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

2019 – 2020

Under – Graduate Programme in Mathematics

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
Part – I : Language	4	12
Part – II : English	4	12
Part – III		
Major		
Core	12	59
Elective	3	15
Allied		
Allied (Physics/ Computer Science)	3	12
Allied (Statistics)	3	10
Group Project	1	3
Part – IV		
SBEC	3	6
NMEC	2	4
VLOC	1	2
Env. Studies	1	2
SBC	1	1
Part – V		
Extension Activities	1	1
Gender Studies	1	1
Total	**39**	**140**

List of Core Courses

1. Algebra, Trigonometry and Differential Calculus
2. Integral Calculus and Analytical Geometry of Three Dimensions
3. Sequences & Series
4. Differential Equations and Laplace Transforms
5. Theory of Equations and Fourier Series
6. Modern Algebra
7. Real Analysis
8. Mechanics
9. Numerical Methods
10. Complex Analysis
11. Discrete Mathematics
12. Elementary Number Theory

List of Elective Courses:

1. Vector Calculus
2. Mathematical Modeling
3. Operations Research
4. Graph Theory
5. Fundamentals of Data Structures and Algorithms

List of Non Major Elective Courses (NMEC) (Offered to students of other discipline)

1. Mathematics for Competitive Examinations
2. Statistical Applications

List of Skill Based Elective Courses (SBEC):

1. Mathematics for Competitive Examinations
2. Introduction to Scientific Computing (OCTAVE)
3. Programming in C (Linux OS)

Skill Based Course (SBC)

1. Life Skills

Extra Credit Courses:

1. Data Structures
2. Fourier Transforms
3. Fuzzy Mathematics
4. Simulation

Learning Outcomes of Under-Graduate Programme in Mathematics

General Outcomes	Specific Outcomes
On successful completion of the programme, the student will be 1. skillful in logical thinking and reasoning. 2. able to apply mathematics for problems occurring in different fields of science and engineering. 3. be able to take up mathematics programme at Master's level anywhere in and outside India.	After the successful completion of the under-graduate programme in Mathematics, the student is expected to 1. be able to clear exams in mathematical aptitude 2. be able to analyse any data using statistical tools 3. be able to develop codes using C-language for simple problems 4. be able to use packages like octave, R etc. 5. be able to apply mathematics for solving transportation problems, assignment problems and some physical problems involving differential equations, transforms, vector calculus etc.

B.Sc. Mathematics – Programme Description

(For the students admitted from the year 2016 onwards)

Sem.	Part	Course	Course Code	Course Title	Prerequisites	Hrs / week	Credits	Marks		
								CIA	ESA	Total
I	I	Tamil I /*	U15TM1L1	செய்யுள், இலக்கிய வரலாறு, உரைநடை,மொழிப்பயிற்சியும் படைப்பாக்கமும்		6	3	25	75	100
	II	English I	U16EGNL1	English Communication Skills-I		6	3	40	60	100
	III	Core I	U14MA101	Algebra, Trigonometry and Differential Calculus		5	4	25	75	100
		Allied I	U16PHY01/ U16CSY11	Mechanics, Sound, Thermal Physics and Optics / Fundamentals of C Programming		4	4	25	75	100
		Allied Practical	U16PHYP1/ U16CSYP1	Allied Physics Practical/ Allied Computer Science Practical		3	--	--	--	--
	IV	Env. Stud.	U15EST11	Environmental Studies		2	2	25	75	100
		VLOC.	U14VL1:1/ U14VL1:2	Value education (RI / MI)		2	2	25	75	100
		SBEC I	U14MA1S1	Mathematics for Competitive Examinations		2	2	25	75	100
II	I	Tamil II /*	U15TM2L2	செய்யுள், இலக்கிய வரலாறு, சிறுகதைத்திரட்டு,மொழிப்பயிற்சி & படைப்பாக்கம்		6	3	25	75	100
	II	English II	U16EGNL2	English Communication Skills –II		6	3	40	60	100
	III	Core II	U14MA202	Integral Calculus and Analytical Geometry of Three Dimensions	U14MA101	5	5	25	75	100
		Elective I	U14MA2:1	Vector Calculus	U14MA101	6	5	25	75	100
		Allied II	U16PHY02/ U16CSY22	Electricity, Atomic Physics and Digital Electronics / Object Oriented Programming with JAVA		4	4	25	75	100
		Allied Practical	U16PHYP1/ U16CSYP1	Allied Physics Practical/ Allied Computer Science Practical		3	4	40	60	100
III	I	Tamil III/*	U15TM3L3	செய்யுள் - காப்பியங்கள், இலக்கிய வரலாறு, நாவல், மொழிப்பயிற்சி		6	3	25	75	100
	II	English III	U16EGNL3	English for Competitive Examinations		6	3	40	60	100
	III	Core III	U17MA303	Sequences and Series		5	4	25	75	100
		Core IV	U14MA304	Differential Equations and Laplace Transforms	U14MA101, U14MA202	5	4	25	75	100
		Allied III	U17MAS31	Mathematical Statistics I		4	4	25	75	100
	IV	SBEC II	U16MAPS2	Introduction to Scientific Computing (OCTAVE)		2	2	40	60	100
		NMEC I		***To be selected from courses offered by other departments***		2	2	25/ 40	75/ 60	100

Sem.	Part	Course	Course Code	Course Title	Pre requisites	Hrs./ week	Credits	Marks		
								CIA	ESA	Total
IV	I	Tamil IV /*	U15TM4L4	செய்யுள் - நாடகம், இலக்கிய வரலாறு, மொழிப்பயிற்சி		5	3	25	75	100
	II	English IV	U16EGNL4	English through Literature		5	3	40	60	100
	III	Core V	U16MA405	Theory of Equations and Fourier Series		6	5	25	75	100
		Allied IV	U17MAS42	Mathematical Statistics II	U17MAS31	6	4	25	75	100
		Allied Practical	U16MA4P1	Mathematical Statistics III	U17MAS31	4	2	40	60	100
	IV	NMEC II		***To be selected from courses offered by other departments***		2	2	25/ 40	75/ 60	100
		SBC	U16LFS41	Life Skills		2	1	100	--	100
	V	Extension Activities	U16ETA41				1	-	-	-
V	III	Core VI	U16MA506	Algebra		7	6	25	75	100
		Core VII	U16MA507	Real Analysis	U17MA303/ U16MA303	7	6	25	75	100
		Core VIII	U14MA508	Mechanics	U14MA101, U14MA2:1	6	5	25	75	100
		Core IX	U14MA509	Numerical Methods	U14MA101, U14MA202	5	4	25	75	100
		Group Project	U16MA5PJ	Project		3	3	40	60	100
	IV	SBEC III	U14MAPS3	Programming in C (Linux OS)		2	2	40	60	100
VI	III	Core X	U16MA610	Complex Analysis	U16MA507	6	6	25	75	100
		Core XI	U16MA611	Discrete Mathematics		6	5	25	75	100
		Core XII	U16MA612	Elementary Number Theory		6	5	25	75	100
		Elective II	U16MA6:2	Mathematical Modeling	U14MA101, U14MA202	6	5	25	75	100
		Elective III	U16MA6:3	Operations Research		6	5	25	75	100
	V		U16GST61	Gender Studies			1	20	80	100
Total							**140**			**3800**

SBEC- Skill Based Elective Course **NMEC- Non Major Elective Course**
VLOC- Value added Life Oriented Course **SBC- Skill Based Course**
CIA- Continuous Internal Assessment **ESA- End Semester Assessment**

* Other Languages	Hindi	Sanskrit	French		Hindi	Sanskrit	French
Semester I	U14HD1L1	U15SK1L1	U14FR1L1	Semester III	U14HD3L3	U15SK3L3	U14FR3L3
Semester II	U14HD2L2	U15SK2L2	U14FR2L2	Semester IV	U14HD4L4	U15SK4L4	U14FR4L4

Core Course I – Algebra, Trigonometry and Differential Calculus

Sem. I **Code : U14MA101**
Total Hrs. 75 **Credits : 4**

General objectives:

On completion of this course, the learner will

1. know the properties of Eigen values, Eigen vectors and the applications of characteristic equations.
2. know the expansions of circular and hyperbolic functions, their inter-relations.
3. be able to understand higher order differentiation and differentiation of functions of several variables and to comprehend the applications of differential calculus.

Learning outcomes:

On completion of the course, the student will be able to

1. find the eigen values, eigen vectors of a given matrix.
2. expand circular functions as a series.
3. evaluate limits of combination of trigonometric functions.
4. find higher derivatives of given functions.

Algebra

Unit I

Characteristic equation – Eigen values and Eigen vectors of the matrix – Cayley-Hamilton theorem.

Trigonometry

Unit II

Expansion of cos $n\theta$, sin $n\theta$ and tan $n\theta$ (n is a positive integer) – derivations and problems - Expansion of $\cos^n \theta$, $\sin^n \theta$ and $\tan^n \theta$ in a series of sines, cosines and tangents of multiples of θ, θ given in radians – Expansion of $\cos\theta$, $\sin\theta$ and $\tan\theta$ in terms of θ - Hyperbolic functions – Relation between the circular and hyperbolic functions.

Differential Calculus

Unit III

Leibnitz formula for the n^{th} derivative of product - Curvature – circle, radius and center of curvature – Cartesian formula for the radius of curvature - The co-ordinates of the center of curvature - Evolute and involute - Radius of curvature (polar co-ordinates).

Unit IV

Meaning of the derivative – Meaning of the sign of the differential coefficient – Related problems – Maxima and Minima – Conditions for maximum and minimum values of f(x) – Related problems.

Unit V

Partial differentiation – Total differential coefficient – Implicit functions – Homogeneous functions – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

Text Books

1. T. K. Manickavasagam Pillay, T. Natarajan and K. S. Ganapathy, Algebra Volume II, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Reprint 2011 (Unit I).
2. S. Narayanan, T. K. Manickavasagam Pillay, Trigonometry, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Reprint 2009 (Unit II).
3. S. Narayanan and T. K. Manickavasagam Pillay, Calculus Volume I, S. Viswanathan (Printers & Publishers) Pvt. Ltd. Reprint 2011 (Units III, IV and V).

Unit I Chapter 2 § 16
Unit II Chapter 3 § 1-5 (excluding formation of equations) Chapter 4§ 1, 2
Unit III Chapter 3 § 2.1, 2.2 Chapter 10 § 2.1 – 2.6
Unit IV Chapter 4 § 1, 2.1, 2.2 Chapter 5 § 1.1 – 1.5
Unit V Chapter 8 § 1.3 – 1.7, 4 & 5

References

1. S. Arumugam & Others, Trigonometry, New Gamma Publications, 1985 Revised Edition
2. S. Arumugam & A.Thangapandi Issac, Modern Algebra, New Gamma Publications, 2000.
3. S. Sudha, Algebra, Analytical Geometry of (2D) and Trigonometry, Emerald Publishers, Chennai, First Edition 1998.
4. K. Viswanathan Naik, Modern Algebra, Emerald Publishers, Chennai, Reprint 1992.
5. P. Duraipandian, Laxmi Duraipandian, Jayamala Paramasivan, Trigonometry, Emerald Publishers, Chennai, Reprint 1999.
6. S. Sudha, Calculus, Emerald Publishers, Chennai, First Edition 1998.

Core course II - Integral Calculus and Analytical Geometry of Three Dimensions

Sem. II **Code : U14MA202**
Total Hrs.. 75 **Credits : 5**

General objectives:

On completion of this course, the learner will

1. know the evaluation of indefinite integrals of standard forms.
2. know methods of solving multiple integrals.
3. be able to understand properties of straight lines and spheres.

Learning outcomes:

On completion of the course, the student will be able to

1. evaluate indefinite integrals and multiple integrals.
2. find equations of straight lines and spheres satisfying given conditions.

Integral Calculus

Unit I

Integration of the forms

(i) $\int [(px+q) /(ax^2+bx+c)]dx$ (ii) $\int [(px+q) / (\sqrt{} (ax^2+bx+c))]dx$
(iii) $\int [(px+q)\sqrt{}(ax^2+bx+c)]dx$ (iv)$\int dx /(a+bcosx)$ - Properties of definite integrals – Integration by parts.

Unit II

Reduction formula, Beta and Gamma functions.

Unit III

Multiple integral - Double integral – Change of order of integration – Triple integral.

Analytical Geometry of Three Dimensions

Unit IV

Equation of the straight line – shortest distance between two skew lines – Equation to the line of shortest distance.

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. Narayanan and T. K. Manickavasagam Pillay, Calculus Volume – II, S. Viswanathan (Printers and Publishers) Pvt. Ltd., 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 1 § 7.3 (Rule b, type (ii)), 8 (Cases (ii) & (iii)), 9, 11, 12
Unit II Chapter 1 § 13.1 – 13.10 Chapter 7 § 2.1,2.3,3,4,5
Unit III Chapter 5 § 1, 2.1,2.2 (Problems Only), 3.1,3.2,4
Unit IV Chapter 3 § 1 - 8
Unit V Chapter 4

References

1. S. Sudha, Calculus, Emerald Publishers, Chennai, First Edition 1998.
2. P. Duraipandian, Laxmi Duraipandian, D. Muhilan, Analytical Geometry 3 Dimensional, Emerald Publishers, Chennai, Reprint 2003.
3. Shanthi Narayanan and Mittal P.K., Analytical Solid Geometry, 16th Edition, S. Chand & Co., New Delhi, 1969.

Elective I - Vector Calculus

Sem. II **Code : U14MA2:1**
Total Hrs. 90 **Credits : 5**

General objectives:

On completion of this course, the learner will

1. know the physical applications of derivatives of vectors.
2. be able to understand line integral, surface integral and volume integral and understand their inter-relations and their applications.

Learning outcomes:

On completion of the course, the student will be able to

1. find derivatives of vector functions.
2. evaluate line, surface and volume integrals.

Vector Differentiation

Unit I

Limit of a vector function – Continuity of vector functions – Derivative of a vector function – Geometrical significance of vector differentiation – Physical application of derivatives of vectors – Partial derivatives of a vector function – Scalar and vector point functions – Level surface – Gradient of a scalar point function – Directional derivative of a scalar point function – Equation of tangent plane and normal line to level surface.

Unit II

Divergence and curl of a vector point function – Solenoidal vector – Irrotational vector – Vector identities.

Vector Integration

Unit III

Vector integration – Line integral – Application of line integral .

Unit IV

Surface and Volume integrals – Applications - Gauss Divergence theorem
.

Unit V

Stoke's theorem – Green's theorem in plane .

Text Book

P. R. Vittal and V. Malini, Vector Analysis, Margham Publications, Chennai, 2006.

Unit I Chapter 1 Page 1 - 20
Unit II Chapter 1 Page 22 - 51
Unit III Chapter 2 Page 54 - 72
Unit IV Chapter 2 Page 75 - 106
Unit V Chapter 2 Page 108 - 140

References

1. T. K. Manickavasagam Pillay and Others , Vector Calculus, S. Viswanathan Publications.
2. S. Shanti Narayan, A Text Book of Vector Calculus, S. Chand and Co., New Delhi, 1966.
3. K. Viswanatham & S. Selvaraj, Vector Analysis, Emerald Publishers, Chennai, Reprint 1999.
4. P. Duraipandian, Laxmi Duraipandian, Vector Analysis, Emerald Publishers, Chennai, Reprint 2003.

Core Course III - Sequences and Series

Sem. III **Code : U17MA303**
Total Hrs. 75 **Credits : 4**

General objectives:

On completion of this course, the learner will

1. be able to understand the different types of sequences and subsequences.
2. be able to understand and the tools of testing the convergence of sequences in the light of metric spaces and the algebra of sequences.
3. be able to understand the convergence of series through convergence of sequences.
4. know the binomial, exponential and logarithmic series.

Learning outcome:

On completion of the course, the student will be able to test convergence of a given sequence and of a given series.

Unit I

Definition of a metric space – 'R' as a metric space with usual metric – Infinite Sequences – Bounded Sequences – Limit of a sequence– Convergent, Divergent and Oscillating Sequences.

Unit II

Properties of convergent and divergent sequences – Monotonic sequences – Behavior of monotonic sequences - Theorems on limits.

Unit III

Subsequences - Cauchy sequences – Cauchy's general principle of convergence. Infinite Series – Convergence, Divergence and oscillation of a series – General properties of series - Geometric series.

Unit IV

Cauchy's general principle of convergence for infinite series - Comparison test for convergence and divergence of series of positive terms – The k-series- Application of the comparison tests(simple problems) – Binomial theorem for rational index – Exponential theorem – Logarithmic series.

Unit V

An important property of convergent series - D'Alembert's ratio test with simple problems - Cauchy's root test - Cauchy's integral test and their simple problems– Raabe's test – Alternating series –Series of positive & negative terms - Tests for absolute convergence.

Text Book

M. K. Venkatraman and Manorama Sridhar, Sequences and Series, The National Publishing Company, 2002.

Unit I Chapter 2 § 2.1 – 2.6
Unit II Chapter 2 § 2.7 - 2.11
Unit III Chapter 2 § 2.12, 2.15, 2.16 Chapter 3 § 3.1 - 3.5
Unit IV Chapter 3 § 3.6 – 3.12 Chapter 4 § 4.4
Chapter 5 § 5.3 Chapter 6 § 6.1, 6.2
Unit V Chapter 3 § 3.13 – 3.16, 3.19, 3.20, 3.25 – 3.28

References

1. M. K. Singal and Asha Rani Singal, A First Course in Real Analysis , R. Chand & Co.,1984.
2. S. Arumugam, A. Thangapandi Isaac, Sequences and Series, New Gamma PublishingHouse, 1999.
3. T. K. Manicavachagom Pillay , T. Natarajan and K. S Ganapathy, Algebra (Volume 1), S. Viswanathan Pvt. Ltd., 2004.
4. Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd., 1970.

Core Course IV - Differential Equations and Laplace Transforms

Sem. III **Code : U14MA304**
Total Hrs. 75 **Credits : 4**

General objectives :

On completion of this course, the learner will

1. know methods of solving first order and second order and non-linear (first order) ordinary differential equations with constant and variable coefficients.
2. know methods of solving first order, higher degree partial differential equations of standard forms.
3. know methods of finding Laplace transforms and inverse Laplace transforms for real functions.
4. be able to apply Laplace transforms for solving ordinary differential equations.

Learning outcomes:

On completion of the course, the student will be able to

1. classify and solve specific types of ordinary and partial differential equations.
2. solve differential and integral equations using Laplace transforms.

Differential Equations

Unit I

Differential Equations - Linear differential equations with constant co-efficients – The operators D and D^{-1} – Particular Integral – Special methods of finding particular integral – Linear equations with variable co-efficients – To find the particular integral – Special method of evaluating the particular integral when x is of the form x^m.

Unit II

Exact differential equations – conditions of integrability of Mdx + Ndy = 0 – Practical rule for solving an exact differential equation – Rules for finding integrating factors – equations of the first order but of higher degree – Solvable for x, y, dy/dx – Clairaut's form – equations that do not contain x explicitly - Equations that do not contain y explicitly- Equations homogeneous in x & y.

Unit III

Partial differential equations - Derivation of partial differential equations by elimination of constants, arbitrary functions – Different Integrals of P.D.E. – Solutions of P.D.E. in some simple cases- Standard types of first order equations – Standard I, II, III, IV - Equations reducible to the standard forms - Lagrange's equation.

Laplace Transforms

Unit IV

The Laplace Transforms – Sufficient conditions for the existence of the Laplace Transforms – Laplace Transforms of periodic functions – General theorems – Evaluation of certain integrals using Laplace Transforms.

Unit V

The inverse transforms – Inverse transforms of functions – Method of partial fractions – Application of Laplace Transforms to solve ordinary differential equations.

Text Book

S. Narayanan & T. K. Manickavasagam Pillay, Calculus Volume III, S. Viswanathan Pvt. Ltd., 2008.

Unit I Chapter 2 § 1, 1.2, 2, 3, 4, 8, 8.1,8.2,8.3
Unit II Chapter 1 § 3.1 – 3.3, 4, 5, 5.1 – 5.5, 6.1, 7.1 - 7.3
Unit III Chapter 4 § 1, 2, 2.1, 2.2, 3, 4, 5, 5.1 – 5.5, 6
Unit IV Chapter 5 § 1, 1.1, 1.2, 2, 3.4, 5
Unit V Chapter 5 § 6, 7, 8, 9

References

1. P. R. Vittal, Differential Equations and Laplace Transforms, Margham Publications, 2004.
2. S. Sudha, Differential Equations and Integral Transforms, Emerald Publishers, 2003.

Allied Course III - Mathematical Statistics I

Sem. III **Code : U17MAS31**
Total Hrs. 60 **Credits : 4**

General objectives:

On completion of this course, the learner will

1. know continuous discrete random variables, their probability functions and distribution functions.
2. know the definition and properties of standard discrete distributions and their applications in analyzing data.
3. know methods of finding correlation and regression co-efficients between two data sets and their applications.

Learning outcome:

On completion of the course, the student will be able to analyse discrete and continuous data through measures of central tendency and measures of dispersions.

Unit I

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

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

Unit III

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

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

Unit V

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

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. Gaybill, 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.

Core Course V - Theory of Equations and Fourier Series

Sem. IV **Code : U16MA405**
Total Hrs. 90 **Credits : 5**

General objectives:

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.

Learning outcomes:

On completion of the course, the student will be able to

1. find roots of a given algebraic equation and find algebraic equation having given roots.
2. find Fourier series of a given periodic function.

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 2π - Odd and even functions.

Unit V

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

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. S. Arumugam, Issac, Trigonometry & Fourier Series 2000.
2. M. L. Khanna., Theory of Equations, Jaiprakash, Merrut, 1966.

Allied Course IV - Mathematical Statistics II

Sem. IV **Code : U17MAS42**
Total Hrs. 90 **Credits : 4**

General objectives:

On completion of this course, the learner will

1. know some standard continuous distributions.
2. know different sampling techniques.
3. know and apply tests of significance.
4. be able to deduce statistical inference of a data through sampling techniques.

Learning outcome:

On completion of the course, the student will be able to deduce statistical inference of a given data through sampling techniques.

Unit I

Bernoulli distribution – Binomial distribution – Poisson distribution - Rectangular distribution

Unit II

Normal distribution - Gamma distribution – Beta distribution of first and second kind – exponential distribution – Chi-square variate – derivation of the Chi-square distribution – MGF of Chi-square distribution.

Unit III

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

Unit IV

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

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

Text Book

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, 7.2, 7.3
	Chapter 8 § 8.1
Unit II	Chapter 8 § 8.2, 8.3 - 8.6
	Chapter 13 § 13.1 – 13.3
Unit III	Chapter 12 § 12.1 – 12.3
	Chapter 15 § 15.1 - 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.

Allied Practical – Mathematical Statistics III

Sem. IV **Code : U16MA4P1**
Total Hrs. 60 **Credits : 2**

General objectives:

On completion of this course, the learner will

1. be able to apply the software package R to derive statistical inferences.
2. know the different commands and packages available in R and their applications in different statistical studies.

Learning outcomes:

On completion of the course, the student will be able to

1. develop codes using R for analysing statistical data.
2. use different modules of R for different applications to analyse a data

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. One-way Between-Groups ANOVA
11. Unplanned and planned comparisons
12. Two-way Between-Groups ANOVA
13. Chi-square test of independence
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 VI – Algebra

Sem. V **Code : U16MA506**
Total Hrs. 105 **Credits : 6**

General objective:

On completion of this course, the learner will be able to understand various algebraic structures including sets, groups, rings and vector spaces and their properties.

Learning outcome:

On completion of the course, the student will be able to identify different algebraic structures, isomorphic and non-isomorphic structure.

Unit I

Groups-Subgroups-Cyclic groups-Order of an element-Cosets and Lagrange's Theorem.

Unit II

Normal subgroups and Quotient groups -Isomorphism and Homomorphism.

Unit III

Rings and Fields-Elementary properties of Rings-Isomorphism-Types of Rings - Characteristic of a Ring – Subrings-Ideals - Quotient rings -Homomorphism of Rings.

Unit IV

Vector Spaces –Subspaces –Linear Transformations-Span of a set-Linear independence.

Unit V

Basis and Dimensions –Rank and Nullity-Matrix of a Linear Transformation.

Text Book

N. Arumugam and A. Thangapandi Issac, Modern Algebra, Scitech Publishing House 2003. 5th Reprint July 2006.

Unit I Chapter 3 § 3.5 to 3.8
Unit II Chapter 3 § 3.9 to 3.11
Unit III Chapter 4 § 4.1 to 4.8 and 4.10
Unit IV Chapter 5 § 5.1 to 5.5
Unit V Chapter 5 § 5.6 to 5.8

References

1. M. L. Santiago, Modern Algebra, Tata McGraw Hill,2003
2. R. Balakrishnan and N. Ramabhadran, A Text Book of Modern Algebra, Vikas, New Delhi, 2000.
3. Shanthi Narayanan, A Text Book of Modern Abstract Algebra, S. Chand & Co., New Delhi, 1972.

Core Course VII – Real Analysis

Sem. V **Code : U16MA507**
Total Hrs. 105 **Credits : 6**

General objectives:

On completion of this course, the learner will

1. know the structure of real line.
2. know the properties of functions defined on the real line.

Learning outcomes:

On completion of the course, the student will be able to

1. analyse continuity, derivability, integrability of given real valued function and find derivatives, integrals of given real valued function through limits.
2. analyse the structure of the real line.

Unit I

Real number system – field axioms. Order relations in R. Absolute Value of a real number and its Properties – Supremum and infimum of a set. Order Completeness property – countable and uncountable sets.

Unit II

Continuous functions – Limit of functions – Algebra of limits – Continuity of function – Types of discontinues. Elementary properties of continuous functions and Uniform continuity of a function.

Unit III

Differentiability of a function – derivability and continuity – Algebra of derivatives – inverse function's theorem: Darboux's theorem on derivatives.

Unit IV

Rolle's theorem – Mean value theorems on derivatives Taylor's theorem with Remainder. Power series expansion.

Unit V

Riemann Integration – Definition – Darboux's theorem conditions for Integrability – Integrability of continuous and monotonic functions - Integral functions continuity and derivability of integral functions. The first mean value theorem and the fundamental theorem of calculus.

Text Books

1. M. K. Singal & Asha Rani Singal, A First Course in Real Analysis, R. Chand & Co., 2008 (Units I, II, III & IV).
2. Shanthi Narayan, A Course of Mathematical Analysis, S. Chand & Co.,1986. (Unit V)

Unit I	Chapter 1 – Section:1-10
Unit II	Chapter 5 – Section:1-8
Unit III	Chapter 6 – Section:1-5
Unit IV	Chapter 7 – Section:1-6
Unit V	Chapter 6

References

1. S. L. Gupta and N. R. Gupta, Principles of Real Analysis, Pearson Education Pvt. Ltd., New Delhi, Second Edition 2003.
2. Tom Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.

Core Course VIII – Mechanics

Sem. V **Code : U14MA508**
Total Hrs. 90 **Credits : 5**

General objectives:

On completion of this course, the learner will

1. know various methods of finding the resultant of a finite number of forces and methods of resolving forces.
2. be able to understand the effect of different types of forces acting at a point in equilibrium.
3. know the various properties of motion of a projectile, a simple harmonic motion and orbital motion.

Learning outcomes:

On completion of the course, the student will be able to

1. resolve a given force and find equation of catenary.
2. analyse the motion of a projectile.
3. analyse simple harmonic and orbital motions.

Statics

Unit I

Law of parallelogram of forces – Lami's theorem – Resolution of forces

Unit II

Like parallel forces – Unlike parallel forces – Moments – Varigon's theorem of moments – Generalized theorem of moments – Equation to common catenary – Tension at any point – Geometrical properties of common catenary.

Dynamics

Unit III

Projectiles – Path of a projectile – Time of flight – Horizontal range – Motion of a projectile up an inclined plane.

Unit IV

Definition of S.H.M. – Geometrical representation of S.H.M. – Composition of S.H.M. of the same period and in the same line – Composition of S.H.M's of the same period in two perpendicular directions.

Unit V

Radial and transverse components of velocity and acceleration – Differential equation of a central orbit – Given the orbit to find the law of force – Given the law of force to find the orbit.

Text Books

1. M. K. Venkataraman, Statics, Agasthiar Publications, 2007 (Units I & II)
2. M. K. Venkataraman, Dynamics, Agasthiar Publications, 2009 (Units III, IV & V).

Unit I	Chapter 2	§ 1 - 4 & § 9 – 16
Unit II	Chapter 3	§ 1 – 13
	Chapter 11	§ 1 – 9
Unit III	Chapter 6	§ 1 – 16
Unit IV	Chapter 10	§ 1 – 7
Unit V	Chapter 11	§ 1 – 13

References

1. K. Viswanath Naik, M. S. Kasi, Statics, Emerald Publishers, 1992.
2. K. Viswanath Naik, M. S. Kasi, Dynamics, Emerald Publishers, 1992.

Core Course IX –Numerical Methods

Sem. V **Code : U14MA509**
Total Hrs. 75 **Credits : 4**

General objectives:

On completion of this course, the learner will

1. know and apply different numerical techniques to solve algebraic and differential equations.
2. know methods of finding approximate values for definite integrals.

Learning outcome:

On completion of the course, the student will be able to solve algebraic, differential and integral equations numerically.

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

Finite differences – Differences of a polynomial - Factorial polynomial - 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 – 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 5 § 5.1, 5.2, 5.3, 5.4,
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. S. S. Sastry, Introducing Methods of Numerical Analysis, Prentice Hall of India Private Limited, New Delhi, 3rd Edition 2002.
2. M. K. Venkataraman, Numerical Methods in Science and Engineering, The National Publishing Company, Chennai, 2004.

Group Project

Sem. V **Code : U16MA5PJ**
Total Hrs. : 45 **Credits : 3**

Core Course X - Complex Analysis

Sem. VI **Code : U16MA610**
Total Hrs. 90 **Credits : 6**

General objectives:

On completion of this course, the learner will

1. know the definition of analytic functions and understand their properties.
2. know bilinear transformations and understand its properties.
3. be able to understand integration of complex valued functions and their higher derivatives.
4. be able to understand zeros and singularities of an analytic function and to apply their properties in the evaluation of definite integrals.

Learning outcomes:

On completion of the course, the student will be able to

1. identify analytic functions
2. analyse the effect of BT on the complex plane.
3. evaluate complex integrals through residues.

Unit I

Analytic functions – Continuous functions – Differentiability - Cauchy Riemann equations –Harmonic functions.

Unit II

Bilinear transformations – Cross ratio – Fixed points of a bilinear transformation – Some special bilinear transformations.

Unit III

Complex integration - Definite Integral – Cauchy's theorem – Cauchy's integral formula – Higher derivatives.

Unit IV

Series, Expansions – Taylor's series – Laurent's series – Zeros of an analytic function – Singularities.

Unit V

Calculus of residues – Cauchy residue theorem – Evaluation of definite integrals.

Text Book

S. Arumugam, A. Thangapandi Issac, A. Somasundaram, Complex Analysis, New Gamma Publishing House, 5th Reprint, January 2006 .

Unit I Chapter 2 § 2.4 - 2.8
Unit II Chapter 3 § 3.1 - 3.5
Unit III Chapter 6 § 6.1 - 6.4
Unit IV Chapter 7 § 7.1 - 7.4
Unit V Chapter 8 § 8.1 – 8.3

References

1. S. Narayanan, T. K. Manickavasagam Pillay, Complex Analysis, S. Viswanathan Printers & Publishers, 1989.
2. P. Duraipandian, Laxmi Duraipandian, D. Muhilan , Complex Analysis, Emerald Publishers, Revised Edition 2001.
3. Ruel V. Churchill, James Ward Brown, Complex Variables and Application, McGraw Hill Publishing Company, 5th Edition 1990.

Core Course XI - Discrete Mathematics

Sem. VI **Code : U16MA611**
Total Hrs.: 90 **Credits : 5**

General objectives:

On completion of this course, the learner will

1. know the formal languages.
2. be able to understand the applications of Lattices and Boolean algebra in compiling techniques.
3. be able to apply the knowledge of the formal languages in encoding and decoding of messages.

Learning outcomes:

On completion of the course, the student will be able to

1. construct compiling techniques based on lattices & Boolean algebra.
2. encode & decode messages through formal languages.

Unit I

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

Unit II

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

Unit III

Lattices – Some properties of Lattices – New Lattices – Modular and distributive Lattices.

Unit IV

Boolean Algebra – Boolean Polynomials – Karnaugh Map.

Unit V

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 § 1-4
Unit IV Chapter 10 § 5-7
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.

Core Course XII – Elementary Number Theory

Sem. VI **Code : U16MA612**
Total Hrs. 90 **Credits : 5**

General objectives:

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.

Learning outcomes:

On completion of the course, the student will be able to

1. analyse integers
2. solve problems in combinatorics

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

References

1. David M. Burton, Elementary Number Theory, Allyn and Bacon, Inc.,1980.
2. Ivan Niven and H. Zuckerman, An Introduction to Theory of Numbers, John Wiley & Sons; 5th edition, 1991.

Elective II – Mathematical Modeling

Sem. VI **Code : U16MA6:2**
Total Hrs. 90 **Credits : 5**

General objectives:

On completion of this course, the learner will

1. be able to understand physical systems through Mathematical models.
2. be able to understand applications of differential equations, difference equations and graph theory in Mathematical modeling.

Learning outcome:

On completion of the course, the student will be able to deduce inferences from a given mathematical model.

Unit I

Ordinary differential equation – Linear growth model – Growth of science and scientists – Non-linear growth and decay models – Diffusion of glucose or a medicine in the bloodstream.

Unit II

Modeling in population dynamics – Prey-predator models – Competition models – Multi-species models – Modeling of epidemics – Simple epidemic models – A model for diabetic-mellitus.

Unit III

Modeling in second order O.D. E. – Modeling of planetary motion – Motion under central force – Circular motion – Elliptic motion of a satellites – Rectilinear motion.

Unit IV

Modeling through difference equations – Linear difference equation – Obtaining complementary function by use of matrices – Harrod model – cob-web model – Applications of Actuarial science.

Unit V

Modeling through graphs – seven bridge problem – representing results of tournament – Genetic graph – Food web – Communication network – Matrices associated with a directed graph – Detection of clique – Terms of signed graph.

Text Book

J. N. Kapur, Mathematical Modeling, Wiley Eastern Limited, New Age International Pvt. Ltd., Reprint 2013.

Unit I Chapter 2 § 2.1 – 2.3 , 2.4.2
Unit II Chapter 3 § 3.1.1 – 3.1.3, 3.2.1 & 3.5.1
Unit III Chapter 4 § 4.1.1 – 4.3.1
Unit IV Chapter 5 § 5.2.1 – 5.2.6, 5.3.1, 5.3.2 & 5.3.4
Unit V Chapter 7 § 7.1.2 – 7.3.1

References

1. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East-West Press, New Delhi, 1985.
2. R. Olink, Mathematical Models in Social and Life Sciences, 1978.

Elective Course III - Operations Research

Sem. VI **Code : U16MA6:3**
Total Hrs. 90 **Credits : 5**

General objectives:

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.

Learning outcome:

On completion of the course, the student will be able to analyse and solve Linear Programming Problems, Transportation Problems, Assignment Problems, network & 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.

Elective Course - Graph Theory

Total Hrs. 90 **Credits: 5**

General objectives:

On completion of this course, the learner will

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

Learning outcomes :

On completion of the course, the student will be able to

1. identify standard graphs and list their properties.
2. use standard graphs to model different networks and study the networks.

Unit I

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

Unit II

Trees – Properties of trees – Pendent vertices in a tree – Distances and centre 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 Reparability.

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

Narasing 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 – 3.10 (except 3.6)
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.
1. F. Harray, Graph Theory, Narosa publishing House, New Delhi.
2. S. A. Chudum, Graph Theory, Macmillan India Limited, New Delhi

Elective Course : Fundamentals of Data Structures and Algorithms

Total Hrs. 90 **Credits: 5**

General Objectives

1. To understand the various representations of data.
2. To learn the different algorithms involved in sorting and finding the shortest path.

Unit I

Arrays and Sequential Representations: Ordered Lists – Stacks and Queues – Evaluation of Expressions – Multiple Stacks and Queues – Singly Linked Lists – Linked Stacks and Queues – Doubly Linked Lists and Dynamic Storage Management.

Unit II

Trees: Binary Tree Representations – Tree Traversal – Threaded Binary Trees – Binary Tree Representation of Trees – Graphs and Representations – Traversals, Connected Components and Spanning Trees – Shortest Paths: Single Source All Destinations – Activity Networks – Topological Sort and Critical Paths.

Unit III

Divide and Conquer: General Method – Binary Search – Finding the Maximum and Minimum – Merge Sort – Quick Sort – The Greedy Method: General Method – Knapsack Problem – Job Sequencing with Deadlock – Minimum Cost Spanning Trees: Krushcal's Algorithm – Optimal Storage on Tapes – Optimal Merge Patterns.

Unit IV

Dynamic Programming: General Method – Reliability Design – All Pairs Shortest Paths – 0/1 Knapsack Problem – The Traveling Salesperson Problem.

Unit V

Backtracking: The General Method – The 8-Queen's Problem – Graph Coloring – Hamiltonian Cycles – Knapsack Problem.

Text Book

1. Ellis Horowitz, Sartaj Sahni, Rajasekaran, *Fundamentals of Computer Algorithms*, Silicon Press, 2010.

References

1. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, Pearson Education, 2nd edition,2011.
2. Ellis Horowitz and Sartaj Sahni, *Fundamentals of Data Structure*, Galgotia Book House, 1978.
   www.studytonight.com/data-structures/

UG - Skill Based Elective Courses (SBEC)

Sem.	Course	Code	Title	Hrs./ week	Credits	Marks		
						CIA	ESA	Total
I	SBEC I	U14MA1S1	Mathematics for Competitive Examinations	2	2	25	75	100
III	SBEC II	U16MAPS2	Introduction to Scientific Computing (OCTAVE)	2	2	40	60	100
V	SBEC III	U14MAPS3	Programming in C (Linux OS)	2	2	40	60	100

SBEC Course I - Mathematics for Competitive Examinations

Sem. I **Code : U14MA1S1**
Total Hrs. 30 **Credits : 2**

General objective:

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

Learning outcome:

On completion of the course, the student will be able to solve arithmetic problems in various screening examinations.

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.

SBEC Course II – Introduction to Scientific Computing (OCTAVE)

Sem. III **Code : U16MAPS2**
Total Hrs. 30 **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.

Learning outcomes:

On completion of the course, the student will be able to

1. develop codes (using OCTAVE) to solve algebraic & differential equations.
2. trained in using different modules of OCTAVE to solve algebraic differential equations.

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

SBEC Course III – Programming in C (Linux OS)

Sem. V **Code : U14MAPS3**
Total Hrs. 30 **Credits : 2**

General objectives:

On completion of this course, the learner will

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

Learning outcomes:

On completion of the course, the student will be able to

1. develop codes in C to solve algebraic, differential & integral equations.
2. work in Linux operating systems.

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,1980.
4. T. Veerarajan and T. Ramachandran, Numerical Methods With Programs in C and C++, Tata McGraw-Hill Publishing Company Limited, 2004.

UG – Skill Based Courses (SBC)

Sem.	Course	Code	Title	Hrs./ week	Credit	Marks		
						CIA	ESA	TOTAL
IV	SBC– I	U16LFS41	Life Skills	2	1	100	-	100

LIFE SKILLS

Semester IV **Course code: U16LFS41**
Total Hrs : 30 **Credit 1**

General Objectives :

1. To acquire skills and abilities for adaptive and positive behavior that helps to deal effectively with the demands and challenges of everyday life.

2. To develop creative, communicative and critical thinking skills necessary for employability

Learning outcome:

On completion of the course, the student will be able to face interviews with confidence.

Unit I Basics of Communication skills & Effective Communication

Features of Communication – Process of Communication Verbal, non-verbal, Body Language – Postures & Etiquette –Listening& speaking Skills- Communication Barriers – Listening & speaking Skills.

Unit II Personal Effectiveness

Maslow's theory – Self-esteem- Role Conflict – Intra & Inter personal Skills – Efficiency Vs effectiveness – Team Building – Emotional Intelligence & Quotient

Unit III Interview Skills

Types of Interviews – Resume Formats & preparation - Cover letters – Simple rules to face interviews – Dos &Don'ts in a an Interview – Telephonic Interview and Etiquette - Group Discussions – Types – Methods – Ingredients and Tips for a Successful Group Discussion.

Unit IV Test of Reasoning & Numerical Ability

A. Numerical Ability: Problems related to Average – Percentage – Profit /Loss – Simple & Compound Interest- Time & Work – Boats & Streams etc.
B. Logical reasoning: Logical Detection – Nonverbal reasoning – Problems related to seating arrangements – Relationship model – Assertion & Reasoning etc.
C. Online Tests: Aptitude – Logical Reasoning – Problem Solving –Time management in Online tests- Online tests on Language skills- Aptitude and technical rounds

Unit V Outbound Learning

Physical, Mental, and emotional exercises

Texts for Reference:

1. Barun.K.Mitra, Personality Development and Soft Skills, 6th edition, Oxford University press Noida 2012.
2. M.Sarada, The complete Guide to Resume Writing, Sterling Publishers Pvt Ltd, New Delhi 2012.
3. Gloria J.Galances& Katherine Adams, Effective Group Disscussions,Theory & practice,12th Edition, Tata McGraw Hill pvt. Ltd. 2012.
4. Francis Soundararaj, Basics of Communication in English, Soft Skills for Listening Speaking, Reading& Writing, Macmillan Publishers India Ltd. 2013.

Scheme of Evaluation

1.	EQ test	10 Marks
2.	Resume	10 Marks
3.	Numerical Ability Test	10 Marks
4.	Online test 1(aptitude)	10 Marks
5.	Group Discussion	10 Marks
6.	Team Work	10 Marks
7.	OBL Observation / Work book	40 Marks
	Total	**100 Marks**

UG – Extra Credit Courses

Sem.	Course	Code	Title	Hrs.	Credits	Marks		
						CIA	ESA	TOTAL
V	I	UXMA5:1	Data Structures and Algorithms	-	2	-	100	100
	II	UXMA5:2	Fourier Transforms	-	2	-	100	100
VI	III	UXMA6:1	Fuzzy Mathematics	-	2	-	100	100
	IV	UXMA6:2	Simulation	-	2	-	100	100

Extra Credit Course-I –Data Structures and Algorithms

Sem. V **Code : UXMA5:1**
Credits : 2

General objective:

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

Learning outcome:

On completion of the course, the student will be able to analyse and create algorithms.

Unit I

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

Unit II

Algorithms analysis, Algorithms Design Paradigms. Lists : stacs, 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-II –Fourier transforms

Sem. V **Code : UXMA5:2**
Credits : 2

General objective:

On completion of this course, the learner will know the definitions, properties and applications of Fourier transforms

Learning outcome:

On completion of the course, the student will be able to solve Partial Differential Equations using Fourier Transforms.

Unit I

Introduction – Fourier integral theorem - Definition of Fourier transforms - Alternative form of Fourier complex integral formula – Problems

Unit II

Properties of Fourier transform – Convolution theorem - Parseval's identity

Unit III

Inverse Fourier transform – Problems

Unit IV

Finite Fourier transform

Unit V

Solution of Partial Differential equations using Fourier transforms

Text Book:

T.Veerarajan, Engineering Mathematics, third edition, Tata McGraw Hill Publishing Company Limited, New Delhi (2005)

Unit I	:	Chapter 6:Sections 6.1 – 6.4
Unit II & Unit III	:	Chapter 6:Sections 6.6
Unit IV & Unit V	:	Chapter 6:Section 6.7

Reference

J.K.Goyal and K.P.Gupta, Integral Transforms, K.K.Mittal for Pragati Prakashan, 7th edition(1995-96)

Extra Credit Course – III – Fuzzy Mathematics

Sem. VI **Code : UXMA6:1**
Credits : 2

General objectives:

On completion of this course, the learner will

1. be able to understand fuzzy logic as a tool for quantifying uncertainty
2. know to include factors of uncertainty in modeling so as to derive realistic solutions.

Learning outcome:

On completion of the course, the student will be able to identify fuzzy sets and perform set operations on fuzzy sets.

Unit I

Crisp Sets – Fuzzy Sets - Basic Types – Basic Concepts – Characteristics and Significance of the Paradigm shift.

Unit II

Additional properties of α-cuts-representations of fuzzy sets- Extension principle for fuzzy sets.

Unit III

Fuzzy set operations – Fuzzy complements – Fuzzy intersections: t-norms-Fuzzy Unions: t-conorms-combination of operations- Aggregation operations.

Unit IV

Fuzzy Numbers - Linguistic Variables – Arithmetic operations on intervals- arithmetic operations on fuzzy numbers.

Unit V

Lattice of fuzzy numbers-Fuzzy Equations.

References

1. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic Theory and Applications, Prentice Hall of India, 2002, New Delhi.
2. George J. Klir, Tina. A. Folger, Fuzzy Sets, Uncertainty and Informations, Prentice Hall of India, 2003.

Extra Credit Course – IV – Simulation

Sem. VI **Code : UXMA6:2**
Credits : 2

General objective:

On completion of this course the learner will be able to understand the theoretical aspects of simulation.

Learning outcome:

On completion of the course, the student will be able to model simple systems.

Unit I

Introduction to Simulation: Advantages and disadvantages, Area of application – systems and environmental components of a system – Discrete and continuous system – model of a system – types of models – Discrete – Event system simulation – steps in simulation study

Unit II

Simulation Examples: Simulation of Queuing systems – simulation of inventory systems – other examples.

Unit III

Random Number Generation – Properties of Random numbers – Techniques for Generating Random numbers – Generation of Pseudo-Random numbers – Tests for Random numbers – The Kolmogorov Smirnov test – The Chi-square test.

Unit IV

Random Variable Generation – Inverse transform techniques – Exponential distribution – Uniform distribution – Triangular distribution – Weibull distribution, Empirical continuous distribution, discrete distribution

Unit V

Direct transformation for the Normal and Lognormal distribution – convolution method – Acceptance – Rejection Technique

Text Book

Jerry Banks, John S.Carson, II, Barry L. Nelson, Davil M.NICOL, Discrete – Event System Simulation, Prentice-Hall of India Private Limited(2005)

Unit I Chapter 1 Sections 1.1 – 1.11
Unit II Chapter 2 Sections 2.1 – 2.3
Unit III Chapter 7 Sections 7.1, 7.2, 7.3, 7.4.1
Unit IV Chapter 8 Sections 8.1: 8.1.1 – 8.1.7
Unit V Chapter8 Sections 8.2, 8.3, 8.4