BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI - 620 024.

ALLIED MATHEMATICS for

B.Sc. Physics / Chemistry / Electronics / Geology Programmes

(Applicable to the candidates admitted from the academic year 2022-23 onwards)

ALLIED COURSE I
CALCULUS AND FOURIER SERIES

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

1. To learn the basic Mathematics for their concepts.
2. To train the students in the basic Integrations.

UNIT – I:

Successive Differentiation – nth derivative of standard functions (Derivation not needed) simple problems only-Leibnitz Theorem (proof not needed) and its applications-Curvature and radius of curvature in Cartesian only (proof not needed)–Total differential coefficients (proof not needed) - Jacobians of two & three variables –Simple problems in all these.

UNIT – II:

Evaluation of integrals of types:

$$1)\int \frac{px+q}{ax^2+bx+c}dx \quad 2)\int \frac{px+q}{\sqrt{ax^2+bx+c}}dx \quad 3)\int \frac{dx}{(x+p)\sqrt{ax^2+bx+c}} \quad 4)\int \frac{dx}{a+b\cos x} \quad 5)\int \frac{dx}{a+b\sin x}$$

Integration by trigonometric substitution and by parts of the integrals

$$1)\int \sqrt{a^2-x^2}\,dx \quad 2)\int \sqrt{a^2+x^2}\,dx \quad 3)\int \sqrt{x^2-a^2}\,dx$$

UNIT – III:

General properties of definite integrals – Evaluation of definite integrals of types:

$$1)\int_a^b \frac{dx}{(x-a)(b-x)} \quad 2)\int_a^b \sqrt{(x-a)(b-x)}\,dx \quad 3)\int_a^b \sqrt{\frac{(x-a)}{(b-x)}}dx$$

Reduction formula (When n is a positive integer) for

$$1)\int_a^b e^{ax}x^n dx \quad 2)\int_a^b \sin^n x\,dx \quad 3)\int_a^b \cos^n x\,dx \quad 4)\int_0^x e^{ax}x^n dx \quad 5)\int_0^{\frac{\pi}{2}} \sin^n x\,dx$$

UNIT – IV:

Evaluation of Double and Triple integrals in simple cases – Changing the order and evaluation of double integral. (Cartesian only)

UNIT – V:

Definition of Fourier Series – Finding Fourier Coefficients for a given periodic function with period 2π - Use of Odd & Even functions in evaluating Fourier Coefficients - Half range sine & cosine series.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Linear approximations of vector valued functions

REFERENCES:

1. T.K. Manickavasagam Pillai & others, Calculus, Volume I, S.V Publications, Reprint 2016 (Unit I).
2. T.K. Manickavasagam Pillai & others, Calculus, Volume II, S.V Publications, Reprint 2016 (Units II, III & IV).
3. S. Arumugam, Isaac and Somasundaram, Trigonometry & Fourier Series, New Gamma Publishers, Hosur, 1999 (Unit V).
4. M.L. Khanna, Differential Calculus, Jaiprakashnath and Co., Meerut-2004.

COURSE OUTCOMES:

After completing this course, the students will be able to

- Explain the relationship between the derivative of a function as a function and the notion of the derivative as the slope of the tangent line to a function at a point.
- Derive reduction formula and thereby evaluate some standard integrals.
- Identify odd and even functions. Use that to determine Fourier series expansion of the given functions.
- Apply change of variable method to evaluate double integral.

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ALLIED COURSE II
ALGEBRA, ANALYTICAL GEOMETRY (3D)
AND TRIGONOMETRY

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To learn the basic concepts of Algebra
- To learn the basic needs Trigonometry

UNIT – I:

Binomial, Exponential and Logarithmic series (Formulae only) – summation & approximation related problems only.

UNIT – II:

Non-Singular, Symmetric, Skew symmetric, Orthogonal, Hermitian, Skew Hermitian and Unitary matrices – Characteristic equation, Eigen values, Eigen vectors – Cayley - Hamilton's Theorem (proof not needed) –Simple applications only.

UNIT – III:

Finding the Shortest distance between two skew lines and the equation of the plane containing them– Condition for Coplanarity – Equation of a Sphere – Tangent plane – Plane section of a sphere.- Finding the center & radius of the circle of intersection – Sphere through the circle of intersection (only problems in all the above)

UNIT – IV:

Expansion of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ (n being a positive integer) - Expansion of $\sin^n \theta$, $\cos^n \theta$, $\sin^n \theta \cos^m \theta$ in a series of sines & cosines of multiples of θ (θ - given in radians) - Expansion of $\sin \theta$, $\cos \theta$, $\tan \theta$ in terms of powers of θ (only problems in all the above).

UNIT – V:

Euler's formula for $e^{i\theta}$ - Definition of Hyperbolic functions –Formulae involving Hyperbolic functions -Relation between Hyperbolic & circular functions – Expansion of $\sinh x$, $\cosh x$, $\tanh x$ in powers of x - Expansion of Inverse hyperbolic functions $\sinh^{-1} x$, $\cosh^{-1} x$ and $\tanh^{-1} x$-Separation of real & imaginary parts of $\sin(x+iy)$, $\cos(x+iy)$, $\tan(x+iy)$, $\sinh(x+iy)$, $\cosh(x+iy)$, $\tanh(x+iy)$.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An Introduction to SAGEMATH

REFERENCES:

1. T.K. Manickavasagam Pillai & others, Algebra, Volume I, S.V Publications, Reprint 2016 (Unit I).
2. T.K.Manicavachagam Pillai & others, Algebra, Volume II, S.V Publications, Reprint 2016 (Unit II).
3. T.K.Manickavasagom Pillai, Analytical Geometry (3D) and Vector Calculus, New Gamma Publishing House, 1991(Unit III).
4. S. Arumugam, Isaac and Somasundaram, Trigonometry & Fourier Series, New Gamma Publishers, Hosur, 1999(Units IV & V).
5. M.L. Khanna, Differential Calculus, Jaiprakashnath and Co., Meerut-2004.

COURSE OUTCOMES:

After completing this course, the students will be able to

- Applying the skills to solve problems in operative algebra.
- Gain knowledge about the regular geometrical figures and their properties.
- To Understand the definitions of the inverse trigonometric functions and to Compute the domain and range of the hyperbolic and inverse trigonometric functions and to find exact values of composite functions with inverse trigonometric functions

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ALLIED COURSE III
ODE, PDE, LAPLACE TRANSFORMS
AND VECTOR ANALYSIS

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- The Students will be able to apply the concepts and methods described in the syllabus they can solve problems using the ordinary and partial differential equation.
- They will know a number of applications The text and class discussion will introduce the concepts, methods, applications, and logical arguments
- Learn the application of Laplace transform in engineering analysis.
- Learn the required conditions for transforming variable or variables in functions by the Laplace transform.
- Learn the use of available Laplace transform tables for transformation of functions and the inverse transformation.
- Vector analysis is a mathematical shorthand and the vector form helps to provide the clear understanding of the physical laws. This makes the calculus of the vector functions the natural instrument for the physicist and engineers in solid mechanics, electromagnetism.

UNIT – I:

Ordinary Differential Equation of first order but of higher degree — Equations solvable for x solvable for Clairaut's form (simple cases only) — Linear equations with constant coefficients — Finding Particular integrals in the cases of e" , sin (kx) , cos (kx) (where k is a constant), x* where k is a positive integer , and e "' *f(x)* where f(x) is any function of x- (only problems in all the above —No proof needed for any formula).

UNIT – II:

Formation of Partial differential equations by eliminating constants and by elimination of arbitrary functions — definition of general, particular & complete solutions — Singular integral (geometrical meaning not required) — Solutions of first order eqnations in the standard forms- $f(p,q) = 0$, $f(x,p,q) = 0$, $f(y,p,q) = 0$, $f(z,p,q) = 0$, $f_1(x,p) = f_2(y,q)$, $z = xp + yq + f(p,q)$ - Lagrange's method of solving $Pp + Qq = R$,where P,Q,R are functions of x,y,z — (Geometrical Meaning is not needed)- (only problems in all the above — No proof needed for any formula).

UNIT – III:

Laplace Transform — Definition — Lee "') ,L(cos(at)) , L (sin (at)) L(t •) , where n is a positive integer. Basic theorems in Laplace Transforms (formula only)- L [e °" cos bt], L [e " sin bt], L |e '* f (t)] — L [f (t)], L[fi (t)], L [f " (t)]

UNIT – IV:

Inverse Laplace Transforms related to the above standard forms-Solving Second Order ODE with constant coefficients ii sing Laplace Transforms.

UNIT – V:

Gradient of a vector — directional derivative — unit normal vector tangent plane — Divergence-Curl — solenoidal & irrotational vectors — Double operators Properties connecting grad., div., and curl of a vector

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Introduction to Linear Systems of Differential Equations

REFERENCES:

1. S.Narayanan & T.K. Manicavachagam Pillay Differential Equation and its Applications, S. Viswanathan Publishers, 2015 (Units I, II, III & IV).
2. M.L. Khanna, Differential Calculus, Daiprakashnath and Co., Meerut-2004 (Unit V).

COURSE OUTCOME:

After completing this course, the students will be able to

- Solve differential equations using appropriate methods and to present mathematical solutions in a concise and informative manner.
- Develop a logical understanding of the subject with mathematical skills so that students are able to apply mathematical methods & principles in solving problems in engineering fields.
- Calculate Laplace transforms and inverses.
- Apply Laplace transforms to solution of differential and integral equations
- Explain the physical significance of vector calculus, parameterise curves and calculate line integrals,
- Use vector operators, calculate double and triple integrals and surface integrals, apply the Green's, Stokes and Divergence theorems and calculate complex integrals.

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BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI - 620 024.

ALLIED MATHEMATICS for

B.C.A., B.Sc. ARTIFICIAL INTELLIGENCE & MACHINE LEARNING, B.Sc. COMPUTER SCIENCE, B.Sc. CYBER SECURITY, B.Sc. INFORMATION TECHNOLOGY & B.Sc. SOFTWARE DEVELOPMENT PROGRAMMES

(Applicable to the candidates admitted from the academic year 2022-23 onwards)

ALLIED COURSE I
ALGEBRA AND CALCULUS

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To train the students to solve the problems in theory of equations
- To provide knowledge about the matrix, differentiation and various methods for evaluation of integrals.

UNIT – I:

Theory of Equations: Relation between roots & coefficients – Transformations of Equations – Diminishing ,Increasing & multiplying the roots by a constant- Forming equations with the given roots –Rolle's Theorem, Descarte's rule of Signs(statement only) – simple problems.

UNIT – II:

Matrices : Singular matrices – Inverse of a non-singular matrix using adjoint method - Rank of a Matrix – Consistency - Characteristic equation, Eigen values, Eigen vectors – Cayley Hamilton's Theorem (proof not needed) –Simple applications only

UNIT – III:

Differentiation: Maxima & Minima – Concavity , Convexity – Points of inflexion - Partial differentiation – Euler's Theorem - Total differential coefficients (proof not needed) –Simple problems only.

UNIT – IV:

Integration : Evaluation of integrals of types:

$$1)\int \frac{px+q}{ax^2+bx+c}dx \quad 2)\int \frac{px+q}{\sqrt{ax^2+bx+c}}dx \quad 3)\int \frac{dx}{a+b\cos x} \quad 4)\int \frac{dx}{a+b\sin x}$$

Evaluation using Integration by parts – Properties of definite integrals – Fourier Series in the range $(0, 2\pi)$ – Odd & Even Functions – Fourier Half range Sine & Cosine Series

UNIT – V:

Differential Equations: Variables Separable – Linear equations – Second order of types $(aD^2 + bD + c)y = F(x)$ where a,b,c are constants and $F(x)$ is one of the following types

$(i)e^{Kx}$ $(ii)\sin(kx)$ or $\cos(kx)$ $(iii)x^n, n$ being an integer $(iv)e^{Kx}f(x)$

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Derivatives of Implicit and parametric Functions

REFERENCES:

1. T.K. Manickavasagam Pillai & others, Algebra, Volume I, S.V Publications , 1985 Revised Edition (Units I, II)
2. S. Narayanan, T.K. Manicavachagam Pillai, Calculus, Vol. II, S. Viswanathan Pvt Limited, 2003. (Units III, IV and V)
3. M.L. Khanna, Differential Calculus, Jaiprakashnath and Co., Meerut-2004.

COURSE OUTCOMES:

After completing this course, the students will be able to

- Train the students to solve the problems in theory of equations.
- Apply Cayley Hamilton theorem for finding the inverse of square matrices.
- Get exposed the basic concepts of differentiation and integration.
- Acquire the knowledge about differential equations.

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ALLIED COURSE II
NUMERICAL ANALYSIS AND PROBABILITY

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To learn knowledge about an algebraic and transcendental equations.
- To make the students gain wide knowledge in probability which plays a main role in solving real life problems.

UNIT – I:

Algebraic & Transcendental equations: Bisection Method, Newton Raphson Method, Iteration method - Finite differences – Forward, Backward differences – Newton's forward & backward difference interpolation formulae – Lagrange's interpolating polynomial.

UNIT – II:

Numerical differentiation - Numerical Integration using Trapezoidal rule and Simpson's first & second rules (proof not needed) - Solutions to Linear Systems – Gaussian Elimination Method – Jacobi & Gauss Siedal iterative methods – Theory and problems.

UNIT – III:

Numerical solution of ODE: Solution by Taylor Series Method, Euler's Method, Runge - Kutta 2nd order method- Adam's Predictor Corrector Method and Milne's Predictor Corrector Methods.

UNIT – IV:

Arithmetic Mean – Geometric Mean – Harmonic Mean - Median, Mode , Standard Deviation - Quartile Deviation – Percentiles - Expectation – Variance and covariance.

UNIT – V:

Correlation and Regression –Properties of Simple Correlation and regression coefficients – Simple Numerical Problems only.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An introduction to MATLAB

REFERENCES:

1. S.S. Sastry, Numerical Analysis (Unit 1 , 2 , 3)
2. Gupta. S.C & Kapoor, V.K, Fundamentals of Mathematical Statistics, Sultan Chand & sons, New Delhi -1994. (Units 4 & 5)

3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Private Limited, 1999.
4. C.E. Froberg, Introduction to Numerical Analysis, II Edn., Addison Wesley, 1979.

COURSE OUTCOMES:

After completing this course, the students will be able to

- Solve algebraic and transcendental equations.
- Appreciate the importance of probability of random variables and understand the correlation and regression coefficients.

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ALLIED COURSE III
OPERATIONS RESEARCH

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the basic concepts about Linear Programming Problem, Transportation Problem Assignment Problem, Sequencing Problem and Network.
- To make students solve real life problems in Business and Management.

UNIT – I:

Operations Research: Introduction - Basics of OR – OR & decision making – Role of Computers in OR - Linear programming formulations & graphical solution of two variables – Canonical & standard forms of LPP

UNIT – II:

Simplex Method: Simplex Method for <, =, > constraints – Charne's method of penalties– Two phase Simplex method.

UNIT – III:

Transportation problem: Transportation algorithm –Degeneracy algorithm – Degeneracy in Transportation Problem, Unbalanced transportation problem- Assignment algorithm –Unbalanced Assignment problem

UNIT – IV:

Sequencing problem: Processing of n jobs through two machines – Processing of n jobs through 3 machines – processing of two jobs through m machines.

UNIT – V:

Networks: Network – Fulkerson's rule - measure of activity – PERT computation – CPM computation - Resource scheduling.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Integer and Dynamic programming.

REFERENCES:

1. Manmohan & Gupta , Operations Research, Sultan Chand Publishers, New Delhi
2. Prem Kumar Gupta and D.S. Hira, Operations Research : An Introduction,
3. S. Chand and Co., Ltd. New Delhi,
4. Hamdy A. Taha, Operations Research (7th Edn.), McMillan Publishing Company, New Delhi, 1982.

COURSE OUTCOMES:

After completing this course, the students will be able to

- Acquire the basic concepts of LPP.
- Apply various methods for finding a solution of an LPP.
- Use the basic concepts of TP, AP and Network Problems to develop the problem solving skills.

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BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI - 620 024.

ALLIED MATHEMATICS for

Allied Mathematics for B.Sc. Statistics Programmes

(Applicable to the candidates admitted from the academic year 2022-23 onwards)

ALLIED COURSE I
CALCULUS AND FOURIER SERIES

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To train the students in basic calculus
- To learn the basic ideas of Fourier Series

UNIT – I:

Maxima & Minima – Concavity , Convexity – Points of inflexion – Partial differentiation – Euler's Theorem - Total differential coefficients (proof not needed) – Simple problems only.

UNIT - II:

Evaluation of integrals of types:

1) $\int \frac{px+q}{ax^2+bx+c}dx$ 2) $\int \frac{px+q}{\sqrt{ax^2+bx+c}}dx$ 3) $\int \frac{dx}{(x+p)\sqrt{ax^2+bx+c}}$ 4) $\int \frac{dx}{a+b\cos x}$ 5) $\int \frac{dx}{a+b\sin x}$

Evaluation using Integration by parts. Integration by trigonometric substitution and by parts of the integrals

1) $\int \sqrt{a^2-x^2}\,dx$ 2) $\int \sqrt{a^2+x^2}\,dx$ 3) $\int \sqrt{x^2-a^2}\,dx$

UNIT – III:

General properties of definite integrals – Evaluation of definite integrals of types

1) $\int_a^b \frac{dx}{(x-a)(b-x)}$ 2) $\int_a^b \sqrt{(x-a)(b-x)}\,dx$ 3) $\int_a^b \sqrt{\frac{(x-a)}{(b-x)}}dx$

Other simple problems. - Evaluation of Double and Triple integrals in simple cases Changing the order and evaluation of the double integration – Beta, Gamma functions.

UNIT – IV:

Laplace Transforms – Inverse Laplace Transforms –Application of Laplace Transform in Solving second order Ordinary differential equation with constant coefficients.

UNIT – V:

Definition of Fourier Series – Fourier Coefficients for a given periodic function with period 2π - Use of Odd & Even functions in evaluating Fourier Coefficients– Half range sine & cosine series.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Convolution Integrals

REFERENCES:

1. S. Narayanan, T.K. Manichavasagam Pillai, Calculus, Vol. II, S. Viswanathan Pvt Limited, 2003
2. S. Narayanan, T.K. Manicavachagam Pillai, Calculus, Vol. III, S. Viswanathan Pvt Limited, and Vijay Nicole Imprints Pvt Ltd, 2004.

COURSE OUTCOMES:

After completing this course, the students will be able to

- Explain the relationship between the derivative of a function as a function and the notion of the derivative as the slope of the tangent line to a function at a point.
- Derive reduction formula and thereby evaluate some standard integrals.
- Identify odd and even functions. Use that to determine Fourier series expansion of the given functions.
- Apply change of variable method to evaluate double integral

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ALLIED COURSE II

ALGEBRA

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To learn the basic ideas of vector spaces
- To learn the basic ideas of rank and linear transformation

UNIT – I:

Binomial, Exponential and Logarithmic series (Formulae only) – summation and approximation related problems only.

UNIT – II:

Non-Singular , Symmetric , Skew symmetric, Orthogonal, Hermitian, Skew Hermitian and Unitary matrices – simple properties & problems –Inverse of a non-singular matrix using adjoint method

UNIT – III:

Rank of a Matrix – Consistency - Characteristic equation , eigen values ,eigen vectors – Cayley Hamilton's Theorem (proof not needed) – Simple applications only

UNIT – IV:

Vector spaces and its properties –linear independence – Basis & Dimension – Subspaces

UNIT – V:

Linear transformation and its properties –Rank & nullity.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An introduction to power series.

REFERENCES:

1. T.K. Manichavasam Pillai, T. Natarajan, K.S. Ganapathy, Algebra, Vol.I, S. Viswanathan Pvt Limited, Chennai, 2004 (Unit 1)
2. A.R. Vasistha, Matrices, Krishna Prakeshan Mandir, 24th Edition, 1994-95 (Unit 2 & 3)
3. M.L.Santiago, Modern Algebra (Unit 4 & 5), Arul Publications, Madras, 1993.
4. Narayanan, T.K. Manicavachagam Pillai & Ramnath, Advanced Mathematics for Engineers & Scientists, S. Viswanathan Publishers Pvt. Ltc., 1994

COURSE OUTCOMES:

After completing this course, the students will be able to

- Applying the skills to solve problems in operative algebra.
- Apply Cayley Hamilton theorem for finding the inverse of square matrices.
- Find rank and nullity of given linear transformations.

ALLIED COURSE III
ANALYSIS AND THEORY OF EQUATIONS

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the basic ideas of sequences.
- To learn the basic ideas of series Learn the application of Laplace transform in engineering analysis.

UNIT – I:

Theory of equations-formation of equations- irrational and imaginary roots – relation between Roots & coefficients –Reciprocal equations –Reducing roots by a number – multiplying roots by a number.

UNIT – II:

Real Number system – Absolute value of a real number – definition of supremum (LUB) and Infimum (GLB) – Limit of a function.

UNIT – III:

Definition of a sequence – Convergence and divergence of a sequence – Bounded sequences –Monotonic sequence –Algebra of sequences.

UNIT – IV:

Convergence and divergence of a series –Geometric series –simple tests for convergence of a Series (Comparison tests, ratio test, root test, Leibnitz test) – conditional convergence and absolute convergence of alternating series – Simple problems.

UNIT – V:

Continuous function and its properties – (Simple theorems only) – Uniform Continuity – Rolle's Theorem – Mean Value Theorem – Taylor's Theorem – Maclaurin Series.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

Systems of polynomial equations

REFERENCES:

1. T.K. Manicavachagam Pillai, Analysis, S.V. Publications, Chennai, 1985 (Unit 1 & 2).
2. Malik S.C, Mathematical Analysis, Wiley Eastern, New Delhi, 1984.

COURSE OUTCOME:

After completing this course, the students will be able to

- Know the foundation of Theory of Equations.
- Train the students to solve the problems in theory of equations.

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BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI - 620 024.

ALLIED MATHEMATICS for

Allied Mathematics for B.Sc. Mathematics Programmes

(Applicable to the candidates admitted from the academic year 2022-23 onwards)

ALLIED COURSE I
MATHEMATICAL STATISTICS I

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the basic concepts of statistics
- To learn the basic ideas of statistical data

UNIT – I:

Statistical data – Primary data and Secondary data(definitions only), Formation of frequency distribution, various measures of central tendency – mean ,median, mode, geometric mean harmonic mean – simple problems – properties of above measures.

UNIT – II:

Measures of dispersion – Range quartile deviation mean deviation, standard deviation – their coefficients- merits and demerits (simple problems) – Skewness and kutosis Karlpearson's coefficients- Bowley's coefficients- simple problems.

UNIT – III:

Probability- Definition, axiomatic approach to probability - Additive and Multiplicative laws of Probability (two variables only) and Conditional probability – simple problems- Concept of random variables – discrete and continuous random variables - Distribution function, pmf and pdf and their properties- simple problems.

UNIT – IV:

Mathematical Expectation – addition and multiplication theorems (two variables only) – Moment generating and characteristics functions, their properties – Conditional expectation and conditional variance (simple problems).

UNIT – V:

Binomial and Poisson distributions – moments, moment generating function cumulant generating function (Simple problems)- fitting of binomial and poisson distribution.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An introduction to SPSS software

REFERENCES:

1. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2. S.P. Gupta , Statistical Methods (Revised edition 2001)
   UNIT – I : Chapter I, II Sec 2.1-2.9 of (1)
   UNIT – II : Chapter III Sec 3.1-3.7, 3.13,3.14 of (1)
   UNIT – III : Part – II Chapter 1 of (2)
   UNIT – IV : Chapter VI Sec 6.1-6.4,6.9,6.10,6.12 of (1)
   UNIT – V : Chapter VII Sec 7.1,7.3
3. Gupta S.C. and Kapoor V.K., Fundamentals of Applied Statistics, Sultan Chand & Sons.
4. R.S.N. Pillai and Bagavathi, Practical statistics, Second edition (2013)

COURSE OUTCOMES:

After completing this course, the students will be able to

- Understand random variables and probability distributions.
- Know the difference between continuous and random variables.
- Acquire the knowledge by using Binomial and Poisson distribution.

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ALLIED PRACTICAL
MATHEMATICAL STATISTICS

Code: **(Practical)** **Credit: 2**

25 marks for records and 75 marks for Practical Examination
Passing minimum for Record – 10 marks (out of 25 marks)
Practical Examination – 30 marks (out of 75 marks)

COURSE OBJECTIVES:

- To train the students in solving statistical problems

UNIT – I:

Moments of central tendency- A.M, median, G.M and H.M- Measures of Dispersion- quartile deviation, standard deviation and co-efficient of variation measures of skewness - calculations of first four moments, Central moments, B_1, B_2.

UNIT – II:

Bivariate discrete probability distribution- marginal distribution and conditional distribution – Calculation of mean, variance, covariance, correlation coefficient, expectation - conditional expectations and conditional variance.

UNIT – III:

Fitting of binomial, poisson and normal distributions (area method only).

UNIT – IV:

Calculation of Karl pearson's coefficient of correlation, Spearman's rank correlation and regression equations.

UNIT – V:

Large sample tests- Test of single mean- Difference between means – single proposion and Difference between proposion. Exact simple test- t' test for single mean, Difference between means, paired t - test - chi square test for goodness of fit and independence of attributes.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An introduction to R package

REFERENCES:

1. R.S.N. Pillai and Bagavathi, Practical statistics, Second edition (2013).
   UNIT – I : Chapter 3, 4 & 5
   UNIT – II : Chapter 12
   UNIT – III : Chapter 13

UNIT – IV : Chapter 6 & 7
UNIT – V : Chapter 14 & 15

2. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
3. S.P. Gupta, Statistical Methods (Revised edition 2001).

COURSE OUTCOMES:

After completing this course, the students will be able to

- Understand and critically discuss the issues surrounding sampling and significance.
- Check the given data are correlated or not using Karl Pearson's coefficient of correlation or Spearman's rank correlation.

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ALLIED COURSE III

MATHEMATICAL STATISTICS II

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To learn the basic concepts of Discrete continuous distributions
- To learn the test of significance

UNIT – I:

Normal distribution – derivation of normal from binomial – chief characteristics – M.G.F & C.G.F of normal distributions – Moments of normal distributions – area property – fitting of normal distributions.

UNIT – II:

Continuous distributions – Rectangular, Gamma, Beta, exponential – distributions - sampling distributions, 't' , 'F' and Chi-square distributions.

UNIT – III:

Correlation – Rank correlation, Karl Pearson's correlation co-efficient and its properties. Linear regression and its properties, concept of multiple and partial correlation for three variables only.

UNIT – IV:

Test of significance – Definition of null hypothesis, alternative hypothesis, sampling distribution, standard error and critical region. Type I and Type II errors, one tailed and two tailed tests. Large sample test for single mean, Difference between means, single proportion and difference between proportions.

UNIT – V:

Small sample tests – 't' test for single mean. Difference between means. Paired 't' test, Chi- square test for goodness of fit and independence of attributes.

UNIT – VI CURRENT CONTOURS (For Continuous Internal Assessment Only):

An introduction to Data science.

REFERENCES:

1. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2. R.S.N. Pillai and Bagavathi, Practical statistics, Second edition (2013).
3. S.P. Gupta, Statistical Methods (Revised edition 2001).

COURSE OUTCOME:

After completing this course, the students will be able to

- Understand the meaning of correlation, regression and its properties.
- Apply the concepts of t, F, z distributions and its applications.
- Apply the concepts of sampling techniques and procedure of testing of hypothesis for large samples.

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BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI - 620 024.

ALLIED MATHEMATICS for

B.Sc. Data Science Programmes

(Applicable to the candidates admitted from the academic year 2022-23 onwards)

ALLIED COURSE I
MATHEMATICS I

Code: **(Theory)** **Credit: 4**

COURSE OBJECTIVES:

- To demonstrate basic mathematical concepts in data science, relating to calculus.
- To understand the concept of vector Space and its operations.
- To explain matrix operations to transform and decompose data

UNIT – I:

LIMITS AND CONTINUITY: Function of single variable – Definition, limit, continuity, piecewise continuity, periodic, differentiable, absolutely integrable, fundamental theorem of Calculus.

UNIT – II:

SEQUENCES AND SERIES: Infinite Sequences – convergence, divergence, limit, Sandwich theorem, continuous function theorem, increasing, decreasing, bounded, function limit properties – Infinite Series – convergence and divergence – Integral test, comparison test, ratio test, root test. Alternating series - alternating series test, absolute and conditional convergence – power series, Taylor series and Maclaurin series.

UNIT - III:

FUNCTIONS OF TWO VARIABLES: Models, partial derivative and its geometrical interpretation. Stationary points – maxima, minima and saddles. Taylor series about a point. Constrained maxima and minima – Lagrange multipliers method.

UNIT - IV:

ORDINARY DIFFERENTIAL EQUATIONS: Linear Differential Equations of first order - Exact differential equations, Integrating factors, Bernoulli equations - Linear Differential Equations of higher order with constant coefficients - Euler's equation with variable coefficients - Simultaneous equations - Method of variation of parameters. Modeling simple systems.

UNIT -V:

L_pDistances and their Relatives- Mahala Nobis Distance-Cosine and Angular Distance-Jaccard Distance-Edit Distance-Angular distance-Euclidean distance-Bag of words Vectors-k grams-Normed similarities-set similarities.

Unit VI: Current Contours (for Continuous Internal Assessment Only):

Contemporary Developments Related to the Course during the Semester Concerned.

REFERENCES:

1. Hass M. D. J., Giordano Weir F.R., "Thomas Calculus", Pearson Education, 2013.(Unit 1 : Chapter 1, Unit 2 : Chapter 10, Unit III: Chapter14, Unit IV: Chapter 9)
2. Jeff M. Phillips, "Mathematical Foundations for Data Analysis", December 2018. (Unit V: Chapter 4.1 - 4.5)
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2011.
4. Lian, Hungerford, and Holcomb "Mathematics with Applications", Addison Wesley, 2010.
5. Riley K. F., Hobson M. P. and Bence S. J., "Mathematical Methods for Physics and Engineering", Cambridge University Press, 2006.
6. Michael D. Greenberg, "Advanced Engineering Mathematics", Pearson Education, 2014.
7. https://towardsdatascience.com/4-mathematical-numbers-and-set-concept-for-data-scientist-b3587611070f
8. https://www.cs.utah.edu/~jeffp/M4D/M4D-v0.4.pdf

Course Outcomes:

Upon successful completion of this course the students would be able to:

- Describe the fundamentals of basic mathematics
- Identify and apply the concepts of
- Apply data analytics for real world problems
- Explore machine learning
- Implement

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ALLIED PRACTICAL
DATA ANALYTICS USING SPREAD SHEETS

Code: **(Practical)** **Credit: 2**

COURSE OBJECTIVES:

- To Impart Practical Training in Spread Sheets
- To demonstrate descriptive statistics using spread sheets
- To describe data analysis toolpak in spread sheet.

1. Demonstrate the usage of the following built-in-functions in spreadsheet.
   MAX, SUM, AVERAGE, CONCATENATE, LEN, LOWER, UPPER and TRIM
2. Demonstrate the usage of the following logical functions in spreadsheet.
   AND, OR, NOT, IF and IFERROR
3. Demonstrate the usage of the following built-in-functions in spreadsheet.
   SUMIFS, AVERAGEIFS, COUNTIFS, COUNTA,
4. Demonstrate any 10 math and trigonometric functions in spreadsheet.
5. Create and demonstrate the usage of a pivot table in spreadsheet.
6. Display the transpose of a given matrix using spreadsheet.
7. Add the Data Analysis Toolpak in the spreadsheet.
8. Demonstrate the descriptive statistics in spreadsheet.
9. Find the Correlation between two variables in spreadsheet.
10. Preform Regression analysis in spreadsheet.
11. Demonstrate the usage of the following Data Analysis built-in-functions in spreadsheet.
    VLOOKUP, HLOOKUP, FIND, SEARCH, LEFT, RIGHT, RANK
12. Demonstrate the usage of Data Cleaning – Text Functions in spread sheet
    DATA CLEANING USING TEXT TO COLUMN
    CONDITIONAL FORMATTING
13. Perform SORTING with single and multiple columns in spread sheet.
14. Demonstrate the usage of FILTERING in spread sheet
15. Construct various Line, Bar and Pie charts in spread sheet.
16. Construct Scatterplots for the data in spread sheet.
17. Generate a Histogram for the data in spreadsheet
18. Implement Student's T-test in spreadsheet.
19. Demonstrate the usage of what-if Analysis in spreadsheet.
20. Implement table group in insert tab to analyze data in spread sheet

Course Outcomes:

Upon successful completion of this course the students would be able to:

1. Relate the use of spread sheets to solve simple problems
2. Analyze various concepts in spread sheet
3. Understand the concept of correlation between two variable
4. Understand the usage of regression analysis in spread sheet
5. Solve problems related to pivot table

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COURSE II
MATHEMATICS II

Code: **(Theory)** **Credit: 2**

COURSE OBJECTIVES:

- To demonstrate basic mathematical concepts in data science, relating to algebra, and calculus.
- To understand the concept of vector Space and its operations.
- To explain matrix operations to transform and decompose data

UNIT – I:

SYSTEM OF LINEAR EQUATIONS AND MATRICES: System of linear equations, Gauss – elimination, Elementary matrices and a method for finding inverse of a matrix.

UNIT – II:

VECTOR SPACES: Introduction to vector spaces – Addition and Multiplication- properties of vector spaces; Linear dependence; Linear independence – rank/dimension for vector space using gaussian elimination.

UNIT - III:

INNER PRODUCT SAPCES: Inner product, Length, angle and orthogonality – Orthogonal sets – Orthogonal projections – Inner product spaces – Orthonormal basis: Gram-Schmidt process – QR Decomposition- Best Approximation, Least-squares.

UNIT - IV:

LINEAR TRANSFORMATION: Introduction to linear transformations – General Linear Transformations – Kernel and range – Matrices of general linear transformation- Geometry linear operators-Change of basis.

UNIT - V:

EIGEN VALUES AND EIGEN VECTORS: Introduction to Eigen values- Diagonalizing a matrix- Orthogonal diagonalization-, Applications to differential equations- Positive definite matrices- Similar matrices –Quadratic forms- Quadratic surfaces Singular value decomposition.

Unit VI: Current Contours (for Continuous Internal Assessment Only):

Contemporary Developments Related to the Course during the Semester Concerned.

REFERENCES:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", Wiley, 2011. (Unit I : Chapter 1, Unit III : Chapter 6, Unit V: Chapter 7)
2. Jeff M. Phillips, "Mathematical Foundations for Data Analysis", December 2018 (Unit II: Chapter 3)
3. 1.Gilbert Strang, "Linear Algebra and its Applications", Thomson Learning, 2009.
4. 2. Steven J. Leon, "Linear Algebra with Applications", Prentice Hall, 2006.
5. David C. Lay, "Linear Algebra and its Applications", Pearson Education, 2011.
6. https://www.kdnuggets.com/2018/09/essential-math-data-science.html
7. https://www.cs.utah.edu/~jeffp/M4D/M4D-v0.4.pdf

COURSE OUTCOMES:

Upon successful completion of this course the students would be able to:

- Describe the fundamentals of basic mathematics
- Identify and apply the concepts of linear algebra
- Apply data analytics for real world problems
- Implement mathematical concepts in data science
- Implement linear transformation.

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