**Under- Graduate Programme
in Mathematics**

**Courses of Study, Schemes of Examinations
& Syllabi
(Choice Based Credit System)**

**DEPARTMENT OF MATHEMATICS
(DST – FIST sponsored)**

**BISHOP HEBER COLLEGE (Autonomous)
(Reaccredited with 'A' Grade (CGPA – 3.58/4.0) by the NAAC &
Identified as College of Excellence by the UGC)
DST – FIST Sponsored &
DBT Sponsored
TIRUCHIRAPPALLI – 620 017
TAMIL NADU, INDIA**

2023 – 2024

Eligibility:

A pass in Higher Secondary Examination /Junior College with a first class in both Mathematics and Physics.

Structure of the Curriculum

Parts of the Curriculum	No. of Courses	Credits	Hours
Part – I : Language	4	12	24
Part – II : English	4	12	24
Part – III			
Major			
Core	14	58	68
Elective	4	12	19
Project	1	4	4
Allied			
Allied (Physics)	2	10	12
Allied (Statistics)	2	8	8
Part – IV			
SEC	7	13	11
PCS	1	2	4
VLO	1	2	2
Env. Studies	1	2	2
Part – V			
Foundation Course	1	2	2
Extension Activities	1	1	-
Summer Internship	1	2	-
Total	**44**	**140**	**180**

List of Core Courses

1. Algebra & Trigonometry
2. Differential Calculus
3. Analytical Geometry (Two and Three Dimensions)
4. Integral Calculus
5. Vector Calculus and Applications
6. Differential Equations and Applications
7. Industrial Statistics
8. Elements of Mathematical Analysis
9. Abstract Algebra
10. Real Analysis
11. Mathematical Modelling
12. Linear Algebra
13. Complex Analysis
14. Mechanics

List of Elective Courses

1. Optimization Techniques
2. Discrete Mathematics
3. Graph Theory and Applications
4. Numerical Methods with Applications

List of Skill Enhanced Courses (SEC)

1. Mathematics for Competitive Examinations
2. Statistics with R Programming
3. Introduction to Scientific Computing (OCTAVE)
4. Data Analysis using GeoGebra
5. Programming in C (Linux OS)
6. Life Skills
7. Applicable Mathematics for Society

List of Professional Competency Skill (PCS)

1. Quantitative Aptitude and Reasoning

Extra Credit Courses

1. Theory of Equations and Fourier Series
2. Elementary Number Theory
3. Data Structures and Algorithms
4. Transformation Techniques (Laplace, Fourier)

B. Sc. Mathematics – Curriculum Structure
(For the Students Admitted from the Year 2023 onwards)

Sem.	Part	Course	Course Code	Course Title	Hrs. / Week	Credits	CIA	ESA	Total
I	I	Tamil I /*	U23TM1L1	பொதுத்தமிழ் - I	6	3	25	75	100
	II	English I	U23EG1L1	General English - I	6	3	25	75	100
	III	Core I	U23MA101	Algebra &Trigonometry	4	4	25	75	100
		Core II	U23MA102	Differential Calculus	4	4	25	75	100
		Allied I	U23PH1Y1	Allied Physics I	3	3	25	75	100
		Allied Practical I	U23PHPY1	Allied Physics Practical I	3	2	40	60	100
	IV	SEC I	U23MA1E1	Mathematics for Competitive Examinations	2	2	25	75	100
		Foundation Course	U23MA1N1	Bridge Mathematics	2	2	-	-	100
					30	**23**			
II	I	Tamil II /*	U23TM2L2	பொதுத்தமிழ் – II	6	3	25	75	100
	II	English II	U23EG2L2	General English – II	6	3	25	75	100
	III	Core III	U23MA203	Analytical Geometry (Two & Three Dimensions)	4	4	25	75	100
		Core IV	U23MA204	Integral Calculus	4	4	25	75	100
		Allied II	U23PH1Y2	Allied Physics II	3	3	25	75	100
		Allied Practical II	U23PHPY2	Allied Physics Practical II	3	2	40	60	100
	IV	SEC II	U23MAPE2	Statistics with R Programming	2	2	40	60	100
		SEC III	U23MAPS3	Introduction to Scientific Computing (OCTAVE)	2	2	40	60	100
					30	**23**			
III	I	Tamil III/*	U23TM3L3	பொதுத்தமிழ் – III	6	3	25	75	100
	II	English III	U23EG3L3	General English – III	6	3	25	75	100
	III	Core V	U23MA305	Vector Calculus and Applications	5	5	25	75	100
		Core VI	U23MA306	Differential Equations and Applications	5	4	25	75	100
		Allied III	U23MA3Y3	Mathematical Statistics	4	4	25	75	100
	IV	SEC IV	U23MA3S4	Data Analysis using GeoGebra	1	1	-	-	100
		SEC V	U23MAPS5	Programming in C (Linux OS)	2	2	40	60	100
		EVS I	U23EST41	Environmental Studies	1	-			
					30	**22**			

Sem.	Part	Course	Course Code	Course Title	Hrs./ week	Credits	CIA	ESA	Total
							Marks		
IV	I	Tamil IV /*	U23TM4L4	பொதுத்தமிழ் – IV	6	3	25	75	100
	II	English IV	U23EG4L4	General English – IV	6	3	25	75	100
	III	Core VII	U23MA407	Industrial Statistics	4	4	25	75	100
		Core VIII	U23MA408	Elements of Mathematical Analysis	5	5	25	75	100
		Allied IV	U23MA4:P	Statistics with R Programming	4	4	40	60	100
	IV	SEC VI	U23MAPS6	Life Skills	2	2	40	60	100
		SEC VII	U23MA4S7	Service Learning - Applicable Mathematics for Society	2	2	40	60	100
		EVS II	U23EST41	Environmental Studies	1	2	25	75	100
					30	**25**			
V	III	Core IX	U23MA509	Abstract Algebra	5	4	25	75	100
		Core X	U23MA510	Real Analysis	5	4	25	75	100
		Core XI	U23MA511	Mathematical Modelling	5	4	25	75	100
		Core Project	U23MA5PJ	Project with Viva Voce	4	4	40	60	100
		Elective I	U23MA5:A	Optimization Techniques	5	3	25	75	100
		Elective II	U23MA5:B	Discrete Mathematics	4	3	25	75	100
	IV	VLO	U23VLO51 \ U23VLO52	Value Education (RI / MI)	2	2	25	75	100
		Internship /Industrial Training	U23MA5I1	Carried out in II Year Summer Vacation (30 Hours)	-	2			
					30	**26**			
VI	III	Core XII	U23MA612	Linear Algebra	6	4	25	75	100
		Core XIII	U23MA613	Complex Analysis	5	4	25	75	100
		Core XIV	U23MA614	Mechanics	5	4	25	75	100
		Elective III	U23MA6:A	Graph Theory and Applications	5	3	25	75	100
		Elective IV	U23MA6:B	Numerical Methods with Applications	5	3	25	75	100
	IV	PCS	U23MA6G1	Quantitative Aptitude and Reasoning	4	2	25	75	100
		Extension Activity	U23ETA61	Outside College Hours	-	1			
					30	**21**			

Total Credits : 140

* Other Languages	Hindi	Sanskrit	French		Hindi	Sanskrit	French
Semester I				Semester III			
Semester II				Semester IV			

UG – Non-Major Elective Courses (NMEC)

Sem.	Course	Code	Title	Hr. / Week	Credits	CIA	ESA	Total
I	NMEC I	U23MA1E1	Mathematics for Competitive Examinations	2	2	25	75	100
II	NMEC II	U23MAPE2	Statistics with R Programming	2	2	40	60	100

SEC- Skill Enhancement Course   **NMEC-** Non-Major Elective Course

VLO- Value added Life Oriented Course   **PCS –** Professional Competency Skill

CIA- Continuous Internal Assessment   **ESA-** End Semester Assessment

Core Course I – Algebra & Trigonometry

Semester: I   **Code: U23MA101**

Hrs. / Week: 4   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Basic ideas on the Theory of Equations, Matrices and Number Theory.
2. Knowledge to find expansions of trigonometry functions, solve theoretical and applied problems.

Course Outline:

Unit-I:

Reciprocal Equations – Standard form – Increasing or decreasing the roots of a given equations – Removal of terms, Approximate solutions of roots of polynomials by Horner's method – related problems.

Unit-II: Summation of Series:

Binomial – Exponential – Logarithmic series (Theorems without proof) – Approximations – related problems.

Unit-III:

Characteristic equation – Eigen values and Eigen Vectors – Similar matrices – Cayley-Hamilton Theorem (Statement only) – Finding powers of square matrix, Inverse of a square matrix up tp order 3, Diagonalization of square matrices – related problems.

Unit-IV:

Expansions of $\sin n\theta$, $\cos n\theta$ in powers of $\sin\theta$, $\cos\theta$ – Expansion of $\tan n\theta$ in terms of $\tan\theta$, Expansions of $\cos^n\theta$, $\sin^n\theta$, $\cos^m\theta\sin^n\theta$- Expansions of $\tan(\theta_1 + \theta_2 +, \dots, +\theta_n)$ – Expansions of $\sin\theta$, $\cos\theta$ and $\tan\theta$ in terms of θ – related problems.

Unit-V:

Hyperbolic functions – Relation between circular and hyperbolic functions Inverse hyperbolic function, Logarithm of complex quantities, Summation of trigonometric series – related problems.

Text Books:

1. T. K. Manicavachagam Pillay, T. Natarajan, K. S. Ganapathy, Algebra, Volume I, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Reprint 2008 (Unit I & Unit II)
2. T. K. Manickavasagam Pillay, T. Natarajan and K. S. Ganapathy, Algebra Volume II, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Reprint 2006 (Unit III).
3. S. Narayanan, T. K. Manicavachagam Pillay, Trigonometry, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Reprint 2009 (Unit IV & Unit V)

        Unit I   Chapter 6 § 16, 16.1, 16.2, 17, 19, 30
        Unit II   Chapter 3 § 5 - 10, 14; Chapter 4 § 2 - 6

        Unit III   Chapter 2 § 16, 16.1- 16.5; Chapter 3 § 1- 5

Unit IV   Chapter 3 § 1- 5
Unit V   Chapter 4 § 1, 2, 2.1 - 2.3; Chapter 5 § 5, 5.1, 5.2; Chapter 6 § 1, 2

References:

1. W. S. Burnstine and A. W. Panton, Theory of equations
2. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
3. G. B. Thomas and R. L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
4. J. Stewart, L. Redlin, and S. Watson, Algebra and Trigonometry, Cengage Learning, 2012.
5. Calculus and Analytical Geometry, G. B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010.

Website and e-Learning Source:

https://nptel.ac.in

Core Course II – Differential Calculus

Semester: I   **Code: U23MA102**

Hrs. / Week: 4   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. The basic skills of differentiation, successive differentiation, and their applications.
2. Basic knowledge on the notions of curvature, evolutes, involutes and polar co-ordinates and in solving related problems.

Course Outline:

Unit-I: Successive Differentiation:

Introduction (Review of basic concepts) – The nth derivative – Standard results – Fractional expressions – Trigonometrical transformation – Formation of equations involving derivatives – Leibnitz formula for the nth derivative of a product.

Unit-II: Partial Differentiation:

Partial derivatives – Successive partial derivatives – Function of a function rule – Total differential coefficient – A special case – Implicit Functions.

Unit-III: Partial Differentiation (Continued):

Homogeneous functions – Partial derivatives of a function of two variables – Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.

Unit-IV: Envelope:

Method of finding the envelope – Another definition of envelope – Envelope of family of curves which are quadratic in the parameter.

Unit-V: Curvature:

Definition of Curvature – Circle, Radius and Centre of Curvature – Evolutes and Involutes – Radius of Curvature in Polar Co-ordinates.

Text Books:

S. Narayanan and T. K. Manickavasagam Pillay, Calculus Volume – I, S. Viswanathan (Printers and Publishers) Pvt. Ltd.

Unit-I:	Chapter III – 1.1-1.6, 2.1,2.2
Unit-II:	Chapter VIII – 1.1 – 1.5
Unit-III:	Chapter VIII – 1.6, 1.7, 4, 4.1, 5
Unit-IV:	Chapter X – 1.1-1.4
Unit-V:	Chapter X – 2.1-2.6

References:

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2010.
3. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
4. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.
5. T. Apostol, Calculus, Volumes I and II.
6. S. Goldberg, Calculus and mathematical analysis.

Website and e-Learning Source:

https://nptel.ac.in

Foundation Course - Bridge Mathematics

Semester : I   **Code : U23MA1N1**

Hrs. / Week :   2   **Credits : 2**

Pre-requisite : 12th Standard Mathematics

Objectives of the Course:

1. To bridge the gap and facilitate transition from higher secondary to tertiary education.
2. To instil confidence among stakeholders and inculcate interest for Mathematics.

Course Outline :

Algebra:

UNIT-I:

Binomial theorem, General term, middle term, problems based on these concepts.

Unit II:

Sequences and series (Progressions). Fundamental principle of counting. Factorial n.

Unit III:

Permutations and combinations, Derivation of formulae and their connections, simple applications, combinations with repetitions, arrangements within groups, formation of groups.

Trigonometry:

Unit IV:

Introduction to trigonometric ratios, proof of sin(A+B), cos(A+B), tan(A+B) formulae, multiple and sub multiple angles, sin(2A), cos(2A), tan(2A) etc., transformations sum into product and product into sum formulae, inverse trigonometric functions, sine rule and cosine rule

Unit V:

Calculus: Limits, standard formulae and problems, differentiation, first principle, uv rule, u/v rule, methods of differentiation, application of derivatives, integration - product rule and substitution method.

Text Books:

1. NCERT class XI and XII text books.
2. Any State Board Mathematics text books of class XI and XII

Website and e-Learning Source:

https://nptel.ac.in

Core Course III – Analytical Geometry (Two & Three Dimensions)

Semester: II   **Code: U23MA203**

Hrs. / Week: 4   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Necessary skills to analyze characteristics and properties of two- and three-dimensional geometric shapes.
2. To present mathematical arguments about geometric relationships.
3. To solve real world problems on geometry and its applications.

Course Outline:

Unit-I:

Pole, Polar - conjugate points and conjugate lines – diameters – conjugate semi diameters of an ellipse - conjugate diameters of hyperbola.

Unit-II:

Polar coordinates: General polar equation of straight line – Polar equation of a circle given a diameter, Equation of a straight line, circle, conic – Equation of chord, tangent, normal. Equations of the asymptotes of a hyperbola.

Unit-III:

General equation of a plane – several forms of equations of plane – Angle between planes – plane passing through the line of intersection of two planes – length of perpendicular – the plane bisecting angle between the planes.

Unit-IV:

Representation of line–angle between a line and a plane – co – planar lines–shortest distance between two skew lines –length of the perpendicular–intersection of three planes.

Unit-V:

Equation of a sphere-general equation-section of a sphere by a plane-equation of the circle- tangent plane- angle of intersection of two spheres.

Text Books:

1. P. Duraipandian, Laxmi Duraipandian, D. Muhilan, Analytical Geometry 2- Dimensional, Emerald publishers. (Unit I & II)
2. T. K. Manicavachagom Pillay, T. Natarajan, A Text book of Analytical Geometry (Part -II Three Dimensions), S. Viswanathan (Printers and Publishers) Pvt. Ltd., (Unit III, IV & V)

Unit I	Chapter 6 § 6.9, 6.10, 6.13
	Chapter 7 § 7.3, 7.4.
Unit II	Chapter: 9 § 9.1 – 9.8.
Unit III	Chapter II § 1 - 11.
Unit IV	Chapter III § 1 - 8, 10
Unit V	Chapter IV § 1 - 8

References:

1. S. L. Loney, Co-ordinate Geometry.
2. Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010.
3. Robert C. Yates, Analytic Geometry with Calculus, Prentice Hall, Inc., New York, 1961.
4. Earl W. Swokowski and Jeffery A. Cole, Algebra and Trigonometry with Analytic Geometry, Twelfth Edition, Brooks/Cole, Cengage Learning, CA, USA, 2010.
5. William H. McCrea, Analytical Geometry of Three Dimensions, Dover Publications, Inc, New York, 2006.
6. S. G. Venkatachalapathy, Analytical Geometry (2 Dimensions & 3 Dimensions), Margham Publications, 2013.

Website and e-Learning Source

https://nptel.ac.in

Core Course IV – Integral Calculus

Semester: II   **Code: U23MA204**

Hrs. / Week: 4   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Knowledge on integration and its geometrical applications, double, triple integrals and improper integrals.
2. Knowledge about Beta and Gamma functions and their applications.
3. Skills to Determine Fourier series expansions.

Course Outline:
Unit-I:

Reduction formulae -Types, integration of product of powers of algebraic and trigonometric functions, integration of product of powers of algebraic and logarithmic functions - Bernoulli's formula.

Unit-II:

Multiple Integrals - Definition of double integrals - Evaluation of double integrals – Change of order of integration - Double integrals in polar coordinates.

Unit-III:

Triple integrals –applications of multiple integrals - volumes of solids of revolution - areas of curved surfaces–change of variables - Jacobian.

Unit-IV:

Beta and Gamma functions – infinite integral - definitions–recurrence formula of Gamma functions – properties of Beta and Gamma functions- relation between Beta and Gamma functions - Applications.

Unit-V:

Definition of Fourier series – Finding Fourier series expansion of a periodic function with period 2π - Odd and Even functions - Half range Fourier Series.

Text Books:

1. S. Narayanan and T. K. Manickavasagam Pillay, Calculus Volume – II, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Reprint 2019. (Units I - IV).
2. T. K. Manickavasagam Pillay, S. Narayanan, Calculus Volume III, S. Viswanathan Pvt. Ltd., 2008 (Units V).

Unit I	Chapter 1	§ 13.2 – 13.10, 15.1
Unit II	Chapter 5	§ 2.1 – 2.2, 3.1 – 3.2
Unit III	Chapter 5	§ 4, 5.1 – 5.4, 6.1, 7
	Chapter 6	§ 1.1 – 1.2
Unit IV	Chapter 7	§ 1.1 – 1.4, 2.1 – 2.3, 3, 4, 6
Unit V	Chapter 6	§ 1 to 4, 5.1, 5.2

References

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
3. D. Chatterjee, Integral Calculus and Differential Equations, Tata-McGraw Hill Publishing Company Ltd.
4. P. Dyke, An Introduction to Laplace Transforms and Fourier Series, Springer Undergraduate Mathematics Series, 2001 (second edition).

Website and e-Learning Source

https://nptel.ac.in

Core Course V – Vector Calculus and Applications

Semester: III   **Code: U23MA305**

Hrs. / Week: 5   **Credits: 5**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Knowledge about differentiation of vectors and on differential operators. Knowledge about derivatives of vector functions.
2. Skills in evaluating line, surface and volume integrals.
3. The ability to analyze the physical applications of derivatives of vectors.

Course Outline:

Unit I

Vector and Scalar point function – Derivative of a vector and derivative of a sum of vectors – Derivative of a product of a scalar and a vector point function – Derivative of a scalar product and vector product - The vector operator 'del', the gradient of a scalar point function.

Unit II

Divergence of a vector– Curl of a vector point function – Solenoidal and Irrotational vector - simple applications.

Unit III

Laplacian operator, Vector Identities - Examples - Line Integral - Application of line integral-Theorems on Line integrals.

Unit IV

Surface Integrals and Volume Integrals – Applications.

Unit V

Gauss divergence Theorem, Stoke's Theorem, Green's Theorem in two dimensions (only statement) – Verification of the theorems - Applications to real life situations.

Text Book(s):

1. P.R. Vittal, V. Malini, Vector Calculus, Fourier Series and Fourier Transforms, Margham Publications, Chennai, Reprint 2016.
   Unit I : Chapter 1: 1 – 22
   Unit II : Chapter 1: 22 – 35 (omit physical interpretation of Divergence and curl)
   Unit III : Chapter 2: 35 - 53, 59 - 75
   Unit IV : Chapter 2: 75 – 89
   Unit V: Chapter 2: 89 – 142 (omit proof of theorems and deductions)

Reference Book(s):

1. J.C. Susan, Vector Calculus, (4th Edn.) Pearson Education, Boston, 2012.
2. A. Gorguis, Vector Calculus for College Students, Xilbius Corporation, 2014.
3. J.E. Marsden and A. Tromba, Vector Calculus, (5thedn.) W.H. Freeman, New York, 1988.

Website and e-Learning Source

https://nptel.ac.in

Core Course VI – Differential Equations and Applications

Semester: III   **Code: U23MA306**

Hrs. / Week: 5   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Knowledge about the methods of solving Ordinary and Partial Differential Equations.
2. The understanding of how Differential Equations can be used as a powerful tool in solving problems in science.

Course Outline:

Unit-I:

Ordinary Differential Equations: Variable separable - Homogeneous Equation-Non-Homogeneous Equations of first degree in two variables -Linear Equation - Bernoulli's Equation-Exact differential equations.

Unit-II:

Equation of first order but not of higher degree: Equation solvable for dy/dx- Equation solvable for y-Equation solvable for x- Clairaut's form - Linear Equations with constant coefficients-Particular integrals of algebraic, exponential, trigonometric functions and their products.

Unit-III:

Simultaneous linear differential equations- Linear Equations of the Second Order -Complete solution in terms of a known integrals-Reduction to the Normal form-Change of the Independent Variable-Method of Variation of Parameters.

Unit-IV:

Partial differential equation: Formation of PDE by Eliminating arbitrary constants and arbitrary functions – complete integral – singular integral-General integral-Lagrange's Linear Equations – Simple Applications.

Unit-V:

Special methods – Standard forms-Charpit's Methods – Simple Applications.

Text Book:

S.Narayanan & T.K.Manickavachagam Pillay, Differential Equations and its Applications, S.Viswanathan (Printers and Publishers) Pvt. Ltd., 2015.

Unit I	Chapter II	§ 1, 2, 3, 4, 5, 6.1, 6.2, 6.3
Unit II	Chapter IV	§ 1, 2, 2.1, 2.2, 3.1
	Chapter V	§ 1, 2, 3, 4, 4.1, 4.2
Unit III	Chapter VI	§ 6
	Chapter VIII	§ 1, 1.1, 2, 3, 4
Unit IV	Chapter X II	§ 2, 3, 3.1, 3.2, 4
Unit V	Chapter X II	§ 5, 5.1 ,5.2 ,5.3 ,5.4, 6, 6.1

References:

1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
2. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967.
3. G.F. Simmons, Differential equations with applications and historical notes, 2ndEd, Tata Mcgraw Hill Publications, 1991.
4. H.T. H. Piaggio, Elementary Treaties on Differential Equations and their applications, C.B.S Publisher & Distributors, Delhi,1985.
5. Braun, M. Differential Equations and their Applications. (3rd Edn.), Springer- Verlag, New York. 1983.
6. Tyn Myint-U and Lognath Debnath. Linear Partial Differential Equations for Scientists and Engineers. (4th Edn.) Birhauser, Berlin. 2007.

Website and e-Learning Source:

https://nptel.ac.in

Allied III – Mathematical Statistics

Semester: III   **Code: U23MA3Y3**

Hrs. / Week: 4   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

On completion of this course, the learner will

1. Know methods of calculation of measures of central tendency and measures dispersion of a data.
2. Know methods of finding correlation and regression co-efficient between two data sets and their applications.
3. Know the properties of some discrete and continuous distributions.
4. know continuous discrete random variables, their probability functions and distribution functions.

Course Outline:

Unit-I: Measure of Central Tendency

Measures of central tendency – Arithmetic mean - Median – Mode – Geometric mean – Harmonic mean –Measures of dispersion - Range – Quartile deviation – Mean deviation – Standard deviation and root mean square deviation – coefficient of dispersion – Skewness - Kurtosis.

Unit-II: Baye's Theorem

Probability – Mathematical Notion – law of multiplication – Baye's theorem – random variable – distribution function – discrete random variable – continuous random variable.

Unit-III: Probability Mass Function and Mathematical Expectation

Joint probability mass function and marginal and conditional probability function – joint probability distribution function – joint density function – marginal density function – independent random variables – The conditional distribution function and conditional probability density function – mathematical expectation – addition and multiplication theorem of expectation – covariance.

Unit-IV: Moment Generating Function

Expectation of a continuous random variable – conditional expectation and conditional variance – moment generating function – cumulants – characteristic function.

Unit-V: Bivariate Frequency Distribution

Bi-variate distribution, correlation – scatter diagram – Karl Pearson coefficient of correlation – calculation of the correlation coefficient for a bivariate frequency distribution – rank correlation – regression – lines of regression.

Text Book:
1. S.C. Gupta, V.K. Kapoor, Elements of Mathematical Statistics, Sultan Chand & sons, Educational Publishers, New Delhi, 3rd Edition, Reprint 2008.

       Unit I   Chapter 2 § 2.3, 2.5-2.9

                      Chapter 3 § 3.3-3.6, 3.7, 3.7.1, 3.7.2, 3.8, 3.11, 3.12

Unit II	Chapter 4 § 4.6, 4.7, 4.8
	Chapter 5 § 5.1, 5.2, 5.3, 5.4
Unit III	Chapter 5 § 5.5.1, 5.5.2, 5.5.3, 5.5.4, 5.5.5
	Chapter 6 § 6.1, 6.2, 6.3, 6.4
Unit IV	Chapter 6 § 6.7, 6.8, 6.9, 6.10, 6.11
Unit V	Chapter 10 § 10.1, 10.2, 10.3, 10.4, 10.6, 10.7, 10.7.1

References:

1. A.M. Mood, F.A. Faybill, and O.C. Bosses, Introduction to Theory of Statistics, McGraw hill, 1974.
2. Rahatgi, U.K., An introduction to probability theory and Mathematical statistics, Wiley Eastern, 1984.

Website and e-Learning Source:

- https://archive.nptel.ac.in/courses/111/105/111105090/
- https://archive.nptel.ac.in/courses/111/106/111106112/

Core Course VII – Industrial Statistics

Semester: IV   **Code: U23MA407**

Hrs. / Week: 4   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. To bridge the gap between industry academia interface – to apply the theory learnt to industrial applications.

Course Outline:

Unit I: Discrete distributions

Bernoulli distribution – Binomial distribution – Poisson distribution.

Unit II: Continuous Distribution

Rectangular distribution - Normal distribution - Gamma distribution.

Unit III: Sampling, Parameter and Statistic

Sampling introduction – types of sampling – parameters and statistic - Introduction to theory of estimation–characteristics of estimators – method of estimation – Rao-Cramer inequality.

Unit IV: Test of Hypothesis

Tests of significance – null hypothesis – errors in sampling – critical region and level of significance – tests of significance for large samples – sampling of attributes.

Unit V: Test of Statistics

Chi-square probability curve - Applications of Chi-square distribution – student's 't' test – F-statistic - ANOVA (one way classification)

Text Book:

1. S.C. Gupta, V.K. Kapoor, Elements of Mathematical statistics, Sultan Chand & Sons, Educational Publishers, New Delhi, 3rd Edition, Reprint 2008.

> Unit   I :   Chapter 7   § 7.1,7.1.1, 7.2,(7.2.1,7.2.2,7.2.5(Formula only)
>   7.2.6-7.2.10, 7.3(7.3.1-7.3.8),
> Unit   II: Chapter 8   § 8.1, 8.2.1,8.2.2,8.2.5-8.2.9, 8.2.13,8.2.14
>   Chapter 13 § 13.1 – 13.3
> Unit   III : Chapter 12 § 12.1 – 12.3
>   Chapter 15 § 15.1 and 15.3 -15.4
> Unit   IV :   Chapter 12 § 12.4 – 12.9
> Unit   V :   Chapter 13 § 13.4,13.5
>   Chapter 14 § 14.1 – 14.3
>   Chapter 17 § 17.1,17.2

References

1. A.M. Mood, F.A. Graybill and O.C. Boses, Introduction to Theory of Statistics, McGraw Hill,1974.
2. Rahatgi U.K., An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern,1984.
3. Baisnab A., Jas M., Elements of Probability and Statistics, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 1993.
4. Fruend John E, Mathematical Statistics, Prentice Hall of India, New Delhi.

Website and e-Learning Source:

https://nptel.ac.in

Core Course VIII – Elements of Mathematical Analysis

Semester: IV   **Code: U23MA408**

Hrs. / Week: 5   **Credits: 5**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Identify and characterize sets and functions and understand, test and analyze the convergence and divergence of sequences, series.
2. Understand metric spaces with suitable examples.

Course Outline:

Unit-I:

Sets and Functions: Sets and elements- Operations on sets- functions- real valued functions-equivalence-countability- real numbers- least upper bounds.

Unit-II:

Sequences of Real Numbers: Definition of a sequence and subsequence-limit of a sequence – convergent sequences–divergent sequences- bounded sequences-monotone sequences

Unit-III:

Operations on convergent sequences – operations on divergent sequences – limit superior and limit inferior-Cauchy sequences.

Unit-IV:

Series of Real Numbers: Convergence and divergence – series with non –negative terms-alternating series-conditional convergence and absolute convergence- tests for absolute convergence.

Unit-V:

Limits and Metric Spaces: Limit of a function on a real line - Metric spaces - Limits in metric spaces – Continuous Functions on Metric Spaces: Function continuous at a point on there a line-Function continuous on a metric space.

Text Book(s):

1. Richard R. Goldberg, Methods of Real Analysis: Oxford and IBH Publishing, (1 January 2020).

    Unit I   Chapter 1 §1.1 – 1.7
    Unit II   Chapter 2 §2.1 – 2.6
    Unit III   Chapter 2 §2.7 – 2.10
    Unit IV   Chapter 3 § 3.1 – 3.4 and 3.6
    Unit V   Chapter 4 § 4.1 – 4.3
                    Chapter 5 § 5.1 and 5.3

References:

1. Ethan D. Bloch, The Real Numbers and Real Analysis, Springer, 2011.
2. G.M. The fundamentals of Mathematical Analysis, vol I. Pergamon Press, New York, 1965.
3. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
4. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000.
5. E. Fischer, Intermediate Real Analysis, Springer Verlag, 1983.
6. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

Website and e-Learning Source:

https://nptel.ac.in

Allied IV – Statistics with R Programming

Semester: IV   **Code: U23MA4:P**

Hrs. / Week: 4   **Credits: 4**

Objectives of the Course:

On completion of this course, the learner will
1. be able to apply the software R to derive statistical inferences.
2. know the different commands and packages available in R and their applications in different statistical studies.

List of Experiments:

1. Calculation of measures of central tendency
2. Calculation of measures of dispersion
3. Graphical display of data
4. Analyzing data using tables
5. Expectations of discrete and continuous random variable
6. Binomial, Normal and Poisson Distributions
7. One sample t- test
8. Independent sample t-test
9. Dependent sample t-test
10. Unplanned and planned comparisons
11. Coefficient of variation
12. Calculation of skewness and Kurtosis
13. Calculation of correlation coefficient
14. Bi-variate correlation
15. Partial correlation
16. Rank Correlation
17. Linear regression

References:

1. Mark Gardener, Beginning R – The statistical Programming Language, Wiley Publications, 2015
2. W.John Braun and Duncan J. Murdoch, A First Course in Statistical Programming with R, Cambridge University Press, 2007.

Core Course IX – Abstract Algebra

Semester: V   **Code: U23MA509**

Hrs. / Week: 5   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Concepts of Sets, Groups and Rings.
2. Construction, characteristics and applications of the abstract algebraic structures.

Course Outline:

Unit-I:

Introduction to groups- Subgroups- cyclic groups and properties of cyclic groups- Lagrange's Theorem-A counting principle – Examples.

Unit-II:

Normal subgroups and Quotient group- Homomorphism- Automorphism -Examples.

Unit-III:

Cayley's Theorem-Permutation groups – Examples.

Unit-IV:

Definition and examples of ring- Some special classes of rings- homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings.

Unit-V:

The field of quotients of an integral domain-Euclidean Rings - The particular Euclidean Ring – Examples.

Text Book:

Topics in Algebra – I.N.Herstein, Wiley Eastern Ltd. Second Edition (1st January 2006)

Unit I	Chapter 2 § 2.1 – 2.5	
Unit II	Chapter 2 § 2.6 – 2.8	
Unit III	Chapter 2 § 2.9 – 2.10	
Unit IV	Chapter 3 § 3.1 – 3.5	
Unit V	Chapter 3 § 3.6 – 3.8	

References:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.

Website and e-Learning Source:

https://nptel.ac.in

Core Course X – Real Analysis

Semester: V   **Code: U23MA510**

Hrs. / Week: 5   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Real Numbers and properties of Real–valued functions.
2. Connectedness, Compactness, Completeness of Metric spaces.
3. Convergence of sequences of functions, Examples and counter examples

Course Outline:

Unit-I:

Continuous Functions on Metric Spaces: Open sets– closed sets–Discontinuous function on R1. Connectedness, Completeness and Compactness: More about open sets-Connected sets.

Unit-II:

Bounded sets and totally bounded sets: Complete metric spaces- compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity.

Unit-III:

Calculus: Sets of measure zero, definition of the Riemann integral, existence of the Riemann integral properties of Riemann integral.

Unit-IV:

Derivatives-Rolle's theorem, Law of mean, Fundamental theorems of calculus.

Unit-V:

Taylor's theorem-Point wise convergence of sequences of functions, uniform convergence of sequences of functions.

Text Book:

Methods of Real Analysis-Richard R. Goldberg (John Wiley & sons, 2nd edition) (Indian edition – Oxford and IBH Publishing Co, New Delhi, 1st January 2020)

Unit I	Chapter 5 § 5.1 – 5.6
	Chapter 6 § 6.1 and 6.2
Unit II	Chapter 6 § 6.3 – 6.8
Unit III	Chapter 7 § 7.1 – 7.4
Unit IV	Chapter 7 § 7.5 – 7.8
Unit V	Chapter 8 § 8.5
	Chapter 9 § 9.1 and 9.2

Reference Books:

1. Principles of Mathematical Analysis by Walter Rudin, Tata McGraw Hill Education, Third edition (1 July 2017).
2. Mathematical Analysis Tom M A postal, Narosa Publishing House, 2ndedition (1974), Addison-Wesley publishing company, New Delhi.

Website and e-Learning Source:

https://nptel.ac.in

Core Course XI – Mathematical Modelling

Semester: V

Hrs. / Week: 5

Code: U23MA511

Credits: 4

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Construction and Analysis of Mathematical models found in real life problems.
2. Modelling through differential and difference equations.

Course Outline:

Unit-I:

Mathematical Modelling: Simple situations requiring mathematical modelling, characteristics of mathematical models.

Unit-II:

Mathematical Modelling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.

Unit-III:

Mathematical Modelling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models, Model with removal and model with immigrations. Epidemics: simple epidemic model, Susceptible-infected- susceptible (SIS) model, SIS model with constant number of carriers. Medicine: Model for Diabetes Mellitus.

Unit – IV:

Introduction to difference equations: Some simple models – linear difference equation – complementary function – particular solution – obtaining complementary function by use of matrices – solution of a system of linear homogeneous difference equations with constant coefficients – solution of linear difference equations by using Laplace transform.

Unit-V:

Mathematical Modelling through difference equations: Harrod Model, cob web model application to Actuarial Science, Non-linear difference equations model for Population growth, Age- Structured Population models, Hardy-Weinberg Law.

Text Book:

J. N. Kapur, Mathematical Modeling, New Age International publishers (2009).

Unit I	Chapter 1 § 1.1 – 1.4
Unit II	Chapter 2 § 2.1 – 2.4
Unit III	Chapter 3 § 3.1.1 – 3.1.3, 3.2.1 – 3.2.3, 3.2.5 – 3.2.6 and 3.5.1
Unit IV	Chapter 5 § 5.1, 5.2.1 – 5.2.6
Unit V	Chapter 5 § 5.3.1, 5.3.2 and 5.3.4

References:

1. Mathematical Modeling by Bimalk. Mishra and Dipak K.Satpathi. Ane Books Pvt. Ltd(1 Januuary 2009)
2. Mathematical Modeling Models, Analysis and Applications, by Sandip Banerjee, CRC Press, Taylor & Francis group, 2014
3. Mathematical Modeling applications with Geogebra by Jonas Hall & Thomas Ligefjard, John Wiley & Sons, 2017
4. Mark M. Meerschaert: Mathematical Modeling, Elsevier Publ., 2007.
5. Edward A. Bender: An introduction to mathematical Modeling, CRC Press,2002
6. Walter J. Meyer, Concepts of Mathematical Modeling, Dover Publ., 2000

Website and e-Learning Source:

https://nptel.ac.in

Project with Viva Voce

Elective I – Optimization Techniques

Semester: V   **Code: U23MA5:A**

Hrs. / Week: 5   **Credits: 3**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

On completion of this course, the learner will

1. be able to understand Linear Programming Problems (LPP) and to know methods of solving them.
2. be able to apply LPP to solve transportation and assignment problems.
3. know the basics and the methods of solving network problems.
4. know the basics of inventory models and to solve inventory problems.

Unit I

Introduction - Origin and development of O.R. – Nature and features of O.R. – Scientific method in O.R. – Methodology of Operations Research – Applications of O.R. – Opportunities and shortcomings of O. R. – Formulation of L.P.P. graphical solution; general L.P.P., Canonical and standard forms of L.P.P.

Unit II

Simplex methods to solve LPP (Ordinary Simplex method, Big-M-method, Two-phase-Simplex method) Duality in L.P.P.- Introduction, General primal – Dual pair, formulating a dual problem, Dual simplex method.

Unit III

Introduction – General transportation problem (theorems are not included) – the transportation problem – finding an initial basic feasible solution – Degeneracy in transportation problem – MODI method – Some exceptional cases.

Assignment problem : Introduction – Mathematical formulation of the problem – solution methods of assignment problem – special cases in assignment problem.

Unit IV

Introduction – Network and basic components – Logical sequencing – Rules of network construction – Critical path Analysis – Probability consideration in PERT – Distinction between PERT and CPM.

Unit V

Introduction – The inventory decisions – Costs associated with inventories – Factors affecting inventory control – Economic order quantity – Deterministic inventory problems with no shortages – Deterministic inventory problems with shortages – Probabilistic inventory problems.

Text Book

Kanti Swarup, P.K. Gupta , Manmohan, Operations Research, Sultan chand & sons, fourteenth Edition, 2008.

Unit I	Chapter 1 : 1.1-1.4,1.8,1.10,1.11
	Chapter 2 : 2.1 - 2.4
	Chapter 3 : 3.1 – 3.5
Unit II	Chapter 4 : 4.1,4.3,4.4
	Chapter 5 : 5.1 – 5.3,5.7,5.9
Unit III	Chapter 10 : 10.1,10.2,10.5,10.9,10.12,10.13,10.15
	Chapter 11 : 11.1 – 11.4
Unit IV	Chapter 25 : 25.1 - 25.4,25.6 – 25.8
Unit V	Chapter 19 : 19.1,19.4,19.6,19.7,19.9,19.10,19.11
	Chapter 20 : 20.5 – 20.6

References

1. Hamdy M. Taha, Operations Research, Prentice Hall, New Delhi, 2000.
2. S. D. Sharma, Operations Research, Kedar Nath Ram Nath and Co., India, 1985.

Website and e-Learning Source:

https://nptel.ac.in

Elective II – Discrete Mathematics

Semester: V   **Code: U23MA5:B**

Hrs. / Week: 4   **Credits: 3**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Basic knowledge of applications of Lattices and Boolean algebra in compiling techniques.
2. Basic knowledge of the formal languages in encoding and decoding of messages.

Course Outline:

Unit I: Recurrence and Solutions:

Recurrence relations – Recurrence – An introduction, Polynomials, and their Evaluations - Recurrence Relations – Solution of finite order Homogeneous (linear) relations – Solution of Non-homogeneous Relations. **Relations**

Unit II: Generating Functions and Recursive Functions:

Generating functions – Some common Recurrence Relations – Primitive Recursive functions – Recursive and Partial Recursive functions.

Unit III: Lattices:

Lattices – Some properties of Lattices – New Lattices.

Unit IV: Boolean Algebra:

Modular and Distributive Lattices - Boolean Algebra – Boolean Polynomials.

Unit V: Coding Theory:

Coding theory – Introduction - Hamming distance - Encoding a message – group codes - procedure for generating group codes - decoding and error correction - an example of a single error correcting code.

Text Book:

M. K. Venkatraman., N. Sridharan and N. Chandrasekaran, Discrete Mathematics, The National Publishing Company, September 2007.

Unit I	Chapter 5 § 1 – 5
Unit II	Chapter 5 § 6 – 9
Unit III	Chapter 10 § 1 – 3
Unit IV	Chapter 10 § 4 – 6
Unit V	Chapter 8 § 1 – 7

References:

1. J. P. Trembly and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill book Company, 1997.
2. J. E. Hop Croft and J. D. Willman, Introduction to Automata Theory, Nicosia Publishing House, C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Book Company, 1986.
3. C. L. Liu, Elements of Discrete Mathematics, McGraw Hill Book Company, 1986.

Website and e-Learning Source:

1. NPTEL: Course on Discrete Mathematics by Department of CSE, IIT Ropar
SWAYAM: Course on Discrete Mathematics offered by IIT Ropar, IIT Bhilai

Core Course XIII – Linear Algebra

Semester: VI   **Code: U23MA612**

Hrs. / Week: 6   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Vector Spaces, linear dependence and independence of vectors. Dual spaces, Inner product and norm – orthogonalization process.
2. Linear transformations. Various operators on vector spaces.

Course Outline:

Unit-I:

Vector spaces – Subspaces – Linear Combinations and linear span - Systems of Linear equations – Homogenous Equations – Non-homogenous Equations – Elementary Matrices – Row reduced - Echelon form.

Unit-II:

Linear Dependence and Linear independence – Bases – Dimensions.

Unit-III:

Linear transformations, null spaces and ranges – Matrix representation of a linear transformation – invertibility and isomorphisms – dual spaces.

Unit-IV:

Eigen values, eigen vectors, diagonalizability – invariant subspaces – Cayley– Hamilton theorem.

Unit-V:

Inner products and norms – Gram Schmidt Orthogonalization Process - Orthogonal complements.

Text Book:

Linear Algebra - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5th edition (2018) Pearson.

Unit I	Chapter 1 § 1.2, 1.3, 1.4; Chapter 3 § 3.3, 3.4
Unit II	Chapter 1 § 1.5, 1.6
Unit III	Chapter 2 § 2.1 – 2.4, 2.6
Unit IV	Chapter 5 § 5.1, 5.2, 5.4
Unit V	Chapter 6 § 6.1, 6.2

Reference Books

1. I.N.Herstein, Topics in Algebra, Wiley EasternLtd. Second Edition, 2006.
2. N.S.Gopalakrishnan, University Algebra, New Age International Publications, Wiley Eastern Ltd.
3. John B.Fraleigh, First course in Algebra, Addison Wesley.

4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
5. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
6. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
7. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.

Website and e-Learning Source:

https://nptel.ac.in

Core Course XIII – Complex Analysis

Semester: VI   **Code: U23MA613**

Hrs. / Week: 5   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Apply concept and consequences of analyticity and C-R equations.
2. Understand the concept of mappings and transformations.
3. Compute complex contour integrals and applying Cauchy's integral in various versions.
4. Understand zeros and singularities of an analytic function, apply their properties in the evaluation of definite integral.

Course Outline:

Unit-I: Analytic functions:

Functions of a Complex variable –Limits –Theorem on limits –Continuity – Derivatives – Differentiation formulas – Cauchy Riemann equation – conditions for differentiability – Polar coordinates– Analytic functions– Harmonic functions.

Unit-II: Conformal mapping:

Mappings – Mapping by exponential function – Linear transformation – The transformation w=1/z– Mappings by 1/z – Linear fractional transformations (bilinear).

Unit-III: Complex Integration:

Contour integrals– Some examples – Simply and Multiply connected domains– Cauchy integral formula – Formula for derivatives– Liouville's theorem –Fundamental theorem of Algebra– Maximum modulus principle.

Unit – IV: Sequences and Series:

Convergence of sequences – Convergence of series– Taylor's series – Laurent series– Absolute and uniform convergence of power Series – Continuity of sums of power series–Integration & differentiation of power series.

Unit-V: Residues and Poles:

Residues – Cauchy Residue theorem – Using a single residue – The three types of isolated singular points – Residues at poles – Zeros of analytical functions – Zeros and poles.

Text Book:

Complex variables and application, Seventh Edition by James Ward Brown and Ruel V. Churchill, Mc-Graw Hill Book Co., International Edition, 2009.

Unit I	Chapter 2 § 11, 14, 15, 17 – 23, 25
Unit II	Chapter 2 § 12, 13
	Chapter 8 § 83 - 86
Unit III	Chapter 4 § 39, 40, 46 - 50
Unit IV	Chapter 5 § 51 – 59
Unit V	Chapter 6 § 62 - 69

References:

1. Theodore W. Gamelan, Complex Analysis, Springer Verlag, 2008
2. Joseph Bak and Donald J. Newman, Complex analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.
3. Richard A. Silverman, Introductory Complex Analysis. Dover Publications, 1972.
4. S. Ponnusamy and H. Silverman, Complex variables with applications, Birkhauser, 2006.

Website and e-Learning Source

https://nptel.ac.in

Core Course XIV – Mechanics

Semester: VI   **Code: U23MA614**

Hrs. / Week: 5   **Credits: 4**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:
1. Equilibrium of a particle under the action of given forces.
2. Simple Harmonic Motion
3. Projectiles

Course Outline:

Unit-I:

Force: Newton's laws of motion – Resultant of two forces on a particle - Equilibrium of a Particle: Equilibrium of a particle – Limiting equilibrium of a particle on an inclined plane.

Unit-II:

Forces on a Rigid Body: Moment of a Force – General motion of a body – Equivalent systems of forces- Parallel Forces – Forces acting along a Triangle - A specific reduction of Forces: Reduction of coplanar forces into a force and couple – Problems involving frictional forces.

Unit-III:

Work, Energy and Power: Work – Conservative field of force – Power -Rectilinear Motion under Varying Force: Simple Harmonic Motion - along a horizontal line – along a vertical line.

Unit – IV:

Projectiles: Forces on a projectile – Projectile projected on an inclined plane.

Unit-V:

Central Orbits: General orbits – Central orbit – Conic as a centered orbit.

Text Books:
1. Ruina and R. Pratap, Introduction to Statics and Dynamics, Oxford University Press, 2014.
2. S.L. Loney, The Elements of Statics and Dynamics, Cambridge University Press, 1904.

References:
1. J.L. Meriam and L. G. Kraige, Engineering Mechanics: Statics, Seventh Edition,Wiley and sons Pvt ltd., New York, 2012.
2. J.L. Meriam, L. G. Kraige, and J.N. Bolton, Engineering Mechanics: Dynamics, 8thedn, Wiley and sons Pvt ltd., New York, 2015.
3. K. Dhiman, P.Dhinam and D. Kulshreshtha, Engineering Mechanics (Statics and Dynamics), McGraw Hill Education(India) Private Limited, New Delhi, 2015.

Website and e-Learning Source:
https://nptel.ac.in

Elective III – Graph Theory and Applications

Semester: VI   **Code: U23MA6:A**

Hrs. / Week: 5   **Credits: 3**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. To know the basic concepts of Graph theory.
2. To know the applications of Graphs in other disciplines.

Course Outline:

UNIT I

Definition of a graph, Finite and infinite graphs, Incidence and Degree, Isolated and pendent vertices, Isomorphism, Sub-graphs, Walks, paths and circuits, Connected and disconnected graphs, Components, Euler graphs, Operations on graphs, More on Euler graphs, Hamiltonian paths and circuits.

Unit II

Trees, Properties of trees, Pendent vertices in a tree, Distance and centers in a tree, Rooted and binary trees, Spanning trees, Fundamental circuits, Finding all spanning trees of a graph, Spanning trees in a weighted graph.

Unit III

Cut-sets, Properties of a Cut set, All Cut sets in a graph, Fundamental circuits and Cut-sets, Connectivity and Separability.

Unit IV

Planar graphs, Kuratowski's two graphs, Representation of a planar graph, Detection of planarity, Geometrical dual, Combinatorial dual.

Unit V

Matrix representation of graphs, Incidence matrix, Circuit matrix, Fundamental circuit matrix and rank of the circuit matrix, Cut-set matrix, Adjacency matrix, Chromatic number, Chromatic partitioning, Chromatic polynomial.

Text Book:

1. Narasingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, New Delhi, Fifteenth printing, 2009.

Unit I	Chapter 1: 1.1- 1.5
	Chapter 2: 2.1, 2.2, 2.4 - 2.9
Unit II	Chapter 3: 3.1 - 3.5, 3.7 – 3.10
Unit III	Chapter 4: 4.1- 4.5
Unit IV	Chapter 5: 5.2 - 5.7
Unit V	Chapter 7: 7.1, 7.3, 7.4, 7.6, 7.9
	Chapter 8: 8.1, 8.2, 8.3

References:

1. S. Arumugam, S. Ramachandran, Invitation to Graph Theory, Gamma Publication, Palayamkottai, 1994.
2. F. Harray, Graph Theory, Narosa Publishing House, New Delhi.
3. S. A. Chudum, Graph Theory, Macmillan India Limited, New Delhi

Website and e-Learning Source:

1. https://nptel.ac.in/courses/111/106/111106102/
2. https://youtu.be/E40r8DWgG40

Elective IV – Numerical Methods with Applications

Semester: VI   **Code: U23MA6:B**

Hrs. / Week: 5   **Credits: 3**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. To introduce the various topics in Numerical methods.
2. To apply numerical techniques to solve algebraic and differential equations.
3. To apply numerical techniques to find approximate values for definite integrals.

Course Outline:

Unit I
Introduction to numerical analysis -The solution of algebraic and transcendental equations – Bisection method – Iteration method – Regular Falsi method, Newton-Raphson method.

Unit II
Solution of simultaneous linear algebraic equations – Direct methods – Gauss elimination method – Gauss-Jordan method – Iterative methods – Jacobi method – Gauss-Seidal method.

Unit III
Interpolation for equal intervals – Gregory-Newton interpolation formulae – Interpolation with unequal intervals – Lagrange's interpolation formula – Inverse interpolation.

Unit IV
Numerical differentiation and integration – Newton's formulae to compute the derivative – Numerical integration – A general quadrature formula – Trapezoidal rule - Simpson's one third rule – Simpson's three-eighth rule.

Unit V
Numerical solution of ordinary differential equation – Taylor series method – Euler's method – Runge-Kutta methods – Milne's Predictor corrector methods.

Text Book

P. Kandasamy, K. Thilagavathy, K. Gunavathy, Numerical Methods, S. Chand & Company limited, New Delhi, Reprint 2009.

Unit I	Chapter 3	§ 3.1, 3.1.1, 3.2, 3.2.1, 3.2.2, 3.3, 3.3.1, 3.4, 3.4.1, 3.4.3, 3.4.4
Unit II	Chapter 4	§ 4.1, 4.2, 4.2.1, 4.7, 4.8, 4.9
Unit III	Chapter 6	§ 6.1, 6.2, 6.3
	Chapter 8	§ 8.7, 8.8
Unit IV	Chapter 9	§ 9.1, 9.2, 9.3, 9.7, 9.8, 9.9, 9.10, 9.13, 9.14
Unit V	Chapter 11	§ 11.5, 11.9, 11.12, 11.13, 11.16, 11.17

References

1. Dr Perumal Mariappan, Numerical Methods for Scientific Solutions, New Century Book House, Pvt. Ltd, Chennai.
2. S. S. Sastry, Introducing Methods of Numerical Analysis, Prentice Hall of India Private Limited, New Delhi, 3rd Edition 2002.
3. M. K. Venkataraman, Numerical Methods in Science and Engineering, The National Publishing Company, Chennai, 2004.

Website and e-Learning Source:

https://nptel.ac.in

Skill Enhancement Courses (SEC)

Sem.	Course	Code	Title	Hr. / Week	Credits	Marks		
						CIA	ESA	Total
I	SEC I	U23MA1E1	Mathematics for Competitive Examinations	2	2	25	75	100
II	SEC II	U23MAPE2	Statistics with R Programming	2	2	40	60	100
II	SEC III	U23MAPS3	Introduction to Scientific Computing (OCTAVE)	2	2	40	60	100
III	SEC IV	U23MA3S4	Data Analysis using GeoGebra	1	1	-	-	100
III	SEC V	U23MAPS5	Programming in C (Linux OS)	2	2	40	60	100
IV	SEC VI	U23MAPS6	Life Skills	2	2	-	-	100
IV	SEC VII	U23MA4S7	Applicable Mathematics for Society	2	2	40	60	100

SEC I - Mathematics for Competitive Examinations

Semester: I   **Code: U23MA1E1**

Hrs. / Week: 2   **Credits: 2**

Objectives of the Course:

On completion of this course, the learner will be able to apply arithmetic and logical reasoning in solving brain teasers.

Unit I

Numbers - HCF & LCM – Decimal Fractions – Simplification.

Unit II

Square roots and Cube roots - Percentage – Average – Ratio and Proportion - Partnership.

Unit III

Profit and Loss - Time and Work- Pipes and Cisterns - Time and Distance

Unit IV

Problems on Trains – Problems on Boats and Streams - Problems on Numbers - Problems on ages.

Unit V

Simple interest – Compound interest Area - Volume & Surface Areas.

Text Book:

R.S. Aggarwal, Objective Arithmetic S. Chand and Company Ltd., New Delhi, 2003.

SEC II Statistics with R Programming

Semester: II   **Code: U23MAPE2**

Hrs. / Week: 2   **Credits: 2**

Objectives of the Course:

On completion of this course, the learner will
1. be able to apply the software R to derive statistical inferences.
2. know the different commands and packages available in R and their applications in different statistical studies.

List of Experiments:

1. Calculation of measures of central tendency
2. Calculation of measures of dispersion
3. Graphical display of data
4. Analyzing data using tables
5. Binomial, Normal and Poisson Distributions
6. Coefficient of variation
7. Measures of skewness
8. Calculation of correlation coefficient
9. Rank Correlation
10. Finding Regression lines

References:

1. Mark Gardener, Beginning R – The statistical Programming Language, Wiley Publications, 2015
2. W.John Braun and Duncan J. Murdoch, A First Course in Statistical Programming with R, Cambridge University Press, 2007.

SEC III - Introduction to Scientific Computing (OCTAVE)

Semester: II   **Code: U23MAPS3**

Hrs. / Week: 2   **Credits: 2**

General objective:

On completion of this course, the learner will know how to use OCTAVE as a software package and create customized programmes in computing.

List of Practicals :

1. Matrix manipulations such as multiplication, inverse, determinant, random, magic etc.
2. Solving system of linear equations.
3. To plot 2D and 3D graphs.
4. Solving quadratic equations.
5. Write an OCTAVE program to check the given string is palindrome or not.
6. To find the binomial coefficients nCr
7. Program to generate Fibonacci numbers.
8. Program to solve an algebraic equation using bisection method.
9. Program to solve an algebraic equation using Newton Raphson method.
10. Solving first order Ordinary Differential Equations
11. Solving second order Ordinary Differential Equations

References:

1. Jesper Schmidt Hansen, GNU Octave Beginner's Guide, Packt Publishing, 2011

SEC IV - Data Analysis using GeoGebra

Semester: III   **Code: U23MA3S4**

Hrs. / Week: 1   **Credits: 1**

General objectives:
On completion of this course, the learner will

1. Know the basic concepts of GeoGebra.
2. Learn to use GeoGebra for data analysis.
3. Visualize the mathematical concepts.

List of Practicals:

1. Data analysis using Geogebra
2. Regression analysis
3. Calculation of linear correlation coefficient
4. Graphing Polar equations
5. Derivative Graphing with Geogebra
6. Find the intersection of Two Lines
7. Angle between (i) two planes, (ii) a plane and a line, (iii) two lines
8. Shortest distance between skew lines
9. Creating a Triangular Prism
10. Graphing Spherical coordinates
11. Creating Spheres with an adjustable radius
12. Surface area of Sphere
13. Sphere and Tangent plane
14. Plotting points using cylindrical coordinates

References:

1. https://www.math.utah.edu/~emina/teaching/5270s13/Intro_to_Geogebra.pdf
2. https://wiki.geogebra.org/en/Manual
3. https://www.youtube.com/channel/UC5hJLoPg27unBIMhs5cCgsg

SEC V – Programming in C (Linux OS)

Semester: III   **Code: U23MAPS5**

Hrs. / Week: 2   **Credits: 2**

Objectives of the Course:

On completion of this course, the learner will

2. know basic concepts of computer programming in C.
3. know how to write programmes using C for numerical computing.

List of Practicals

Unit I
Introduction to C programming in Linux Operating system.

Unit II
Solving Algebraic equation, by using Bisection and Newton-Raphson Method.

Unit III
Numerical Integration by using Trapezoidal and Simpson's method.

Unit IV
Solving initial value problem by using Euler method and RK fourth order method.

Unit V
Solving boundary value problem by using finite difference method.

References:
1. E. Balagurusamy, Programming in ANSI C, Tata McGraw Hill Publishing Pvt. Ltd., Second edition, 2nd reprint 2001.
2. Christopher Negus, Linux Bible, Wiley Publishing, Inc., 2005 Edition.
3. Samuel D. Conte, Carl de Boor, Elementary Numerical Analysis – An Algorithmic Approach, International Student Edition, McGraw-Hill Book Company,2000.
4. T. Veerarajan and T. Ramachandran, Numerical Methods with Programs in C and C++, Tata McGraw-Hill Publishing Company Limited, 2004.

SEC VI - Life Skills

Semester: IV   **Code: U23MAPS6**

Hrs. / Week: 2   **Credits: 2**

SEC VII - Applicable Mathematics for Society

Semester: IV   **Code: U23MA4S7**

Hrs. / Week: 2   **Credits: 2**

Objectives of the Course

1. To comprehend the key concepts of S-L and differentiate the community service and Service-Learning
2. To identify the system of a business organization and convert the given problem into LPP
3. To construct the solution for Assignment and Transportation problem
4. To demonstrate the solution through correlation and regression
5. To apply the data collected from the community to the content
6. To analyze the solution for the community need using mathematical tool

Course Outline

Unit I: Concepts of Service-Learning:

Service learning – Definition, Principles- engagement, reflection, reciprocity, public dissemination; Meaning of community and understanding of community dynamics. Project planning stages and Ethical concerns.

Unit II: Mathematical Applications:

Operations Research in small or medium scale industries, Numerical methods for solving real life differential equations.

Unit III: Data Analysis with Packages:

Probability and Statistics: Conditional Probability-Application of discrete and continuous distributions-Linear Relationship between two variables-Correlation Co-efficient method- Rank Correlation - Linear Regression-Testing of Hypothesis, Graph Theoretical concept for finding shortest path. Mathematics for competitive exams.

Unit IV: Data Survey in Community:

Community profile: Area analysis, awareness of education, finding solutions for the industrial problems, calculating the step by step growth of a particular concern.

Unit V: Service to Community:

Training the community to face the competitive exams, finding the shortest path, Analysing the best data.

Textbooks:

1. Kanti Swarup, P. K. Gupta, Man Mohan, "Operations Research ", Sultan Chand & Sons, 2007.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathy, Numerical Methods, S. Chand & Company limited, New Delhi, Reprint 2009.
3. S.C. Gupta, V.K. Kapoor, Elements of Mathematical Statistics, Sultan Chand & sons, Educational Publishers, New Delhi, 3rd Edition, Reprint 2008.

References:

1. M. K. Venkataraman, Numerical Methods in Science and Engineering, The National Publishing Company, Chennai, 2004.

UG – Professional Competency Skill (PCS)

Sem.	Course	Code	Title	Hr. / Week	Credits	Marks		
						CIA	ESA	Total
VI	PCS	U23MA6G1	Quantitative Aptitude and Reasoning	2	2	25	75	100

PCS - Quantitative Aptitude and Reasoning

Semester: VI   **Code: U23MA6G1**

Hrs. / Week: 4   **Credits: 2**

Objectives of the Course:

1. To understand the basic concepts of quantitative ability
2. To understand the basic concepts of logical reasoning Skills
3. To acquire satisfactory competency in use of reasoning
4. To solve campus placements aptitude papers covering Quantitative Ability, Logical, Reasoning Ability
5. To compete in various competitive exams.

Course Outline

Unit I

Numbers - HCF & LCM – Decimal Fractions – Simplification -Square roots and Cube roots - Percentage – Average.

Unit II

Ratio and Proportion - Partnership - Profit and Loss - Time and Work- Pipes and Cisterns - Time and Distance - Problems on Trains – Problems on Boats and Streams.

Unit III

Problems on Numbers - Problems on ages - Simple interest – Compound interest Area - Volume and Surface Areas.

Unit IV

Analogy – Classification – Series Completion – Coding and Decoding – Blood Relations – Direction Sense Test – Logical Venn Diagrams.

Unit V

Alphabet Test – Number, Ranking and Time Sequence Test – Mathematical Operations – Logical Sequence of Words – Arithmetical Reasoning - Analytical Reasoning – Mirror Images.

Text Books :

1. Dr. R. S. Aggarwal, Quantitative aptitude for Competitive examination By R S Agarwal, S. Chand Co. Pvt. Ltd., New Delhi, Eighth Edition, 2017 (Scope as in Chapters- 1-13, 17-18, 21-24, 27-28, 30-31, 36-39).

2. Dr. R. S. Aggarwal, A Modern Approach To Verbal & Non Verbal Reasoning, S. Chand Co. Pvt. Ltd., New Delhi, Revised Edition, 2018 (Scope as in Chapters- 1-5, 8-9).

Under-Graduate Programme

Allied Mathematics Courses
(Physics)

Courses of Study, Schemes of Examinations
& Syllabi
(Choice Based Credit System)

THE DEPARTMENT OF MATHEMATICS
(DST – FIST sponsored)
BISHOP HEBER COLLEGE (Autonomous)
(Reaccredited with 'A' Grade (CGPA – 3.58/4.0) by the NAAC &
Identified as College of Excellence by the UGC)
DST – FIST Sponsored College &
DBT Star College
TIRUCHIRAPPALLI – 620 017
TAMIL NADU, INDIA

2023 – 2024

Allied Mathematics Courses offered to Students of B. Sc. Physics

(For the candidates admitted from the year 2023 onwards)

Sem.	Course	Code	Title	Credits	Hrs./ week	Marks		
						CIA	ESA	Total
I	Allied I	U23PHMY1	Algebra, Calculus and Analytical Geometry of 3D	5	6	25	75	100
II	Allied II	U23PHMY2	Differential Equations, Laplace Transforms and Fourier Series	5	6	25	75	100

Allied Course I – Algebra, Calculus and Analytical Geometry of Three Dimensions

Semester: I   **Code: U23MA1Y1**

Hrs. / Week : 6   **Credits: 5**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Basic ideas on the properties of eigen values, eigen vectors and the applications of characteristic equations
2. Knowledge to understand the applications of differential calculus, properties of definite integrals.

Course Outline:
Algebra

Unit I
Eigen values and Eigen vectors - Cayley - Hamilton theorem – Diagonalization of matrices (problems only).

Calculus

Unit II
Leibnitz ' s formula for n^{th} derivative of a product – Curvature and radius of Curvature – Cartesian formula for radius of curvature.

Unit III
Properties of Definite Integrals – Reduction Formulae for $\int e^{ax} x^n dx, \int \sin^n x \, dx, \int \cos^n x \, dx,$ where n is

a positive integer – Evaluation of $\int_0^\infty e^{-ax} x^n dx, \int_0^{\frac{\pi}{2}} \sin^n x \, dx, \int_0^{\frac{\pi}{2}} \cos^n x \, dx,$ where n is a positive integer.

Analytical Geometry of Three Dimensions

Unit IV
Representation of line–angle between a line and a plane – coplanar lines–shortest distance between two skew lines –length of the perpendicular.

Unit V
Sphere – standard equation – length of the tangent from any point – Sphere passing through a given circle- Intersection of two spheres – tangent plane.

Text Books:
1. S.G. Venkatachalapathy, Allied Mathematics (in single volume), Margham Publications, Chennai, Reprint 2011.   (Units I, II, III)
2. T. K. Manickavasagam Pillay and T. Natarajan, A Textbook of Analytical Geometry (Part – II Three Dimensions), S. Viswanathan (Printers and Publishers) Pvt. Ltd., Reprint 2008. (Units IV & V).

Unit I   Chapter 6:   6.36 - 6.57
Unit II   Chapter 9:   9.19 – 9.26, 9.40 – 9.50
Unit III   Chapter 10: 10.99 – 10.115, 10.135 – 10.164
Unit IV   Chapter 3:   1 – 8, 47 – 75
Unit V   Chapter 4:   1 – 8, 93 – 114

References:

1. Dr. P. Mariappan, Dr. V. Franklin and others, Calculus and Analytical Geometry of 3D, 1st edition, New Century Book House Pvt. Ltd, Chennai.
2. T. K. Manichavasagam Pillai, T. Natarajan & K. S. Ganapathy, Algebra (Vol. II), S.Viswanathan Pvt. Ltd.Reprint 2004.
3. S. Narayanan and T. K. Manichavasagam Pillai, Calculus (Vol. I, II) Viswanathan Printers and Publishers, Reprint 2003.
4. Vittal. P. R, Allied Mathematics, Margham Publications, Chennai, Reprint 2000.
5. M. K. Venkataraman, Engineering Mathematics, National Publishing Company, 1999.

Allied Course – II Differential Equations, Laplace Transforms and Fourier Series

Semester: II   **Code: U23MA2Y2**

Hrs. / Week : 6   **Credits: 5**

Pre-requisite: 12th Standard Mathematics

General objectives:

On completion of this course, the learner will

1. know methods of solving differential equations of one dimension and higher dimension.
2. know application of Laplace transforms in solving ordinary differential equations.
3. be able to understand periodic functions through circular functions as Fourier series.

Course Outline:

Differential Equations

Unit I

Ordinary Differential Equations – First Order and Higher Degree – Equation solvable x, y and $\dfrac{dy}{dx}$

- (simple problems only) – Clairaut 's Form (simple case only).

Unit II

Derivation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions – classification of Integrals – some standard types of First Order Partial Differential Equations – Other standard forms.

Laplace Transforms

Unit III

Definition - Condition for the existence of the Laplace Transforms-Properties of Laplace Transforms - Laplace Transform of some standard functions – Some general theorems.

Unit IV

The Inverse Laplace Transform – Shifting theorem for Inverse Transform – The method of partial fraction can be used to find the Inverse transform of certain functions – Related theorems – Special cases- Applications to solutions of Differential Equations.

Fourier Series

Unit V

Definition – To determine the values of a_0, a_n, b_n – Bernoulli's Formula – Sufficient conditions for representing f(x) by Fourier Series – Even and Odd functions – Properties of Odd and Even functions – Fourier Series of even and odd functions – Half range Fourier Series.

Text Book:

1. S.G. Venkatachalapathy, Allied Mathematics (in single volume), Margham Publications, Chennai, Reprint 2011. (Units I-V)

Unit I	Chapter 13	13.1 – 13.33
Unit II	Chapter 15	15.1 – 15.35
Unit III	Chapter 16	16.1 – 16.22
Unit IV	Chapter 16	16.25 – 16.56
Unit V	Chapter 12	12.1 – 12.42

References:

1. Dr P Mariappan, Differential Calculus, New Century Book House, Pvt. Ltd, Chennai.
2. Dr R Gethsi Sharmila, Dr R Janet and Others, Differential Equations, Laplace Transforms and Fourier Series, New Century Book House, Pvt. Ltd, Chennai.
3. S. Narayanan, T.K. Manichavasagam Pillai, Calculus Volume III, S. Viswanathan Pvt. Ltd, Reprint 2004.
4. Vittal. P. R, Allied Mathematics, Margham Publications, Chennai, Reprint 2000.

Under-Graduate Programme

Allied Mathematics Courses
(Chemistry)

Courses of Study, Schemes of Examinations
& Syllabi
(Choice Based Credit System)

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TIRUCHIRAPPALLI – 620 017
TAMIL NADU, INDIA

2023 – 2024

Allied Mathematics Courses offered to Students of B. Sc. Chemistry

(For the candidates admitted from the year 2023 onwards)

Sem.	Course	Code	Title	Credits	Hrs./ week	Marks		
						CIA	ESA	Total
I	Allied I	U23CHMY1	Algebra and Calculus	5	6	25	75	100
II	Allied II	U23CHMY2	Differential Equations and Laplace Transforms	5	6	25	75	100

Allied Course I – Algebra and Calculus

Semester: I   **Code: U23CHMY1**

Hrs. / Week : 6   **Credits: 5**

Pre-requisite: 12th Standard Mathematics

Objectives of the Course:

1. Basic ideas on the properties of eigen values, eigen vectors and the applications of characteristic equations.
2. Knowledge to understand the applications of differential calculus, properties of definite integrals.

Algebra

Unit I
Eigen values and Eigen vectors - Cayley - Hamilton theorem – Diagonalization of matrices (Problems only).

Calculus

Unit II
Differentiation-Definition – Rules for differentiation – Standard forms -Successive differentiation – nth derivatives – Standard forms – Use of Partial fractions – Application of De-Moivre's theorem- Trigonometrical transformations.

Unit III
Leibnitz's theorem (statement only) on the nth differential coefficient of the product of two functions of x (problems only) – curvature and radius of curvature- cartesian formula for radius of curvature.

UNIT IV
Introduction – Methods of Integration – Integrals of the functions involving $a^2 \pm x^2$ - Integrals of

functions of the form $\int \left[f(x) \right]^n f'(x) dx$ - Definite Integrals – Properties of definite integrals –

Reduction formulae for the three definite integrals: $\int_0^\infty e^{-ax} x^n dx, \int_0^{\frac{\pi}{2}} \sin^n x \, dx, \int_0^{\frac{\pi}{2}} \cos^n x \, dx$, where n is a

positive integer (problems only).

UNIT V
The Gamma and Beta functions – Gamma function – recurrence formulae for Γn - connection between gamma function and factorials – Beta function – relation between beta and gamma functions – applications of Beta and Gamma functions.

Text Books:

1. S.G. Venkatachalapathy, Allied Mathematics (in single volume), Margham Publications, Chennai, Reprint 2011(Units I, III, IV)

2. Dr. M. K. Venkataraman, Dr. Manorama Sridhar, Allied Mathematics Vol-II, Agasthiar Publications first edition, July 2006 (Unit II, V)

Unit I	Chapter 6	Pg. 6.36 – 6.57
Unit II	Chapter 1	Pg. 1.1 – 1.6
	Chapter 2	Pg. 2.1 – 2.29
Unit III	Chapter 9	Pg. 9.19 – 9.26, 9.40 – 9.50
Unit IV	Chapter 10	Pg.10.1 – 10.28, 10.99 – 10.115, 10.135 – 10.164
Unit V	Chapter 8	Pg. 8.1 – 8.31

References:

1. Dr. P. Mariappan, Dr. V. Franklin and others, Calculus and Analytical Geometry of 3D, 1st edition, New Century Book House Pvt. Ltd, Chennai.
2. T. K. Manichavasagam Pillai, T. Natarajan & K. S. Ganapathy, Algebra (Vol.II) , S.Viswanathan Pvt. Ltd.Reprint 2004.
3. S. Narayanan and T. K. Manichavasagam Pillai, Calculus (Vol. I, II) Viswanathan Printers and Publishers, Reprint 2003.
4. M. K. Venkataraman, Engineering Mathematics, National Publishing Company, 1999.

Allied Course – II Differential Equations and Laplace Transforms

Semester: II   **Code: U23CHMY2**

Hrs. / Week : 6   **Credits: 5**

Pre-requisite: 12th Standard Mathematics

General objectives:

On completion of this course, the learner will

1. know methods of solving differential equations.
2. know application of Laplace transforms in solving ordinary differential equations.

Course Outline:

Differential Equations

Unit I:

Ordinary Differential Equations – First Order and Higher degree – Equations solvable for x, y and $\frac{dy}{dx}$ (simple problems only) – Clairaut's form (simple case only)

Unit II:

Derivation of Partial Differential Equations by elimination of arbitrary functions – classification of Integrals – some standard types of First Order Partial Differential Equations – Other standard forms.

Unit III:

Definition – Condition for the existence of the Laplace Transforms – Properties of Laplace Transforms – Laplace Transform of some standard functions – Some general theorems.

Unit IV:

The Inverse Laplace Transforms – Shifting theorem for Inverse Transform – The method of partial fraction can be used to find the Inverse transform of certain functions – Related theorems.

Unit V:

Special cases – applications to solutions of Differential Equations.

Text Books:

1. S.G. Venkatachalapathy, Allied Mathematics (in single volume), Margham Publications, Chennai, Reprint 2011(Units I - V)

Unit I	Chapter 13	13.1 – 13.33
Unit II	Chapter 15	15.1 – 15.35
Unit III	Chapter 16	16.1 – 16.22
Unit IV	Chapter 16	16.25 – 16.35
Unit V	Chapter 62	16.35 – 16.66

References:

1. Dr. R. Gethsi Sharmila, Dr. R. Janet and others, Differential Equations, Laplace Transform sand Fourier Series, New Century Book House Pvt. Ltd, Chennai.
2. S. Narayanan and T. K. Manichavasagam Pillai, Calculus (Vol. III) S.Viswanathan Printers and Publishers, Reprint 2004.
3. Vittal.P.R., Allied Mathematics, Margham Publications, Chennai, Reprint 2000.

Under-Graduate Programme
Allied Mathematics Courses
(Computer Science / Computer Applications)

Courses of Study, Schemes of
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TIRUCHIRAPPALLI –
620 017 TAMIL NADU,
INDIA

2023 – 2024

Allied Mathematics Courses Offered to Students of

B. Sc. Computer Science / Bachelor of Computer Applications (BCA)

(For the Candidates Admitted from the Year 2023 onwards)

Sem.	Course	Code	Title	Credits	Hrs./ week	Marks		
						CIA	ESA	Total
I	Allied I	U23CSMY1 / U23CAMY1	Numerical Methods	5	6	25	75	100
II	Allied II	U23CSMY2 / U23CAMY2	Optimization Techniques	5	6	25	75	100

<div align="center">

Allied Course I – Numerical Methods

</div>

Semester: I   **Code: U23CSMY1 / U23CAMY1**

Hrs. / Week: 6   **Credits: 5**

Pre-requisite: 12th Standard Mathematics

Objectives:
1. To introduce the various topics in Numerical methods.
2. To apply numerical techniques to solve algebraic and differential equations.
3. To apply numerical techniques to find approximate values for definite integrals.

Course Outline:

Unit I
Introduction to Numerical Analysis-Solution of algebraic and transcendental equations – Bisection method – Iterative method – Regula Falsi method – Newton Raphson Method.

Unit II
Solution of simultaneous linear algebraic equations – Direct method – Gauss Elimination method – Gauss Jordan Method – Iterative methods – Gauss Jacobi Method - Gauss Seidel method.

Unit III
Interpolation – Gregory Newton's forward and backward interpolation formulae – Lagrange's interpolation formula – Inverse interpolation formula.

Unit IV
Numerical Differentiation and Integration – Newton's formulae to compute the derivative – Trapezoidal rule, Simpson's one-third rule – Simpson's three-eighth rule.

Unit V
Numerical solution of ordinary differential equations – Taylor series method – Euler's method – Runge-Kutta Methods – Milne's Predictor Corrector Method.

Text Book
P. Kandasamy, K. Thilagavathy, K. Gunavathy, Numerical Methods, S. Chand & Company Ltd, Reprint 2013.

Unit I	Chapter 3	§ 3.1, 3.1.1, 3.2, 3.3, 3.4 (Problems only)
Unit II	Chapter 4	§ 4.1, 4.2, 4.2.1, 4.7, 4.8, 4.9 (Problems only)
Unit III	Chapter 6	§ 6.1, 6.2, 6.3 (Problems only)
	Chapter 8	§ 8.7, 8.9 (Problems only)
Unit IV	Chapter 9	§ 9.1, 9.2,9.3, 9.7, 9.9, 9.13, 9.14 (Problems only)
Unit V	Chapter 11	§ 11.1, 11.5, 11.9, 11.12, 11.13, 11.16, 11,17 (Problems only)

Reference
1. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India Private Limited, 2005.
2. Dr Perumal Mariappan, Numerical Methods for Scientific Solutions, New Century Book House, Pvt. Ltd, Chennai.

Allied Course II – Optimization Techniques

Semester: II   **Code: U23CSMY2 / U23CAMY2**

Hrs. / Week : 6   **Credits: 5**

Pre-requisite: 12th Standard Mathematics

Objectives:

1. To understand Linear Programming Problems (LPP) and Methods to solve them.
2. To apply LPP for solving transportation and assignment problems
3. To know the basics and methods of solving network problems
4. To know the basics of inventory models and to solve inventory problems

Course Outline:

Unit I

Introduction to Operations Research - Linear programming problem - Introduction – General LPP – Basic feasible solution – Optimum basic feasible solution – Alternate basic feasible solution – Degenerate solution – Unbounded solution – Graphical solution method – Simplex method.

Unit II

Linear programming problem -   Artificial variable techniques – Big–M method – Two phase method.

Unit III

Transportation Problem - Definition – formulation and solution of transportation problem – Initial Basic Feasible Solution – North-West corner , Row Minima, Column Minima, Matrix Minima, Vogel's Approximation Method – Optimum Basic Feasible Solution – MODI method.

Unit IV

Assignment Problem - Definition – Comparison with transportation problem – Formulation and solution of assignment problems – Hungarian method – Unbalanced assignment problems.

Unit V

Networks – PERT - CPM - Introduction – Network and basic components – Rules of network construction – Time calculations in networks – Critical Path Method - Time calculations in PERT – Probability of meeting the scheduling time – PERT algorithm – Related problems.

Text book

Kanti Swarup, P. K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons Educational Publishers, New Delhi, 14th Edition 2008.

Unit I	Chapter 3: 3.1- 3.5
	Chapter 4 : 4.1,4.3
Unit II	Chapter 4 : 4.4
Unit III	Chapter 10 : 10.1 ,10.2, 10.5, 10.8 - 10.10 ,10.12,10.13
Unit IV	Chapter 11 : 11.1 – 11.4
Unit V	Chapter 25 : 25.1 – 25.4, 25.6-25.8

References

1. Hamdy A.,Taha, Operations Research, Keerthi Publishing House , 1997.
2. S. DharaniVenkatakrishnan , Operations Research , Keerthi Publishing House, 1997.
3. S. D. Sharma Kedarnath , Operations Research, Ramnath Publishers and Co., Meerut 1997.
4. M. P. Gupta, J. K. Sharma, Operations Research for Management, National Publishing House, 1992.

UG – Extra Credit Courses

Course	Code	Title	Hr. / Week	Credits	Marks		
					CIA	ESA	Total
I	UX3MA5SA	Theory of Equations and Fourier Series	-	2	-	100	100
II	UX3MA5SB	Elementary Number Theory	-	2	-	100	100
III	UX3MA6SC	Data Structures and Algorithms	-	2	-	100	100
IV	UX3MA6SD	Transformation Techniques (Laplace, Fourier)	-	2		100	100

Extra Credit Course I - Theory of Equations and Fourier Series

Code: **Credits: 2**

Objectives of the Course:

On completion of this course, the learner will
1. be able to understand the relation between the roots and coefficients of a polynomial.
2. know the methods of finding Fourier series expansion for periodic functions and their applications.

Theory of Equations
Unit I
Relations between the roots and coefficients - Symmetric functions of the roots – Sum of the powers of the roots - Newton's theorem.

Unit II
Transformations of equations – Reciprocal equations– Diminishing and increasing the roots – form of the quotient and remainder when a polynomial is divided by a binomial – Removal of terms.

Unit III
Formation of equation whose roots are any power of the roots of a given equation – Transformation in general – Descartes' rule of signs – Horner's Method.

Fourier series
Unit IV
Definition of Fourier series – Finding Fourier series expansion of a periodic function with period 2n - Odd and even functions.

Unit V
Half Range Fourier series - Development in cosine series-development in sine series-Change of interval-Combination of series. 14

Text Books:
1. T. K. Manickavasagam Pillay, T. Natarajan, K. S. Ganapathy, Algebra Volume I, S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai, 2011 (Units I, II & III).
2. T. K. Manickavasagam Pillay, S. Narayanan, Calculus Volume III, S. Viswanathan Pvt. Ltd., 2008 (Units IV & V).

     Unit I Chapter 6 § 11 to 14

     Unit II Chapter 6 § 15 to 19

     Unit III Chapter 6 § 20,21,24,30

     Unit IV Chapter 6 § 1 to 3

     Unit V Chapter 6 § 4 to 7

References

1. Dr P Mariappan, Fourier Series, Lap Lambert Publications, 2021.
2. Dr R Gethsi Sharmila, Dr R Janet and Others, Differential Equations, Laplace Transforms and Fourier Series, New Century Book House, Pvt. Ltd, Chennai.
3. S. Arumugam and Issac, Trigonometry & Fourier Series 2000.
4. M. L. Khanna., Theory of Equations, Jaiprakash, Merrut, 1983.

Extra Credit Course II – Elementary Number Theory

Code: **Credits:** 2

Objectives of the Course:

On completion of this course, the learner will
1. be able to understand the properties of prime and composite numbers.
2. know the famous theorem due to Fermat and Euler.

Course Outline:

Unit I
Absolute value-Divisibility of integers-Division Algorithms-Greatest common divisor-Euclidean Algorithm-Least common multiple.

Unit II
Prime and Composite numbers-The sieve of Eratosthenes-Euclid's theorem-Unique factorization theorem-positional representation of an integer-Divisors of an integer-Arithmetic functions-product of divisors.

Unit III
Perfect numbers-Euclid's theorem-Abundant, deficient and amicable numbers-Triangular number-Euler function-Greatest integer functions.

Unit IV
Congruences-Residues-Residue classes-complete residue system-Reduced residue system-Magic number-Divisibility tests-linear congruence.

Unit V
Introduction-Fermat's theorem-Euler's Extension of Fermat's theorem-Wilson's theorem-Lagrange's theorem.

Text Book:
S. Kumaravelu and Susheela Kumaravelu, Elements of Number Theory, Nagarcoil, January 2002.

Unit I	Chapter 2 § 53 – 57
	Chapter 3 § 61 - 76
Unit II	Chapter 4 § 77 - 97
Unit III	Chapter 4 § 98 - 113
Unit IV	Chapter 6 § 155 - 188
Unit V	Chapter 7 § 191 - 211

References:
1. David M. Burton, Elementary Number Theory, Allyn and Bacon, Inc.,1994.
2. Ivan Niven and H. Zuckerman, An Introduction to Theory of Numbers, John Wiley & Sons; 5th edition, 1991.

Extra Credit Course - III –Data Structures and Algorithms

Code: **Credits:** 2

Objectives of the Course:

On completion of this course, the learner will be able to understand data structures and algorithms.

Course Outline:

Unit I

Abstract data types and data structures, classes and objects Complexity of algorithms: worst case, average case and amoritized complexity.

Unit II

Algorithm analysis, Algorithms Design Paradigms. Lists: stacks, queues, implementation, garbage collection.

Unit III

Dictionaries: Hash tables, Binary search trees, AVL trees, Red-Black trees, Splay trees, Skip-lists, B-trees. Priority Queues.

Unit IV

Graphs: Shortest path algorithms, minimal spanning tree algorithms, depth – first and breadth –first search.

Unit V

Sorting: Advanced sorting methods and other analysis, lower bound on complexity, order statistics.

Text Book:

A.V.Aho, J.E.Hopcroft, and J.D.Ullman, Data Structures and Algorithms, Addison Wesley, Reading Massachusetts, USA, 1983

References:

1. S.Sahni, Data Structures, Algorithms and Applications in C++, University press(India) Pvt.Ltd./Orient Longman Pvt.Ltd., 2nd edition, 2005.
2. Adam Drozdek, Data Structures, Algorithms and Applications in C++, Vikas Publishing House/ Thomson International Student Edition, Second Edition, 2001.

Extra Credit Course – IV – Transformation Techniques (Laplace & Fourier)

Code: **Credits: 2**

Objectives of the Course:

On completion of this course, the learner will

1. Know methods of finding Laplace transforms and inverse Laplace transforms for real functions.
2. be able to apply Laplace transforms for solving ordinary differential equations.
3. know methods of finding Fourier transforms and Fourier integrals.
4. be able to apply Fourier transforms for solving differential equations.

Course Outline:

Laplace Transform

Unit-I:

Laplace Transform of a Function – Laplace Transforms of Elementary Functions – Linearity of the Laplace Transform – Shifting Theorems – First Shifting Theorem – Unit Step Function – Second Shifting Theorem – Change of Scale Property – Piecewise Continuous Function – Existence Theorem for Laplace Transforms – Laplace Transforms of Derivatives – Laplace Transforms of Integrals – Differentiation of Laplace Transforms – Integration of Laplace Transforms

Unit-II:

Inverse Laplace Transform of a Function – Existence and Uniqueness of Inverse Laplace Transform – Elementary Inverse Laplace Transform Formulae – Linearity of the Inverse Laplace Transform – Value of $L^{-1}(F(s-a))$, $L^{-1}(e^{-as}F(s))$, $L^{-1}(F(s/a))$, $L^{-1}(F(s)/s)$, $L^{-1}(F'(s))$, $L^{-1}\left(\int_s^\infty F(s)dS\right)$ in terms of $L^{-1}(F(s))$.

Unit-III:

Convolution theorem – Inverse Laplace Transforms by the method of Partial Fractions – Solution of Differential Equations by using Laplace Transformation.

Fourier Transform

Unit-IV:

Fourier Transform and Its Inverse – Shifting Property of Fourier Transforms – Modulation Property of Fourier Transforms – Convolution Theorem.

Unit-V:

Fourier Sine and Cosine Transforms – Linearity of Transforms – Change of Scale Property of Transforms – Transforms of Derivatives – Parseval's Identities.

Text Books:

1. P. Gupta, Topics in Laplace and Fourier Transforms, Fire Wall Media, Laxmi
   Publication PVT Ltd, 1st Edition (2019)

Unit I	Chapter 1:	1.1 - 1.15
Unit II	Chapter 2:	2.1 - 2.11
Unit III	Chapter 2:	2.12 - 2.14
Unit IV	Chapter 5:	5.3 - 5.6
Unit V	Chapter 5:	5.7 - 5.11

References:

1. S. Narayanan & T. K. Manickavasagam Pillay, Calculus Volume III, S.
   Viswanathan Pvt. Ltd., 2008.
2. Dr P Mariappan, M. Maragatham, Laplace Transforms – An Application, Lambert
   Academic Publishing, 2021.
3. Dr R Gethsi Sharmila, Dr R Janet and Others, Differential Equations, Laplace
   Transforms and Fourier Series, New Century Book House, Pvt. Ltd, Chennai, 2020.
4. P. R. Vittal, Differential Equations and Laplace Transforms, Margham Publications,
   2004.