

Holy Cross College (Autonomous), Nagercoil
Kanyakumari District, Tamil Nadu.
Accredited with A⁺ by NAAC - IV cycle – CGPA 3.35

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli



Semester I - IV

Guidelines & Syllabus

DEPARTMENT OF MATHEMATICS



2023-2026

(With effect from the academic year 2024-2025)

**Issued from
THE DEANS' OFFICE**

Programme Educational Objectives (PEOs)

POs	Upon completion of M. Sc. Degree Programme, the graduates will be able to:	Mapping with Mission
PEO1	apply scientific and computational technology to solve social and ecological issues and pursue research.	M1, M2
PEO2	continue to learn and advance their career in industry both in private and public sectors.	M4 & M5
PEO3	develop leadership, teamwork, and professional abilities to become a more cultured and civilized person and to tackle the challenges in serving the country.	M2, M5 & M6

Programme Outcomes (POs)

Pos	Upon completion of M.Sc. Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	apply their knowledge, analyze complex problems, think independently, formulate and perform quality research.	PEO1 & PEO2
PO2	carry out internship programmes and research projects to develop scientific and innovative ideas through effective communication.	PEO1, PEO2 & PEO3
PO3	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe.	PEO2
PO4	develop innovative initiatives to sustain ecofriendly environment	PEO1, PEO2
PO5	through active career, team work and using managerial skills guide people to the right destination in a smooth and efficient way.	PEO2
PO6	employ appropriate analysis tools and ICT in a range of learning scenarios, demonstrating the capacity to find, assess, and apply relevant information sources.	PEO1, PEO2 & PEO3
PO7	learn independently for lifelong executing professional, social and ethical responsibilities leading to sustainable development.	PEO3

Programme Specific Outcomes (PSOs)

PSO	Upon completion of M.Sc. Degree Programme, the graduates of Mathematics will be able to:	PO Addressed
PSO-1	acquire good knowledge and understanding, to solve specific theoretical & applied problems in different area of mathematics & statistics	PO1 & PO2
PSO-2	understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.	PO3 & PO5
PSO-3	prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions	PO6
PSO-4	pursue scientific research and develop new findings with global Impact using latest technologies.	PO4 & PO7
PSO-5	possess leadership, teamwork and professional skills, enabling them to become cultured and civilized individuals capable of effectively overcoming challenges in both private and public sectors.	PO5 & PO7

SEMESTER I
ELECTIVE COURSE I: a) NUMBER THEORY AND CRYPTOGRAPHY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP231EC1	4	1	-	-	3	5	75	25	75	100

Pre-requisite:

Students should know the basic concepts of Number Theory.

Learning Objectives:

1. To gain deep knowledge about Number theory.
2. To know the concepts of Cryptography.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand quadratic and power series forms and Jacobi symbol.	K1 & K2
2	apply binary quadratic forms for the decomposition of a number into sum of sequences.	K3
3	determine solutions using Arithmetic Functions.	K3
4	calculate the possible partitions of a given number and draw Ferrer's graph.	K4
5	identify the public key using Cryptography.	K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Units	Contents	No. of Hours
I	Divisibility and Euclidean algorithm - Congruences, Euler's theorem, Wilson's Theorem, Chinese Remainder Theorem, Primitive roots Chapter 1: 1.2, Chapter 2: 2.1,2.3,2.8	15
II	Quadratic Residues – Quadratic Reciprocity – The Jacobi Symbol. Chapter 3: 3.1, 3.2, 3.3	15
III	Arithmetic functions – The Mobius Inversion Formula – Multiplication of arithmetic functions. Chapter 4: 4.2, 4.3	15
IV	Linear Diophantine equations – Sum of Four and Five Squares – Sum of Fourth Powers - Sum of Two Squares. Chapter 5: 5.1,5.3 ,5.4	15
V	Public Key Cryptography Public key Cryptography – Concepts of public key Cryptography – Modular arithmetic – RSA – Discrete logarithm – Elliptic curve Cryptography Text book 2. Chapter 4: 4.1, 4.2, 4.3 Chapter 6: 6.1, 6.2	15
	Total	75

Self Study	Arithmetic functions
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Textbooks

1. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery (2006). *An Introduction to the Theory of Numbers*. United States: John - Wiley & Sons.
2. Neal Koblitz (1987). *A Course in Number Theory and Cryptography*. New York: Springer.

Reference Books

1. Hardy, G. H., & Wright E. M. (1975). *An Introduction to the Theory of Number*. United States: Oxford at the Clarendon Press.
2. David M. Burton (1989). *Elementary Number Theory*. Dubuque, Iowa: Wm. C. Brown Publishers
3. Tom. M. Apostol.(1998). *Introduction to Analytic Number Theory*. New Delhi: Narosa Publishing House.
4. Graham Everest and Thomas Ward(2008).*An Introduction to Number Theory*. New York: Springer.
5. Kenneth Ireland and Michael Rosen (1990). *A classical Introduction to Modern Number Theory*. New York: Springer.

Web Resources

1. <https://youtu.be/PkpFBK3wGJc>
2. <https://youtu.be/mIStB5X4U8M?list=PL-BD05SCClbag8KTPzaPzzggJ96aBsVkT>
3. <https://ejionascu.ro/notes/ntbook.pdf>
4. <https://cse.buffalo.edu/~xinhe/cse191/Classnotes/note07-1x2.pdf>
5. https://www.maths.dur.ac.uk/users/athanasios.bouganis/entc1415/lecture_notes.pdf

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	3	3	3	3	3
CO2	3	3	3	2	2	3	2	3	3	3	3
CO3	3	3	2	2	2	2	3	3	3	3	3
CO4	3	3	2	2	2	2	3	3	3	3	2
CO5	3	3	3	3	2	3	2	3	3	3	3
TOTAL	15	15	12	11	11	12	13	15	15	15	14
AVERAGE	3	3	2.4	2.2	2.2	2.4	2.6	3	3	3	2.8

3 – Strong, 2- Medium, 1- Low

SEMESTER II**ELECTIVE COURSE III: a) MATHEMATICAL STATISTICS**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP232EC1	3	1	-	-	3	4	60	25	75	100

Pre-requisite

Knowledge in Probability Theory and Statistics

Learning Objectives

1. To enhance knowledge in mathematical statistics and acquire basic knowledge about various distributions.
2. To understand about mathematical expectations, moment generating function technique and the Central Limit Theorem.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	recall the basic probability axioms, conditional probability, random variables and related concepts	K1
2	learn the transformation technique for finding the p.d.f of functions of random variables and use these techniques to solve related problems	K2
3	compute marginal and conditional distributions and check the stochastic independence	K3
4	employ the relevant concepts of analysis to determine limiting distributions of random variables	K2
5	design probability models to deal with real world problems and solve problems involving probabilistic situations.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply

Units	Contents	No. of Hours
I	Distributions of Functions of Random Variables – Sampling Theory – Transformations of Variables of the Discrete Type – Transformations of Variables of the Continuous Type – The t and F Distributions Chapter 4: 4.1 – 4.4	12
II	Limiting Distributions – Stochastic Convergence – Limiting Moment Generating Functions – The Central Limit Theorem Chapter 5: 5.1 – 5.4	12
III	Estimation – Point Estimation – Measures of Quality of Estimators – Confidence Intervals for Means – Confidence Interval for Difference of Means – Confidence Interval for Variances Chapter 6: 6.1 – 6.5	12
IV	Statistical Hypothesis – Some Examples and Definitions – Certain Best Tests – Uniformly Most Powerful Tests – Likelihood Ratio Tests Chapter 7: 7.1 – 7.4	12
V	Other Statistical Tests – Chi-Square Tests – The Distributions of Certain Quadratic Forms – A Test of Equality of Several Means – Noncentral χ^2 and Noncentral F Chapter 8: 8.1 – 8.4	12

Total	60
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Self-study	Sampling Theory
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Textbook

Robert V. Hogg and Allen T. Craig, 1978. *Introduction to Mathematical Statistics*, Fourth Edition, New York: Macmillan Publishing Co

Reference Books

- 1.Kapur, J.N., and Saxena, H.C, 2010. *Mathematical Statistics*, 12thEdition, S. Chand & Co.
- 2.KadarkaraiThangam, K., and Subas Chandra Bose. A, 1995. *Probability and Statistics*, 1stEdition, Jeyalakshmi Publishers.
3. Morris H. DeGroot, 1975. *Probability and Statistics*, Addison Wesley Publishing Company.
- 4.Suddhendu Biswass.,and Sriwastav, G.L, 2011. *Mathematical Statistics*, Narosa Publishing House.
5. Murthy, T.S.R, 1995. *Probability and Statistics*, 1stEdition, I.K. International Publishing House.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. <https://users.encs.concordia.ca/~doedel/courses/comp-233/slides.pdf>
3. <https://www.utstat.toronto.edu/mikevans/jeffrosenthal/book.pdf>
4. <http://www.uop.edu.pk/ocontents/Book.pdf>

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	3	3	3	3	1	2	3	1	2	3
CO2	3	2	3	2	2	2	3	2	2	3	2	3
CO3	3	3	2	2	3	3	3	2	2	3	3	2
CO4	3	3	2	3	2	2	3	3	2	3	3	2
CO5	2	2	3	3	3	2	2	2	2	2	2	3
TOTAL	12	12	13	13	14	12	12	11	11	12	12	13
AVERAGE	2	2	2	3	3	2	2	2	2	2	2	3

3 – Strong, 2- Medium, 1- Low

SEMESTER – II**ELECTIVE COURSE III: b) STATISTICAL DATA ANALYSIS USING R PROGRAMMING**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP232EC2	4	-	-	-	3	4	60	25	75	100

Pre-requisite:

Students should know basic skills of computer.

Learning Objectives:

1. The basics of statistical computing and data analysis.
2. How to use R for analytical programming.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall R and its development history	K1
2.	demonstrate how to import and export data with R	K2 & K4
3.	explain discrete distributions	K3
4.	apply various concepts to write programs in R	K3 & K5
5.	apply estimation concepts in R programming	K2 & K3

K1 - Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate

Units	Contents	No. of Hours
I	Statistical Software R - R and its development history – Structure of R - installation of R Chapter 1: 1.1, 1.2, 1.3	12
II	Descriptive Statistics – Basics - Excursus: Data Import and Export with R – Import of ICU-Dataset Chapter 2: 2.1, 2.2, 2.3	12
III	Colors and Diagrams – Colors - Excursus: Export of diagrams - Diagrams Chapter 3: 3.1, 3.2, 3.3	12
IV	Probability Distributions – Discrete Distributions – Continuous Distributions Chapter 4: 4.1 and 4.2	12
V	Estimation – Introduction – Point Estimation Chapter 5: 5.1 and 5.2	12
	Total	60

Self-study	R and its development history
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Textbook

1. Matthias Kohl, 2015. *Introduction to statistical data analysis with R*, (First edition), bookboon.com, The e Book company.

Reference Books

1. Torsten Hothorn, Brian Everitt S, 2014. *A Handbook of Statistical Analyses using R*, (Third edition), CRC PRESS, Taylor & Francis Group
2. Purohit S.G., Gore S.D., and Deshmukh S.R., 2015. *Statistics using R*, (Second edition), Narosa Publishing House, New Delhi.
3. Crawley, M. J, 2006. *Statistics - An introduction using R*, (Second edition), John Wiley, London 32.
4. Verzani J, 2005. *Using R for Introductory Statistics*, (Second edition), Chapman and Hall /CRC Press, New York
5. Braun W. J., and Murdoch D. J, 2021. *A First Course in Statistical Programming with R*, (Third edition), Cambridge University Press, New York.
6. Dalgaard P, 2008. *Introductory Statistics with R*, (Second edition), Springer.
7. Gardener M, 2012. *Beginning R: The Statistical Programming Language*, Wiley Publications.

Web Resources

1. <https://www.udemy.com/course/statistics-using-r/>
2. <https://sims.strathmore.edu/executive-education/r-programming/>
3. <https://www.educba.com/statistical-analysis-with-r/>

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	2	3	3	3	2	3	2
CO2	3	3	2	2	2	3	2	3	3	2	3	2
CO3	3	3	2	2	2	2	3	3	3	3	3	2
CO4	3	3	2	2	2	2	3	3	3	3	2	2
CO5	3	3	2	3	2	3	2	3	3	2	3	2
TOTAL	15	15	10	11	11	12	13	15	15	12	14	10
AVERAGE	3	3	2	2.2	2.2	2.4	2.6	3	3	2.4	2.8	2

3 - Strong, 2- Medium, 1- Low

SEMESTER II**ELECTIVE COURSE IV: a) OPERATIONS MODELING**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
MP232EC4	3	1	-	-	3	4	60	25	75	100

Pre-requisite

Knowledge of probability distributions and statistics

Learning Objectives

1. To analyze different situations in the industrial/ business scenario involving limited resources
2. To finding the optimal solution within constraints.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	build and solve Transportation and Assignment problems using appropriate method	K1
2	learn the constructions of network and optimal scheduling using CPM and PERT	K2
3	ability to construct linear integer programming models and solve linear integer programming models using branch and bound method	K3
4	understand the need of inventory management.	K2
5	understand basic characteristic features of a queuing system and acquire skills in analyzing queuing models	K3

K1 - Remember; **K2** - Understand; **K3** - Apply

Units	Contents	No. of Hours
I	Transportation Models and its Variants: Definition of the Transportation Model – Non-Traditional Transportation Model– Transportation Algorithm – The Assignment Model. Chapter 5: Sections 5.1, 5.2, 5.3, 5.4. Exercise problems.	12
II	Network Analysis: Network Definitions–Minimal Spanning Tree Algorithm – Shortest Route Problem–Maximum Flow Model –CPM – PERT. Chapter 6: Sections 6.2, 6.3, 6.4, 6.5, 6.7. Exercise problems.	12
III	Inventory Theory: Basic Elements of an Inventory Model – Deterministic Models: Single Item Stock Model with and without Price Breaks –Multiple Items Stock Model with Storage Limitations Chapter11–Sections11.1,11.2,11.3,	12
IV	Probabilistic Models: Continuous Review Model- Single Period Models. Chapter16–Sections16.1, 16.2, 16.3, Exercise problems.	12

V	<p>Queuing Theory: Basic Elements of Queuing Model –Role of Poisson and Exponential Distributions– Pure Birth and Death Models – Specialised Poisson Queues-(M/G/1):GD/∞/∞)- Pollaczek - Khintchine Formula.</p> <p>Chapter 17: Sections 17.2, 17.3, 17.4, 17.6, 17.7. Exercise problems.</p>	12
	Total	60

Self-study	Exercise Problems
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Textbooks

1. Hamdy A.Taha, *Operations Research*(Sixth Edition), Prentice Hall of India Private Limited, New Delhi.
2. Hamdy A.Taha, *Operations Research*(Third Edition), Prentice Hall of India Private Limited, New Delhi.

Reference Books

1. Pathak, H.K, Dr. Pradeep, K. Joshi and C.Sharma, *Shree Operations Research*, Shiksha Sahitya Prakashan Publication, Reprint 2022-23.
2. Srinivasan G, *Operations Research :Principles and Applications*, Second Edition, Eastern Economy Edition, PHI.
3. Hamdy A. Taha, *Operations Research* (seventh Edition) Prentice Hall of India Private Limited, New Delhi.
4. Kanti Swarup, P.K. Gupta and Man Mohan, *Operations Research*, 13th edition, Sultan. Chand and Sons, 2007.
5. R.K. Gupta, *Operations Research*, Krishna Prakashan Media, 1992.

Web Resources

1. https://en.wikipedia.org/wiki/Operations_research
2. <https://www.techtarget.com/whatis/definition/operations-research-OR>
3. <https://www.britannica.com/topic/operations-research>
4. <https://www.springer.com/journal/12351>
5. <https://www.or.ncsu.edu/about/what-is-operations-research/>

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	3	3	3	3	1	2	3	1	2	3
CO2	3	2	3	3	2	2	3	2	2	3	2	3
CO3	3	3	2	2	3	3	3	2	2	3	3	2
CO4	3	3	2	3	2	2	3	3	2	3	3	2
CO5	2	2	3	3	3	2	2	2	3	2	2	3
TOTAL	12	12	13	14	14	12	12	11	12	12	12	13
AVERAGE	2	2	2	3	3	2	2	2	2	2	2	3

3 – Strong, 2- Medium, 1- Low

	Content Addressing Professional Ethics
	Content Addressing Environmental Sustainability