.D.-Operations Research(Kedarnath Ramnath and Co. Meerut)
- 4) Manju Sharma - Linear Programming (Ramprasad and Sons Agra)
- 5) G. Gopikuttan-Quantitative Methods and Operations Research (Himalaya publishing House)



**B.A. / B.Sc. Third Year (SEMESTER-VI)**

**SSTACT1353**

**DSC-20: Demography  
(Maximum no. of periods 30)**

<b>Programme: Degree Course in Statistics</b>	<b>Year: Third</b>	<b>Course Type DSC</b>	<b>Semester: VI</b>
<b>Class: B.A./B.Sc. III</b>	<b>Level 5.5</b>		
<b>Prerequisites: —</b>			
<b>Course Code: SSTACT1353</b>		<b>Course Title: Demography</b>	
<p><b>Course Objectives:</b> The Learning Objectives of this course are as follows:</p> <ul style="list-style-type: none"> <li>• To learn fundamental concepts of demography and vital statistics and their role in population studies.</li> <li>• To develop understanding of mortality and fertility measures and their applications in demographic analysis.</li> <li>• To provide knowledge of reproduction rates and life tables for analysing population structure and growth.</li> <li>• To familiarize with concepts and measurement of national income and related economic indicators.</li> </ul> <p>Course Outcomes: After completion of the course students will able to:</p> <ul style="list-style-type: none"> <li>• <b>CO1:</b> Understand the concept and importance of vital statistics.</li> <li>• <b>CO2:</b> Analyse age-specific fertility rates and total fertility rate (TFR).</li> <li>• <b>CO3:</b> Understand concepts of stationary and stable populations.</li> <li>• <b>CO4:</b> Analyse the importance and limitations of national income estimation.</li> </ul>			
<b>Credits: 2</b>		<b>DSC-20</b>	
<b>Max. Marks: 50</b>		<b>Min. Passing Marks:20</b>	
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 2-0-0</b>			

<b>Module No.</b>	<b>Unit No.</b>	<b>Topic</b>	<b>No. of Lectures</b>
<b>1.0</b>		<b>Elements of Demography and Mortality</b>	<b>8</b>
	<b>1.1</b>	Introduction and uses of vital statistics, Methods of obtaining vital statistics by registration and census method	
	<b>1.2</b>	Measurement of population Rates and Ratios of vital events.	
	<b>1.3</b>	Measurement of mortality, Crude Death Rate (CDR), Specific Death Rates (SDR), Age Specific Death Rates (ASDR)	
	<b>1.4</b>	Service time distribution, Waiting time, Queue length, Infant Mortality Rate (IMR), Standardized Death rate (STDR), Force of Mortality	
<b>2.0</b>		<b>Fertility and Reproduction Rates</b>	



	2.1	Fertility Rate, Sex ratio, Crude Birth Rate (CBR),	7
	2.2	Merits and Demerits	
	2.3	General Fertility Rate (GFR), Age Specific Fertility Rate,	
	2.4	Total Fertility Rate (TFR)	
<b>3.0</b>		<b>Gross Reproduction Rate and Life Table</b>	7
	3.1	Gross reproduction Rate (GRR), Net reproduction rate (NRR)	
	3.2	Stationary Population, Stable Population	
	3.3	Life table, construction of Life table and uses, Central Mortality rate	
	3.4	Measurement of population growth, Abridged life tables	
<b>4.0</b>		<b>National Income</b>	8
	4.1	Definition, concepts of national Income, Gross national product (GNP), net national product (NNP), Personal Income, Disposable income. Per capita income	
	4.2	Gross domestic product (GDP), National income at market price, National income at factor cost, National income at current prices.	
	4.3	National income at current prices. National income at constant prices, Methods of estimation of national income.	
	4.4	Output method. Income method, Expenditure method, Importance of national income Difficulties in the calculation of national income	
		<b>Total</b>	<b>30</b>

**Text Books:**

1. Fundamentals of Applied Statistics-S. C. Gupta, V. K. Kapoor (Sultan Chand and Sons)

**Reference Books:**

- 1)Shrivastava, O. S. (1983), A textbook of demography: with economics of manpower supply & manpower demand. Vikas Publishing House.
- 2)Gupta, S. P. (2014). Statistical methods (44th ed.). Sultan Chand & Sons.
- 3)BenjaminBernard (1960), Elements of Vital Statistics, George Allen and Unwin Ltd.



**B.A. / B.Sc. Third Year (SEMESTER-VI)**  
**SSTACP1351 DSC-21: PRACTICAL -IX (Practical Based on Theory DSC-18)**  
 (Maximum No. of Periods 60)

<b>Programme: Degree Course in Statistics Class: B.A./B.Sc. III</b>	<b>Year: Third Level 5.5</b>	<b>Course Type DSC</b>	<b>Semester: VI</b>
<b>Prerequisites: This course requires the basics of Continuous distributions.</b>			
<b>Course Code: SSTACP1351</b>	<b>Course Title: Practical -IX (Practical Based on Theory DSC-18)</b>		
<b>Course objectives:</b> The Learning objectives of this course are as follows: <ul style="list-style-type: none"> <li>• To apply ANOVA with one-way, two-way classification.</li> </ul> <b>Course outcomes: After completion of the course students will able to:</b> <ul style="list-style-type: none"> <li>• CO1: Apply ANOVA one-way and two-way classification.</li> <li>• CO2: Compute Missing plot techniques RBD.</li> <li>• CO3: Compute Missing plot techniques LSD.</li> <li>• CO4: Apply Factorial experiments.</li> </ul>			
<b>Credits: 2</b>	<b>DSC-21</b>		
<b>Max. Marks: 50</b>	<b>Min. Passing Marks:20</b>		
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4</b>			

<b>Practical-IX (Practical Based on Theory DSC-18)</b>		
<b>Sr. No.</b>	<b>Title of Experiments</b>	<b>No. of Experiments</b>
1	ANOVA one way classification	1
2	ANOVA two-way classification with one-entry per cell	1
3	Analysis of Completely Randomized Design	1
4	Analysis of Randomized Block Design	1
5	Analysis of Latin Square Design	1
6	Missing plot Technique of RBD	1
7	Missing plot Technique of LSD	1
8	Efficiency of LSD over RBD	1
9	$2^2$ Factorial Experiment	1
10	$2^3$ Factorial Experiment	1



**B.A. / B.Sc. Third Year (SEMESTER-VI)**  
**SSTACP1352 DSC-22: PRACTICAL -X (Practical Based on Theory DSC-19)**  
 (Maximum No. of Periods 60)

<b>Programme: Degree Course in Statistics</b>	<b>Year: Third</b>	<b>Course Type DSC</b>	<b>Semester: VI</b>
<b>Class: B.A./B.Sc. III</b>			
<b>Level 5.5</b>			
<b>Prerequisites:</b>			
<b>Course SSTACP1352</b>	<b>Code:</b>	<b>Course Title: Practical -X (Practical Based on Theory DSC-19)</b>	
<p><b>Course objectives:</b> The Learning Objectives of this course are as follows:</p> <ul style="list-style-type: none"> <li>• Learn to apply various optimisation techniques.</li> </ul> <p><b>Course outcomes:</b> After completion of the course students will able to:</p> <ul style="list-style-type: none"> <li>• <b>CO1:</b> Apply game theory in decision making situation.</li> <li>• <b>CO2:</b> Compute job sequencing problem.</li> <li>• <b>CO3:</b> Compute travelling salesman problem.</li> <li>• <b>CO4:</b> Apply CPM-PERT technique for networking.</li> </ul>			
<b>Credits: 2</b>	<b>DSC-22</b>		
<b>Max. Marks: 50</b>	<b>Min. Passing Marks:20</b>		
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4</b>			

<b>Practical-X (Practical Based on Theory DSC-19)</b>		
<b>Sr. No.</b>	<b>Title of Experiments</b>	<b>No. of Experiments</b>
<b>1</b>	n jobs through two machines sequencing problem	2
<b>2</b>	2 jobs through K machines sequencing problem	2
<b>3</b>	Travelling Salesmen problem	2
<b>4</b>	Queuing problem	2
<b>5</b>	Game with and without Saddle point	2
<b>6</b>	Graphical method to solve $2 \times n$ and $m \times 2$ game	2
<b>7</b>	Dominance Property	1
<b>8</b>	Network construction problem	1
<b>9</b>	PERT	2
<b>10</b>	CPM	2



**B.A. / B.Sc. Third Year (SEMESTER-VI)**  
**SSTAET1351 DSE-05-: Introduction to Stochastic Process**  
**(Maximum No. of Periods 30)**

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSE	Semester: VI
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTAET1351</b>	Course Title: <b>Introduction to Stochastic Process</b>		
<p><b>Course Objectives:</b> Some of the major objectives are:</p> <ul style="list-style-type: none"> <li>• To identify the situations where stochastic modelling is applicable.</li> <li>• To identify the states and model the situation using Poisson process.</li> </ul> <p><b>Course Outcomes (CO's):</b> After completion of the course students will able to:</p> <p><b>CO1:</b> Understand of the fundamental concepts of stochastic processes.</p> <p><b>CO2:</b> Understand and apply Poisson process.</p> <p><b>CO3:</b> Apply Markov process with discrete state space.</p> <p><b>CO4:</b> Apply Markov process with continuous state space.</p>			
Credits: 2	DSE-03		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 2-0-0			

Module No.	Unit No.	Topic	No. of Lectures
<b>1.0</b>	<b>1</b>	<b>Markov Chain</b>	<b>7</b>
	<b>1.1</b>	Introduction, Definition of Stochastic Process	
	<b>1.2</b>	Definition of Markov Chain, Transition Probability Matrix, Order of Markov Chain, Markov Chain as graphs	
	<b>1.3</b>	Higher transition probabilities. Generalization of independent Bernoulli trials	
	<b>1.4</b>	Correlated Random walk, Classification of States and Chains	
<b>2.0</b>	<b>2</b>	<b>Poisson Process</b>	<b>8</b>
	<b>2.1</b>	Definition of Poisson process, Postulates of Poisson process, Properties of Poisson process	
	<b>2.2</b>	Inter-arrival time, Properties of Poisson process, Generalization of Poisson	
	<b>2.3</b>	Poisson process in higher dimensions, Poisson cluster process, Pure birth process, Yule Furry process	



	2.4	Time dependent process, Pure death process, Birth and death process.	
3.0	3	<b>Markov Process with Discrete State Space</b>	7
	3.1	Introduction, Chapman Kolmogorov Equations,	
	3.2	Limiting distributions, Graph theoretic approach for determining V	
	3.3	Randomization, Derived Markov chain	
	3.4	Erlang process: introduction and its distribution	
4.0	4	<b>Markov Process with Continuous State Space</b>	8
	4.1	Introduction, Brownian motion, Wiener process	
	4.2	Differential equations for a linear process, Kolmogorov equations	
	4.3	First passage time distribution for wiener process, Distribution of the Maximum of a Wiener process	
	4.4	Distribution of the first passage time to a fixed point	
<b>Total No. of Lectures =</b>			<b>30</b>

#### Text Books:

1) Medhi, J.(2009):Stochastic Processes, New Age International Publishers.

#### Reference Book:

1. Basu, A.K. (2005): Introduction to Stochastic Processes, Narosa Publishing.
2. Bhat, B.R. (2000): Stochastic Models: Analysis and Applications, New Age International Publishers.
3. Karlin, Sand Taylor H.M, A First Course in Stochastic Process, Academic Press.

### B.A. / B.Sc. Third Year (SEMESTER-VI)

SSTAEP1351

**DSE-06: Practical-III**

**(Maximum no. of periods 60)**

<b>Programme: Degree Course in Statistics</b> <b>Class: B.A./B.Sc. III</b>	<b>Year: Third</b> <b>Level 5.5</b>	<b>Course Type</b> <b>DSE</b>	<b>Semester: VI</b>
<b>Prerequisites: —</b>			
<b>Course Code: SSTAEP1351</b>		<b>Course Title: Practical III (Practical Based on Theory DSE-05)</b>	
<b>Course Objectives:</b> Some of the major objectives are: <ul style="list-style-type: none"> <li>• To compute stochastic modelling where it is applicable.</li> </ul> <b>Course Outcomes (CO's):</b> After completion of the course students will able to: <p><b>CO1:</b> Compute transition probabilities.</p> <p><b>CO2:</b> Determine steady state distributions and classification of states.</p> <p><b>CO3:</b> Simulate Markov chain, Poisson process.</p> <p><b>CO4:</b> Simulate Brownian motion and first passage time.</p>			
<b>Credits: 2</b>		<b>DSE-06</b>	
<b>Max. Marks: 50</b>		<b>Min. Passing Marks:20</b>	
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4</b>			



<b>Practical-III (Practical Based on Theory DSE-06)</b>		
<b>Sr. No.</b>	<b>Title of Experiments</b>	<b>No. of Experiments</b>
<b>1</b>	Construction of Transition Probability Matrix (TPM)	1
<b>2</b>	Computation of n-step transition probabilities	1
<b>3</b>	Verification of Chapman–Kolmogorov equations	1
<b>4</b>	Determination of steady-state (limiting) distribution	1
<b>5</b>	Classification of states (transient, recurrent, absorbing)	1
<b>6</b>	Graph representation of a Markov chain	1
<b>7</b>	Simulation of a Markov chain using random numbers	1
<b>8</b>	Simulation of a correlated random walk	1
<b>9</b>	Simulation of a Poisson process for given rate ( $\lambda$ )	1
<b>10</b>	Verification of inter-arrival times (Exponential distribution)	1
<b>11</b>	Estimation of Poisson parameter ( $\lambda$ )	1
<b>12</b>	Simulation of pure birth process	1
<b>13</b>	Simulation of birth–death process	1
<b>14</b>	Simulation of Brownian motion (Wiener process)	1
<b>15</b>	Simulation of first passage (hitting) time for Wiener process	1



SSTAET1352

**B.A. / B.Sc. Third Year (SEMESTER-VI)**  
**DSE-07: Introductory Clinical Trials**  
**(Maximum No. of Periods 30)**

Programme: Degree Course in Statistics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSE	Semester: VI
<b>Prerequisites:</b> This course does not require any pre-requisite.			
Course Code: <b>SSTAET1352</b>	Course Title: <b>Introductory Clinical Trials</b>		
<b>Course Objectives:</b> Some of the major objectives are: <ul style="list-style-type: none"> <li>• Understand basics of clinical trials designs.</li> <li>• Learn basic models for bioequivalence designs and their analysis.</li> </ul> <b>Course Outcomes (CO's):</b> After completion of the course students will able to: <p><b>CO1:</b> Understand of fundamental concepts of clinical trials.  <b>CO2:</b> Understand and apply designs of clinical trials.  <b>CO3:</b> Understand and able to apply bioequivalence designs and their analysis.  <b>CO4:</b> Understand and able to apply designs based on end point.</p>			
Credits: 2	DSE-07		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 2-0-0			

Module No.	Unit No.	Topic	No. of Lectures
<b>1.0</b>	<b>1</b>	<b>Introduction to Clinical Trials</b>	<b>07</b>
	1.1	Need and ethics of clinical trials, bias and random error in clinical studies, conduct of clinical trials,	
	1.2	Overview of Phase I-IV trials, Multicenter trials. Data management: data definitions	
	1.3	Case report forms, Database design, Data collection systems for good clinical practice.	
	1.4	Bioavailability, Pharmacokinetics and Pharmaco-dynamics, Two-compartment model	
<b>2.0</b>	<b>2</b>	<b>Design of Clinical Trials</b>	<b>08</b>
	2.1	Parallel vs. Cross-over designs, Cross-sectional vs. Longitudinal designs	
	2.2	Objectives and endpoints of clinical trials, Design of Phase I trials, design of single-stage and Multi-stage Phase II trials	
	2.3	Design and monitoring of Phase III trials with sequential stopping, Design of bio-equivalence trials	
	2.4	Inference for 2x2 crossover design: Classical methods of interval	
<b>3.0</b>	<b>3</b>	<b>Bioequivalence Study Design and Analysis</b>	<b>07</b>



	<b>3.1</b>	Power and sample size determination, multiplicative (or log-transformed) model, ML method of estimation	
	<b>3.2</b>	Assessment of inter and intra subject variabilities, detection of outlying subjects	
	<b>3.3</b>	Optimal crossover designs: Balaam's design, two sequence dual design, Optimal four period designs	
	<b>3.4</b>	Assessment of bioequivalence for more than two drugs, Williams design	
<b>4.0</b>	<b>4</b>	<b>Designs Based on Clinical Endpoints</b>	
	<b>4.1</b>	Weighted least squares method, log-linear models, generalized estimating equations	<b>08</b>
	<b>4.2</b>	Drug interaction study, dose proportionality study, steady state analysis	
	<b>4.3</b>	Interim analysis and group sequential tests, alpha spending functions	
	<b>4.4</b>	Analysis of categorical data	
		<b>Total No. of Lectures =</b>	<b>30</b>

#### Text Books:

1) Chow S.C. and Liu J.P. (2004). Design and Analysis of Clinical Trials. 2<sup>nd</sup> Ed. Marcel Dekkar.

#### Reference Book:

1. Chow S.C. and Liu J. P. (2009). Design and Analysis of Bioavailability and bioequivalence. 3rd Ed. CRC Press.
2. Fleiss J. L. (1989). The Design and Analysis of Clinical Experiments. Wiley.
3. Friedman L. M. Furburg C. Demets D. L. (1998). Fundamentals of Clinical Trials, Springer.
4. Jennison. C. and Turnbull B. W. (1999). Group Sequential Methods with Applications to Clinical Trails, CRC Press.
5. Marubeni. E. and Valsecchi M. G. (1994). Analyzing Survival Data from Clinical Trials and Observational Studies, Wiley.



**B.A. / B.Sc. Third Year (SEMESTER-VI)**  
**DSE-08: Practical-IV**  
**(Maximum no. of periods 60)**

SSTAEP1352

<b>Programme: Degree Course in Statistics</b> <b>Class: B.A./B.Sc. III</b>	<b>Year: Third Level 5.5</b>	<b>Course Type DSE</b>	<b>Semester: VI</b>
<b>Prerequisites: —</b>			
<b>Course Code: SSTAEP1352</b>	<b>Course Title: Practical IV (Practical Based on Theory DSE-07)</b>		
<b>Course Objectives:</b> Some of the major objectives are: <ul style="list-style-type: none"> <li>To compute stochastic modelling where it is applicable.</li> </ul> <b>Course Outcomes (CO's):</b> After completion of the course students will able to: <p><b>CO1:</b> Identify bias and random error and design case report.</p> <p><b>CO2:</b> Simulate Phase I dose and design single stage and multi-stage phase II clinical trials.</p> <p><b>CO3:</b> Determine sample size and power calculation for clinical trials.</p> <p><b>CO4:</b> Implement crossover design and able to analyze of categorical clinical trial data.</p>			
<b>Credits: 2</b>	<b>DSE-08</b>		
<b>Max. Marks: 50</b>	<b>Min. Passing Marks:20</b>		
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4</b>			

**Practical-III (Practical Based on Theory DSE-07)**

<b>Sr. No.</b>	<b>Title of Experiments</b>	<b>No. of Experiments</b>
1	Identification of bias and random error in clinical trial datasets	1
2	Design of Case Report Forms (CRF) for a clinical study	1
3	Creation of clinical trial database structure and data definitions	1
4	Simulation of Phase I dose-escalation trial design	1
5	Design of single-stage and multi-stage Phase II clinical trials	1
6	Comparison of parallel and crossover clinical trial designs	1
7	Analysis of 2×2 crossover design using classical methods	1
8	Estimation of pharmacokinetic parameters using two-compartment model	1
9	Simulation of bioavailability and pharmacokinetic data	1
10	Sample size and power calculation for clinical trials	1
11	Bioequivalence analysis using log-transformed model	1
12	Assessment of inter- and intra-subject variability in bioequivalence studies	1
13	Implementation of optimal crossover designs (Balaam/Williams design)	1
14	Interim analysis using group sequential methods and alpha spending functions	1
15	Analysis of categorical clinical trial data (e.g., chi-square test, logistic model)	1



SSTAVC1351

**B.A. / B.Sc. Third Year (SEMESTER-VI)**  
**VSC-04: Data Analysis using SPSS Software**  
**(Maximum no. of periods 60)**

<b>Programme: Degree Course in Statistics</b> <b>Class: B.A./B.Sc. III</b>	<b>Year: Third Level 5.5</b>	<b>Course Type VSC</b>	<b>Semester: VI</b>
<b>Prerequisites: —</b>			
<b>Course Code: SSTAVC1351</b>		<b>Course Title: Data Analysis using SPSS Software</b>	
<p><b>Course Objectives:</b> The Learning Objectives of this course are as follows:</p> <ul style="list-style-type: none"> <li>• Learn to analyse statistical data using SPSS software and its practical applications.</li> <li>• Develop skills in data management, including data entry, cleaning, transformation, and handling missing values, descriptive statistics and correlation analysis for summarizing and exploring data, inferential statistics, including hypothesis testing, ANOVA, and regression analysis using SPSS.</li> </ul> <p>Course Outcomes: After completion of the course students will able to:</p> <ul style="list-style-type: none"> <li>• CO1: Understand the SPSS environment and basic operations.</li> <li>• CO2: Create various types of graphs and charts in SPSS.</li> <li>• CO3: Compute measures of central tendency and variability.</li> <li>• CO4: Perform and interpret simple and multiple regression analysis.</li> </ul>			
<b>Credits: 2</b>		<b>VSC</b>	
<b>Max. Marks: 50</b>		<b>Min. Passing Marks: 20</b>	
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4</b>			

<b>Module No.</b>	<b>Unit No.</b>	<b>Topic</b>	<b>No. of Lectures</b>
<b>1.0</b>		<b>Overview of SPSS</b>	<b>15</b>
	<b>1.1</b>	Mouse and keyboard processing, Frequently-used dialog boxes,	
	<b>1.2</b>	Editing output, printing results, Creating and editing a data file	
	<b>1.3</b>	Managing Data: Listing cases, Replacing missing values	
	<b>1.4</b>	Computing new variables, recording variables, exploring data, selecting cases, sorting cases, Merging files.	
<b>2.0</b>		<b>Graphs</b>	<b>15</b>
	<b>2.1</b>	Creating graphs and charts	
	<b>2.2</b>	Editing graphs and charts	
	<b>2.3</b>	Frequencies, Bar charts	



	2.4	Histograms, Percentiles	
<b>3.0</b>		<b>Descriptive Statistics and Correlation</b>	
	3.1	Measures of central tendency, Variability	<b>15</b>
	3.2	Deviation from normality, Size and stability	
	3.3	Cross Tabulation and Chi-square analysis, The means procedure	
	3.4	Bivariate Correlation, Partial correlations and the correlation matrix	
<b>4.0</b>		<b>ANOVA and Regression</b>	
	4.1	The T-test procedure: Independent–samples, paired samples, and one sample tests	<b>15</b>
	4.2	The one-way ANOVA procedure: One way analysis of variance	
	4.3	General Linear model: Two-way analysis of variance	
	4.4	Simple Linear Regression, Multiple regression analysis	
		<b>Total</b>	<b>60</b>

**Text Books:**

1. SPSS Statistics for Data Analysis and Visualization by Jason Verlen, Andrew Wheeler, Jon Peck, Jesus Salcedo, Keith McCormick, John Wiley & Sons.
2. How to Use SPSS A Step-by-Step Guide to Analysis and Evaluation 1st Edition by Brian C. Cronk, Cronk Brian C.

SSTAOJ1351

**B.A. / B.Sc. Third Year (SEMESTER-VI)  
ON THE JOB TRAINING  
(Maximum no. of periods 120)**

<b>Programme: Degree Course in Statistics Class: B.A./B.Sc. III</b>	<b>Year: Third Level 5.5</b>	<b>Course Type OJT</b>	<b>Semester: VI</b>
<b>Prerequisites: —</b>			
<b>Course Code: SSTAOJ1351</b>		<b>Course Title: On the Job Training</b>	
<b>Credits: 4</b>		<b>OJT</b>	
<b>Max. Marks: 100</b>		<b>Min. Passing Marks: 40</b>	
<b>Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-8</b>			

**Note: As per University guidelines.**



**PROFORMA FOR PRACTICAL EXAMINATION**  
**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**  
**Faculty of Science and Technology**  
**B. Sc. Third Year (Semester – V/VI) Winter / Summer Examination (Year)**  
**Core Practical Course: Statistics**  
**Course Code: \_\_\_\_\_ Course Name: \_\_\_\_\_**

**Time: 02 Hours**

**Marks:30**

Note: i) Attempt any two questions.

ii) Figures to the right indicate full marks.

iii) All questions carry equal marks.

I) Question paper: 20 Marks

II) Viva-Voce: - 05

III) No. of practical's done by the student during the semester: - 03

III) Record Book: - 02

Q. 1.

Q. 2.

Q. 3.

Q. 4.

**ROFORMA FOR PRACTICAL EXAMINATION**  
**Swami Ramanand Teerth Marathwada University Nanded**  
**Faculty of Science and Technology**  
**B. Sc. Third Year (Semester – V /VI)**  
**Vocational Course: Statistics**  
**Course Code: ----- Course Name: -----**

**Time: 02 Hours**

**Marks:30**

Note: i) Attempt any two questions.

ii) Figures to the right indicate full marks.

iii) All questions carry equal marks.

I) Question paper: 20 Marks

II) Viva-Voce: - 05

III) No. of practical's done by the student during the semester: - 03

III) Record Book: - 02

Q. 1.

Q. 2.

Q. 3.

Q. 4.