SCHOOL OF BASIC SCIENCES
DEPARTMENT OF MATHEMATICS
BOARD OF STUDIES – MINUTES OF MEETING

The Minutes of the meeting of Board of Studies for the Department Mathematics for the programme B.Sc Mathematics / B.Sc Statistics / M.Sc Mathematics / M.Sc Statistics held on 03.08.2022 at 11.00 a.m. in the Conference Hall, BIHER.

The following members were present:

S.No.	Members	Designation
1.	Dr.A.Muthukumaravel, Dean, Faculty of Arts & Science, BIST,BIHER, Chennai-126.	Chairman
2.	Dr. R. Ezhilarasi, Associate Professor & Head ,Dept. of Mathematics, SIVET College, Gowarivakkam,	Academic Expert Member
3.	Dr.S. Bala Assistant Professor & Head ,Dept. of Mathematics, SIVET College, Gowarivakkam,	Academic Expert Member
4.	Dr.Siva M, Assistant Professor & Head, Dept of Mathematics, Faculty of Arts & Science, BIST,BIHER, Chennai-73	Internal Member
5.	Dr.K.Manimekalai, Professor, Dept of Mathematics, Faculty of Arts & Science, BIST,BIHER, Chennai-126.	Internal Member
6.	Mr.V.Nandakumar, Assistant Professor, Dept of Mathematics, Faculty of Arts & Science, BIST,BIHER, Chennai – 126.	Internal Member
7.	Dr.N.Ramya, Assistant Professor, Dept of Mathematics, Faculty of Arts & Science, BIST,BIHER, Chennai	Internal Member
8.	Dr.J.Shanmugam, Director Academics, BIHER	Special Invitee
9.	Dr.VenkateshBabu, Dean Academics, BIHER	Special Invitee
10.	Dr.PremJayakumar, COE, BIST,BIHER	Special Invitee

Agenda Point No.: 1.0

Welcoming the members by Chairman, BOS

The Chairman BOS, has welcomed all the members of the BOS present. He also introduced all the members of the board. He further briefed about the Regulations 2020 which is drafted common to all the UG Programmes and PG programmes under the School of Basic Sciences..

Agenda Point No.: 2.0

Brief by the Director-Academic

Dr. J.Shanmugam, Director, Academic, BOS has presented the outlines of the Regulations R2020 for all the UG and PG programme under the School of Basic Sciences.

He further requested the members to express their views on the curriculum & syllabus of II and III year UG and PG programme based on the feedback obtained from the students, Alumni, Industry experts and the teachers under the School of Basic Sciences.

It is resolved to recommend the curriculum to the batches of students of UG & PG programmes admitted from May 2020.

Agenda Point No.: 3.0

To Present the feedback and proposed courses forI, II & III year of UG and PG programme (Regulations R2020) B.Sc Mathematics, B.Sc Statistics and M.Sc Mathematics under the Department of Mathematics, School of Basic Sciences by the Chairman, BOS.

The chairman BOS, Dept of Mathematics has presented the feedback obtained from the students, Alumni, Industry experts and the teachers.

The Chairman BOS, has presented the curriculum and syllabus I, II & III year of UG and PG programme under Regulations 2020 starting from III to VI semesters and invited the members for their valuable comments and suggestions.

It was discussed that the curriculum and syllabus suggested takes care of a few points raised in the feedback report and decided to take action on the other points when the BOS decides the curriculum and syllabus for 1^{st}, 2^{nd}, 3^{rd} to 4^{th} /6^{th} semesters including the major elective and skill based elective courses. The Feedback Report, Analysis and proposed action to be taken are appended herewith (Appendix-I)

It was resolved to recommend the Feedback received from the stakeholders, the report, Analysis and Action Taken.

Agenda Point No.: 4.0

To present and recommend the modified syllabus and introduction of new courses for I –VI semesters B.Sc program

The Chairman, BOS presented the new courses introduced and the revised syllabus of the courses from I-VI semesters for B.Sc Mathematics program based on the feedback.

The external members suggested the following

Resolution 4.1

It is resolved to recommend to introduce the following courses between I and VI semesters for B.Sc. Mathematics programme.

It is resolved to recommend to replace the course Advanced Real Analysis- I and Advanced Graph Theory and Advanced Numerical Methods in Ist semester for M.Sc Mathematics.

It is resolved to recommend to introduce the following courses between I and IV semesters for B.Sc. Statistics programme.

It is resolved to recommend to introduce the following courses between I and VI semesters for M.Sc. Statistics programme.

It is resolved to recommend to swap the courses Real analysis in V semester for B.Sc Mathematics

Resolution 4.2

Resolved to recommend to introduce the following Major Elective Courses for B.Sc Mathematics programme.

Major Electives:

- Mathematical Statistics I
- Mathematical Statistics II
- Mathematical Statistics Practical I
- Allied Physics I
- Allied Physics Practical I
- Allied Physics II
- Allied Physics Practical II
- SCILAB and R Programming
- SCILAB and R Programming Practical

Resolved to recommend to introduce the following Major Courses-I and Major Elective-II papers in Semester I for M.Sc Mathematics programme.

- **Major Course – I:**
- 1. Advanced Real Analysis- I
- 2. Advanced Graph Theory
- **Major Elective – II:**
- 1. Stochastic Process

Resolved to recommend to introduce the following Major papers in Semester I, III and V for B.Sc Statistics programme.

Semester I

1. U20MAP326- Probability Theory

Semester III

1. Allied -III – Introduction to Database Management System
2. Allied – IV – Elementary Number Theory

Semester V

1. U20MAP333 Analysis of Variance
2. U20MAP336 Computational Statistics
3. U20MAP337 Quality Control and Reliability

Resolution 4.3

Resolved to recommend to include the following Skill Based Electives (one subject in IV semester and two subjects in V semester)

List of Skill Based Electives: (As discussed in BOS for the Dept. of B.Sc (Mathematics/CS/Physics/Viscom/Microbiology/Biotechnology/BBA/B.Com)

1. Business Process Outsourcing – Management
2. Customer Relationship
3. Entrepreneurial Development
4. Human Resource Management
5. Marketing Management
6. Office Management
7. Retail Marketing
8. Salesmanship and Advertising
9. Soft Skills
10. Computer Application
11. Multimedia
12. Advanced Excel
13. Web Designing
14. MS Office
15. Flash
16. Computer Hardware and Networking
17. Computer Programming
18. Office Automation Tools
19. Quantitative and Aptitude Reasoning
20. Quantitative and Aptitude
21. Quantitative and Aptitude
22. Regression Analysis with SPSS

Resolution

After the detailed discussion it was resolved to recommend the detailed modified curriculum and syllabus of III-VI semesters for B.Sc Mathematics program incorporating the above suggestions of the members. The modified syllabus for II & III year is given in Appendix-A.

Agenda Point No.: 5.0.

To present and recommend the modified syllabus for III –VI semesters B.Sc Mathematics

The Chairman, BOS presented the following modified syllabus and introduction of new courses for III –VI semesters B.Sc Mathematics.

Vote of Thanks

The Chairman, BOS thanked all the members for attending the meeting and for their valuable suggestions & feedback.

BOARD OF STUDIES MEETING FOR THE DEPARTMENT COMPUTER SCIENCE FOR THE PROGRAMME B.Sc Mathematics / B.Sc Statistics / M.Sc Mathematics / M.Sc Statistics ON 12.5.2020 AT 11.00 A.M. IN THE CONFERENCE HALL, BIHER.

ATTENDANCE SHEET

The following members were present in the BOS Meeting for the Department of Mathematics.

The following members were present:

S.No.	Members	Designation	Signature
1.	Dr.A.Muthukumaravel, Dean, Faculty of Arts & Science, BIST,BIHER, Chennai-126.	Chairman	
2.	Dr. R. Ezhilarasi, Associate Professor & Head ,Dept. of Mathematics, SIVET College, Gowarivakkam,	Academic Expert Member	
3.	Dr.S. Bala Assistant Professor & Head ,Dept. of Mathematics,	Academic Expert Member	
4.	Dr. DR.P.Sumathi, Associate Professor & Head, Dept of Mathematics, Faculty of Arts & Science, BIST,BIHER,	Internal Member	
5.	Dr.K.Manimekalai, Professor, Dept of Mathematics, Faculty of Arts & Science, BIST,BIHER, Chennai-126.	Internal Member	
6.	Mr.V.Nandakumar, Assistant Professor, Dept of Mathematics, Faculty of Arts & Science, BIST,BIHER,	Internal Member	
7.	Dr.N.Ramya, Assistant Professor, Dept of Mathematics, Faculty of Arts & Science, BIST,BIHER,	Internal Member	
8.	Dr.J.Shanmugam, Director Academics, BIHER	Special Invitee	
9.	Dr.VenkateshBabu, Dean Academics, BIHER	Special Invitee	
10.	Dr.PremJayakumar, COE, BIST,BIHER	Special Invitee	

ANNEXURE-I

BHARATH INSTITUTE OF HIGHER EDUCATION AND RESEARCH
SCHOOL OF BASIC SCIENCES
DEPARTMENT OF MATHEMATICS
B.Sc Mathematics – CURRICULUM

Semester I:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	U20TAP101/ U20LSP101 / U20LSP102	Tamil / Hindi /French	5	4	3	30	70	100
Part II	U20LEP201	English	5	4	3	30	70	100
Part III	U20MAP301	Algebra and Trigonometry	5	4	3	30	70	100
	U20MAP302	Calculus	4	3	3	30	70	100
	U20MAP319	MathematicalStatistics I	5	4	3	30	70	100
	U20MAP3L2	MathematicalStatistics Practical I	4	2	3	40	60	100
Part IV	U20CYP401	Environmental Studies	2	2	3	30	70	100
		Total	**30**	**23**				**700**

Semester II:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	U20TAP102/ U20LSP1013/ U20LSP104	Tamil / Hindi /French	5	4	3	30	70	100
Part II	U20LEP202	English	5	4	3	30	70	100
Part III	U20MAP303	Differential Equations and LaplaceTransforms	5	4	3	30	70	100
	U20MAP304	Analytical Geometry 3D	4	3	3	30	70	100
	U20MAP320	MathematicalStatistics I	5	4	3	30	70	100
	U20MAP3L3	MathematicalStatistics Practical I	4	2	3	40	60	100
Part IV	U20BCP401	Value Education	2	2	3	30	70	100
		Total	**30**	**23**				**700**

Semester III:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	U20TAP103/ U20LSP105/ U20LSP106	Tamil / Hindi /French	5	4	3	30	70	100
Part II	U20LEP203	English	5	4	3	30	70	100
Part III	U20MAP305	Sequences And Series	5	4	3	30	70	100
	U20MAP306	Numerical Analysis	4	3	3	30	70	100
	U20PYP315	Allied Physics I	5	4	3	30	70	100
	U20PYP3L8	Allied Physics Practical-I	4	2	3	40	60	100
Part IV	U20TAP401 / U20TAP402	Basic Tamil – I, for those who studied other language under Part I Advanced Tamil – I,for those who studied Tamil under Part I	2	2	3	30	70	100
		Total	**30**	**23**				**700**

Semester IV:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	U20TAP104/ U20LSP107/ U20LSP108	Tamil / Hindi /French	5	4	3	30	70	100
Part II	U20LEP204	English	5	4	3	30	70	100
Part III	U20MAP307	Vector Calculus, Fourier Series and Fourier Transforms	5	4	3	30	70	100
	U20MAP308	Fuzzy Set Theory	4	3	3	30	70	100
	U20PYP316	Allied Physics II	5	4	3	30	70	100
	U20PYP3L9	Allied Physics Practical-II	4	2	3	40	60	100

Part IV	U20TAP403 / U20TAP404	Basic Tamil – I, for those who studied other language under Part I Advanced Tamil – I,for those who studied Tamil under Part I	2	2	3	30	70	100
		Total	**30**	**23**				**700**

Semester V:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part III	U20MAP309	Real Analysis-1	5	5	3	30	70	100
	U20MAP310	Algebraic Structures	5	5	3	30	70	100
	U20MAP311	Operations Research	4	4	3	30	70	100
	U20MAP312	Mechanics	5	5	3	30	70	100
	U20MAP313	SCILAB and RProgramming	4	4	3	30	70	100
	U20MAP3L1	**Practical – V :** SCILAB and RProgramming	**4**	**2**	**3**	**40**	**60**	**100**
Part IV		Skill Based Elective – II	2	2	3	30	70	100
		Skill Based Elective - III	2	2	3	30	70	100
		Total	**30**	**26**				**800**

Semester VI:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part III	U20MAP314	Real Analysis-2	5	4	3	30	70	100
	U20MAP315	Complex Analysis	5	4	3	30	70	100

	U20MAP316	Graph theory	5	4	3	30	70	100
	U20MAP317	Discrete Mathematics	5	4	3	30	70	100
	U20MAP318	Mathematical Modelling	5	4	3	30	70	100
Part V	U20EAP501	Extension Activities	-	1	-	-	-	-
		Total	**30**	**22**				**600**
		GRAND TOTAL		**140**				**4300**

B.Sc STATISTICS– CURRICULUM

Semester I:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	U20TAP101/ U20LSP102/ U20LSP101	Tamil / French/ Hindi	4	3	3	30	70	100
Part II	U20LEP201	English	4	3	3	30	70	100
	U20MAP325	Descriptive Statistics	5	4	3	30	70	100
	U20MAP326	Probability Theory	5	4	3	30	70	100
	U20MAP341	Mathematics for Statistics I	4	3	3	30	70	100
	U20MAP3L4	Statistics Practical I	**3**	**2**	**3**	**40**	**60**	**100**
Part IV	U20CYP401	Environmental Studies	2	2	3	30	70	100
		Total	**27**	**21**				**700**

Semester II:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	U20TAP102/ U20LSP104/ U20LSP103	Tamil / French/ Hindi	3	3	3	30	70	100
Part II	U20LEP202	English	3	3	3	30	70	100
Part III	U20MAP327	Actuarial Statistics	5	4	3	30	70	100
	U20MAP328	Probability and Random variables Allied Statistics-II	5	4	3	30	70	100
	U20MAP342	Mathematics for Statistics II	4	3	3	30	70	100
Part IV	U20BCP401	Value Education	3	2	3	30	70	100

	U20MAP3L5	Major Practical -2	**4**	**2**	**3**	**40**	**60**	**100**
		Total	**30**	**22**				**700**

Semester III:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	U20TAP103/U20LSP106/ U20LSP105	Tamil / French/ Hindi	4	3	3	30	70	100
Part II	U20LEP203	English	4	3	3	30	70	100
Part III	U20MAP329	Distribution Theory	5	4	3	30	70	100
	U20MAP330	Numerical Methods	5	4	3	30	70	100
	U20CSP327	Allied III- Introduction to Database Management System	3	3	3	30	70	100
	U20MAP344	Allied IV - Elementary Number theory	3	**3**	**3**	30	70	100
	U20MAP3L6	Statistics Practical III	4	**2**	**3**	**40**	**60**	**100**
Part IV	U20TAP401	Basic Tamil – I, for those who studied other language under Part I	2	2	3	30	70	100
	U20TAP402	Advanced Tamil – I, for those who studied Tamil under Part I						
		Total	**30**	**24**				**800**

Semester IV:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	U20TAP104/ U20LSP108/ U20LSP107	Tamil / French/ Hindi	4	3	3	30	70	100
Part II	U20LEP204	English	4	3	3	30	70	100
Part III	U20MAP331	Theory of Estimation	5	4	3	30	70	100
	U20MAP332	Testing of Hypotheses	5	4	3	30	70	100
	U20CSP331	Introduction to C	4	4	3	30	70	100
	U20MAP3L7	Statistics Practical IV	4	**2**	**3**	**40**	**60**	**100**

Part IV	U20TAP403	Basic Tamil – II, for those who studied other language under Part I	2	2	3	30	70	100
	U20TAP404	Advanced Tamil – II, for those who studied Tamil under Part I						
Part V		Skill Based Elective I	**2**	**2**	**3**	30	70	100
		Total	**30**	**24**				**800**

Semester V:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part III	U20MAP333	Analysis of Variance	4	4	3	30	70	100
	U20MAP334	Sampling Theory	5	4	3	30	70	100
	U20MAP335	Introduction to Real Analysis	4	4	3	30	70	100
	U20MAP336	Computational Statistics	5	4	3	30	70	100
	U20MAP337	Quality Control and Reliability	5	4	3	30	70	100
Part IV		Skill Based Elective – II	2	2	3	30	70	100
		Skill Based Elective - III	2	2	3	30	70	100
		Total	**30**	**24**				**800**

Semester VI:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part III	U20MAP338	Applied Statistics	5	4	3	30	70	100
	U20MAP339	Stochastic Process	5	4	3	30	70	100
	U20MAP340	Matrix Algebra	5	4	3	30	70	100
	U20MAP346	**Major Elective – II** Introduction to Discrete Mathematics	**3**	**3**	3	30	70	100
	U20PRP3L1	Project		**10**	**-**	**-**	**-**	**200**
Part V	U20EAPXXX	Extension Activities	2	1	-	-	-	-
		Total	**21**	**27**				**600**
		GRAND TOTAL		**140**				**4400**

LIST OF ELECTIVES

MAJOR ELECTVES: I

Sub Code	Sub Name	No. of periods per week			C
		L	T	P	
U20MAP341	Mathematics for Statistics I	3	1	0	4
U20MAP342	Mathematics for Statistics II	3	1	0	4
U20CSP327	Introduction to Database Management System	3	1	0	4

MAJOR ELECTVES: II

Sub Code	Sub Name	No. of periods per week			C
		L	T	P	
U20MAP346	Introduction to Discrete Mathematics	3	1	0	4
U20MAP345	Introduction to Mathematical Modelling	3	1	0	4
U20MAP344	Elementary Number theory	3	1	0	4

M.Sc Mathematics – CURRICULUM

Semester I:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	P20MAP101	Algebra-I	5	4	3	30	70	100
	P20MAP102	Advanced Real Analysis I	5	4	3	30	70	100
	P20MAP103	Ordinary Differential Equations	5	4	3	30	70	100
	P20MAP104	Advanced Graph Theory	5	4	3	30	70	100
Part II	P20MAP120	Major Elective-1 Advanced Numerical Methods	4	3	3	30	70	100
Part V	P20LEP401	Communicative English	4	3	3	30	70	100

		Total	**28**	**22**				**600**

Semester II:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	P18MCMA201	Algebra – II	5	4	3	30	70	100
	P18MCMA202	Real Analysis-II	5	4	3	30	70	100
	P18MCMA203	Partial Differential Equations	5	4	3	30	70	100
	P18MCMA204	Probability Theory	5	4	3	30	70	100
Part II	P18MEMA021	Major Elective –II Integral Equations, Calculus of Variations and Fourier Transforms	4	3	3	30	70	100
Part III	P18OEVC001	Photography & Videography	**1**	**1**	**3**	**40**	**60**	**100**
		Total	**26**	**21**				**600**

Semester III:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	P18MCMA301	Complex Analysis – I	5	4	3	30	70	100
	P18MCMA302	Operations Research	5	4	3	30	70	100
	P18MCMA303	Mechanics	5	4	3	30	70	100
	P18MCMA304	Topology	5	4	3	30	70	100
	P18MEMA021	Major Elective –III	4	3	3	30	70	100

Part-II		Fuzzy Sets and Applications						
Part III	P18OEBA004	Customer Relationship Management	**2**	**2**	**3**	**40**	**60**	**100**
		Total	**26**	**21**				**600**

Semester IV:

Part	Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
Part I	P18MCMA401	Complex Analysis- II	5	4	3	30	70	100
	P18MCMA402	Differential Geometry	5	4	3	30	70	100
	P18MCMA403	Functional Analysis	5	4	3	30	70	100
	P18MCMA404	Number Theory And Cryptography	5	4	3	30	70	100
Part Part IV	P18OEBA001	Open Elective –IV- Quantitative Aptitude Skills	4	3	3	30	70	100
	P18MCYO001	Stress Management by yoga	1	1	3	40	60	100
Part III	P18PRMA4P1	Project	2	9	3	40	60	100
		Total	**26**	**24**				**600**

M.Sc STATISTICS – CURRICULUM

Semester I:

Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
P20MAP116	Statistical Inference-I	4	4	3	30	70	100
P20MAP117	Advanced Operations	4	4	3	30	70	100

	Research -I						
P20MAP118	Advanced ProbabilityTheory	4	4	3	30	70	100
P20MAP119	Optimization Techniques	4	4	3	30	70	100
P20MAP211	Real Analysis and Matrix Theory	**3**	**3**	**3**	**30**	**70**	**100**
P20MAP1L1	Major Pratical-1	**2**	**2**	**3**	**40**	**60**	**100**
	Total	**21**	**21**				**600**

Semester II:

Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
P20MAP120	Statistical Inference-II	4	4	3	30	70	100
P20MAP121	Advanced Distribution Theory	4	4	3	30	70	100
P20MAP122	Advanced Operations Research-II	4	4	3	30	70	100
P20MAP218	Advanced Numerical Analysis	3	3	3	30	70	100
P20MAP214	Multivariate Analysis	3	3	3	30	70	100
P20MAP1L2	Major Pratical-II	**2**	**2**	**3**	**40**	**60**	**100**
	Total	**20**	**20**				**600**

Semester III:

Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
P20MAP123	Design of Experiments	4	4	3	30	70	100
P20MAP124	Sampling Techniques	4	4	3	30	70	100
P20MAP125	Advanced Theory of Estimation	4	4	3	30	70	100
P20MAP216	Statistical Mathematics	3	3	3	30	70	100
P20MAP401	Quantitative Aptitude Skills	2	2	3	30	70	100
P20MO9503	MOOC	2	2	3	30	70	100
P20PRP3L1	Internship	-	2	-	-	-	100
P20MAP1L3	Major Pratical-III	**4**	**2**	**3**	**40**	**60**	**100**
	Total	**21**	**23**				**800**

Semester IV:

Sub Code	Sub Name	Hrs	Credit	Exam Hrs	Int. Mark	Ext. Mark	Total
P20MAP126	Advanced Actuarial Statistics	4	4	3	30	70	100
P20MAP127	Statistical Quality Control	4	4	3	30	70	100
P20MAP128	Advanced Level in Testing of Hypothesis	4	4	3	30	70	100
P20PRP3L2	Project	2	2	-	-	-	100
P20MAP1L4	Major Pratical-IV	**2**	**2**	**3**	**40**	**60**	**100**
	Total	**16**	**16**				**500**
	GRAND TOTAL		**80**				**2500**

LIST OF ELECTIVES

MAJOR ELECTVES: I

Sub Code	Sub Name	No. of periods per week			C
		L	T	P	
P20MAP211	Real Analysis and Matrix Theory	3	0	0	3

MAJOR ELECTVES: II

Sub Code	Sub Name	No. of periods per week			C
		L	T	P	
P20MAP214	Multivariate Analysis	3	0	0	3

MAJOR ELECTVES: III

Sub Code	Sub Name	No. of periods per week			C
		L	T	P	
P20MAP218	Advanced Numerical Analysis	3	0	0	3

MAJOR ELECTVES: IV

Sub Code	Sub Name	No. of periods per week	

		L	T	P	C
P20MAP216	Statistical Mathematics	3	0	0	3

U20MAP308	**Fuzzy Set Theory**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite course – Mathematics Studied in Higher Secondary studies				
	Course Coordinator Name & Department :- Dr. M Siva / Mathematics				

COURSE OBJECTIVES :-

To identify methods appropriate for solving problems. Apply methods to specific problems.

COURSE OUTCOMES (COs)	
CO1	***Understand*** classical set to fuzzy set
CO2	***Estimate*** the crisp set versus fuzzy set
CO3	***Compute*** operations on fuzzy sets
CO4	***Study*** about the fuzzy arithmetic fuzzy numbers
CO5	***Expand*** fuzzy relations crisp versus fuzzy relations
CO6	***Formation*** of the fuzzy set theory fundamental notions

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	**COs/Pos**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	L						H		
	CO2	H	L								
	CO3	H	L								
	CO4	H	L								
	CO5	H	L								
	CO6	H	L								

3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Substream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity		
				✓						

4	Approval		Academic Council Meeting

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	End Semester Examinations		

UNIT I INTRODUCTION **12**

From Classical sets to Fuzzy sets: Introduction – Crisp sets – Fuzzy sets – Basic Types - Basic concepts – Characteristics and significance of the paradigm shift.

Chapter 1: Sections 1.1 to 1.5

UNIT II PROPERTIES OF FUZZY SETS **12**

Fuzzy Sets versus Crisp Sets - Additional properties of α sets – Representation of Fuzzy sets – Extension principle for Fuzzy sets

Chapter 2: Sections 2.1 to 2.3

UNIT III OPERATIONS ON FUZZY SETS **12**

Operations on Fuzzy sets – Types of operations – Fuzzy compliments – Fuzzy intersections: t – norms – Fuzzy Unions: t – conforms.

Chapter 3: Sections 3.1 to 3.4

UNIT IV FUZZY NUMBERS **12**

Fuzzy Arithmetic Fuzzy Numbers – Linguistic variables - Arithmetic operations on intervals – Lattice of fuzzy numbers – Fuzzy equations.

Chapter 4: Sections 4.1 to 4.6

UNIT V RELATIONS **12**

Fuzzy Relations Crisp versus Fuzzy relations-Projections and cylindric extensions – Binary Fuzzy relations - Fuzzy equivalence relations – Fuzzy compatibility relations – Fuzzy morphisms.

Chapter 5: Sections 5.1 to 5.3, 5.5 to 5.6

TEXT BOOK:

1. Fuzzy Sets and Fuzzy Logic – Theory and Applications by George J Klir, Bo Yuan, Prentice Hall of India, Fourth Printing, June 2001.
2. A. Kaufman, Introduction to the theory of Fuzzy subsets, Vol - I, Academic Press, New York, 1975.
3. Fuzzy Set Theory, Fuzzy Logic and Their Applications by Dr. A.K. Bhargava, SChand Publication.

REFERENCES:

1. Fuzzy Mathematical Concepts Front Cover S.Nanda, N.R.Das Alpha Science International, 2010
2. Fuzzy Sets And Applications by Sudhir K, Pragati Prakashan, 2008
3. Fuzzy Sets and Their Applications by Vilém Novák, Taylor & Francis Publication, 1989
3. H. J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai, 1996.

U20MAP313	**SCILAB AND R PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite course – Mathematical Statistics 1				
	Course Coordinator Name & Department :- Dr. M Siva / Mathematics				

COURSE OBJECTIVES :-

To orient the students to introduce the basic syntax, basics of Matrices in Scilab, plotting graphs and flow control, to introduce the basics of R and solving matrices, arrays in R

COURSE OUTCOMES (COs)	
CO1	Understand the syntax, Mathematical Operators, Predefined constants, Built in functions
CO2	Estimation of algebra of matrices and determinant
CO3	Compute basic operations in matrices in Scilab and R
CO4	Study the flow controls in Scilab
CO5	know the methods of plotting graphs
CO6	Formation of lists, arrays and loops in R

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	**COs/Pos**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
2	CO1	H	L						H		
	CO2	H	L								
	CO3	H	L								
	CO4	H	L								
	CO5	H	L								
	CO6	H	L								

3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Substream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity		
					✓					
4	Approval		Academic Council Meeting							

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	End Semester Examinations		

UNIT- I INTRODUCTION TO SCILAB **12**

Data types, Variables and Constants in Scilab - Basic syntax, Mathematical Operators, Predefined constants, Built in functions - Representation of Complex numbers, Polynomials, Vectors.

UNIT- II MATRICES **12**

Basics of Matrices in Scilab - Matrix Addition and Multiplication - M-Files - Determinants of 2 x 2 and 3 x 3 matrices - Data structures using built in functions.

UNIT- III GRAPHICS & FLOW CONTROL **12**

Plotting Bar Graphs in Scilab - Plotting Mathematical Functions in Scilab, font sizes, titles and labels - Mesh & Surface Plot - Printing graphics - Programming - Functions - Loops - Conditional statements

UNIT- 1V INTRODUCTION TO R PROGRAMMING **12**

Introduction to R - R Data Structures - Help functions in R - Vectors - Scalars - Declarations - recycling - Common Vector operations - Using all and any - Vectorized operations - NA and NULL values - Filtering - Vectorised if -then else - Vector Equality - Vector Element names

UNIT- V MATRICES, ARRAYS AND LISTS **12**

Creating matrices - Matrix operations - Applying Functions to Matrix Rows and Columns - Adding and deleting rows and columns - Vector/Matrix Distinction - Avoiding Dimension Reduction - Higher Dimensional arrays - lists - Creating lists - General list operations - Accessing list components and values - applying functions to lists - recursive lists

TEXT BOOKS:

1. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications by Alain Vande Wouwer, Carlos Vilas, and Philippe Saucez
2. Scilab: A Practical Introduction to Programming and Problem Solving by TejasSheth
3. A First Course in Statistical Programming with R by W Braun
4. Programming With R by S. R. Mani Sekhar And T. V. Suresh Kumar

REFERENCES:

1. SCILAB—A Beginner‘s Approach by Anil Kumar Verma
2. Introduction to Scilab: For Engineers and Scientists by Sandeep Nagar
3. Beginning R - The Statistical Programming Language by Mark Gardener
4. A Beginner's Guide to R by Alain F. Zuur, Elena N. Ieno, and Erik Meesters

U20MAP3L1	SCILAB AND R PROGRAMMING LAB	L	T	P	C
	Total Contact Hours – 60	0	0	4	2
	Prerequisite course – Mathematical Statistics 1				
	Course Coordinator Name & Department :- Dr. M Siva / Mathematics				

COURSE OBJECTIVES :-

To orient the students to introduce the basic syntax, basics of Matrices in Scilab, plotting graphs and flow control, to introduce the basics of R and solving matrices, arrays in R

COURSE OUTCOMES (COs)	
CO1	Understand the syntax, Mathematical Operators, Predefined constants, Built in functions
CO2	Estimation of algebra of matrices and determinant
CO3	Compute basic operations in matrices in Scilab and R
CO4	Study the flow controls in Scilab
CO5	know the methods of plotting graphs
CO6	Formation of lists, arrays and loops in R

Mapping of Course Outcomes with Program outcomes (POs)
(1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	H	L						H		
	CO2	H	L								
	CO3	H	L								
	CO4	H	L								
	CO5	H	L								
	CO6	H	L								
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Substream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			
					✓						
4	Approval		Academic Council Meeting								

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey

3	Seminar	3	Industry
4	Online test	4	Alumni
5	End Semester Examinations		

List of Experiments to be implemented in

SCILAB:SCILAB PROGRAMMING

1. Plotting points in 2 dimension
2. Plotting points in 3 dimension
3. Vectors Addition, subtraction and multiplication
4. Matrix addition and subtraction
5. Matrix multiplication
6. Determinant of matrices
7. Bar graph representation
8. Programme using display function

R PROGRAMMING

1. Vectors Addition, subtraction and multiplication
2. Matrix addition and subtraction
3. Matrix multiplication
4. Determinant of matrices
5. Bar graph representation
6. Programme using display function

TEXT BOOKS:

5. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific andEngineering Applications by Alain Vande Wouwer, Carlos Vilas, and Philippe Saucez
6. Scilab: A Practical Introduction to Programming and Problem Solving by TejasSheth
7. A First Course in Statistical Programming with R by W Braun
8. Programming With R by S. R. Mani Sekhar And T. V. Suresh Kumar

REFERENCES:

1. SCILAB—A Beginner‘s Approach by Anil Kumar Verma
2. Introduction to Scilab: For Engineers and Scientists by Sandeep Nagar
3. Beginning R - The Statistical Programming Language by Mark Gardener
4. A Beginner's Guide to R by Alain F. Zuur, Elena N. Ieno, and Erik Meesters

U20MAP318	**MATHEMATICAL MODELLING**						**L**	**T**	**P**	**C**
	Total Contact Hours - 60						3	1	0	4
	Prerequisite – Mathematics in HSC									
	Course Coordinator Name & Department :- Dr.R.Ishwariya / Mathematics									
COURSE OBJECTIVES :- To provide students an introduction to problem-driven applications of mathematics with a focus on design and analysis of models using differential equations.										
COURSE OUTCOMES (COs)										
CO1	***Construct*** the model for real life problems using differential equations									
CO2	***Estimate*** the solutions using graphs									
CO3	***Compute*** the solutions of the differential equations									
CO4	***Study*** the comparison of the Mathematical modelling									
CO5	***Enhance*** the knowledge towards Mathematical modelling									
CO6	***Developing*** the graphs for modelling									
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) 3-High, 2-Medium, 1-Low										
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
2	CO1	H		M						
	CO2	H								
	CO3		M							
	CO4	H								
	CO5	M								
	CO6	H	L							
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/VE/ SBE/ Soft Skill	Part V Extension Activity		
				✓						
4	Approval	Academic Council Meeting								

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	End Semester Examinations		

UNIT- I MATHEMATICAL MODELLING THROUGH ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER **12**

Linear Growth and Decay Models – Non-Linear Growth and Decay Models – CompartmentModels – Dynamics problems – Geometrical problems.

UNIT- II MATHEMATICAL MODELLING THROUGH SYSTEMS OF ODES OF FIRSTORDER **12**

Population Dynamics – Epidemics – Compartment Models – Economics – Medicine, Arms Race,Battles and International Trade – Dynamics.

UNIT- III MATHEMATICAL MODELLING THROUGH ODES OF SECOND ORDER **12**

Planetary Motions – Circular Motion and Motion of Satellites – Mathematical Modelling throughLinear Differential Equations of Second Order – Miscellaneous Mathematical Models.

UNIT- IV MATHEMATICAL MODELLING THROUGH DIFFERENCE EQUATIONS **12**

Simple Models – Basic Theory of Linear Difference Equations with Constant Coefficients –Economics and Finance – Population Dynamics and Genetics – Probability Theory.

UNIT- V MATHEMATICAL MODELLING THROUGH GRAPHS

Solutions that can be Modelled through Graphs – Mathematical Modelling in Terms of DirectedGraphs, Signed Graphs, Weighted Digraphs and Unoriented Graphs.

TEXT BOOKS:

1. J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, New Delhi, 1988.
2. Giordano, Fox, Horton, A First Course in Mathematical Modeling, *5th edition*, Cengage, 2013.
3. Edward A. Bender, An Introduction to Mathematical Modeling, Dover Publications, 2012.

REFERENCES:

1. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East –West Press PvtLimited, New Delhi, 1981.
2. Seyed M. Moghadas, Majid Jaberi-Douraki, Mathematical Modelling: A Graduate Textbook, John Wiley& Sons, 2018.
3. Jagat Narain Kapur, Mathematical Modelling, New Age International, 1988.
4. Sandip Banerjee, Mathematical Modeling Models, Analysis and Applications, Taylor & Francis,2014.

SEMESTER – I

U20MAP326	**PROBABILITY THEORY**						**L**	**T**	**P**	**C**	
	Total Contact Hours – 60						3	1	0	4	
	Prerequisite – Mathematics in HSC										
	Course Coordinator Name &Department :- Mrs. B. Sumithra / Statistics										
COURSE OBJECTIVES :- To orient the students to solve the theorems using probability theory and develop problem solving skills.											
COURSE OUTCOMES (Cos)											
CO1	***Understand*** the basic concepts of Probability										
CO2	***Estimate*** the trials designed to determine										
CO3	***Compute*** the probabilities of events under a given probabilistic model										
CO4	***Study*** the basic theoretical probability										
CO5	***Learn*** the equation and theorem										
CO6	***Formation*** of basic measure theory framework										
Mapping of Course Outcomes with Program outcomes (Pos) (1/2/3 indicates strength of correlation) H-High, M-Medium, L -Low											
1	Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS	PSO2	PS

									O1		O3
2	CO1	H	H	L	M	-	M	-	H		
	CO2	H	H	L	M	-	-	-			
	CO3	H	M	H	H	-	H	-			
	CO4	H	M	M	M	-	-	-			
	CO5	M	M	M	H	-	H	-			
	CO6	H	H	H	M	-	M	-			
3	Category	Part I Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/VE/ Soft Skill	Part V Extension Activity			
4	Approval	Academic Council Meeting									

UNIT I BASIC TERMINOLOGY 12

Meaning and definition of Random Experiment – Outcome – Trial and Event – Exhaustive Event – Favourable Events – Mutually Exclusive Events – Equally Likely Events and Independent Events – Mathematical Probability and Statistical Probability and its limitations – Axiomatic Approach to Probability.

UNIT II THEOREMS ON PROBABILITY 12

Addition theorem – Multiplication theorem – Conditional Probability – Baye's theorem and its properties – simple problems.

UNIT III RANDOM VARIABLES 12

Discrete – continuous and mixed random variables – probability mass – probability density and cumulative distribution functions – problems.

UNIT IV MATHEMATICAL EXPECTIONS 12

Mathematical expectation – moments – probability and moment generating function – median and quartile – Markov inequality – Chebyshev's inequality – problems.

UNIT V SPECIAL DISTRIBUTIONS 12

Discrete uniform – binomial – geometric – negative binomial – hypergeometric – Poisson continuous uniform – exponential – problems.

TEXT BOOK:

1. Rohatgi V.K. and *Md*. Ehsanes *Saleh* A.K, "An Introduction to Probability and Statistics" – Willey, 2nd Edition (2008).
2. Gupta S.C., and V.K.Kapoor, "Fundamental of Mathematical Statistics". – Sultan Chand & Sons, New Delhi. (2013).
3. Milton J.S. and Arnold J.C., "Introduction to Probability and Statistics" (2002).

REFERENCE BOOK:

1. Larson H.J., "Introduction to Probability Theory and Statistical Inference" – 2nd Edition (1974).
2. Ross S.M., "Introduction to Probability and Statistics for Engineers and Scientists" – 5th Edition (2014).
3. Ross S.M., "A First Course in Probability", - 9th Edition (2014).
4. Hines W.W., Montgomery D.C., Gpldsman D.M. and Borror C.M., "Probability and Statistics in Engineering", (2014).

SEMESTER V

U20MAP333	**ANALYSIS OF VARIANCE**				**L**		**T**	**P**	**C**		
	Total Contact Hours - 60				3		1	0	4		
	Prerequisite – Descriptive Statistics										
	Course Coordinator Name &Department :- Dr.R.Ravikumar, Mathematics										
COURSE OBJECTIVES :- The objective of this course is to understand the basic principles of experimental design and to apply it in quality control.											
COURSE OUTCOMES (COs)											
CO1	***Know*** the basic principles of analysis of variance										
CO2	***Learn*** the difference between the one way and two way ANOVA										
CO3	***Use*** the methods of CRD, LSD, RBD										
CO4	***Demonstrate*** factorial experiment										
CO5	***Understand*** the concept of orthogonal contrast										
CO6	***Apply*** the experimental design in quality control										
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	H	H	L	M	-	M	-	H		
	CO2	H	H	L	M	-	-	-			
	CO3	H	M	H	H	-	H	-			
	CO4	H	M	M	M	-	-	-			
	CO5	M	M	M	H	-	H	-			

	CO6	H	H	H	M	-	M	-			
3	Category	Part I Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/VE/ Soft Skill	Part V Extension Activity			
4	Approval	Academic Council Meeting									

UNIT I ANALYSIS OF VARIANCE **12**

Analysis of Variance: Definition and assumptions. Cochran's theorems (statement only) ANOVA - One way and Two-way classifications (with one observation per cell). Experimental error.

UNIT II DESIGN OF EXPERIMENT **12**

Design of Experiment: Need, terminology Randomization, Replication and Local control; Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) - Estimation of missing values in RBD and LSD (one and two).

UNIT III FACTORIAL EXPERIMENT **12**

Factorial experiment - main effects and interactions; definitions of contrast and orthogonal contrast; Analysis of 2^2 and 2^3 experiments.

UNIT IV CONFOUNDING IN FACTORIAL DESIGN **12**

Confounding in factorial design –Total Confounding and Partial confounding in 2^3 experiments.

UNIT VANALYSIS OF CO-VARIANCE **12**

Analysis of co-variance for a one-way layout with one concomitant variable and an RBD with one concomitant variable.

TEXT BOOK:

1. S.C. Gupta and V.K. Kapoor (2013), "Fundamentals of Applied Statistics", Sultan Chand & Sons, New Delhi. [Units I & II]
2. Das, M.N. and Giri, N.C, (1997), Design and Analysis of Experiments, Wiley Eastern Ltd., New Delhi. [Units III to V]
3. Statistical Methods, Gupta S.P, Sultan Chand & Sons, New Delhi. (1995).

REFERENCE BOOK:

1. Douglas Montgomery (2010), "Design and Analysis of Experiments", Wiley India, India.
2. Cochran.W.G. & G.M. Cox (1957), Experimental designs, Wiley International edition, India

3. Mathematical Statistics, John E Freund, 5th Edition, Pearson
4. Mathematical Statistics with Applications, Miller, 8th Edition, Pearson

U20MAP336	**COMPUTATIONAL STATISTICS**						**L**	**T**	**P**	**C**	
	Total Contact Hours - 60						3	1	0	4	
	Prerequisite – Descriptive Statistics										
	Course Coordinator Name & Department :- Dr.R.Ishwariya / Mathematics										
COURSE OBJECTIVES :- To orient the students to solve the problems in statistics using R and numerical methods and to enough knowledge in regression analysis, random variables and probability density											
COURSE OUTCOMES (COs)											
CO1	***Understand*** the syntax of R programming										
CO2	***Estimate*** the results using numerical methods and linear methods for regression analysis										
CO3	***Compute*** the problems using numerical methods										
CO4	***Study*** the simulation of random variables										
CO5	***Enhance*** the knowledge on nonparametric probability density estimation										
CO6	***Develop*** the R Programming using library function										
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	H	H	L	M	-	M	-	H		
	CO2	H	H	L	M	-	-	-			
	CO3	H	M	H	H	-	H	-			
	CO4	H	M	M	M	-	-	-			
	CO5	M	M	M	H	-	H	-			
	CO6	H	H	H	M	-	M	-			
3	Category	Part I Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/VE/ Soft Skill	Part V Extension Activity			
4	Approval	Academic Council Meeting									

UNIT- I INTRODUCTION STATISTICAL PROGRAMMING USING R 12

Reading data tables and frames - data aggregation - code factorization and optimization and statistical libraries in R.

UNIT- II NUMERICAL METHODS IN STATISTICS 12

Floating-point arithmetic and error analysis - recursive methods for computations of summary statistics.

UNIT- III LINEAR METHODS FOR REGRESSION ANALYSIS 12

Multiple regression analysis - orthogonalization by Householder transformations (QR) - singular value decomposition (SVD) - linear dimension reduction using principal component analysis (PCA).

UNIT- 1V SIMULATION OF RANDOM VARIABLES 12

Random number generators - discrete and continuous random variables - inverse transform method - acceptance-rejection method - mixture methods.

UNIT- V NONPARAMETRIC PROBABILITY DENSITY ESTIMATION 12

Histograms - kernel-density estimation - bandwidth selection - finite mixture modeling.

TEXT BOOKS:

1. Handbook of Computational Statistics, Gentle, James E., Härdle, Wolfgang Karl, Mori, Yuich, Springer,2004.
2. Computational Statistics, Givens and Hoeting, Wiley Series in Prob. and Statistics, 2005.
3. Computational Statistics, Geof H. Givens, Wiley–Blackwell, 2005.

REFERENCES:

1. Computational Statistics : An Introduction to R, Gunther Sawitzki, Chapman and Hall/CRC, 2009.
2. Computational Statistics, James E. Gentle, Springer NewYork. 2009.
3. Elements of Computational Statistics, James E. Gentle, Springer Science & Business Media, 2002.
4. Basic Elements of Computational Statistics**,** Wolfgang Karl Härdle, Ostap Okhrin, Yarema Okhrin, Springer, 2017.

U20MAP337	**QUALITY CONTROL AND RELIABILITY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Analysis of Variance				
	Course Coordinator Name &Department :- Dr.M Siva/Mathematics				

COURSE OBJECTIVES: - To introduce the concepts and develop working knowledge on Statistical Quality Control techniques, X Chart, P chart, Control chart for attributes, Double sampling plans, Variable sampling plans.											
COURSE OUTCOMES (COs)											
CO1	***Understand*** the Statistical Quality Control techniques in Industry										
CO2	***Estimate*** the control chart for variables										
CO3	***Compute*** the concept of Control chart for attributes.										
CO4	***Study*** the usage of Acceptance of sampling plans for attributes										
CO5	***Learn*** the ATI curves for single and Double sampling plans										
CO6	***Formation*** of Variable sampling plans.										
Mapping of Course Outcomes with Program outcomes (POs) (1/2/3 indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	H	H	L	M	-	M	-	H		
	CO2	H	H	L	M	-	-	-			
	CO3	H	M	H	H	-	H	-			
	CO4	H	M	M	M	-	-	-			
	CO5	M	M	M	H	-	H	-			
	CO6	H	H	H	M	-	M	-			
3	Category	Part I Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/VE/ SBE/ Soft Skill	Part V Extension Activity			
4	Approval	Academic Council Meeting									

UNIT INEED FOR STATISTICAL QUALITY CONTROL TECHNIQUE 12

Need for Statistical Quality Control techniques in Industry - Causes of Quality variation control charts – Use of the Shwhart - control chart - Specification and tolerance limits - 3 sigma limits - warning limits - application of theory of runs in quality control.

UNIT II CONTROL CHART FOR VARIABLES 12

Control chart for variables - X Chart - R chart - purpose of the charts - Basis of subgrouping - plotting X and R results - determining the trial control limits - Interpretation of control charts X and R

UNIT III CONTROL CHART FOR ATTRIBUTES 12

Control chart for attributes - purpose of the chart - P chart - np chart - construction of P and np chart - choice between chart for P and chart for np - construction of c-chart.

UNIT IV ACCEPTANCE OF SAMPLING PLANS FOR ATTRIBUTES 12

Acceptance of sampling plans for attributes - Producer's risk and consumer's risk - concepts of AQL, LTPD, AOQ, AOQL, ATI and ASN - single, double and Multiples sampling plans - OC, AOQ, ATI curves for single and double sampling plans.

UNIT V VARIABLE SAMPLING PLANS 12

Variable sampling plans - Sigma known and sigma unknown determination of n and k for one sided specification - OC curve.

TEXT BOOK:

1. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of applied statistics, Sultan Chand & Sons.
2. Gupta, R.C. (1974): Statistical Quality Control.
3. Montgomery, D.C. (1983): Introduction to Statistical Quality Control, John Waley & Sons.

REFERENCE BOOK:

1. Grant, E, L. and Laven Worth, R.S.: Statistical Quality Control, McGraw Hill.
2. Statistical quality control methods by Irving Wingate Burr, 1976.
3. Statistical Quality Control by M. Jeya Chandra, 2001.
4. Ekambaram, S K. (1963): Statistical basis of Acceptance sampling, Asia Publishing House.

SEMESTER I

P20MAP116	**STATISTICAL INFERENCE – 1**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – UG Level Statistics				
	Course Coordinator Name &Department :- Mrs. B. Sumithra / Statistics				
COURSE OBJECTIVES :- To orient the students to solve the theorems using Fundamental notions and develop problem solving skills.					
COURSE OUTCOMES (COs)					

CO1	***Understand*** the basic concepts of Estimation Methods
CO2	***Constructions*** of shortest confidence intervals
CO3	***Compute*** fundamental notions of interval estimation
CO4	***Study*** the information inequality
CO5	***Expand*** the usage of theorems
CO6	***Formation*** of the large sample properties of MLE

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	H	H	L			L	_	H		
	CO2	H		L			_	H			
	CO3	H	M					H			
	CO4	H		M			M				
	CO5	M	M					H			
	CO6	H		H			H				
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/VE/ SBE/	Part V Extension Activity			
				✓							
4	Approval	Academic Council Meeting									

UNIT I ESTIMATION **12**

Parametric point estimation – properties of estimates – Consistency – weak consistency, consistency in the r^{th} mean, strong consistency, Fisher's consistency and interrelated theorems. Sufficient condition for consistency, Unbiasedness – mean, median and modal unbiasedness;

sufficient statistics – Factorization theorem, Distributions admitting sufficient statistic, procedure for finding minimal sufficient statistic.

UNIT II INEQUALITY **12**

The information inequality – Cramer-Rao (CR) inequality, Kiefer-Chapman-Robbins (KCR) inequality, CR inequality from KCR inequality, Bhattacharya inequality; Minimum variance bound estimator, Invariant (equivariant) estimators (concept only).

UNIT III THEOREMS **12**

Uniformly minimum variance unbiased estimators (UMUE), A necessary and sufficient condition for an unbiased estimator to be a UMVUE; Completeness and Boundedly completeness; Relation between complete statistic and minimal sufficient statistic; Boundedly complete but not complete; Rao-Blackwell Theorem, Lehmann-Scheffes theorem

UNIT IV METHODS OF ESTIMATION **12**

Methods of estimation – method of moments, method of maximum likelihood and the small sample properties. Large sample properties of MLE – Consistency, Asymptotic normality, Asymptotic efficiency.

UNIT V INTERVAL AND BAYES ESTIMATION **12**

Interval estimation – Fundamental notions of interval estimation, shortest confidence intervals; Constructions of shortest confidence intervals.

Notion of Bayes estimation – concept of prior, posterior and conjugate priors. Simple problems involving quadratic error loss function – Elementary notions of minimax estimation – Simple illustrations.

TEXT BOOK:

1. Goon, A.M. Gupta M.K. and Das Gupta B.C., “An outline of statistical theory” -Vol II, The world press, Calcutta (1980).

2. Lehmann E.I., “Theory of point estimation” - Wiley Eastern (1983).
3. Rohatgi, V.K., “Statistical Inference “- Wiley Eastern (1986).

REFERENCE BOOK:

1. Hogg, R.V and Craig, A.T “An Int to Mathematical Statistics” 6thEdn. Pearson Education Pub. New Delhi. (2009)
2. Abraham Wald., “Sequential Analysis”- John Wiley &Sons(1959).
3. Mood, A.M, Graybill, F.A., and Bose D.C.,“Introduction to Theory of Statistics” - McGraw-Hill(1974).
4. Rao. C.R.,“Linear Statistical Inference and its applications” -Wiley Eastern(1998):.

P20MAP117	**ADVANCED OPERATIONS RESEARCH-I**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – UG Level Statistics Corequistie - Practical-I				
	Course Coordinator Name & Department :- Dr. M. Kavitha /Mathematics				
COURSE OBJECTIVES :- To recognize the importance and value of Operations Researchand Mathematical modeling in solving practical problems in industry.					
COURSE OUTCOMES (COs)					
CO1	***Identify*** and develop operational research models from the verbal description of the real system				
CO2	***Understand*** the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type				
CO3	***Use***variables for formulating mathematical models in management science, industrial engineering, assignment and transportation problems				
CO4	***Apply*** the concepts of game theory				
CO5	***Extract*** the concepts of PERT – CPM calculations				
CO6	***Develop*** to design new simple models, like: CPM, PERT to improve decision –making and develop critical thinking and objective analysis of decision problems.				

Mapping of Course Outcomes with Program outcomes (POs) (L/M/H indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	H	H	L			L		H		
	CO2	H		L				H			
	CO3	H	M					H			
	CO4	H		M			M				
	CO5	M	M					H			
	CO6	H		H			H				
3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)	
					□						
4	Approval	Academic Council Meeting									

UNIT I LINEAR PROGRAMMING 12

Simplex method - Duality - Sensitivity analysis - Revised simplex method - Parametric linear programming.

UNIT II - ASSIGNMENT PROBLEM **12**

Mathematical Formulation of an Assignment Problem – Assignment Algorithm - Unbalanced Assignment Models – Travelling Salesman Problems – Transportation Problems – Optimum solution.

UNIT III – SEQUENCING PROBLEM 12

Processing Each of n Jobs Through m Machines- Processing n Jobs Through 2 Machines-Processing n Jobs Through 3 Machines-Processing 2 Jobs Through m Machines-Processing n Jobs Through m Machines- Travelling Salesman Problem.

UNIT IV – GAME THEORY **12**

Game Theory – Two person zero sum game – The Maximin – Minimax principle – problems - Solution of 2 x 2 rectangular Games – Domination Property – (2 x n) and (m x 2) - graphical method – Problems.

UNIT V – SCHEDULING PROBLEMS **12**

Network scheduling by PERT / CPM – Introduction – Network and basic components– Rules of Network construction – Time calculation in Networks – CPM. PERT – PERT calculations – Problems.

TEXT BOOK:

1. Kandiswarup, P.K.Gupta, Man Mohan, "Operations Research", Sultan Chand & Sons Education Publications, New Delhi, 12th Revised edition, 2004.
2. HamdyTaha, "Operations Research", PHI India Publication.
3. G. Srinivasan , Operations Research : Principles and Applications, Prentice Hall of India

REFERENCES:

1. V.Sundaresan, K.S.Ganapathy Subramanian, K.Ganesan, "Resource Management Techniques", A.R.Publications, 2012.
2. Prem Kumar Gupta D. S. Hira, Operations Research, 5th Edition, S. Chand & Company Ltd., Ram Nagar, New Delhi, 1998.
3. R.Paneerselvam, Operations Research, 2nd edition, Prentice Hall of India
4. Carl L. Sandblom and Horst A. Eiselt, Operations Research: A Model-Based Approach, Springer

P20MAP118	ADVANCED PROBABILITY THEORY	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – UG Level Statistics				
	Course Coordinator Name &Department :- Dr.R.Ravikumar, Mathematics				
COURSE OBJECTIVES :-The aim of the course is to pay a special attention to applications of					

measure theory in the probability theory, understanding of LebesguemeasureandLebesgue integral with their applications..											
COURSE OUTCOMES (COs)											
CO1	***Understand*** the concept of measure theory										
CO2	***Gain*** the ability to understand the concepts of measurable functions, sequence of random variables, convergence, modes of convergence										
CO3	***Study*** the concepts of random variables, sigma-fields generated by random variables, probability distributions and independence of random variables related to measurable functions										
CO4	***Use***Lebesgue integral and its properties										
CO5	***Apply***monotone and continuity properties of probability measure										
CO6	***Learn*** the functions of random variable										
Mapping of Course Outcomes with Program outcomes (POs) (L/M/H indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	H	H	L			L		H		
	CO2	H		L				H			
	CO3	H	M					H			
	CO4	H		M			M				
	CO5	M	M					H			
	CO6	H		H			H				
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Substream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/VE/ SBE/	Part V Extension Activity			
				✓							
4	Approval	Academic Council Meeting									

UNIT 1 **12**

A brief review of limit supremum, limit infimum and limit of sequence of real numbers.Sequence of sets, limit supremum, limit infimum and limit of sequence of sets, Monotone sequence of sets. Class of sets- Semi ring, ring, sigma ring (definition and examples only), field and sigma field. Borel sigma field and monotone class. Definition of minimal sigma field, generated sigma field and induced sigma field. Set functions, additive set functions and sigma additive set functions. Measure and its properties. Measure space. Probability measure, finite measure, sigma finite measure, complete measure, counting measure and signed measure (definition and examples only).

UNIT II **12**

Outer measure, Lebesgue measure, Lebesgue –Stieltjes measure and its application in probability theory.Caratheodory extension theorem (statement only). Cantor set, Construction of cantor set, Measure and uncountability of a Cantor set. Measurable functions and properties (viz. linearity, product, maxima, minima, limit sup, limit inf, and modulus of measurable functions). Simple functions. Sequence of measurable functions. Point-wise convergence, almost everywhere convergence, uniform convergence, convergence in measure, convergence in pth mean (concept only).

UNIT III **12**

Integral of non- negative simple function, integral of non-negative measurable functions and integral of measurable functions. Lebesgue integral and its properties. Monotone convergence theorem, Fatou's theorem, Lebesgue dominated convergence theorem. Lebesgue – 8 Stieltjesintegral and its reduction to Riemann-Stieltjes integral and Riemann integral. Absolute continuity and singularity of measures (definition only). Lebesgue decomposition theorem and Radon-Nykodym theorem (statement and applications only).

UNIT IV **12**

Sample space and events, probability measure, probability space. Limit of sequence of events, monotone and continuity properties of probability measure. Independence of sequence of events, conditional probability and Bayes theorem. Borel- Cantelli lemma, Borel zero-one law and Kolmogorov 0-1 law.

UNIT V **12**

Random Variables, discrete and continuous-type random variables, induced probability measure and induced probability space, probability distribution and distribution function, properties of distribution function., mixture of distribution functions (concept only). Decomposition of distribution function-Jordan decomposition theorem. Functions of a random variable, random vectors, distribution function of random vector (concept only). Independence of sequence of random variables.

TEXT BOOKS

1. Jain, ,P.K. and Gupta, V.P.(2000). Lebesgue Measure and Integration, New Age International (P) Ltd., New Delhi (For Unit 2).
2. Kingman, J.F.C. and Taylor, S.J. (1977). A text book of Introduction to Measure Theory and Probability, 3rdEdn., Cambridge University Press, London (For Unit 1, Unit 2 and Unit 3)
3. Laha, R.G. and Rohatgi, V.K. (1979). Probability Theory, John Wiley, New York (For Unit 4 and Unit 5).

REFERENCE BOOKS

1. Bhat, B.R. (1999). Modern Probability Theory, 3rd Edition, New Age International Publishers.
2. Rohatgi, V.K. and Saleh, Ehsanes (2014). An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd. (For Unit 4 and Unit 5)
3. Roussas, G.G.(2014). An Introduction to Measure-Theoretic Probability, Academic Press, USA.

P20MAP119	OPTIMIZATION TECHNIQUES	L	T	P	C
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – UG Level Statistics				
	Course Coordinator Name & Department:- Dr. M. Kavitha /Mathematics				

COURSE OBJECTIVES:-To apply mathematical concepts and principles to perform numerical and symbolic computations in real numbers.

COURSE OUTCOMES (COs)

CO1	***Understand*** the concepts of optimization techniques.
CO2	***Estimate*** the solution of LPP.
CO3	***Compute*** the Linear andNon-linear programming**.**
CO4	***Study*** the concept of scientific approach of operation research.
CO5	***Apply*** theclassification of queuing models.
CO6	***Develop*** todeterministic models of following types : single item static model with and without price breaks - Multiple item static model with storage limitation.

Mapping of Course Outcomes with Program outcomes (POs)
(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	H	H	L			L		H		
	CO2	H		L				H			
	CO3	H	M					H			
	CO4	H	H	M			M				
	CO5	M	M					H			
	CO6	H		H			H				

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					□					

4	Approval	Academic Council Meeting

UNIT I LINEAR PROGRAMMING PROBLEM 12

Formulation of LPP. Graphical Method – Simplex Method – Artificial Variable Techniques, Big-M Method of solving LPP

UNIT IIINTEGER PROGRAMMING 12

Cutting-plane algorithms - Branch and bound method - Zero-one implicit enumeration. Dynamic programming - elements of DP model - examples of DP models and computations - Solution of LPP by DP.

UNIT III NON-LINEAR PROGRAMMING 12

Kuhn-Tucker conditions – Lagrangian multipliers method - Quadratic programming-Geometric programming (without constraints).

UNIT IV QUEUING THEORY 12

Classification of queues - Detailed study of M/M/1 and M/M/C queues with finite and infinite capacity subject to general queue discipline - Pollazek-Khintchine formula - Tandem or series queues.

UNIT V INVENTORY MODELS 12

ABC inventory system - Deterministic models of following types : single item static model with and without price breaks - Multiple item static model with storage limitation - Probabilistic models of the following types : Continuous review model - Single period models.

TEXT BOOK:

1. 1. Taha, H.A (1982), Operations Research - An introduction, 5th edition, Prentice-Hall, New Delhi.Chapters 2, 3 (omit 3.6), 4, 5, 9 (omit 9.5.2), 10, 14 (omit 14.3.4, 14.3.5, 14.4.3, 14.5), 15 (omit 15.7, 15.8.2), 19 (omit 19.1.2, 19.2.1A), 20 (omit all Sections except 20.2.2, 20.2.3))
2. V.SunderesanK.S.GanapathySubramaniam, K.Ganesan, Operations research, A.R.Publications, 3rd Edition.
3. KantiSwarup, P.K. Gupta and ManMohan, Operations Research, 13thedition, Sultan Chand and Sons, 2007

REFERENCES:

1. Hillier and Liberman (1962), Introduction to Operations Research, McGraw Hill International Edition (Fourth edition).
2. Nirmal Singh Kambo (1982), Mathematical Programming Techniques, East-West Press (Revised Edition).
3. Philips, D. T, Ravindra and Solberg, J. J (1976), Operations Research - Principles and Practice, Wiley, New York.
4. R.Pannerselvam, "Operations Research", Prentice Hall of India Private Limited,
   1. New Delhi, Second Edition, 2006.

P20MAP1L1	**PRACTICAL - I**	**L**	**T**	**P**	**C**
	Total Contact Hours – 30	0	0	4	2
	Prerequisite course – Operations Research-I				
	Course Coordinator Name & Department:- Dr. M. Kavitha /Mathematics				
COURSE OBJECTIVES:- To enable the students to know the importance of operation research and its applications					
COURSE OUTCOMES (COs)					

CO1	***Understand*** the need of practical knowledge in operation research.
CO2	***Use*** of experiments in our day today life.
CO3	***Learn*** to give extreme practice to handle and explain thoroughly about concepts.
CO4	***Apply*** all aspects of parametric applications in operation research.
CO5	***Demonstrate*** the Calculation of operation research problems.
CO6	***Solving*** problems using operation research technique system.

Mapping of Course Outcomes with Program outcomes (POs)
(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3
2	CO1	**H**	**M**	**L**	**H**	**M**	**L**	**H**	H		
	CO2	**H**	**M**	**-**	**H**	**M**	**-**	**H**			
	CO3	**H**	**M**	**M**	**H**	**M**	**M**	**H**			
	CO4	**H**	**M**	**L**	**H**	**M**	**L**	**H**			
	CO5	**H**	**M**	**-**	**H**	**M**	**-**	**H**			

3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
					□					
4	Approval	Academic Council Meeting								

I LINEAR PROGRAMMING 6

1. Simplex Method ; 2. Big M Method; 3. Two-phase Method; 4. Duality;
5. Dual Simplex Method; 6. Sensitivity Analysis; 7. Revised Simplex Method;
8. Parametric Programming.

II DYNAMIC PROGRAMMING 6

1) Examples of Dynamic Programming Models
2. Solution of Linear Programming Problems by Dynamic Programming

III NON-LINEAR PROGRAMMING 6

1. Kuhn-Tucker conditions; 2. Lagrangian Multipliers Method
3. QPP; 4. Geometric Programming (without constraints)

IV. QUEUING THEORY 6

1. (M/M/1) : (/FCFS); 2. (M/M/1) : (N /FCFS); 3. (M/M/c) : (/FCFS)
4. (M/M/c) : (N /FCFS); 5. Machine - Repairman Problem.

V. INVENTORY MODELS 6

1. Single Item Static Model; 2. Single Item Static Model with Price Breaks
3. Multiple Item Static Models with Limitations; 4. Continuous Review Mode
5. s - S Policy.

TEXT BOOK:

1. Taha, H : Operations Research, Prentice Hall of India, 8th edition,2007
2. Rao. S.S. : Engineering Optimization, New Age International (P) Ltd, New Delhi 2004
3. G. Srinivasan , Operations Research : Principles and Applications, Prentice Hall of India

REFERENCES:

5. V.Sundaresan, K.S.Ganapathy Subramanian, K.Ganesan, "Resource Management Techniques", A.R.Publications, 2012.
6. Prem Kumar Gupta D. S. Hira, Operations Research, 5th Edition, S. Chand & Company Ltd., Ram Nagar, New Delhi, 1998.
7. R.Paneerselvam, Operations Research, 2nd edition, Prentice Hall of India
8. Carl L. Sandblom and Horst A. Eiselt, Operations Research: A Model-Based Approach, Springer

SEMESTER II

	STATISTICAL INFERENCE – II	L	T	P	C
P20MAP120	**Total Contact Hours - 60**	3	1	0	4
	Prerequisite – Statistical Inference-I				
	Course Coordinator Name &Department :- Mrs. B. Sumithra / Statistics				

COURSE OBJECTIVES :- To orient the students to randomized and non-randomized tests and develop problem solving skills.											
COURSE OUTCOMES (COs)											
CO1	***Understand*** to know about Sequential test										
CO2	***Estimate*** to Know the basic non-parametric tests										
CO3	***Compute*** concept of sufficient statistics										
CO4	***Study*** the usage of hypothesis testing										
CO5	***Expand*** the Invariant tests										
CO6	***Formation*** to gain the concept and properties										
Mapping of Course Outcomes with Program outcomes (POs) (L/M/H indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**L**			**L**	**H**	H		
	CO2	**H**	**M**	-			-	**H**			
	CO3	**H**	**M**	**M**			**M**	**H**			
	CO4	**H**	**M**	**L**			**L**	**H**			
	CO5	**H**	**M**	-			-	**H**			
	CO6	**H**	**M**	-			-	**H**			
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/AVE/ SBE/	Part V Extension Activity			
					✓						
4	Approval	Academic Council Meeting									

UNIT I RANDOMIZED AND NON-RANDOMIZED TESTS 12

Randomized and non-randomized tests. The Neymann – Pearson fundamental lemma, Most Powerful tests, Uniformly most powerful test, Uniformly most powerful test for distributions with monotone likelihood ratio, A generalization of fundamental lemma.

UNIT II HYPOTHESIS TESTING 12

Unbiasedness for hypothesis testing, Uniformly most powerful unbiased tests, Unbiased tests for one parameter exponential family, Similar regions and complete sufficient statistics, Tests with Neymann Structure, Uniformly most powerful similar tests, Locally most powerful tests.

UNIT III INVARIANT TESTS 12

Invariant tests – maximal invariance, uniformly most powerful invariant tests, Likelihood Ratio test, Consistent tests.

UNIT IV NON-PARAMETRIC TESTS 12

One sample non-parametric tests – Kolmogorov–Smirnov test, Sign test, Wilcoxn Signed Rank test, Test for randomness, Two sample non-parametric tests, Kolmogorov Smirnov test, Wald-Wolfowitz run test, Mann-Whitney U test, Median test.

UNIT V SEQUENTIAL TEST 12

Sequential test – Basic Structure of Sequential tests – Sequential Probability Ratio Test (SPRT). Power and expected sample size of SPRT. Optimum properties of SPRT.

TEXT BOOK:

1. Goon, A.M. Gupta, M.K. Das Gupta (1980) : An Outline of Statistical Theory (Vol.II) The World Press Calcutta.

2. Lehmann, E.L (1983): Testing Statistical Hypothesis, Wiley Eastern.
3. Rohatgi, V.K. (1986): An Introduction to probability theory and mathematical statistics, Wiley Eastern, New Delhi.

REFERENCE BOOK

1. Abraham Wald (1959) : Sequential Analysis, John Wiley & Sons.
2. Rao, C.R. (1998): Linear Statistical Inference and its Application, John Wiley, Second Edition.
3. Hogg, R.V and Craig, A.T "An Int to Mathematical Statistics" 6thEdn. Pearson Education Pub. New Delhi. (2009)
4. Mood, A.M, Graybill, F.A., and Bose D.C., "Introduction to Theory of Statistics" - McGraw-Hill (1974).

P20MAP121	**ADVANCED DISTRIBUTION THEORY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Advanced Probability Theory Corequistie - Practical-II				
	Course Coordinator Name &Department :- Dr.R.Ravikumar, Mathematics				
COURSE OBJECTIVES :- The main objective of this course is to allow the students to learn the advanced techniques of modeling real data from diverse discipline					
COURSE OUTCOMES (COs)					
CO1	***Simulate*** statistical models				

CO2	***Account*** for important theorems and concepts in multivariate analysis.
CO3	***Understand*** consistency, estimator, MLE
CO4	***Learn*** whole system of equations with multiple dimensions/variables
CO5	***Use*** non-central distributions in real life problems
CO6	***Learn*** the concepts of Linear Transformations and inner product spaces

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	H	**M**	**M**				**M**	H		
	CO2	H	**M**					**H**			
	CO3	M	**M**	**L**				**M**			
	CO4	H	**M**	**L**				**M**			
	CO5	M	**M**					**M**			
	CO6	H	**M**					**H**			
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Substream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			
				✓							
4	Approval	Academic Council Meeting									

UNIT I **12**

Beta, Gamma, Cauchy, Lognormal, Logistic, Laplace, Logarithmic and Hyper-geometric distributions - Bivariate discrete distributions : Bivariate binomial and bivariate Poisson distributions – Multinominal distribution.

UNIT II **12**

Non-central sampling distributions - Chi-square, t and F distributions and their properties - Compound and mixture of distributions: Binomial, Poisson and Normal distributions - Truncated distributions - Order statistics, their distributions and properties.

UNIT III **12**

Multivariate Normal Distribution (singular and non-singular) - Characteristic function - Moments - Marginal and conditional distributions - Independence of variables - Linear transformation - Distribution of sample mean vector.

UNIT IV **12**

Maximum likelihood estimates of the mean vector and dispersion matrix - Independences of maximum likelihood estimates of mean vector and dispersion matrix .

UNIT V **12**

Distribution of quadratic forms in Normal variables - Independence of two quadratic forms and independence of quadratic form and linear form - Cochran's theorem.

TEXT BOOKS

1. Anderson, T. W (1984), An Introduction to Multivariate Statistical Analysis, John Wiley and Sons (Chapters 1 to 4 only).
2. David, H. A (1981), Order Statistics, John Wiley (Chapters 1 and 2 only).
3. Gupta, S. C and Kapoor, V. K (2002), Fundamentals of Mathematical Statistics, Sultan-Chand Publications, New Delhi. (For units 1 and 2 only).
4. Johnson, N. L and Kotz, S (1972), Distributions in Statistics, Continuous Univariate Distributions, Vols. I and II, John Wiley and Sons.
5. Johnson N. L, Kotz, S and Balakrishnan, N (1997), Discrete Multivariate Distribution, John Wiley and Sons, New York.
6. Searle, S. R (1971), Linear Models, John Wiley and Sons, New York (relevant chapters for Quadratic Forms only).

REFERRENCE BOOKS

1. Hogg, R.V and Craig, A.T (1978), Introduction to Mathematical Statistics, 4th edition, Colliner McMillan.
2. Rao, C. R (1973), Linear Statistical Inference and its Applications, Wiley Eastern.
3. Rohatgi, V. K (1984), An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.

P20MAP122	ADVANCED OPERATIONS RESEARCH -II	L	T	P	C
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Advanced Operations Research-I				
	Course Coordinator Name & Department :- Dr. M. Kavitha /Mathematics				

COURSE OBJECTIVES :- To recognize the importance and value of Operations Research and Mathematical modeling in solving practical problems in industry.

COURSE OUTCOMES (COs)

CO1	***Describe*** the operational research models from the verbal comments of the real system
CO2	***Understand*** the characteristics of different types of dynamic programming environments and the appropriate dynamic programming approaches and tools to be used in each type
CO3	***Use*** variables for formulating mathematical models in management science, industrial engineering, non-linear programming
CO4	***Apply*** to the stochastic programming **.**
CO5	***Extract*** the concepts of inventory models.
CO6	***Develop*** to design new simple models, like decision models to improve decision –making and develop critical thinking and objective analysis of decision problems.

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**M**			**-**	**H**	H		
	CO2	**H**	**-**	**-**			**-**	**H**			
	CO3	**H**	**M**	**M**			**M**	**H**			
	CO4	**H**	**M**	**L**			**L**	**H**			
	CO5	**H**	**M**	**-**			**-**	**H**			
	CO6	**H**	**-**	**-**			**L**	**H**			

3	Category	Humanities & Social Studies	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)
4	Approval	Academic Council Meeting								

UNIT I INTEGER PROGRAMMING **12**

Integer Programming – Pure and Mixed Integer programming problems – Cutting Plane Algorithm – Mixed Algorithm With proof. Additive and Zero One algorithm – Branch and Bound Method

UNIT II DYNAMIC PROGRAMMING **12**

Dynamic Programming – Modeling and solving of recursive equations – Cargo Loading Model – Reliability Model – Warehousing Model – Investment Model. Solving of optimization problems of mathematical nature using dynamic programming models

UNIT III NETWORK MODELS **12**

Scope of Network Applications-Network Definition-Minimal spanning the Algorithm-

Shortest Problem- Maximum flow model- Minimum cost capacitated flow problem-

Network representation-Linear Programming formulation-capacitated Network simplex

algorithm.

UNIT IV STOCHASTIC PROGRAMMING **12**

Stochastic programming – Chance constrained optimization problems – E, V and EV models – simple applications

UNIT V DECISION THEORY 12

Steps in Decision theory approach types of decision making environments decision making under uncertainty, decision making under Rishk; posterior probabilities and Bayesia Analysis;

decision tree analysis, decision making with utilities.

TEXT BOOK:

4. Taha, H : Operations Research, Prentice Hall of India, 8th edition,2007
5. Rao. S.S. : Engineering Optimization, New Age International (P) Ltd, New Delhi 2004
6. G. Srinivasan , Operations Research : Principles and Applications, Prentice Hall of India

REFERENCES:

1. V.Sundaresan, K.S.Ganapathy Subramanian, K.Ganesan, "Resource Management Techniques", A.R.Publications, 2012.
2. Prem Kumar Gupta D. S. Hira, Operations Research, 5th Edition, S. Chand & Company Ltd., Ram Nagar, New Delhi, 1998.
3. R.Paneerselvam, Operations Research, 2nd edition, Prentice Hall of India
4. Carl L. Sandblom and Horst A. Eiselt, Operations Research: A Model-Based Approach, Springer

P20MAP218	**ADVANCED NUMERICAL ANALYSIS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	0	0	3
	Prerequisite – UG Numerical Methods				

	Course Coordinator Name &Department :- Ms.Sumithra/Mathematics

COURSE OBJECTIVES: - The aim of this course is to teach the applications of various numerical techniques for a variety of problems occurring in daily life. At the end of the course, the students will be able to understand the concepts in Numerical Analysis of differential equations.

COURSE OUTCOMES (COs)

CO1	*solve* an algebraic or transcendental equation using an appropriate numerical method.
CO2	*demonstrate* various numerical techniques such as interpolation and cubic splines.
CO3	*evaluate* a derivative at a value and calculate a definite integral using an appropriate numerical technique.
CO4	*apply* different techniques to solve the ordinary differential equations
CO5	*Use* numerical techniques to solve heat and wave differential equations
CO6	*understand* the accuracy, convergence and the errors of various numerical techniques used in real life problems

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**M**			**L**	**H**	H		
	CO2	**H**	**M**	**-**			**-**	**H**			
	CO3	**H**	**M**	**M**			**M**	**H**			
	CO4	**H**	**M**	**L**			**L**	**H**			
	CO5	**H**	**M**	**-**			**-**	**H**			
	CO6	**H**	**M**	**-**			**-**	**H**			
3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)	
						✓					

4	Approval	Academic Council Meeting

UNIT-I ERROR ANALYSIS AND NUMERICAL SOLUTIONS OF ALGEBRAIC EQUATIONS 12

Definition and sources of errors, Propagation of errors, Sensitivity and conditioning, Stability and accuracy, Floating-point arithmetic and rounding errors.

Bisection method. Fixed-point iteration, Newton's method, Secant method, Convergence and order of convergence

UNIT-II LINEAR SYSTEMS OF EQUATIONS 12

Gauss Elimination, Gauss-Jordan method, LU decomposition, Gauss Jacobi method, Gauss-Seidel iteration method.

UNIT-III INTERPOLATION 12

Polynomial Interpolation: Interpolating polynomial, Lagrange and Newton divided difference interpolation, Error in interpolation, Finite difference formulas, Hermite Interpolation. Spline and Approximation: Cubic Spline.

UNIT-IVNUMERICAL DIFFERENTIATION AND INTEGRATION 12

Numerical differentiation with finite differences, Newton’s forward formula, Newton’s backward formula - Numerical integration: Trapezoidal rule, Simpson's 1/3 - rule, Simpson's 3/8 rule, Error estimates for Trapezoidal rule and Simpson's rule, Gauss quadrature formulas.

UNIT-V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Solution by Taylor series, Picard Method of successive approximations, Euler's Method, Modified Euler Method, Runge- Kutta Methods. Finite difference method for boundary value problems.

TEXT BOOKS:

1. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Edition, New Age International, New Delhi, 2015.

2. R.L. Burden and J. D. Faires, Numerical Analysis, 9th Edition, Cengage Learning, 2011.

3. S. S. Sastry, Introductory Methods of Numerical Analysis, 4th Edition, PHI, 2015.

REFERENCE BOOKS:

1. C. F. Gerald and P. O. Wheatly, Applied Numerical Analysis, 7th Edition, Pearson LPE, 2009.

2. R. S. Gupta, Elements of Numerical Analysis, Cambridge University Press, 2nd Edition, 2015.

3. K. Atkinson, An Introduction to Numerical Analysis, John Wiley & Sons, 2nd Edition, 1989.

<table>
<tr><td rowspan="4">P20MAP214</td><td>MULTIVARIATE ANALYSIS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Total Contact Hours - 45</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="5">Prerequisite course – UG Level Mathematics</td></tr>
<tr><td colspan="5">Course Coordinator Name &Department :- Mr.V.Nandakumar/Mathematics</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES :-</td></tr>
<tr><td colspan="6">COURSE OUTCOMES (COs)</td></tr>
<tr><td>CO1</td><td colspan="5">Learn distribution of T^2-statistic</td></tr>
<tr><td>CO2</td><td colspan="5">Study Testing the equality of covariance matrices</td></tr>
<tr><td>CO3</td><td colspan="5">Use Agglomerative techniques</td></tr>
<tr><td>CO4</td><td colspan="5">Compute Eigen value approach to obtain a simultaneous object and variable ordinations.</td></tr>
<tr><td>CO5</td><td colspan="5">Evaluate Standardization of variables and components special covariance structures</td></tr>
<tr><td>CO6</td><td colspan="5">Verify Fitting of regression equations with qualitative variables</td></tr>
<tr><td colspan="6">Mapping of Course Outcomes with Program outcomes (POs)</td></tr>
</table>

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**L**			**L**		H		
	CO2	**H**	**M**					**H**			
	CO3	**H**	**M**	**M**			**M**	**H**			
	CO4	**H**	**M**	**M**			**M**				
	CO5	**H**	**M**					**H**			
	CO6	**H**	**M**					**H**			
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/VE/ SBE/	Part V Extension Activity			
					✓						
4	Approval	Academic Council Meeting									

UNIT I MULTIVARIATE ANALYSIS OF VARIANCE

Generalized T^2-statistic - Likelihood ratio tests - distribution of T^2-statistic - invariant property - Uses of T^2-statistic - single sample, two sample and q sample problems - Problem of symmetry - Beheren - Fisher problem - Test for equality of sub-vectors – Profile analysis - Mabalanobis D^2-statistic - Multivariate analysis of variance - one-way analysis.

UNIT II COVARIANCE MATRICES

Wishart matrix distribution (without proof) and its properties - Inferences from covariance matrices - Testing hypothesis for single covariance matrix - Testing the equality of covariance matrices - Testing the independence of sets of variables - Testing equality of several normal populations.

UNIT III HIERARCHICAL CLUSTERING TECHNIQUES

Standards of good classification - Procedures of classification into one of two populations with known probability distributions - Evaluation of classification function

- Fisher's linear discriminant functions - Determination of error rates by confusion matrix.

Cluster analysis – Distance and similarity measures - Hierarchical clustering techniques : Agglomerative techniques - Single linkage, complete linkage, average linkage methods – Partitioning method : K-means method.

UNIT IV PRINCIPAL COMPONENT ANALYSIS

Extraction of components - Properties and characteristics of components - Total variation, relative importance, hypothesis test on components - Standardization of variables and components special covariance structures.Correspondence analysis - Eigen value approach to obtain a simultaneous object and variable ordinations.

UNIT V CANONICAL CORRELATION ANALYSIS

Extraction of canonical correlations and their variable - Testing the significance of canonical correlation - Interpretation of canonical variables.Multiple regression analysis - Detection and correction of multi-collinearity problems using principal component method - Fitting of regression equations with qualitative variables as repressors - Logistic regression.

BOOKS FOR STUDY

1. Anderson, T. W (1984), An Introduction to Multivariate Statistical Analysis, John Wiley and Sons (Chapters 5 to 7, 9 to 12).
2. Johnson, R. A and Witchern, D. W (1992), Applied Multivariate Statistical Methods, Prentice-Hall of India Ltd (for Units 1, 3, 4 and 5).
3. Luding, J. A and Reynods, J. F (1988), Statistical Ecology – A Premier on Methods on Computing, John Wiley & Sons.

BOOKS FOR REFERENCES :

1. Giri, N. C (1977), Multivariate Statistical Inference, Academic Press.
2. Morrison, D. F (1976), Multivariate Statistical Methods, 2nd edition, McGraw Hill.
3. Rao, C. R (1973), Linear Statistical Inference and its Applications, 2nd edition, John Wiley.
4. Richard A. Johnson, Dean W. Wichern,Applied Multivariate Statistical Analysis 6th Edition.McGraw Hill

P20MAP1L2	PRACTICAL II	L	T	P	C
	Total Contact Hours - 60	0	0	4	2
	Prerequisite – Advanced Distribution Theory				
	Course Coordinator Name &Department :- Dr.R.Ravikumar, Mathematics				

COURSE OBJECTIVES :- The main objective of this course is to allow the students to learn the advanced techniques of modeling real data from diverse discipline

COURSE OUTCOMES (COs)

CO1	***Review*** of linear estimation and basic designs
CO2	***Solve*** the problems on marginal and conditional distributions
CO3	***Understand*** the concept of fitting distributions
CO4	***test*** the variance in different experimental designs
CO5	***Study*** of complete set of mutually orthogonal lattice design
CO6	***Construct*** B.I.B.D. using finite Abelian groups

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**M**			**L**	**H**	H		
	CO2	**H**	**M**					**H**			
	CO3	**H**		**M**			**M**				
	CO4	**H**	**M**	**L**			**L**	**H**			
	CO5	**H**	**M**								
	CO6	**H**						**H**			

3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Substream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/VE/ SBE/	Part V Extension Activity			
				✓							
4	Approval	Academic Council Meeting									

I. Linear Models and Design of Experiment

1. Testing linear hypothesis in linear models
2. 2^4 and 3^3 factorial experiments -Total and Partial confounding.
3. Single replicate of 2^4 factorial experiment
4. 2 x 3 Factorial experiment
5. 2 x 3 x 3 Factorial experiment
6. Split-plot , Split-Split plot experiments
7. Strip plot experiment
8. BIBD
9. PBIBD (2)
10. Lattice design
11. Youden Square design

II. Distributions

1. Fitting of a) Cauchy b) Lognormal c) Logistic d) Laplace and e) Truncated Binomial and Poisson distributions
2. Marginal and conditional distributions of multivariate normal distribution

TEXT BOOKS

7. Anderson, T. W (1984), An Introduction to Multivariate Statistical Analysis, John Wiley and Sons (Chapters 1 to 4 only).
8. David, H. A (1981), Order Statistics, John Wiley (Chapters 1 and 2 only).
9. Gupta, S. C and Kapoor, V. K (2002), Fundamentals of Mathematical Statistics, Sultan-Chand Publications, New Delhi. (For units 1 and 2 only).
10. Johnson, N. L and Kotz, S (1972), Distributions in Statistics, Continuous Univariate Distributions, Vols. I and II, John Wiley and Sons.
11. Johnson N. L, Kotz, S and Balakrishnan, N (1997), Discrete Multivariate Distribution, John Wiley and Sons, New York.
12. Searle, S. R (1971), Linear Models, John Wiley and Sons, New York (relevant chapters for Quadratic Forms only).

REFERRENCE BOOKS

4. Hogg, R.V and Craig, A.T (1978), Introduction to Mathematical Statistics, 4th edition, Colliner McMillan.
5. Rao, C. R (1973), Linear Statistical Inference and its Applications, Wiley Eastern.
6. Rohatgi, V. K (1984), An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.

SEMESTER III

P20MAP124	**SAMPLING TECHNIQUES**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Design of Experiments Corequistie – Pratical-III				
	Course Coordinator Name &Department :- Dr.R.Ishwariya/Mathematics				

COURSE OBJECTIVES :- To orient the students to estimate various sampling techniques and to do know the techniques of ratio and regression estimator											
COURSE OUTCOMES (COs)											
CO1	***Understand*** sampling techniques										
CO2	***Apply*** Estimation of population mean and population sampling										
CO3	***know*** the Source of non-sampling errors										
CO4	***Learn*** the concept of Regression estimator										
CO5	***Study*** the concept of cluster sampling										
CO6	***Use*** the concept of Questionnaire formation and pilot survey										
Mapping of Course Outcomes with Program outcomes (POs) (L/M/H indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**		**L**			**L**	**H**	H		
	CO2	**H**	**M**					**M**			
	CO3	**H**	**M**	**M**			**M**	**H**			
	CO4	**H**		**L**			**L**	**M**			
	CO5	**H**	**M**					**H**			
	CO6	**H**	**M**	**L**				**H**			
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			
				✓							

4	Approval	Academic Council Meeting

UNIT 1: RATIO AND REGRESSION ESTIMATORS

Asymptotic variance of ratio estimators - Bias in ratio estimation - Ratio estimation in stratified sampling - Combined and separate ratio estimators - Multivariate ratio estimators - Variance of regression estimators - Regression estimation in stratified sampling - Comparison of ratio and regression estimators.

UNIT 2: PROBABILITY PROPORTION TO SIZE WITH REPLACEMENT SAMPLING

Estimation of population mean, total – Selection of a ppswr sample – Comparison with simple random sampling with replacement – Estimation of gain due to ppswr sampling – The efficiency of ppswr sampling with respect to srswr for a given cost.

UNIT 3: CLUSTER SAMPLING

Estimate of mean per element and its variance - Optimum cluster size - Clusters of unequal size - Sampling with unequal probabilities with and without replacement - Various estimators and their mean square errors.

UNIT 4: TWO-STAGE SAMPLING AND TWO-PHASE SAMPLING

Two-Stage Sampling - Units of equal size - Variance of estimated mean, optimum sampling and sub-sampling fractions - Stratified sampling of first stage units - Units of unequal size - sampling with equal and unequal probabilities with and without replacement - Different estimates and their mean square errors.

Two-Phase Sampling - The technique and its uses - Double sampling for stratification - Estimate of the mean and its variance - Double sampling for regression estimation - Estimate of the mean and variance.

UNIT 5: LARGE SCALE SAMPLE SURVEYS

Source of non-sampling errors - Non response and its effects - Repeated measurements of subsamples and interpenetration subsamples - Questionnaire formation and pilot survey.

TEXT BOOKS:

1. William, G. Cochran (1977), Sampling Techniques, 3rd edition, Wiley Eastern Limited, New Delhi [Chapters 1, 2 (omit 2.11 to 2.16), 3 (omit 3.4 to 3.12), 4 (omit 4.7, 4.9 to4.11), 5, 8 (omit 8.5, 8.7 to 8.13), 9 (omit 9.5 and 9.6)].

2. S. Sampath, Sampling Theory and Methods, Narosa Publications, 2000.

3.Mankal Narasinha Murthy, Sampling: Theory and Methods, Statistical Pub. Society, 1967.

REFERENCE BOOKS:

1. ParimalMukhopadhyay (1998), Theory and Methods of Survey Sampling, Prentice Hall of India, New Delhi.

2. Rank Yates (1981), Sampling Methods for Censuses and Surveys, 4th edition, Charles Griffin and Company Limited, London.

3. Des Raj, Sampling Theory, McGraw-Hill, 1968.

4.MankalNarasinha Murthy, Sampling: Theory and Methods, Statistical Pub. Society, 1967

P20MAP125	**ADVANCED THEORY OF ESTIMATION**						**L**	**T**	**P**	**C**	
	Total Contact Hours – 60						3	1	0	4	
	Prerequisite – UG Level Statistics										
	Course Coordinator Name &Department :- Mr.V.Nandakumar/Mathematics										
COURSE OBJECTIVES: -To identify methods appropriate for solving problems. Apply methods to specific problems and the relation between the mean square error and variance of an estimator.											
COURSE OUTCOMES (COs)											
CO1	***Understand*** minimum Variance Unbiased estimator										
CO2	***Estimate*** the MVB estimators - Condition for MVB estimators to exist										
CO3	***Compute s***ufficient condition for an estimator to be consistent										
CO4	***Study*** Maximum Likelihood estimators – Properties										
CO5	***Apply*** the Rao–Blackwell theorem in applied problems										
CO6	***Use*** ratio of variances of two independent normal populations.										
Mapping of Course Outcomes with Program outcomes (POs) (L/M/H indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PSO1	PSO2	PSO3

2	CO1	**H**	**M**	**L**			**M**	**H**	H		
	CO2	**H**		**-**			**-**	**H**			
	CO3	**H**		**M**			**M**				
	CO4	**H**	**M**	**L**			**L**	**H**			
	CO5	**H**	**M**	**-**			**-**				
	CO6	**H**	**M**	**-**			**-**	**H**			
3	Category	Part I Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			
				✓							
4	Approval	Academic Council Meeting									

UNIT 1: UNBIASEDNESS

Point Estimator and its optimal properties : Unbiasedness and asymptotic unbiasedness - Minimum Variance Estimators – Cramer-Rao Bound – Chapman-Robin Bound - Bhattacharya system of lower bounds.

UNIT 2: SUFFICIENCY

Sufficient Statistics - Completeness – bounded completeness - Complete sufficient statistics - Factorization theorem – Rao-Blackwell theorem – Lehman-Scehffe Theorem - Minimum Variance Bound Estimators.

UNIT 3: CONSISTENCY

ML Estimators - CAN Estimators - Moment Estimators - CAN properties of ML estimators and moment estimators - ML estimation based on grouped, truncated and censored data.

UNIT 4: OTHER METHODS OF ESTIMATION

Minimum Chi-square estimation - Bayesian Estimators - Estimation procedure for scale and location parameters - Sequential Estimation.

UNIT 5: INTERVAL ESTIMATION

Construction of shortest length confidence bounds based on sufficient statistics - Reliability estimation - Construction of confidence interval for reliability for one parameter family of pdf's.

TEXT BOOKS:

1. Gupta, S. C and Kapoor, V. K (2002), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.

2. Hogg, R. V and Craig, A. T (2002), Introduction to Mathematical Statistics, Pearson Education Asia, India.

3. Mood, A. M, Graybill, F. A and Boes, D. C (1998), Introduction to the Theory of Statistics, McGraw-Hill, New York.

REFERENCE BOOKS:

1. Saxena, H. C (1985), Statistical Inference, Sultan Chand and Sons, New Delhi.

2. Bansilal and Arora (1989), New Mathematical Statistics, Satyaprakashan, New Delhi.

3.Kumar S M ,Theory of Estimation Paperback – 1 January 2014

4.Dr. Amarendra Mishra, Theory of Statistical Estimation Paperback – 26 August 2020

P20MAP126	**ADVANCED ACTUARIAL STATISTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Statistical Inference-II				
	Course Coordinator Name &Department :- Mr.V.Nandakumar/Mathematics				
COURSE OBJECTIVES :- To orient the students to solve the Increasing and Decreasing annuities and The force of mortality μx - Estimation of μx and develop problem solving skills					
COURSE OUTCOMES (COs)					
CO1	***Understand*** to Nominal Rate of Interest				

CO2	***Estimate*** the Accumulation and Present values of Annuities
CO3	***Compute*** the Purchase price of Annuities - Annuities involving income tax
CO4	***Study*** the life table of mortality
CO5	***Learn*** the Principles of insurances
CO6	***Use*** of premium techniques in real life

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**		**L**			**M**	**H**	H		
	CO2	**H**	**M**	**-**			**-**	**H**			
	CO3	**H**	**M**	**M**			**M**				
	CO4	**H**		**M**			**L**	**H**			
	CO5	**H**	**M**	**-**			**-**	**H**			
	CO6	**H**	**M**	**-**			**-**				
3	Category	Part I Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			
				✓							
4	Approval	Academic Council Meeting									

UNIT 1: Utility theory, insurance and utility theory, model for individual claims and their sums, survival function, curtate future, lifetime force of mortality. Life tables and its relation with survival function, examples, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

UNIT 2: Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions, evaluation for special mortality laws.

Multiple decrement tables, central rates of multiples decrement, net single premiums and their numerical evaluations.

UNIT 3: Distribution of aggregate claims, compound Poisson distribution and its applications. Principles of compound interest, nominal and effective rate of interest and discount, force of interest and discount. Compound interest, accumulation factor, continuous compounding.

UNIT 4: Life insurance: insurance payable at the moment of death and at the end of the year of death level benefit insurance, endowment insurance. Deferred insurance and varying benefit insurance, recursions, commutation functions. Life annuities: single payment, continuous life annuities, discrete life annuities, life annuities with monthly payments, commutation functions, varying annuities, recursions, complete annuities- immediate and apportionable annuities due.

UNIT 5: Net premiums: continuous and discrete premiums, true monthly payment premiums, apportionable premiums, commutation functions, accumulation types benefits, payment premiums, apportionable premiums, commutation functions, accumulation types of benefits.

TEXT BOOKS:

1. Mathematical Basis of Life Assurance (IC-81) (2005), Published by Insurance Institute of India, Bombay.

2. Benjamin and pollard, J. H (1980), Analysis of Mortality and other Actuarial Statistics, Second Edition, Heinemann, London. Books for Reference:

3. Frenk Ayres, J. R (1983), Theory and Problems of Mathematics of Finance, Schaum's Outline Series, McGraw-Hill book Company, Singapore.

4. Gupta, S. C and Kapoor, V. K (2001), Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.

5. Shaillaja R Deshmuk (2009), Actuarial Statistics an Introduction using R, University Press, India.

.

REFERENCE BOOKS:

1. Shailaja R. Deshmukh, Actuarial Statistics: An Introduction Using R Paperback – 1 January 2009

2. Dixit, S.P., Modi, C.S. & Joshi, R.V. (2002) Mathematical Basics of Life Assurance.

Insurance Institute of India, Mumbai.
3. Donald, D.W.A.(1975). Compound Interest and Annuities certain .Heinemann, London.
4. Frank Ayres, J.R. (1983). Theory and problems of mathematics of finance.Schaum's outline series, McGraw Hill, Singapore.

P20MAP1L3	**PRATICAL-III**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	4	2
	Prerequisite – Sampling Techniques				
	Course Coordinator Name &Department :- Mr.V.Nandakumar/Mathematics				

COURSE OBJECTIVES :- To know the basic concepts of multivariate analysis, sampling techniques and statistical inferences

COURSE OUTCOMES (COs)

CO1	***Understand*** the various multivariate analysis
CO2	***Apply*** techniques to solve one way multivariate analysis and Problem of Symmetry
CO3	***Compute***Estimation like Reliability and Bayesian
CO4	***Implement***the various sampling techniques
CO5	***Study*** and analyze Profile Analysis, Cluster Analysis
CO6	***Learn*** different sampling techniques

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**L**			**L**	**H**			
	CO2	**H**		**-**			**-**				
	CO3	**H**	**M**	**M**			**M**	**H**			

	CO4	**H**	**M**	**M**			**L**	**H**	H		
	CO5	**H**		-			-	**H**			
	CO6	**H**	**M**	-			-				
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			
				✓							
4	Approval	Academic Council Meeting									

I. MULTIVARIATE ANALYSIS

1. Hottelling T^2-statistic : Single, Double and q-Sample problems
2. Behren-Fisher problem
3. Test for equality of Sub-Vectors
4. Multivariate Analysis of variance - one way analysis
5. Problem of Symmetry
6. Test for independence of sets of variables
7. Profile Analysis
8. Test for equality of Covariance matrices
9. Cluster Analysis
10. Discriminant analysis
11. Principal component analysis
12. Canonical correlation analysis

II. SAMPLING TECHNIQUES

1. Simple Random Sampling
2. Stratified Random Sampling
3. Ratio method of estimation
4. Regression method of estimation
5. Probability proportional to size method
6. Cluster Sampling
7. Two-stage sampling
8. Double Sampling.

III. STATISTICAL INFERENCE: ESTIMATION

1. ML estimators
2. Modified chi-square estimation
3. Reliability estimation
4. Bayesian Estimation
5. Confidence Interval

UNIT I MARKOV CHAINS 12

Stochastic Processes and Examples. Markov Chain – Introduction and Examples – Chapman–Kolmogorov Equations and Classifications of States – Limit Theorems. Transitions among Classes, The Gambler's Ruin Problem and Mean Time in Transient States.

UNIT II CONTINUOUS-TIME MARKOV CHAINS 12

Introduction – Continuous–Time Markov Chains – Birth and Death Processes – The Kolmogorov Differential Equations.

UNIT III RENEWAL THEORY 12

Introduction and Preliminaries – Distribution of the number of renewals – Limit Theorems – Wald's Equation – The Key Renewal Theorem.

UNIT IV BRANCHING PROCESSES 12

Introduction – Properties of Generating Functions – Probability of Extinction – Distribution of Total Number of Progeny.

UNIT V MARKOV PROCESSES WITH CONTINUOUS STATE SPACE 12

Introduction; Brownian Motion – Wiener Process – Differential Equations for a Wiener Process – Kolmogorov Equations.

BOOK FOR STUDY:

1. Ross, S. M (2006), Stochastic Processes, , 2nd edition , John Wiley and Sons, New York.
   Chapter 1 Unit 1 (Only 1.9)

   Chapter 4 Unit 1 (ExcludeExamples 4.3A – 4.3F and 4.5, 4.6, 4.7, 4.8)

   Chapter 5 Unit 2 (Exclude 5.4.1, 5.5, 5.6, 5.7, 5.8)

   Chapter 3 Unit 3 (Exclude 3.4.1, 3.4.2, 3.4.3, 3.5, 3.6, 3.7, 3.8)

2. Medhi, J (1994), Stochastic Processes, New Age International Publications, 2nd edition, New Delhi.
   Chapter 9 Unit 4 (Exclude 9.5, 9.6, 9.7, 9.8, 9.9, 9.10)

   Chapter 5 Unit 5 (Exclude 5.5, 5.6)

3. Basu, A. K (2001), Introduction to Stochastic Process, Narosa Publishing House, New Delhi.

BOOK FOR REFERENCE:

1. Karlin, S and Taylor, H. M (1975), A First Course in Stochastic Processes, Academic Press, New York.
2. Bhatt, U. N (1984), Elements of Applied Stochastic Processes, John Wiley, New York.
3. Parzen, E (1999), Stochastic Processes, SIAM, Philadelphia.

SEMESTER IV

P20MAP127	STATISTICAL QUALITY CONTORL	L	T	P	C

	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Advanced Actuarial Statistics				
	Course Coordinator Name &Department :- Dr.R.Ravikumar, Mathematics				

COURSE OBJECTIVES :- To introduce the concepts and develop working knowledge on Statistical quality control, Multivariate quality control, Reliability and Life time distribution

COURSE OUTCOMES (COs)

CO1	***Formulation*** of quality control
CO2	***Understand*** the Control of Means and process variability
CO3	***Learn*** the concept of auto correlation in process data
CO4	***Apply*** the concept of Regression equations
CO5	***Use*** the methods of life time distribution
CO6	***Inculcate*** the methods of UMVUE estimation.

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**-**			**L**	**H**	H		
	CO2	**H**	**L**	**M**			**-**				
	CO3	**H**	**M**	**M**			**M**	**H**			
	CO4	**H**	**M**	**L**			**L**				
	CO5	**H**	**L**	**-**			**-**	**H**			
	CO6	**H**	**M**	**L**			**-**	**H**			
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			

				✓							
4	Approval	Academic Council Meeting									

Unit 1: **12**

Statistical process control : Moving average control chart – EWMA control chart.

CUSUM control chart : two sided and one sided procedures , V – mask technique, Tabular cusum and decision interval. Economic design of - chart – single assignable X cost model only.

Unit 2: **12**

Multivariate Quality Control Chart : Control of Means and process variability. Modified Control Chart (chart only) and Acceptance control charts.

Statistical process control with auto correlated data: Sources and effects of auto correlation in process data – Model – Based approaches and Model – free approaches.

Unit 3: **12**

Acceptance sampling plan for variables: Advantages and disadvantages – Single sample plans – one sided and two sided specifications – known and unknown sigma.

Continuous sampling plans : CSP-1, CSP-2 and CSP-3 - properties – (statement only).

Unit 4: **12**

Reliability : Definition, applications, Reliability function, Cumulative distribution function – Failure rate function – Hazard rate function – Reliability in terms of hazard rate and failure rate density – Bath tub Curve – Conditional Reliability.

Reliability measures: Mean time to failure, Variance of failure distribution, median time to failure and mode time to failure – Simple problems.

Unit 5: **12**

Life time distribution: Exponential failure model – Derivation – Properties – Estimation of mean life and reliability estimation (with Complete Samples) – UMVUE estimation.

Two parameter exponential model – Estimation of mean life and reliability estimation with complete samples.

Books for study :

1. Montgomery. D.C. (2005) Introduction to Statistical Quality Control, 5th edn. John Wiley (For Unit – I, II & III)
2. Charles E. Ebling (2000) An introduction to Reliability and Maintainability. (For Unit – IV)
3. Sinha S.K. and Kale. S.K Life testing and Reliability Estimation (For Unit – V) (1998)

Books for Reference :

1. Duncan. A.J. (1986) Quality Control and Industrial Statistics, Irwin Homewood
2. Grant., E.L. and Statistical Quality Control, McGraw Hill Leavenworth.R.S. (1980)

P20MAP128	**ADVANCED LEVEL IN TESTING OF HYPOTHESIS**	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Advanced Theory of Estimation Corequistie - Practical –IV				
	Course Coordinator Name & Department :- Dr.R.Ishwariya / Mathematics				
COURSE OBJECTIVES :-	To introduce the concept of simple and composite hypotheses and solve problems using powerful tests, Likelihood Ratio Test, test of significance and non-parametric methods				
COURSE OUTCOMES (COs)					
CO1	***Understand*** to develop Hypothesis				
CO2	***Know*** the Critical regions and sufficient statistics				

CO3	***Gain*** the concept of Likelihood Ratio Test (LRT)
CO4	***Learn*** the usage of One-tailed and two-tailed tests
CO5	***Use*** the Sign test for one sample
CO6	***Apply*** the Sign test for two samples

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**M**			**L**	**H**	H		
	CO2	**H**		**-**			**-**				
	CO3	**H**	**M**	**M**			**M**	**H**			
	CO4	**H**	**M**	**L**			**L**	**H**			
	CO5	**H**	**M**	**-**			**-**	**H**			
	CO6	**H**		**L**			**-**				
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			
				✓							
4	Approval	Academic Council Meeting									

Unit 1: MP and UMP Test Procedures **12**

Formulation of Hypothesis testing - MP and UMP level α test procedures – Neymann-Pearson Fundamental Lemma - Distributions with MLR property – Karlin-Rubin Theorem - LMP Test procedures.

Unit 2:Test procedures for Two-sided Hypothesis

12

Generalized Fundamental Lemma - UMP test procedures for two sided hypotheses on one parameter exponential family - Likelihood Ratio Test procedures - UMP test procedures in presence of nuisance parameters.

Unit 3: Unbiased and Invariant test Procedures **12**

Unbiased tests - Similar tests and tests with Neyman structure - UMP unbiased test procedures in one parameter exponential family - LMP unbiased tests - Invariant tests and MP invariant tests.

Unit 4: SPRT Procedure **12**

Fundamental concepts - SPRT procedures for testing simple hypotheses versus simple alternative - Relationship between SPRT and Random walk - Optimum properties of SPRT - Derivation of power function and ASN function for SPRT procedures relating to Binomial, Poisson, Exponential and Normal distributions.

Unit 5: Confidence Interval and Non Parametric Tests **12**

Relationship between confidence interval and Hypotheses testing problems - Derivation of UMA confidence interval for the parameters of Normal distributions - Non parametric tests : Sign test, Wilcoxon signed ranks test, Man-Whitney U-Test, Kolmogorov-Smirnov one sample and two sample test procedures.

Books for study:

1. Ferguson, T. S (1967), **Mathematical Statistics – A Decision Theoretic Approach**, Academic Press.
2. Lehmann, E. L (1986), **Testing Statistical Hypothesis**, John Wiley.

Books for Reference:

1. Rohatgi, V. K (1984), **An Introduction to Probability Theory and Mathematical Statistics**, Wiley Eastern.
2. Gibbons, J. D (1985), **Non-parametric Methods in Statistics**, Second Edition, Marcel Dekker.

		L	T	P	C
	PRACTICAL – IV				

P20MAP1L4	**Total Contact Hours - 30**	0	0	4	2
	Prerequisite – Testing of Hypothesis				
	Course Coordinator Name &Department :- Mr.V.Nandakumar/Mathematics				

COURSE OBJECTIVES :-To know the basic concepts of statistics and make statistical applications in the context of problems in biological and social sciences.

COURSE OUTCOMES (COs)

CO1	***Understand*** the methods of Process control
CO2	***Apply*** techniques to analysis
CO3	***Compute*** Sequential sampling plan for variables
CO4	***Implement*** ratio tests
CO5	***Study*** and analyze Shainin Lot Plot method.
CO6	***Learn*** Confidence intervals

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**M**			**M**		H		
	CO2	**H**	**M**	**-**			**-**	**H**			
	CO3	**H**	**L**	**M**			**M**				
	CO4	**H**	**M**	**L**			**L**	**H**			
	CO5	**H**	**M**	**M**			**-**	**H**			
	CO6	**H**	**L**	**-**			**L**				
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/ EVS/NME/SPE/	Part V Extension Activity			

				✓							
4	Approval	Academic Council Meeting									

I. PROCESS CONTROL **10**

1. Control charts:
2. X-bar, R, σ, p, np, c, u (fixed and variable sample sizes)
3. Sloping control charts
4. Group Control charts
5. CV chart
6. Modified control charts
7. Median and mid-range charts
8. Charts for moving averages
9. Process capability analysis

II. PRODUCTION CONTROL **10**

1. Sampling Plans: multiple, sequential plans
2. Variable sampling plans with known and unknown σ
3. Sequential sampling plan for variables
4. Chain sampling plans
5. Continuous sampling plans
6. MAPD plan
7. Shainin Lot Plot method.

III. STATISTICAL INFERENCE : TESTING OF HYPOTHESES **10**

1. Most powerful tests
2. Uniformly most powerful tests
3. Sequential probability ratio tests
4. Likelihood ratio tests
5. Non-parametric tests
6. Confidence intervals

	SPSS PACKAGE	**L**	**T**	**P**	**C**
P20MAP149	**Total Contact Hours - 60**	3	0	0	3
	Prerequisite – R Package				

	Course Coordinator Name &Department :- Mrs. B. Sumithra / Statistics

COURSE OBJECTIVES :- To orient the students to solve the problems using SPSS Package and develop problem solvingskills.

COURSE OUTCOMES (COs)

CO1	***Understand*** to know about SPSS package
CO2	***Estimate*** to Know the basic functions of SPSS
CO3	***Compute*** concept of SPSS functions
CO4	***Study*** the usage of SPSS package in Graphs, solving problems.
CO5	***Expand*** the SPSS package for vector and matrix
CO6	***Formation*** to gain the concept of testing of hypothesis in SPSS

Mapping of Course Outcomes with Program outcomes (POs)

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**	**L**			**L**	**H**	H		
	CO2	**H**	**L**				**-**	**H**			
	CO3	**H**	**M**	**M**			**M**	**H**			
	CO4	**H**	**M**	**L**			**L**	**H**			
	CO5	**H**	**M**				**-**	**H**			
	CO6	**H**	**L**				**-**	**H**			
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			
					✓						

4	Approval	Academic Council Meeting

UNIT I DATAHANDLING

Open SPSS data file – save – import from other data source – data entry – labeling for dummy numbers - recode in to same variable – recode in to different variable – transpose of data – insert variables and cases – merge variables and cases.

UNIT II DATA HANDLING 12

Split – select cases – compute total scores – table looks – Changing column - font style and sizes

UNIT III DIAGRAMMATICREPRESENTATION

Simple Bar diagram – Multiple bar diagram – Sub-divided Bar diagram - Percentage diagram - Pie Diagram – Frequency Table – Histogram – Scatter diagram – Box plot.

UNIT IV DESCRIPTIVE STATISTICS

Mean, Median, Mode, SD- Skewness- Kurtosis. Correlation – Karl Pearson's and Spearman's Rank Correlation , Regression analysis: Simple and Multiple Regression Analysis [Enter and stepwise methods]

UNIT V TESTING OF HYPOTHESIS

Parametric – One sample – Two sample Independent t – test – Paired t – test. Non – parametric: One sample KS test- Mann-Whitney U test – Wilcoxon Signed Rank test - Kruskal Wallis test – Friedman test- Chi- square test. Analysis of variance: One way and Two way ANOVA.

Text Books:

1. Agresti, A. and Findlay., B.,"Statistical Analysis for the Social Science"- 4th Edition. Prentice Hall, New Jersey(2008).
2. Clifford E.Lunneborg,"Data analysis by resampling: concepts and applications" -Dusbury Thomson learning. Australia (2000).
3. Everitt, B.S and Dunn, G., "Applied multivariate data analysis" - Arnold London. (2001).

Reference Books:

1. Jeremy J. Foster.,"Data analysis using SPSS for windows" - New edition,Versions 8-10. Sage publications, London(2001).
2. Michael S. Louis.,"Beck Data analysis an introduction, Series: quantitative applications in the social sciences" - Sage. Publications, London(1995).
3. Field, A. P., "Discovering Statistics using SPSS (Introducing Statistical Method)" - Oriental Press, Chennai, India (2009).
4. George, D. SPSS for Windows Step-by-Step: A Simple Guide and Reference 18.0 Update - Eleventh Edition. Allyn and Bacon, Boston, MA, USA (2011).

<table>
<tr><td rowspan="4">P20MAP143</td><td colspan="2">REAL ANALYSIS AND MATRICES THEORY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="2">Total Contact Hours - 45</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="5">Prerequisite – UG Level Mathematics</td></tr>
<tr><td colspan="5">Course Coordinator Name &Department :- Dr.R.AmbrosePrabhu/Mathematics</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES :- To orient the students to study the sequence and series, Riemann integral, functions of several variables, matrix theory problems and develop problem solvingskills</td></tr>
<tr><td colspan="6">COURSE OUTCOMES (COs)</td></tr>
<tr><td>CO1</td><td colspan="5">Understand the sequences and series of functions</td></tr>
<tr><td>CO2</td><td colspan="5">EstimatetheRiemann - Stieltjes integral</td></tr>
<tr><td>CO3</td><td colspan="5">Compute the functions of several variables</td></tr>
<tr><td>CO4</td><td colspan="5">Study about the vector space and sub-space</td></tr>
<tr><td>CO5</td><td colspan="5">Expand the matrices with properties</td></tr>
<tr><td>CO6</td><td colspan="5">Formationofcanonical, triangular forms and Quadratic forms</td></tr>
<tr><td colspan="6">Mapping of Course Outcomes with Program outcomes (POs)</td></tr>
</table>

(L/M/H indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**H**	**L**			**L**	**M**	H		
	CO2	**H**	**L**					**H**			
	CO3	**H**	**M**	**M**			**M**	**M**			
	CO4	**H**	**M**	**L**			**L**	**H**			
	CO5	**H**	**M**					**H**			
	CO6	**H**	**H**					**M**			
3	Category	Humanities & Social Studies (HS)	Basic Sciences (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Any other	Project/Term Paper/ Seminar/ Internship(PR)	
					✓						
4	Approval	Academic Council Meeting									

UNIT – I SEQUENCES AND SERIES **12**

Convergence of infinite numerical sequences and series (review only), Absolute and conditional Convergence, Sequences and series of functions,Pointwise and Uniform convergence, Tests for Uniform convergence Properties of Uniform convergence

UNIT –IIRIEMANN – STIELTIES INTEGRAL **12**

Definition and properties Integrals with step function and monotonic functions as integrators

and their properties Mean value theorem, Taylors theorem, Evaluation of Riemann - Stieltjes integral Fundamental theorem.

UNIT–III FUNCTIONS OF SEVERAL VARIABLES 12

Limits and continuity Partial derivatives and Differentiability - Properties of differentiable functions Higher order derivatives and differentials Young and Schwartz theorems Taylors theorem - Maxima and Minima Extrema under constraints.

UNIT- IV VECTOR SPACE 12

Vector space and sub-space Linear independence and orthogonality, Dimension and basis of a vector space, Orthonormal basis Gram-Schmidt orthogonalization, Inner product space, Simultaneous linear equations (homogeneous and non-homogeneous)

UNIT – V MARTICES 12

Rank, inverse, trace and their properties Characteristic roots and vectors, Idempotent and partitioned matrices G-inverse and Moore Penrose inverse - their properties, Reduction of a matrix into diagonal, echelon, canonical and triangular forms Quadratic forms, reductions of different types Definite quadratic forms Cochran s theorem.

BOOK FOR STUDY:

1. Principles of Mathematical Analysis, Walter Rudin, Third Edition, Mcgraw Hill, 1976.
2. Malik .S.C. and Arora(1987): Mathematical Analysis , Wiley Eastern Ltd
3. Datta, K.E, Matrix and Linear Algebra, Prentice-Hall of India Private Ltd, 1991.
4. Rao, C.R, Linear Statistical Inference and its Applications, Wiley Eastern Ltd, 1973.

BOOK FOR REFERENCES:

1. A Basic Course in Real Analysis by Ajit Kumar and S. Kumaresan, CRC press, Taylor and Francis.
2. Mathematical Analysis Tom M Apostal, Narosa publishing house, New Delhi
3. Searle, S.R, Matrix Algebra useful for Statistics, John Wiley, NY, 1982.
4. Gilbert and Gilbert, Linear Algebra and Matrix Theory, Elsevier Publications, 2005.
5. Graybill, F.A. Matrices and applications in statistics, Wadsworth Publishing Company, Belmont, California, USA, 1983.
6. 5. Ramachandra Rao, A.andBhimasankaran, P, Linear Algebra , TMH, 1992.

P20MAP145	**R PACKAGE**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – UG Level Statistics				
	Course Coordinator Name &Department :- Mrs. B. Sumithra / Statistics				
COURSE OBJECTIVES :- To orient the students to solve the problems using R Package and develop problem solvingskills.					
COURSE OUTCOMES (COs)					
CO1	***Understand*** to know about R package				
CO2	***Estimate*** to Know the basic functions of R				
CO3	***Compute*** concept of R functions				
CO4	***Study*** the usage of R package in Graphs, solving problems.				
CO5	***Expand*** the R package for vector and matrix				
CO6	***Formation*** to gain the concept of homogeneous equations				

Mapping of Course Outcomes with Program outcomes (POs) (L/M/H indicates strength of correlation) H-High, M-Medium, L-Low											
1	COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
2	CO1	**H**	**M**				**L**	**H**	H		
	CO2	**H**	**L**				**M**	**H**			
	CO3	**H**	**M**	**M**				**H**			
	CO4	**H**	**M**	**L**			**M**	**H**			
	CO5	**H**	**M**					**H**			
	CO6	**H**	**L**	**M**			**L**	**H**			
3	Category	Part 1 Tamil/Linguistic Study	Part II Linguistic English	Part III Core	Part III Sub stream	Part III Project	Part IV Basic/ Advanced Tamil/	Part V Extension Activity			
					✓						
4	Approval	Academic Council Meeting									

UNIT I OVERVIEW OF R **12**

Overview of R Environment – R editor – Workspace – Data type – Importing and Exporting Data – Basic Computational Ideas – Merges in R

UNIT II MATRIX **12**

Matrix Determinant – Inverse – Transpose – Trace – Eigen Values and Eigen Vectors – Construction of Bar, Pie, Histogram, Line Chart, Box Plot, Scatter Plot

UNIT IIIPARAMETRIC AND NON-PARAMETRIC TESTS 12

Parametric and Non Parametric testing of Statistical Hypothesis – One Sample t test – two group t test – paired t test – one way ANOVA- two way ANOVA – Latin Square Design – Sign Test – Wilcoxon – MannWitney – Kruskal Wallis

UNIT IV SIMPLE CORRELATION 12

Simple Correlation - Linear Regression – Multiple Linear Regression – Testing for overall significance of Model Coefficients – Testing for Individual Regression Coefficients – Outliers Detection – Dealing with Multi-collinearity

UNIT V CONTROL CHARTS 12

Control Charts – Variable Control Chart - x, R, S. Attribute Control Chart- p, np, c, u. CUSUM Control Chart, EWMA Control Chart, Process Capability Analysis.

TEXT BOOK:

1. Bhuvaneswari .V and Devi .T , "Big Data Analytics: A Practitioner's Approach",- Department of Computer Applications, BharathiarUnivresity (2016).
2. Bhuvaneswari .V , "Data Analytics with R Step by Step" - Lean Publishers (2016).
3. Norman Matloff., "The Art of R Programming – A Tour of Statistical Software Design" – No Starch Press (2011).

REFERENCE BOOK:

1. Michael J. Crawle., "The R Book"- Wiley (2008).
2. John. M., "Statistical Analysiswith R.", - Tata McGraw Hill Publishing Co. Ltd (2010).
3. Learning Statistics using R By RndallE.Schumacker, Sage Publication
4. R for Everyone By Jared P.Lander, Pearson Education