MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI – 12.

B.Sc., Statistics

under CBCS with effect from the academic year 2023-2024 and onwards

Learning Outcome based Curriculum

Vision of the University

To provide quality education to reach the un-reached

Mission of the University

- To conduct research, teaching and outreach progrmmes to improve conditions of human living.
- To create an academic environment that honours women and men of all races, caste, creed, cultures, and an atmosphere that values intellectual curiosity, pursuit of knowledge, academic freedom and integrity.
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development.
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled.

Preamble

The **B.Sc., Statistics** degree programme of Manonmaniam Sundaranar University through its affiliated Colleges aims to provide a strong foundation for higher studies in Statistics to teach essential statistical methods for enabling the students for dealing with real world situations comprising uncertainty. It augments the ability of students to link statistical concepts and methods in other fields and to develop computer programs for carrying out essential statistical computations. It exposes towards the basic opensource software and foster interests among students to work as Statistics and Data Analytics professionals. It prepares skilled human resource for the needs of Statistics personnel in Central and State Government organizations and private sector institutions.

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI – 12.
B.Sc., Statistics
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Eligibility for Admission:

Candidates who have passed the higher secondary examination conducted by Government of Tamil Nadu with Statistics / Mathematics / Business Statistics / Business Mathematics / Computer Science as one of the courses or other equivalent examinations are eligible for admission to the first year of the B.Sc., (Statistics) degree program.

Duration of the Program:

The duration of the program is three academic years comprising of six semesters with two semesters in each academic year. Examinations will be conducted at the end of each semester for the respective courses.

Medium of Instructions and Examinations:

The medium of instructions and examinations for the courses of Part I and Part II shall be in the languages concerned. For the courses of Part III and Part IV, the medium of instructions and examinations shall be in English.

Examination

The regulations for examination, passing minimum in each course and classification of successful candidates and award of ranks are at par with the regulations for other undergraduate science programs of the University.

SCHEME OF EXAMINATION

Sem. (1)	Pt. I/II/ III/ IV/ V (2)	Course No. (3)	Course Category (4)	Course Title (5)	Contact Hrs./week (6)	**L** Hrs. / week (7)	**T** Hrs. / week (8)	**P** Hrs. / week (9)	**C** Credits (10)
I	I	1	Language	Language-Tamil	6	6	0	0	3
	II	2	Language	English	6	6	0	0	3
	III	3	Core-I	Descriptive Statistics	4	3	0	1	4
	III	4	Core-II	Probability Theory	4	3	0	1	4
	III	5	Elective I	Mathematics for Statistics-I	4	4	0	0	3
	III	6	Practical-I	Statistics Practical-I	2	0	0	2	2
	IV	7	Skill Enhancement Course SEC-I	Basics of Statistics	2	2	0	0	2
	IV	8	Skill Enhancement – (Foundation Course)	Office Automation	2	2	0	0	2
	Subtotal				**30**	**26**	**0**	**4**	**23**
II	I	9	Language	Language-Tamil	6	6	0	0	3
	II	10	Language	English	6	6	0	0	3
	III	11	Core-III	Matrix and Linear Algebra	4	3	0	1	4
	III	12	Core-IV	Distribution Theory	4	3	0	1	4
	III	13	Elective – II	Real Analysis	4	4	0	0	3
	III	14	Practical-II	Statistics Practical-II	2	0	0	2	2
	IV	15	Skill Enhancement Course SEC-II	Mathematical Statistics-II	2	2	0	0	2
	IV	16	Skill Enhancement Course SEC-III	Programming in C++	2	2	0	0	2
	Subtotal				**30**	**26**	**0**	**4**	**23**

Note:

Statistics Practical – I : Based on the courses Descriptive Statistics and Probability Theory

Statistics Practical – II :Based on the courses Matrix and Linear Algebra and Distribution Theory

Programme Outcomes (POs)

On completion of the B.Sc., Statistics degree programme, the students will be able to

PO1: Pursue higher studies in Statistics

PO2: Apply knowledge on statistical methods to the real-world problems

PO3: Select and apply appropriate statistical methods for analyzing given database and to make meaningful interpretations

PO4: Draw relevant inferences in decision-making problems involving uncertainty

PO5: Plan and conduct sample surveys

PO6: Develop computer programs and to use statistical software for carrying out statistical computations and data analysis

PO7: Succeed in national and state level competitive examinations; to work as Statistics personnel in Central and State Government organizations and private sector institutions

Programme Specific Outcomes (PSOs)

On completion of the B.Sc., Statistics degree programme, the students will be able to

PSO1: Plan sample surveys and analyze the outcomes

PSO2: Handle data sets and describe their inherent properties employing knowledge acquired on statistics software

PSO3: Select and apply appropriate statistical methods for analyzing data

PSO4: Understand, Interpret and explain the relationships among the characteristics in the data

PSO5: Learn the procedures for making optimal inferences in decision making situations

PSO6: Solve mathematical problems applying statistical theory

PSO7: Develop computer programs for statistical computations

SYLLABUS

SEMESTER – I

1. LANGUAGE - TAMIL

2. ENGLISH

3. DESCRIPTIVE STATISTICS

Course Code		TITLE OF THE COURSE	L	T	P	C
Core		DESCRIPTIVE STATISTICS	3	0	1	4
Prerequisites		Basic knowledge of Statistics	Syllabus Version		2023-24	

L: Lecture T: Tutorial P: Practical C: Credits

Course Objectives:

The main objectives of this course are to

- Understand the origin, significance and scope of Statistics.
- Know the significance of presenting data in the form of tables and diagrams.
- Learn computational aspects of basic statistical measures.

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Levels
CO1	Understand the scope and necessity of Statistics.	K1, K2
CO2	Able to obtain, tabulate and present the data in tables, diagrams and graphs.	K1-K3 and K5
CO3	Apply the formula and compute descriptive measures of statistics.	K2, K3
CO4	Analyze the importance of the data and interpret the calculated results	K2, K4
CO5	Able to choose appropriate curves and to fit them for given data	K1-K3
CO6	Develop computer programs for carrying out computations related to this course	K1 –K6
K1: *Remember* **K2**: *Understand* **K3**: *Apply* **K4**: *Analyze* **K5**: *Evaluate* **K6**: *Create*		

Course Outline:

Unit - I

Origin, scope, limitations and misuses of Statistics – Collection – Classification - Tabulation of data. Population and Sample - Types of Data – Nominal, ordinal, Interval and ratio. Diagrammatic and graphic representation of data: line diagram, frequency polygon, frequency curve, histogram and Ogive curves.

Unit - II

Measures of central tendency: mean, median, mode, geometric mean and harmonic mean. Partition values: Quartiles, Deciles and Percentiles. Measures of Dispersion: Mean deviation, Quartile deviation and Standard deviation – Coefficient of variation. Skewness and Kurtosis.

Unit - III

Linear correlation - scatter diagram, Pearson's coefficient of correlation, computation of co-efficient of correlation from a bivariate frequency distribution, Rank correlation, Coefficient of concurrent deviation- Simple linear regression equations - properties of regression coefficients

Unit - IV

Curve fitting: principle of least squares, fitting of the curves of the form $y = a+bx$, $y = a+bx+cx^2$ and Exponential and Growth curves.

Unit - V

Test of Significance: Testing of hypothesis, two types of errors, level of significance, critical region, Students't – test, Paired t-test and Chi-square test-ANOVA.

UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note 1: Students will be trained to develop appropriate computer programmes in *R* and *Python* related to computations taught in this course.

Note 2: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1. Gupta, S.C. and V.K. Kapoor (2020) Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. Goon, A.M., M.K. Gupta and B. Das Gupta (2017) Fundamentals of Statistics- Vol. I. World Press Ltd, Kolkata.
3. Agarwal, B. L. (2013). Basic Statistics, New Age International Private Limited, New Delhi, India

BOOKS FOR REFERENCE:

1. Anderson, T.W. and Sclove, S.L. (1978) Introduction to Statistical Analysis of data, Houghton Mifflin, Boston.
2. Bhat, B.R., Srivenkataramna, T. and Madhava Rao, K.S. (1996) statistics A Beginner's Text, Vol. I, New Age International, New Delhi.
3. Croxton, F.E. and Cowden, D.J. (1969) Applied General Statistics, Prentice Hall, New Delhi.
4. Spiegel, M.R. and Stephens, L. (2010) Statistics, Schaum's Outline Series, Mc Graw Hill, New York.
5. Holcomb, Z. C. (2017). Fundamentals of Descriptive Statistics, Routledge, New York.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1**.** https://nptel.ac.in/courses/111/104/111104120/
2. https://www.iiserpune.ac.in/~bhasbapat/phy221_files/curvefitting.pdf
3. https://www.toppr.com/guides/maths/statistics/bar-graphs-and- histogram/
4. https://nptel.ac.in/courses/111/104/111104098/

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO3	*High*	*High*	*Medium*	*Medium*	*Low*	*High*	*High*
CO4	*High*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO5	*High*	*Medium*	*Medium*	*High*	*Low*	*High*	*High*
CO6	*Medium*	*High*	*Medium*	*High*	*Low*	*High*	*High*
Correlation Level: *Low* *Medium* *High*							

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*Medium*	*High*	*High*	*High*	*High*	*High*	*High*
CO3	*Medium*	*High*	*High*	*High*	*High*	*Low*	*Medium*
CO4	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO5	*Medium*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Low*	*High*
Correlation Level: *Low* *Medium* *High*							

4. PROBABILITY THEORY

Course Code		TITLE OF THE COURSE	L	T	P	C
Core		**Probability Theory**	3	0	1	4
Prerequisites		Basic knowledge of Set theory, Real analysis and Calculus	Syllabus Version		2023-24	

L: Lecture T: Tutorial P: Practical C: Credits

Course Objectives:

The main objectives of this course are to

- Inculcate knowledge on basic concepts of probability theory
- explore the concepts of random variable, distribution function, expectation and inequalities
- enhance the ability of proving fundamental theorems related to convergence of sequences of random variables and distribution functions
- inculcate the students with the practice of solving problems related to characteristic function and convergence properties of sequences of random variables and distribution functions

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Levels
CO1	Understand the basic concepts of probability theory	**K1, K2**
CO2	Understand and obtain the CDF, Expectations, Moments and Inequalities.	**K1-K3 and K5**
CO3	Describe the concepts of convergence and their implications.	**K2, K3**
CO4	Understand and analyze the importance of Independence and Law of large numbers	**K2, K4**
CO5	Describe the Central Limit Theorem and its applications	**K1-K3**
CO6	Develop computer programs for carrying out computations related to this course	**K1 –K6**

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

Course Outline:

Unit - I

Probability: sample space – Events - algebraic operations on events- definition of probability - independent events – conditional probability - addition and multiplication theorems of probability – Bayes Theorem.

Unit - II

Random variables: Discrete and continuous random variables – distribution function - properties – probability mass function and probability density function – discrete and continuous probability distributions.

Unit - III

Multiple random variables: Joint, marginal and conditional distribution functions - independence of random variables – transformation of random variables and their distribution functions.

Unit - IV

Mathematical expectation: Expectation – properties – Cauchy - Schwartz inequality, conditional expectation and conditional variance. Moment generating function, characteristic function, probability generating function and their properties. Chebyshev's inequality.

Unit - V

Limit Theorems: convergence in probability, weak law of large numbers – Bernoulli's theorem, Khintchine's theorem (statements only) - Central limit theorem.

UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note 1: Students will be trained to develop appropriate computer programmes in *R* and *Python* related to computations taught in this course.

Note 2: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1. Goon, A.M., M. K. Gupta and B. Das Gupta (2017) Fundamentals of Statistics- Vol. I., World Press, Ltd, Kolkata.
2. Gupta, S.C. and V.K. Kapoor (2020) Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.

BOOKS FOR REFERENCE:

1. Robert, V. Hogg, Joseph W. McKean and Allen T. Craig (2013) Introduction to Mathematical Statistics (Seventh Edition), Pearson Education, New York.
2. Lipschutz, S. (2008) Probability Theory (Second Edition), Schaum's Outline Series, McGraw Hill, New York.
3. Alexander, M. Mood, Franklin A. Graybill and Duane C. Boes (2017). Introduction to the Theory of Statistics (Third Edition), Mc Graw Hill Education, New Delhi.
4. Bhuyan K.C. (2010), Probability Distribution Theory and Statistical Inference, New Central Book Agency (P) Ltd., New Delhi.
5. Spiegel, M.R. and Ray, M. (1980) Theory and Problems of Probability and Statistics, Schaum's Outline Series, McGraw Hill, New York.
6. Bhat B.R.(2014) Modern Probability Theory , New Age International Publishers, New Delhi.
7. Rohatgi, V. K. and A. K. Md. E. Saleh (2009). An Introduction to Probability Theory and Mathematical Statistics (Second Edition). John Wiley & Sons, New York

Related Online MOOCs Contents [SWAYAM, NPTEL, Websites etc.]

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+u3y6UdbIvOJ97LFeSCmHQ== P-01. Probability I
2. https://nptel.ac.in/courses/111101004
3. https://nptel.ac.in/courses/111104079

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO3	*High*	*High*	*Medium*	*Medium*	*Low*	*High*	*High*
CO4	*High*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO5	*High*	*Medium*	*Medium*	*High*	*Low*	*High*	*High*
CO6	*Medium*	*High*	*Medium*	*High*	*Low*	*High*	*High*
Correlation Level: *Low* *Medium* *High*							

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*Medium*	*High*	*High*	*High*	*High*	*High*	*High*
CO3	*Medium*	*High*	*High*	*High*	*High*	*Low*	*Medium*
CO4	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO5	*Medium*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Low*	*High*
Correlation Level: *Low* *Medium* *High*							

5. MATHEMATICS FOR STATISTICS - I

Course Code		**TITLE OF THE COURSE**	**L**	**T**	**P**	**C**
Core		**MATHEMATICS FOR STATISTICS**	**4**	**0**	**0**	**3**
Prerequisites		Basic knowledge of Real number system and Calculus	**Syllabus Version**		**2023-24**	

Course Objectives:

The main objectives of this course are to

- Understand the concept of Tangent and polar coordinates
- Know the method of finding the envelop and Curvature
- Learn computational aspects of multiple and infinite integral
- Acquire the knowledge on Homogeneous, Non-homogeneous and Linear equations.

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Levels
CO1	Understand the scope and necessity of Tangent and polar coordinates	**K1, K2**
CO2	Obtain the values of different types of curvature	**K1-K3 and K5**
CO3	Apply the formula and compute the different types of integrals	**K2, K3**
CO4	Evaluate integrals using Beta and Gamma functions.	**K2, K4**
CO5	Construct Homogeneous, Non-homogeneous and Linear equations.	**K1-K3**
CO6	Develop computer programs for carrying out computations related to this course	**K1 –K6**
K1: *Remember* **K2**: *Understand* **K3**: *Apply* **K4**: *Analyze* **K5**: *Evaluate* **K6**: *Create*		

Unit - I

Tangent and Normal-Direction of the tangent-Angle of intersection of curves-subtangent and subnormal - Differential coefficient of the length of an arc of $y=f(x)$ - Polar coordinates - Angle between the radius vector and the tangent-Polar subtangent and polar subnormal - Length of arc in polar coordinates.

Unit - II

Method of finding the envelop - Curvature - Circle, radius and centre of curvature - Cartesian formulae - Evolute and Involute - Radius of curvature when the curve is given in polar coordinates.

Unit - III

Multiple integrals - Evaluation of double integrals - Double integral in polar coordinates - Triple integrals - Applications of multiple integrals.

Unit - IV

Infinite integrals - Integrand becoming infinite at certain points in the interval of integration - Beta and Gamma functions - Properties of Beta functions - Relation between Beta and Gamma functions - Evaluation of integrals using Gamma functions.

Unit - V

Differential equations: Standard types of first order and first degree equations. Variables separable, Homogeneous, Non-homogeneous equations and Linear equation. Equations of first order but of higher degree.

UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note 1: Students will be trained to develop appropriate computer programmes in *R* and *Python* related to computations taught in this course.

Note 2: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1. Narayanan, S. and Manicavachagom Pillay, T.K. (2015) Calculus Vol. I, S.Viswanathan (Printers publishers) Pvt. Ltd., Chennai.
2. Narayanan, S. and Manicavachagom Pillay, T.K. (2014) Calculus Vol. II, S.Viswanathan (Printers publishers) Pvt. Ltd., Chennai.
3. Narayanan, S. and Manicavachagom Pillay, T.K. (2015) Calculus Vol. III, S.Viswanathan (Printers publishers) Pvt. Ltd., Chennai.

BOOKS FOR REFERENCE:

1. P.Duraipandian and S.Udayabaskaran,(1997) Allied Mathematics, Vol. I & II. Muhil Publishers, Chennai
2. S.P.Rajagopalan and R.Sattanathan,(2005) Allied Mathematics .Vol. I & II. Vikas Publications, New Delhi.
3. P.Kandasamy, K.Thilagavathy (2003) Allied Mathematics Vol-I, II S.Chand & company Ltd., New Delhi-55.

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO3	*High*	*High*	*Medium*	*Medium*	*Low*	*High*	*High*
CO4	*High*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO5	*High*	*Medium*	*Medium*	*High*	*Low*	*High*	*High*
CO6	*Medium*	*High*	*Medium*	*High*	*Low*	*High*	*High*
Correlation Level:	*Low*	*Medium*	*High*				

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*Medium*	*High*	*High*	*High*	*High*	*High*	*High*
CO3	*Medium*	*High*	*High*	*High*	*High*	*Low*	*Medium*
CO4	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO5	*Medium*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Low*	*High*
Correlation Level:	*Low*	*Medium*	*High*				

6. STATISTICS PRACTICAL - I

7. BASICS OF STATISTICS (Non-Major Elective)

Course Code		TITLE OF THE COURSE	L	T	P	C
Core		**BASICS OF STATISTICS**	**2**	**0**	**0**	**2**
Prerequisites		Knowledge of data basic Statistical tool	**Syllabus Version**		**2023-24**	

L: Lecture T: Tutorial P: Practical C: Credits

Course Objectives:

The main objectives of this course are to

- Understand the origin, significance and scope of Statistics.
- Know the significance of presenting data in the form of tables and diagrams.
- Learn computational aspects of basic statistical measures.

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Levels
CO1	Understand the scope and necessity of Statistics.	**K1, K2**
CO2	Able to obtain, tabulate and present the data in tables, diagrams and graphs.	**K1-K3 and K5**
CO3	Apply the formula and compute descriptive measures of statistics.	**K2, K3**
CO4	Identify the linear relationship among the variables	**K2, K4**
CO5	Determine the measures of Skewness and kurtosis numerically	**K1-K3**
CO6	Develop computer programs for carrying out computations related to this course	**K1 –K6**

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

Course Outline:

UNIT I

Nature and scope of Statistics - characteristics and limitation of Statistics - statistical investigation - preparation of questionnaire - Population and Sample - collection of data - primary and secondary data.

UNIT II

Processing and presentation of data - Classification of data - tabulation of data - Formation of frequency tables - Diagrammatic presentation of statistical data - bar diagrams - pie diagrams and pictograms - simple problems - Graphical presentation of statistical data - Histogram, frequency curves - simple problems.

UNIT III

Measures of Central tendency: Arithmetic Mean, Median, Mode. Measures of Dispersion: Range, Inter-Quartile Range, Standard Deviation and Coefficient of Variation.

UNIT IV

Simple Correlation- Scatter diagram - Properties of coefficient of correlation- Kendall's coefficient of correlation -Partial and Multiple correlation coefficients. Regression -regression coefficients and their properties-regression equations- Simple problems.

UNIT V

Concept of Skewness and Kurtosis - Karl Pearson's and Bowley's coefficients of Skewness- moments- coefficients of Skewness and Kurtosis - simple problems.

UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note 1: Students will be trained to develop appropriate computer programmes in *R* and *Python* related to computations taught in this course.

Note 2: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2017): Fundamentals of Statistics, Volume-I, World Press Ltd, Calcutta.
2. Gupta, S.C. and V.K. Kapoor. (2020): Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.

BOOKS FOR REFERENCE:

1. Robert, V. Hogg, Joseph W. McKean and Allen T. Craig (2013) Introduction to Mathematical Statistics (Seventh Edition), Pearson Education, New York.
2. Spiegel, M.R., Schiller, J. and Srinivasan, R.A. (2012): Probability and Statistics, Schaum's Outline Series (Fourth Edition). McGraw- Hill Publishing Company, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1**.** https://nptel.ac.in/courses/111/104/111104120**.**
2. https://www.iiserpune.ac.in/~bhasbapat/phy221_files/curvefitting.pdf**.**
3. https://www.toppr.com/guides/maths/statistics/bar-graphs-and- histogram**.**
4. https://nptel.ac.in/courses/111/104/111104098.

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO3	*High*	*High*	*Medium*	*Medium*	*Low*	*High*	*High*
CO4	*High*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO5	*High*	*Medium*	*Medium*	*High*	*Low*	*High*	*High*
CO6	*Medium*	*High*	*Medium*	*High*	*Low*	*High*	*High*
Correlation Level: *Low* *Medium* *High*							

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*Medium*	*High*	*High*	*High*	*High*	*High*	*High*
CO3	*Medium*	*High*	*High*	*High*	*High*	*Low*	*Medium*
CO4	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO5	*Medium*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Low*	*High*
Correlation Level: *Low* *Medium* *High*							

8. OFFICE AUTOMATION

Course Code		**TITLE OF THE COURSE**	**L**	**T**	**P**	**C**
Core		**OFFICE AUTOMATION**	**2**	**0**	**0**	**2**
Prerequisites		Basics of Computers	**Syllabus Version**		**2023-24**	

L: Lecture T: Tutorial P: Practical C: Credits

Course Objectives:

The main objectives of this course are to

- Understanding Office Automation.
- Familiarity with Office Automation Tools.
- Efficient Use of Word Processing Software
- Mastering Spreadsheet Software

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Levels
CO1	Acquire the knowledge on Design text, pictures with MS-word and PowerPoint	**K1**
CO2	Understand the Windows Operating system	**K2**
CO3	Understand the printing and data results	**K2**
CO4	Compute statistical measures	**K3**
CO5	Learn to draw the statistical diagrams and analyze the data using Excel function.	**K4**
CO6	Develop computer programs for carrying out computations related to this course	**K1 –K6**
K1: *Remember* **K2**: *Understand* **K3**: *Apply* **K4**: *Analyze* **K5**: *Evaluate* **K6**: *Create*		

Course Outline:

UNIT I

Introduction to Computer: Introduction - Types of computers - Characteristics of Computers. Generations of Computers: First Generation - Second Generation - Third Generation - Fourth Generation - Fifth Generation.

UNIT II

Computer Software: Introduction - Operating System - Utilities - Compiler and Interpreters – Programming Languages: High level language - Types of High-Level Language. Input Devices: Output Devices.

UNIT III

MS-Office: Text Manipulations - Usage of Numbering, Bullets, Footer and Headers - Usage of Spell check, Find & Replace - Text Formatting - Picture insertion and alignment - Creation of documents, using templates - Formatting a Table - Mail Merge Concepts.

UNIT IV

MS-EXCEL: Cell Editing - Usage of Formulae and Built-in Functions - File Manipulations - Data Sorting (both number and alphabets) - Creating Graphs

UNIT V

MS-POWER POINT: Inserting Clip arts and Pictures - Frame movements of Clip arts and Pictures - Insertion of new slides - Preparation of Organization Charts - Presentation using Wizards - Usage of design templates, Case Studies: Designing Advertisement and Document creation with special features like header, footer, tables, etc - PowerPoint presentation on various concepts

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UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note 1: Students will be trained to develop appropriate computer Software like MS Office related to computations taught in this course.

Note 2: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1. Alexis Leon and Mathews Leon, "Fundamentals of Computer Science and Communication Engineering", Leon Techworld, 1998.
2. Joyce Cox and Team, "Step by Step 2007 Microsoft Office System", PHI Learning Private limited, New Delhi, 2009.

BOOKS FOR REFERENCE:

1. B Ram and Sanjay Kumar, "Computer Fundamentals", 5th Edition, New Age International Publishers, 2014.
2. Anita Goel, "Computer Fundamentals", 1st Edition, Pearson Education India, 2010.
3. Peter Weverka, "MS Office 2013 All-in-One for Dummies", 1st Edition, Wiley Publications, 2013.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. **https://www.msuniv.ac.in/images/econtent/6.Computer%20%20Fundamentals%20 and%20Office%20Automation.pdf**
2. **https://www.wileyindia.com/computer-basics-with-office-automation.html**
3. **https://support.microsoft.com/en-us/office/create-a-cross-reference-300b208c-e45a-487a-880ba02767d9774b**
4. **https://www.informit.com/articles/article.aspx?p=170392**

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO3	*High*	*High*	*Medium*	*Medium*	*Low*	*High*	*High*
CO4	*High*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO5	*High*	*Medium*	*Medium*	*High*	*Low*	*High*	*High*
CO6	*Medium*	*High*	*Medium*	*High*	*Low*	*High*	*High*
Correlation Level: *Low* *Medium* *High*							

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*Medium*	*High*	*High*	*High*	*High*	*High*	*High*
CO3	*Medium*	*High*	*High*	*High*	*High*	*Low*	*Medium*
CO4	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO5	*Medium*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Low*	*High*
Correlation Level: *Low* *Medium* *High*							

SEMESTER – II

9. LANGUAGE - TAMIL

10. ENGLISH

11. MATRIX AND LINEAR ALGEBRA

Course Code		TITLE OF THE COURSE	L	T	P	C
Core		**MATRIX AND LINEAR ALGEBRA**	**3**	**0**	**1**	**4**
Prerequisites		Knowledge of Algebra, vector and Arithmetic Operation	**Syllabus Version**		**2023-24**	

L: Lecture T: Tutorial P: Practical C: Credits

Course Objectives:

The main objectives of this course are to

- To study the basic operations of transpose and inverse of matrices
- To know the structure of orthogonal and unitary matrices
- To learn the invariance properties of ranks
- To know and to apply the concepts of vector space and matrix polynomials.

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Levels
CO1	Understand the scope and necessity of Matrices.	**K1, K2**
CO2	Able to obtain transpose of matrix, inverse and conjugate of matrix	**K1-K3 and K5**
CO3	Apply the formula and compute Rank of a matrix	**K2, K3**
CO4	Analyze and study the properties of matrices using Ranks	**K3, K4**
CO5	Analyze the properties of Matrix polynomials, Characteristic roots	**K3, K5**
CO6	Develop computer programs for carrying out computations related to this course	**K1 –K6**
K1: *Remember* **K2**: *Understand* **K3**: *Apply* **K4**: *Analyze* **K5**: *Evaluate* **K6**: *Create*		

Course Outline:

UNIT I

Matrices-Transpose-Conjugate transpose- Reversal law for the transpose and conjugate transpose. Adjoint of a matrix, Inverse of a matrix, Singular and Non -Singular matrices.

UNIT II

Reversal law for the inverse of product of two matrices. Commutativity of inverse and transpose of matrix, Commutativity of inverse and conjugate transpose of matrix, Orthogonal and Unitary Matrices, Product of unitary matrices, Partitioning of matrices.

UNIT III

Rank of a matrix, Echelon form, Rank of transpose, Elementary transformations, Elementary matrices, Invariance of rank through elementary transformations, Reduction to Normal form, Equivalent matrices.

UNIT IV

Vector space – Linear Dependence - Basis of a vector space –Sub-space - Properties of Linearly Independent and Dependent systems, Row and Column spaces, Equality of Row and Column ranks, Rank of Sum and Product of matrices

UNIT V

Matrix polynomials, Characteristic roots and vectors,Relation between characteristic roots and characteristic vectors, Algebraic and Geometric multiplicity, Nature of characteristic roots in case of special matrices, Cayley- Hamilton theorem.**UNIT VI**

UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note 1: Students will be trained to develop appropriate computer programmes in *R* and *Python* related to computations taught in this course.

Note 2: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1. Vasishtha,A.R.(2014) Matrices, Krishna Prakashan, Meerut.
2. Shanthi Narayan. and Mittal,P.K. (2000) A Text Book of Matrices, S.Chand& Co, New Delhi.

BOOKS FOR REFERENCE:

1. Narayanan and T. K. Manickavachagam Pillai – Ancillary Mathematics, Vol. II, S. Viswanathan Pvt. Ltd, Chennai.
2. Gentle,J.E. (2007) Matrix Algebra Theory, Computations, and Applications in Statistics, Springer, New York.
3. Richard Bronson. (2011) Matrix Operations, Schaum'sOuline Series, McGraw Hill, New York.
4. Searle, S. R. (2006) Matrix Algebra useful for Statistics, Wiley Interscience, New York.
5. M.L. Khanna (2009), Matrices, Jai Prakash Nath& Co.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. **e-books, tutorials on MOOC/SWAYAM courses on the subject**
2. **https://samples.jbpub.com/9781556229114/chapter7.pdf**
3. **https://www.vedantu.com/maths/matrix-rank**
4. **https://textbooks.math.gatech.edu/ila/characteristic-polynomial.html**
5. **https://www.aitude.com/explain-echelon-form-of-a-matrix/**

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*High*	*High*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
CO2	*High*	*High*	*High*	*High*	*Medium*	*High*	*Medium*
CO3	*High*	*High*	*Medium*	*Medium*	*Low*	*High*	*Medium*
CO4	*High*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO5	*High*	*Medium*	*Medium*	*High*	*Low*	*High*	*High*
CO6	*Medium*	*High*	*Medium*	*High*	*Low*	*High*	*High*
Correlation Level: *Low* *Medium* *High*							

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*High*	*High*	*High*	*High*	*High*	*High*	*High*
CO3	*Medium*	*Medium*	*High*	*High*	*High*	*Low*	*Medium*
CO4	*High*	*Medium*	*High*	*High*	*Medium*	*High*	*Medium*
CO5	*Medium*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Medium*	*High*
Correlation Level: *Low* *Medium* *High*							

12. DISTRIBUTIONS THEORY

Course Code		**TITLE OF THE COURSE**	**L**	**T**	**P**	**C**
Core		**DISTRIBUTIONS THEORY**	**3**	**0**	**1**	**4**
Prerequisites		Knowledge of Probability Theory and Real Analysis	**Syllabus Version**		**2023-24**	

L: Lecture T: Tutorial P: Practical C: Credits

Course Objectives:

The main objectives of this course are to

- facilitate for acquiring knowledge on theoretical aspects of probability distributions

- understand relationships among statistical distributions
- inculcate the ability for carrying out statistical analysis of probability distributions.

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Level
CO1	Compute marginal and conditional distributions from joint distributions	**K1 – K3**
CO2	Obtain the distributions of functions of random variables	**K1, K6**
CO3	Describe the properties of univariate discrete distributions	**K3, K5**
CO4	Analyze the properties of univariate continuous distributions and bivariate normal distribution	**K4**
CO5	Derive the sampling distributions related to Normal distribution and to study their properties	**K1, K6**
CO6	Develop computer programs for carrying out computations related to this course	**K1 – K6**
K1: *Remember* **K2**: *Understand* **K3**: *Apply* **K4**: *Analyze* **K5**: *Evaluate* **K6**: *Create*		

Course Outline:

Unit - I

Distributions of functions of one-dimensional and two-dimensional random variables – Distribution function method, Transformations and Moment generating function method.

Unit - II

Discrete distributions: Bernoulli, Binomial, Poisson, Geometric and Negative binomial distributions - Multinomial distribution. Moments – probability generating function, moment generating function, characteristic function and properties.

Unit - III

Continuous distributions: Uniform, Normal, Cauchy and Lognormal distributions - concepts, moments, moment generating function, characteristic function and properties.

Unit - IV

Exponential, Gamma, Beta (first and second kinds) concepts, moments, moment generating function, characteristic function and properties.

Unit - V

Sampling distributions: *Chi*-square, *t* and *F* distributions- concepts, moments, moment generating function, characteristic function and properties.

UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note 1: Students will be trained to develop appropriate computer programmes in *R* and *Python* related to computations taught in this course.

Note 2: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1. Goon, A. M., M.K. Gupta, and B. Dasgupta (2002) Fundamentals of Statistics, Vol. I, (Third Edition), World Press Ltd, Kolkata.
2. Alexander, M. Mood, Franklin A. Graybill and Duane C. Boes (2017). Introduction to the Theory of Statistics (Third Edition), Mc Graw Hill Education, New Delhi.

BOOKS FOR REFERENCE:

1. Bhuyan K.C. (2010), Probability Distribution Theory and Statistical Inference, New Central Book Agency (P) Ltd., New Delhi.
2. Gupta, S. C., and V. K. Kapoor (2020) Fundamentals of Mathematical Statistics, (Twelfth Edition). Sultan Chand & Sons, New Delhi.
3. Robert, V. Hogg, Joseph W. McKean and Allen T. Craig (2013) Introduction to Mathematical Statistics (Seventh Edition), Pearson Education, New York.
4. Rohatgi, V. K. and A. K. Md. E. Saleh (2009). An Introduction to Probability Theory and Mathematical Statistics (Second Edition). John Wiley & Sons, New York.

Related Online MOOCs Contents [SWAYAM, NPTEL, Websites etc.]

1. https://swayam.gov.in/nd2_cec20_ma01/preview
2. **https://nptel.ac.in/courses/111/104/111104032/**

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*High*	*High*	*High*	*High*	*High*	*High*	*High*
CO3	*High*	*High*	*Medium*	*Medium*	*Medium*	*High*	*High*
CO4	*High*	*High*	*High*	*Medium*	*High*	*High*	*High*
CO5	*High*	*High*	*Medium*	*High*	*Low*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*High*	*High*
Correlation Level:	*Low*	*Medium*	*High*				

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*Medium*
CO2	*Medium*	*High*	*High*	*Medium*	*High*	*High*	*High*
CO3	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO4	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO5	*High*	*Medium*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Low*	*High*
Correlation Level:	*Low*	*Medium*	*High*				

13. REAL ANALYSIS

Course Code		TITLE OF THE COURSE	L	T	P	C
Core		REAL ANALYSIS	4	0	0	3
Prerequisites		Knowledge of multivariate calculus and linear algebra and basic set theory	Syllabus Version		2023-24	

L: Lecture T: Tutorial P: Practical C: Credits

Course Objectives:

The main objectives of this course are to

- To study the basic operations of sets and functions
- To know the structure of the real sequence and its convergence
- To learn series and its convergence
- To learn the limits, continuity and derivative of real valued functions
- To know and to apply the Riemann integration

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Level
CO1	Recognize the fundamental concepts of sequence and series	K1
CO2	Acquire the knowledge on Beta, Gamma integrals and some Riemann integrable functions	K1
CO3	Understand the role of mean value theorem in series	K2
CO4	Calculate the Taylor's series and Maclaurin's series	K3
CO5	Examine the Cauchy convergence of Limit superior and limit inferior	K4

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

Course Outline:

Unit - I

Operations on sets, Functions, Real valued functions, Equivalence, Countability, Real Numbers, Cantor set, Least Upper Bounds, Greatest Lower Bound.

Unit - II

Definition of Sequence, Subsequence, Limit of a sequence, Convergent and Divergent sequences, Oscillating sequence, Bounded and Monotone sequences, Operations on convergent sequences, Limit Infimum, Limit Supremum, Cauchy sequences, Summability of sequences.

Unit - III

Definition of Series, Convergent and Divergent series, series with nonnegative terms, alternating series, conditional convergence, absolute convergences and test for absolute convergence

Unit - IV

Limit of a function on the real line, Increasing and Decreasing functions, Continuous function, Operations on continuous functions, Composition of continuous functions, Derivatives, Derivative and continuity, Rolle's Theorem, Mean value theorem, Taylor's theorem

Unit - V

Concept of Riemann Integral, Refinement of partition, Upper and Lower sums, Upper integral and Lower Integral Riemann integrability, Necessary and Sufficient condition for Riemann integrable, Properties of Riemann integrals, Fundamental theorem

UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1. Goldberg. R R(1976) : Methods of Real Analysis, Oxford &IBH.
2. Ranjit Singh and Arora, First course in Real Analysis, Sultan Chand, 1974.
3. Narayanan and Manickavasagam pillai, Ancillary Mathematics, 2009.

BOOKS FOR REFERENCE:

1. Shanthinarayan, (2012): Real Analysis, S. Chand& Co, New Delhi
2. Walter Rudin (2017), Principles of Mathematical Analysis, 3rd Edition, McGraw-Hill

Related Online MOOCs Contents [SWAYAM, NPTEL, Websites etc.]

1. https://tutorial.math.lamar.edu/classes/calci/thelimit.aspx

2. https://www.mathsisfun.com/calculus/derivatives-introduction.html

3. https://www.math.ucdavis.edu/~hunter/m125b/ch1.pdf

4. https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/single-variable-calculus/taylors-theorem/

5. http://www.ms.uky.edu/~droyster/courses/fall06/PDFs/Chapter06.pdf

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*High*	*High*	*High*	*Medium*	*High*	*High*	*Medium*
CO2	*High*	*High*	*High*	*Medium*	*High*	*High*	*High*
CO3	*High*	*High*	*Medium*	*Medium*	*Medium*	*High*	*Medium*
CO4	*High*	*High*	*High*	*Medium*	*High*	*High*	*High*
CO5	*High*	*High*	*Medium*	*High*	*Low*	*High*	*High*
CO6	*High*	*Medium*	*Medium*	*High*	*Medium*	*High*	*Medium*
Correlation Level: *Low* *Medium* *High*							

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*Medium*
CO2	*Medium*	*High*	*High*	*Medium*	*High*	*High*	*High*
CO3	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO4	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO5	*High*	*Medium*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Low*	*High*
Correlation Level: *Low* *Medium* *High*							

14. STATISTICS PRACTICAL – II

15. MATHEMATICS FOR STATISTICS - II

Course Code		**TITLE OF THE COURSE**	**L**	**T**	**P**	**C**
Core		**MATHEMATICS FOR STATISTICS-II**	**2**	**0**	**0**	**2**
Prerequisites		Basic knowledge of theory of equations and Calculus	**Syllabus Version**		**2023-24**	

L: Lecture T: Tutorial P: Practical C: Credits

Course Objectives:

The main objectives of this course are to

- Inculcate and understand the mathematical concepts in calculus.
- Improve problem-solving and analytical skills in differentiation and integration.
- Explore and analyze the concepts of functions using derivatives and integrals.
- Familiarize with the properties of differentiation and integration.
- Apply the appropriate techniques in calculus to solve statistical problems.
- Enhance the ability of solving problems related to maxima and minima.

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Levels
CO1	Understand solving Algebraic and differential equations of different kind applying suitable methods	**K1, K2**
CO2	Acquire knowledge on differentiation and integration and solve related problems.	**K3**
CO3	Develop competency in applying the ideas of derivatives, partial derivatives and integration	**K4**
CO4	Evaluate integrals and application problems on differentiation.	**K5**
CO5	Obtain the maxima and minima for algebraic functions and solutions for integration with appropriate techniques.	**K6**
CO6	Develop computer programs for carrying out computations related to this course	**K1 –K6**
K1: *Remember* **K2**: *Understand* **K3**: *Apply* **K4**: *Analyze* **K5**: *Evaluate* **K6**: *Create*		

Course Outline:

Unit - I

Theory of Equations: Nature of roots, Formulation of equation whose roots sre given. Relation between coefficients and roots - Transformation of equations - Reciprocal equations - Horner's method of solving equatios.

Unit - II

Successive differentiation – Trignometrical tranformations - Leibnitz's Formulas, nth derivative of standard functions - simple problems. Partial differentiation – Successive partial differentiation – Implicit functions – homogeneous functions – Euler's theorem.

Unit - III

Maxima and Minima for one variable – Applicationas – Concavity, Convexity and points of inflexion - Maxima and Minima for two variables – working rule.

Unit – IV

Linear differential equations of second order with constant coefficients - $(aD^2+bD+c)y = X$, various forms of X : $e^{\alpha x}$, $cos\alpha x$ $sin\alpha x$, x^m. Methods of solving homogenious linear differential equations of second order. Laplace transform and its inverse – solving ordinary differential equation with constant coeficients using Laplce transform.

Unit - V

Integration- Reverse process of differentiation – Methods of integration - Integrals of functions containing linear functions of x - Integrals of functions involving $a^2 \pm x^2$ - Integration of rational algebraic functions - $1/(ax^2+bx+c)$, $(px+q)/(ax^2+bx+c)$. Integration of irrational functions - $1/(ax^2+bx+c)^{1/2}$, $(px+q)/(ax^2+bx+c)^{1/2}$, $(px+q)\sqrt{(ax^2+bx+c)}$ - Integration by parts.

UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note 1: Students will be trained to develop appropriate computer programmes in *R* and *Python* related to computations taught in this course.

Note 2: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1.Narayanan,S., Hanumantha Rao and T.K. Manicavachagom Pillay (2008) Ancillary Mathematics, Volume I, S. Viswanathan Pvt. Ltd, Chennai.

2.Narayanan, S. and T.K. Manicavachagom Pillay (2015) Calculus Vol. I, II and III, S. Viswanathan Pvt. Ltd, Chennai.

BOOKS FOR REFERENCE:

1. P.Kandasamy, K.Thilagavathy (2003) Allied Mathematics Vol-I, II S.Chand & company Ltd., New Delhi-55.
2. P.Duraipandian and S.Udayabaskaran,(1997) Allied Mathematics, Vol. I & II. Muhil Publishers, Chennai
3. S.P.Rajagopalan and R.Sattanathan,(2005) Allied Mathematics .Vol. I & II. Vikas Publications, New Delhi.

Related Online MOOCs Contents [SWAYAM, NPTEL, Websites etc.]

1. https://www.youtube.com/watch?v=-OITIc9HeUQ
2. **https://mathinsight.org/integration_applications**
3. **https://ocw.mit.edu/ans7870/resources/Strang/Edited/Calculus/Calculus.pdf**
4.https://www.sac.edu/FacultyStaff/HomePages/MajidKashi/PDF/MATH_150/Bus_Calculus.pdf

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*High*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO3	*High*	*High*	*Medium*	*Medium*	*Low*	*High*	*High*
CO4	*High*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO5	*High*	*Medium*	*Medium*	*High*	*Low*	*High*	*High*
CO6	*Medium*	*High*	*Medium*	*High*	*Low*	*High*	*High*
Correlation Level: *Low* *Medium* *High*							

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*Medium*	*High*	*High*	*High*	*High*	*High*	*High*
CO3	*Medium*	*High*	*High*	*High*	*High*	*Low*	*Medium*
CO4	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO5	*Medium*	*High*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Low*	*High*
Correlation Level: *Low* *Medium* *High*							

16. PROGRAMMING IN C++

Course Code		TITLE OF THE COURSE	L	T	P	C
Core		PROGRAMMING IN C++	2	0	0	2
Prerequisites		Basic knowledge Office Automation	Syllabus Version		2023-24	

L: Lecture T: Tutorial P: Practical C: Credits

Course Objectives:

The main objectives of this course are to

- To learn the concepts of class & objects.
- To inculcate knowledge on Object-oriented programming concepts using C++.
- To gain Knowledge on programming with C++.
- To perform Inheritance, Overloading of operators, functions, constructors, File Handling and exception handling.

Course Outcomes (COs):

At the end of this course of study, the student will be able to

CO No.	Course Outcome	Cognitive Levels
CO1	define and understand the basic concepts in C++ Programming.	K1
CO2	explain and execute C++ programs to explore the concepts of classes and objects.	K2
CO3	apply the skills to write the C++ code using constructors and operator overloading.	K3
CO4	analyze the concepts of OOPS such as Inheritance, Virtual base classes and Abstract classes	K4
CO5	discover the concept of streams, file management, Template and Exception handling in C++	K5

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

Course Outline:

Unit - I

Introduction to C++ - key concepts of Object-Oriented Programming –Advantages – Object Oriented Languages –vI/O in C++ - C++ Declarations. Control Structures : - Decision Making and Statements : If ..else, jump, goto,vbreak, continue, Switch case statements - Loops in C++ : for, while, do - functions in C++ - inline functions – Function Overloading.

Unit - II

Classes and Objects: Declaring Objects – Defining Member Functions – Static Member variables and functions – array of objects –friend functions – Overloading member functions – Bit fields and classes – Constructor and destructor with static members.

Unit - III

Operator Overloading: Overloading unary, binary operators – Overloading Friend functions – type conversion – Inheritance: Types of Inheritance – Single, Multilevel, Multiple, Hierarchal, Hybrid, Multi path inheritance – Virtual base Classes – Abstract Classes.

Unit – IV

Pointers – Declaration – Pointer to Class , Object – this pointer – Pointers to derived classes and Base classes – Arrays – Characteristics – array of classes – Memory models – new and delete operators – dynamic object – Binding, Polymorphism and Virtual Functions.

Unit - V

Files – File stream classes – file modes – Sequential Read / Write operations – Binary and ASCII Files – Random Access Operation – Templates – Exception Handling - String – Declaring and Initializing string objects – String Attributes – Miscellaneous functions .

UNIT VI

Contemporary Issues: Expert lectures, online seminars – webinars. [2 hours]

Note 1: Students will be trained to develop appropriate computer programmes in *c++* related to computations taught in this course.

Note 2: Examination shall be conducted on contents of UNIT I through UNIT V only.

BOOKS FOR STUDY:

1.Narayanan,S., Hanumantha Rao and T.K. Manicavachagom Pillay (2008) Ancillary Mathematics, Volume I, S. Viswanathan Pvt. Ltd, Chennai.
2.Narayanan, S. and T.K. Manicavachagom Pillay (2015) Calculus Vol. I, II and III, S. Viswanathan Pvt. Ltd, Chennai.

BOOKS FOR REFERENCE:

1. E. Balagurusamy, “Object-Oriented Programming with C++”, TMH 2013, 7th Edition.
2. The C++ programming language, Bjarne Stroustrup, Pearson publications.
3. Object Oriented Programming in C++ by N.Barkakati, PHI.
4. Herbert Schildt (2003), “C++: The Complete Reference”, Tata McGraw publication.

Related Online MOOCs Contents [SWAYAM, NPTEL, Websites etc.]

1. **https://onlinecourses.nptel.ac.in/noc20_cs07/preview**
2. **https://onlinecourses.nptel.ac.in/noc20_cs91/preview**
3. **https://onlinecourses.nptel.ac.in/noc22_cs103/preview**
4. **https://onlinecourses.nptel.ac.in/noc23_cs121/preview**

Mapping of Course Outcomes to Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	*High*	*High*	*Medium*	*High*	*Medium*	*High*	*High*
CO2	*High*	*Medium*	*High*	*High*	*Medium*	*High*	*High*
CO3	*High*	*High*	*Medium*	*Medium*	*Low*	*High*	*Medium*
CO4	*High*	*Medium*	*High*	*Medium*	*Medium*	*High*	*High*
CO5	*High*	*Medium*	*Medium*	*High*	*Medium*	*High*	*Medium*
CO6	*Medium*	*High*	*Medium*	*High*	*Medium*	*High*	*High*
Correlation Level: *Low* *Medium* *High*							

Mapping of Course Outcomes to Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	*Medium*	*High*	*High*	*High*	*Medium*	*High*	*High*
CO2	*High*	*High*	*Medium*	*High*	*High*	*High*	*High*
CO3	*Medium*	*Medium*	*High*	*High*	*Medium*	*Medium*	*Medium*
CO4	*High*	*High*	*High*	*High*	*High*	*High*	*Medium*
CO5	*High*	*Medium*	*High*	*Medium*	*Medium*	*High*	*High*
CO6	*High*	*High*	*High*	*High*	*High*	*Medium*	*High*
Correlation Level: *Low* *Medium* *High*							

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