B. Sc Mathematics

Courses of study, Schemes of Examinations

& Syllabi

For the students admitted in the academic year 2020-2021

(Under Choice Based Credit System)

PG AND RESEARCH 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

2020 – 2021

Vision and Mission of the Department.

Our Vision

- ✓ To develop globally competent mathematicians through industry-linked, research-focused, technology-enabled seamless higher education in Mathematics and mould the young minds to serve for the betterment of the society with love and justice.

Our Mission

- ✓ Offer Competent and comprehensive curriculum and conducive environment for holistic development.
- ✓ Inculcate passion for research and perform widely recognized outstanding research in the fields of Mathematics, Statistics and the interdisciplinary areas
- ✓ Collaborate globally, construct industry - academia link and contribute for nation building

Program Outcome and Program Specific Outcomes

Program Outcomes (POs)

After successful completion of the program, the students will be able to:

KNOWLEDGE

PO1: Analyze problems and formulate appropriate mathematical models in various areas of Mathematics.

PO2: Demonstrate knowledge and understanding of pure and applied Mathematics in other disciplines of basic sciences, where the problem-solving techniques are required.

SKILLS

PO3: Express thoughts and ideas of mathematical statements which are validated by establishing the proofs using rigorous mathematical arguments.

PO4: Employ confidently the knowledge of mathematical software and tools for treating the complex mathematical problems and investigate scientific data.

PO5: Create mathematical models of empirical or theoretical phenomena in domains such as physical, natural, or social science.

PO6: Analyze given quantitative and qualitative data by employing different measures, draw conclusions using appropriate mathematical solving methods and communicate effectively.

ATTITUDES

PO7: Demonstrate critical thinking, creativity and lifelong learning necessary for various employment demands.

PO8: Make rigorous mathematical arguments, including how to prove and disprove conjectures.

ETHICAL & SOCIAL VALUES

PO9: Practice moral and ethical values in all walks of life and meet community expectations.

Programme Specific Outcomes (PSOs) – B.Sc.,

After successful completion of the program, the students will be able to:

INTELLECTUAL SKILLS

PSO1: Identify, determine, evaluate and effectively solve the practical problems using Mathematical arguments in a logical and technical manner.

PSO2: Exhibit knowledge and understanding in advanced areas of Mathematics, Statistics, computational packages and programming languages.

PRACTICAL SKILLS

PSO3: Critically analyze and solve real world problems that are expressed in terms of equations, numbers, algebraic structures, etc.

TRANSFERABLE SKILLS

PSO4: Formulate and use quantitative models to address problems arising in social science, business and other areas of science and technology

PG AND RESEARCH DEPARTMENT OF MATHEMATICS

Articulation Matrix 2020 -2021

Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
U14MA101	H	M	M	-	M	M	M	M	-	H	H	M	M
U14MA202	H	H	L	L	L	L	-	-	-	H	M	M	-
U14MA2:1	M	H	M	L	H	M	M	M	-	H	M	M	M
U17MA303	H	H	H	L	H	H	H	H	-	H	M	H	H
U14MA304	L	L	L	M	L	L	-	M	-	M	L	M	L
U17MAS31	H	H	H	H	H	H	M	M	-	H	M	H	H
U16MA405	H	L	L	L	L	L	L	-	-	L	M	L	L
U17MAS42	H	M	L	-	L	L	L	M	-	M	L	L	L
U20MA4P1	M	M	M	H	M	M	M	L	L	M	M	M	L
U16MA506	H	M	H	-	L	M	L	H	-	H	H	M	-
U16MA507	M	M	M	L	M	M	M	M	L	M	L	M	L
U14MA508	H	H	M	-	L	M	M	L	-	H	M	M	L
U14MA509	H	M	M	H	M	H	M	L	-	H	H	M	H
U16MA610	M	L	H	-	M	-	M	H	-	M	H	L	-
U16MA611	H	H	H	M	M	H	M	H	-	H	H	M	L
U16MA612	M	H	M	M	L	M	H	M	-	M	H	H	M
U16MA6:2	M	M	L	M	L	L	L	-	L	M	M	M	M
U20MA6:3	M	H	L	M	H	M	M	L	M	L	M	L	H
U14MA3E1	H	H	M	-	H	H	H	-	-	H	M	H	H
U14MAPE2	M	M	M	H	M	M	M	L	L	M	M	M	L
U14MA1S1	H	H	M	-	H	H	H	-	-	H	M	H	H
U16MAPS2	H	H	L	H	L	L	M	-	-	M	H	L	L
U16MAPS3	M	L	-	H	L	-	M	-	-	L	H	L	M
U20MAY11	H	M	M	-	M	M	M	M	-	M	M	M	L
U20MAY22	H	L	L	L	-	-	L	M	-	L	L	M	L
U20MAY23	H	H	M	M	-	-	L	-	-	H	H	M	L
U20MAC11	M	H	M	L	L	M	-	M	-	H	M	H	L
U20MAC22	H	L	L	L	-	-	L	M	-	L	L	M	-
U20MAC23	M	L	M	L	-	-	L	L	-	L	L	M	-
U20MAZ11	H	H	M	-	H	H	H	L	-	H	H	H	H
U20MAZ22 /U20MAA22	H	H	L	L	L	M	L	L	-	H	L	M	L
U20MAZ23 /U20MAA23	M	M	L	M	L	L	L	L	L	M	M	L	L

B. Sc Mathematics

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	13	62
Elective	3	15
Allied		
Allied (Physics/ Computer Science)	3	12
Allied (Statistics)	3	10
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. 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. MATHLAB
3. Mathematical Modelling
4. Operations Research
5. Graph Theory
6. Information Theory
7. Group Project

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

B.Sc. Mathematics

For the students admitted in the academic year 2020-2021

Sem.	Part	Course	Course Code	Course Title	Hrs / week	Credits	Marks		
							CIA	ESA	Total
I	I	Tamil I /*	U18TM1L1	செய்யுள், இலக்கிய வரலாறு, உரைநடை, சொற்பொழிவுக் கலை	6	3	25	75	100
	II	English I	U20EGNL1	Literature & Language: Prose &Short Stories	6	3	40	60	100
	III	Core I	U14MA101	Algebra, Trigonometry and Differential Calculus	5	4	25	75	100
		Allied I	U18PHY01/ 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.	U16EST11	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 /*	U18TM2L2	செய்யுள், இலக்கிய வரலாறு, சிறுகதை, சொற்பொழிவுக் கலை	6	3	25	75	100
	II	English II	U20EGNL2	Literature & Language: Poetryand Shakespear	6	3	40	60	100
	III	Core II	U14MA202	Integral Calculus and Analytical Geometry of ThreeDimensions	5	5	25	75	100
		Elective I	U14MA2:1 / U20MA2:2	Vector Calculus / MATHLAB	6	5	25	75	100
		Allied II	U18PHY02/ U16CSY22	Electricity, Atomic, Nuclear Physics and Electronics / Object Oriented Programmingwith JAVA	4	4	25	75	100
		Allied Practical	U16PHYP1 /U16CSYP1	Allied Physics Practical/ AlliedComputer Science Practical	3	4	40	60	100
III	I	Tamil III/*	U18TM3L3	செய்யுள் – காப்பியங்கள், இலக்கிய வரலாறு, நாவல், சொற்பொழிவுக் கலை	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 andLaplace Transforms	5	4	25	75	100
		Allied III	U17MAS31	Mathematical Statistics I	4	4	25	75	100
	IV	SBEC II	U16MAPS2	Introduction to ScientificComputing (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	Hrs / week	Credits	Marks		
							CIA	ESA	Total
IV	I	Tamil IV /*	U18TM4L4	செய் யுள் (மேற்கணக்கு, கீழ்கணக்கு), இலக்கிய வரலாறு	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	6	4	25	75	100
		Allied Practical	U20MA4P1	Mathematical Statistics III	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	6	5	25	75	100
		Core VII	U16MA507	Real Analysis	6	6	25	75	100
		Core VIII	U14MA508	Mechanics	6	5	25	75	100
		Core IX	U14MA509	Numerical Methods	5	4	25	75	100
		Core Project	U16MA5PJ	Project	5	5	40	60	100
	IV	SBEC III	U16MAPS3	Programming in C (Linux OS)	2	2	40	60	100
VI	III	Core X	U16MA610	Complex Analysis	6	5	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 Modelling	6	5	25	75	100
		Elective III	U20MA6:3 / U20MA6:4	Operations Research / Information Theory	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	U18HD1L1	U17SK1L1	U18FR1L1	Semester III	U18HD3L3	U17SK3L3	U18FR3L3
Semester II	U18HD2L2	U17SK2L2	U18FR2L2	Semester IV	U18HD4L4	U17SK4L4	U18FR4L4

NMEC offered by the Department	1. Mathematics for Competitive Examinations	U14MA3E1
	2. Statistical Applications (Practical's)	U14MAPE2

Core Course I: ALGEBRA, TRIGONOMETRY AND DIFFERENTIAL CALCULUS

Semester: I **Course Code: U14MA101**

Credit: 4 **Hours/Week: 5**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
CO1	Find the Eigen values, Eigen vectors of a given matrix and diagonalize the matrices.	**K3**	**I**
CO2	Describe circular functions as a series	**K5**	**II**
CO3	Formulate Curvature, Radius of curvature, Evolutes and Involutes of any curve	**K5**	**III**
CO4	Examine the higher derivatives, Maxima and Minima of given functions.	**K4**	**IV**
CO5	Apply higher derivatives in the practical situation problems.	**K3**	**IV**
CO6	Verify Euler's theorem for partial differentiation	**K6**	**V**

2A. SYLLABUS

Unit I: Algebra **(15 hours)**

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

Unit II: Trigonometry **(15 hours)**

Expansion of cos nθ, sin nθ and tan nθ (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 cosθ, sin θ and tan θ in terms of θ - Hyperbolic functions – Relation between the circular and hyperbolic functions.

Unit III: Differential Calculus **(15 hours)**

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

Unit IV: Maxima and Minima **(15 hours)**

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 **(15 hours)**

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

B. TOPICS FOR SELF STUDY

Sl. No.	Topics	Web Links
1	Continued fractions	http://www.maths.surrey.ac.uk/hostedsites/R.Knott/Fibonacci/cfINTRO.html
2	Summation of trigonometrical series	https://www.youtube.com/watch?v=qPO7Zg57T74
3	Tracing of curves	https://www.youtube.com/watch?v=zMU2dVRgW6g
4	Applications of Maxima and Minima	https://www.youtube.com/watch?v=63xO_LhF8zoS

C. TEXTBOOK(s)

1. T. K. Manichavasagam 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. Manichavasagam Pillay, Trigonometry, S. Viswanathan (Printers and Publishers) Pvt. Ltd., Reprint 2009 (Unit II).
3. S. Narayanan and T. K. Manichavasagam 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

D. REFERENCE BOOKS

1. Dr Perumal Mariappan, Differential Calculus – An Application, New Century Book House, Pvt. Ltd, Chennai.
2. Dr P Mariappan and Others, Algebra, Calculus and Analytical Geometry of 3D, 1st Edition, New Century Book House, Pvt. Ltd, Chennai.
3. Dr P. Mariappan and Others, Vector Calculus and Trigonometry, New Century Book House, Pvt. Ltd, Chennai.
4. S. Sudha, Algebra, Analytical Geometry of (2D) and Trigonometry, Emerald Publishers, Chennai, First Edition 1998.
5. S. Sudha, Calculus, Emerald Publishers, Chennai, First Edition 1998.

E. WEB LINKS

1. https://lib.alfaisal.edu/pdf/AlgebraAndTrigonometry-LR.pdf
2. https://amsi.org.au/ESA_Senior_Years/PDF/IntroDiffCall3b.pdf

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit / Section	Course Content	Learning Outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Cayley Hamilton Theorem**		
1.1	Characteristic equation	Find the characteristic equations of the square matrix.	K5
1.2	Eigen Values	Find the Eigen values of the given matrices	K5
1.3	Eigen vectors	Find the Eigen vectors of the given matrices	K5

1.4	Cayley-Hamilton theorem.	Verify Cayley Hamilton theorem for the given square matrices	K6
1.5	Inverse of the matrix	Find the inverse of the matrices using Cayley Hamilton theorem	K5
1.6	Diagonalisation of the matrices	Diagonalise the Square matrix	K5
II	**Expansion of Trigonometric series**		
2.1	Expansion of cos nθ, sin nθ and tan nθ (n is a positive integer)	Expand the trigonometric functions in a series of sines, cosines and tangents	K4
2.2	Derivations and problems	Derive the expansion of the trigonometric functions	K5
2.3	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	Expand the trigonometric functions	K4
2.4	Expansion of cosθ, sin θ and tan θ in terms of θ	Expand the trigonometric functions in a series of sines, cosines and tangents	K4
2.5	Hyperbolic functions	Express circular functions in Hyperbolic and inverse hyperbolic functions	K3
2.6	Relation between the circular and hyperbolic functions	Derive the relation between circular and hyperbolic functions	K5
III	**Curvature Evolutes and Involutes**		
3.1	Leibnitz formula for the n^{th} derivative of product	Find the nth derivative of given function	K5
3.2	Curvature	Evaluate the Curvature for any curve	K6
3.3	Circle, radius, and centre of curvature	Evaluate radius and centre of the curvature for any curve	K6
3.4	Cartesian Formula for the radius of curvature	Derive the Cartesian formula for the radius of curvature for any curve	K4
3.5	The co-ordinates of the centre of curvature	Evaluate the co-ordinates of the centre of curvature for any given curve	K6
3.6	Evolutes	Find the Evolutes of any curve	K5
3.7	Involutes	Find the Involutes of any curve	K5
3.8	Radius of curvature (polar co-ordinates).	Derive the radius of curvature in polar co-ordinates for any given curve	K5
IV	**Maxima and Minima**		
4.1	Meaning of the derivative	Find the derivative of the function	K5
4.2	Meaning of the sign of the differential coefficient	Find the sign of the differential co-efficient	K5
4.3	Related Problems	Find whether the function is increasing or decreasing.	K5
4.4	Maxima and Minima	Find the maxima and minima of given function.	K5
4.5	Conditions for maximum and	Derive the Conditions for maximum and minimum values of f(x)	K6

	minimum values of f(x)		
4.6	Related problems	Determine the maxima and minima of the given problem	K6
V	**Partial Differentiation**		
5.1	Partial differentiation Total differential coefficient	Find the total differential coefficient for the given functions	K5
5.2	Implicit functions	Find the implicit function for the given functions	K5
5.3	Homogeneous function	Verify Euler's theorem for the given curve	K6
5.4	Maxima and minima of functions of two variables.	Find the maxima and minima for the functions with two variables	K5

4. MAPPING SCHEME (POs, PSOs AND COs)

U14MA101	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	L	M	-	M	M	M	M	-	H	H	M	M
CO2	H	M	M	-	M	L	M	M	-	H	H	M	M
CO3	H	L	M	-	L	M	M	M	-	H	M	H	H
CO4	H	M	M	-	L	M	M	M	-	H	H	M	M
CO5	H	M	M	-	M	L	M	M	-	H	H	M	M
CO6	H	L	M	-	L	H	M	M	-	H	H	M	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mrs. B. Abinaya

Core course II: INTEGRAL CALCULUS AND ANALYTICAL GEOMETRY OF THREE DIMENSIONS

Semester: II **Course Code: U14MA202**

Credits: 5 **Hours/Week: 5**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
CO1	Evaluate the solution of integrals of some functions	**K5**	**I**
CO2	Solve complex integrals by beta and gamma functions	**K3**	**II**
CO3	Evaluate Multiple integrals	**K5**	**III**
CO4	Explain straight line in three dimensions	**K5**	**IV**
CO5	Interpret about sphere	**K5**	**V**
CO6	Illustrate tangent plane to a given sphere	**K2**	**V**

2A. COURSE CONTENT

Unit I: Integrals of some function **(15 hours)**

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) $\int dx / (a+b\cos x)$ - Properties of definite integrals – Integration by parts.

Unit II: Beta, Gamma functions **(15 hours)**

Reduction formula, Beta and Gamma functions.

Unit III: Multiple Integrals **(15 hours)**

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

Unit IV: Straight Line **(15 hours)**

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

Unit V: Sphere **(15 hours)**

Sphere – Standard equation – Length of the tangent from any point – Sphere passing through a given circle – Intersection of two spheres – tangent plane.

B. TOPICS FOR SELF STUDY

Sl. No.	Topics	Web Links
1	Shell integration	https://math.libretexts.org/ The Shell Method
2	Kinetic energy improper integrals	https://www.whitman.edu/mathematics/calculus online/section09.07.html
3	Numerical Integration	https://www.whitman.edu/mathematics/calculus online/section08.06.html

4	Calculus with parametric equations	https://www.whitman.edu/mathematics/calculus_online/section10.05.html

C. TEXTBOOK(S)

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

D. REFERENCE BOOKS

1. Dr Perumal Mariappan, Integral Calculus – An Application, New Century Book House, Pvt. Ltd, Chennai.
2. Dr P Mariappan and Others, Algebra, Calculus and Analytical Geometry of 3D, 1st Edition, New Century Book House, Pvt. Ltd, Chennai.
3. Shanthi Narayanan and Mittal P.K., Analytical Solid Geometry, 16th Edition, S. Chand & Co., New Delhi, 1999.

E. WEB LINKS

1. NPTEL: Mathematics - NOC: Multivariable Calculus
2. SWAYAM: Integral Calculus by Prof. Hari Shankar Mahato | IIT Kharagpur

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit / Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Integrals of some functions**		
1.1	(i) $\int [(px+q) / (ax^2+bx+c)]dx$	Find the value of integrals	K5
1.2	(ii) $\int [(px+q) / (\sqrt{(ax^2+bx+c)})]dx$	Evaluate integral function	K5
1.3	(iii) $\int [(px+q)\sqrt{(ax^2+bx+c)}]dx$	Find the value of integrals	K5
1.4	(iv) $\int dx /(a+bcosx)$	Determine the value of integrals	K5
1.5	Properties of definite integrals.	List out the properties of definite integrals	K1
1.6	Integration by parts	Evaluate some integral function	K5
II	**Beta, Gamma functions**		
2.1	Reduction formula	Solve integrals using reduction formula	K3
2.2	Beta functions	Show that integrals by using beta function	K2
2.3	Gamma functions	Evaluate integral function using gamma function	K5
III	**Multiple Integrals**		
3.1	Double integral	Evaluate double integral	K5
3.2	Change the order of integration	Evaluate by changing the order of integration	K5

3.3	Triple integral	Evaluate volume of an integral	K5
IV	**Straight Line**		
4.1	Equation of the straight line	Interpret the forms of straight-line equations	K2
4.2	shortest distance between two skew lines	Find the shortest distance between skew lines.	K1
4.3	Equation to the line of shortest distance	Find the equation to the line of shortest distance	K1
V	**Sphere**		
5.1	Standard equation of sphere	Define sphere and its general equation	K1
5.2	Length of the tangent from any point	Find length of tangent from any point of sphere	K1
5.3	Sphere passing through a given circle	Find equation of sphere passing through a circle	K1
5.4	Intersection of two spheres	Interpret intersection of spheres is a circle	K2
5.5	Tangent plane	Show that the plane touches sphere	K2

4. MAPPING SCHEME (POs, PSOs AND COs)

U14MA202	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	M	-	M	M	-	-	H	M	M	-
CO2	M	H	M	M	L	M	-	-	-	H	M	M	-
CO3	H	H	-	M	L	M	-	-	-	H	M	M	-
CO4	H	H	M	M	M	L	-	-	-	H	M	M	-
CO5	H	H	-	-	M	-	-	-	-	H	M	L	-
CO6	H	M	-	-	M	-	-	-	-	H	M	L	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. K. Srinivasan

Elective Course I: VETOR CALCULUS

Semester: II **Course Code: U14MA2:1**

Credits: 5 **Hours/Week: 6**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
C01	Explain about derivative of vector and scalar functions	**K5**	**I**
C02	Evaluate gradient and directional derivative of scalar point functions	**K5**	**I**
CO3	Estimate divergence and curl of a vector point functions	**K6**	**II**
CO4	Determine vector integration	**K5**	**III**
CO5	Evaluate line, surface and volume integrals	**K5**	**IV**
CO6	Apply Stoke's and Greens theorem to compute the integrals	**K3**	**V**

2A. SYLLABUS

Unit I: Derivatives of Vector and Scalar Functions **(20 hours)**

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 of Vector Functions **(18 hours)**

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

Unit III: Line Integrals **(18 hours)**

Vector integration – Line integral – Application of line integral.

Unit IV: Volume Integrals **(18 hours)**

Surface and Volume integrals – Applications - Gauss Divergence theorem.

Unit V: Surface Integrals **(16 hours)**

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

B. TOPICS FOR SELF STUDY

Sl. No.	Topics	Web Links
1	Chain Rule with more variables	https://ocw.mit.edu/Chain rule with more variables
2	Two-Dimensional Flux	https://ocw.mit.edu/courses/mathematics/-greens-theorem/session-69-flux-in-2d
3	Extended Greens Theorem	https://ocw.mit.edu/courses/extended-greens-theorem-boundaries-with-multiple-pieces
4	Maxwells Equations	https://ocw.mit.edu/maxwells-equations

C. TEXTBOOK(S)

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

D. REFERENCE BOOKS

1. Dr. P. Mariappan and Others, Vector Calculus and Trigonometry, New Century House, Pvt. Ltd, Chennai.
2. T. K. Manickavasagam Pillay and Others, Vector Calculus, S. Viswanathan Publications.
3. S. Shanti Narayan, A Text Book of Vector Calculus, S. Chand and Co., New Delhi, 2003.

E. WEB LINKS

1. NPTEL: Mathematics - NOC: Multivariable Calculus
2. SWAYAM: Vector Calculus by Prof. Hari Shankar Mahato | IIT Kharagpur

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit / Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Derivatives of Vector and Scalar Functions**		
1.1	Limit of a vector function	Illustrate the concept of vector function	K2
1.2	Continuity of vector functions	Explain about the continuity of vector function	K2
1.3	Derivative of a vector function	Find derivatives of vector function	K1
1.4	Geometrical significance of vector differentiation	Relate the vector functions geometrically	K2
1.5	Scalar point functions	Illustrate scalar point function	K2
1.6	vector point functions	Illustrate scalar point function	K2
1.7	Level surface	Understanding concept of level surface	K2
1.7	Physical application of derivatives of vectors	Apply the concept of derivatives of vectors	K3
1.8	Partial derivatives of a vector function	Explain the concept of partial derivatives	K2
1.9	Gradient of a scalar point function	Determine Gradient and directional derivative of vector functions.	K5
1.10	Directional derivative of a scalar point function	Evaluate directional derivative of vector function	K5
II	**Divergence of Vector Functions**		
2.1	Divergence of a vector functions	Understanding the facts of Divergence of vector functions	K2
2.2	Curl of a vector point function	Find Curl of Vector functions	K1
2.2	Solenoidal vector	Show that given vectors are solenoidal	K2

2.3	Irrotational vector	Prove that given vectors are irrotational	K5
2.4	Vector identities	Relating the equality of vector functions	K2
III	**Line Integrals**		
3.1	Vector integration	Apply vector point function in integrals	K3
3.2	Line integral	Illustrate the line integrals	K2
3.3	Application of line integral	Evaluate Line Integrals	K5
IV	**Volume Integrals**		
4.1	Surface Integrals	Explain about surface integrals	K2
4.2	Volume integrals	Interpret volume integrals	K2
4.3	Applications of surface integrals	Evaluate surface integrals	K5
4.4	Applications of volume integrals	Evaluate volume integrals	K5
4.5	Gauss Divergence theorem	Prove and evaluate vector function using Gauss divergence theorem	K5
V	**Surface Integrals**		
5.1	Stoke's theorem	Compare surface integral and line integral	K5
5.2	Evaluate surface integrals by Stoke's theorem	Evaluate surface integrals	K5
5.3	Green's theorem	Apply Green's theorem to evaluate integrals	K3
5.4	Green's theorem in plane	Evaluate vector function using Gauss divergence theorem	K5

4. MAPPING SCHEME (POS, PSOs AND COs)

U14MA2:1	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	M	H	M	-	H	H	M	M	-	H	M	M	M
CO2	M	H	M	-	H	M	M	M	-	H	M	M	M
CO3	M	H	M	-	M	M	L	M	-	H	M	M	M
CO4	M	H	M	M	M	M	M	M	-	H	M	M	M
CO5	M	H	M	M	H	M	M	L	-	H	M	H	H
CO6	M	H	M	M	H	M	H	L	-	H	M	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. K. Srinivasan

Elective Course I – MATHLAB

General objectives & Learning outcomes:

On completion of this course, the learner will

1. know the essential commands of MATLAB.
2. know how to solve flow problems using MATLAB.
3. be able to apply SIMULINK in population dynamics, Linear Economic models and Linear Programming Problems

Unit I

MATLAB Basics – Input and Output – Arithmetic – Algebra – Symbolic Expressions, Variable Precision, and Exact Arithmetic – Managing Variables – Errors in Input – Online Help – Variables and Assignments – Solving Equations – Vectors and Matrices - Vectors – Matrices – Suppressing Output – Functions – Built-in functions – User - defined functions - Graphics – The MATLAB Interface – M-Files – Loops

Unit II

Suppressing Output – Data Classes – Functions and Expressions - More about M-Files – Complex Arithmetic – More on Matrices – Doing Calculus with MATLAB – Default variables- MATLAB Graphics – Two- Dimensional Plots – Three - Dimensional Plots- Special Effects – Customizing and Manipulating Graphics – Sound.

Unit III

M-Books - MATLAB Programming – Branching – More about Loops – Other Programming Commands – Interacting with the Operating System .

Unit IV

SIMULLINK and GUIS SIMULINK - Applications – Mortgage Payments – Monte Carlo Simulation - Population Dynamics – Linear Economic Models - Linear Programming – The 360 ◦ Pendulum.

Unit V

Applications (continued) -Numerical Solution of the Heat Equation – A Model of Traffic flow- Troubleshooting.

Text Book

Brian R.Hunt, Ronald L.Lipsman, Jonathan M. Rosenberg "A guide to MATLAB beginners and Experienced Users", Cambridge University Press edition, 2008.

Unit I Chapter 2 & 3
Unit II Chapter 4 & 5
Unit III Chapter 6 & 7
Unit IV Chapter 8 & 9 upto page 184
Unit V Chapter 9 (Pages 184 to 203) & Chapter 11 Practicals only

References

1. Website: www.ann.jussieu.fr/free.htm
2. MATLAB – The language of technical computing, The MATH WORKS Inc., Version 5 1996

(http: \\www.mathworks.com)
3. L.F. Shampine, I.Gladwell, S. Thompson , Solving ODEs with MATLAB, Cambridge University press 2003.

Core Course III: SEQUENCES AND SERIES

Semester: III **Course Code: U17MA303**

Credits: 4 **Hours/Week: 3**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
CO 1	Explain on basic terminology and convergence of sequences	**K5**	**I**
CO 2	Illustrate properties of convergent and divergent sequences.	**K2**	**II**
CO 3	Solve problems by applying properties	**K3**	**II**
CO 4	Explain the behavior of series and convergence of geometric series	**K5**	**III**
CO 5	Determine if a series convergent or divergent by applying various test	**K5**	**IV**
CO 6	Solve the alternating series problems.	**K3**	**V**

2A. SYLLABUS

Unit I: Infinite sequences (14 hours)

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 (16 hours)

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

Unit III: Cauchy sequence and infinite series (15 hours)

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 series (15 hours)

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: Various types of tests for convergence and divergence (15 hours)

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.

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Sequence of functions	https://mathcs.org/analysis/reals/funseq/pconv.html
2	Power Series	https://www.whitman.edu/mathematics/calculus_online/chapter11.html

3	Application of sequences and series	https://www.utas.edu.au/mathematics-pathways/pathway-to-engineering/supporting-modules-8-12
4	Series of complex numbers and its convergence	https://complex-analysis.com/content/series.html

C. TEXTBOOK(s)

1. 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

D. REFERENCE BOOKS

1. M. K. Singal and Asha Rani Singal, A First Course in Real Analysis, R. Chand & Co., 2008.
2. S. Arumugam, A. Thangapandi Isaac, Sequences and Series, New Gamma Publishing House, 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., 2017.

E. WEB LINKS

1. https://nptel.ac.in/courses/122/104/122104017/
2. https://nptel.ac.in/courses/111/106/111106053/

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit / Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
Unit - I	**Infinite Sequences**		
1.1	Introduction of infinite sequences	Explain infinite sequence	K2
1.2	Bounded sequences	Explain bounded sequences	K2
1.3	Convergent sequences	Describe the definition of convergent sequence and analyze the definition geometrically	K4
1.4	Null sequences	Analyze the concept of null sequences and its properties	K4
1.5	Divergent and Oscillating sequences	Describe the definition of divergent sequence and analyze the definition geometrically	K4
Unit II	**Properties of convergent and divergent sequences**		
2.1	Properties of convergent and divergent sequences	Explain properties of convergent and divergent sequences	K2

2.2	Monotonic sequences	Explain monotonic sequence	K2
2.3	Behavior of Monotonic Sequences	Analyze the monotonic sequence of convergence geometrically	K4
2.4	Theorems on limits	Solve the problem using Cauchy's limit theorems	K3
Unit III	**Cauchy sequence and Infinite series**		
3.1	Subsequences	Explain subsequences	K2
3.2	Cauchy sequences and Cauchy's general principle of convergence	Analyze Cauchy's principle of convergence	K4
3.3	Infinite series and Convergence, Divergence and Oscillation of a series	Explain series of convergence and divergence through sequence convergence	K2
3.4	General properties of Series and the Geometric series	Analyze the Geometric series of convergence	K4
Unit IV	**Cauchy's general principle of convergence for series**		
4.1	Cauchy's general principle of convergence for infinite series	Analyze the Cauchy's principle	K4
4.2	Comparison test for convergence and divergence of a series and k-series	Analyze the comparison test and k-series and apply this test to solve problems	K4
4.3	Binomial theorem for rational index	Determine the limit of binomial series	K5
4.4	Exponential theorem	Analyze the exponential series convergence	K4
4.5	Logarithmic series	Analyze the logarithmic series convergence	K4
Unit V	**Various types of test for convergence and divergence**		
5.1	D' Alembert ratio test	Analyze the D' Alembert ratio test for convergence and divergence	K4
5.2	Cauchy's root test	Solve problems by using Cauchy root test	K3
5.3	Cauchy's integral test	Solve problems by using integral test	K3
5.4	Raabe's test	Solve problems by using Raabe's tests	K3
5.5	Alternating series	Analyze the Leibnitz's test for convergence	K4
5.6	Series of positive and negative terms and test for absolute convergence	Explain the absolute convergence and conditionally convergent	K2

4. MAPPING SCHEME (Pos, PSOs AND COs)

U17MA303	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	M	M	H	H	H	-	H	M	M	M
CO2	H	H	H	M	H	H	H	H	-	H	M	M	M
CO3	H	H	H	-	H	H	H	H	-	H	M	H	H
CO4	H	H	H	-	H	H	H	H	-	H	M	H	H
CO5	H	H	H	-	H	H	H	H	-	H	M	H	H
CO6	H	H	H	-	H	H	H	H	-	H	M	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. N. Lakshmi Narayanan

Core Course IV: DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Semester: III **Course Code: U14MA304**

Credits: 4 **Hours/Week: 5**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Solve ordinary differential equations of first and second order.	**K3**	**I**
CO2	Find Particular integral for various forms of X.	**K5**	**I**
CO3	Solve exact differential equations of first order but of higher degree.	**K3**	**II**
CO4	Identify the standard form of partial differential equation.	**K4**	**III**
CO5	Define Laplace and inverse Laplace transforms.	**K3**	**IV**
CO6	Apply Laplace transforms to solve differential equations.	**K6**	**V**

2A. SYLLABUS

Unit I: Differential Equations (20 hours)

Differential Equations - Linear differential equations with constant coefficients – The operators D and D^{-1}– Particular Integral – Special methods of finding particular integral – Linear equations with variable coefficients – 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 (20 hours)

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 thatdo not contain x explicitly - Equations that do not contain y explicitly- Equations homogeneous in x & y.

Unit III: Partial differential equations (15 hours)

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.

Unit IV: Laplace Transforms (10 hours)

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 (10 hours)

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

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links
1	Differential Equations of higher order	https://www.math.ucdavis.edu/~tracy/courses/math22B/22BBook.pdf
2	Orthogonal Families of Curves	https://vardhaman.org/wp-content/uploads/2018/12/Mathematics-I.pdf
3	One Dimensional Wave and Heat Equation	http://egov.uok.edu.in/eLearningDistance/tutorials/7970_4_2017_170727143335.pdf
4	Applications of Laplace transform	https://math.mit.edu/~jorloff/18.04/notes/topic12.pdf

C. TEXTBOOK(s)

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

D. REFERENCE BOOKS

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

E. WEB LINKS

1. https://nptel.ac.in/courses/111/106/111106100/
2. https://nptel.ac.in/courses/111/106/111106139/

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit / Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Differential Equations with constant coefficients**		
1.1	Linear differential equations with constant co-efficient	Identify a linear differential equation with constant coefficient	K3
1.2	The operators D and D^{-1}	Define the operators D and D^{-1}	K1
1.3	Special methods of finding particular integral	Solve Differential equations with different forms of X	K3
	Differential Equations with variable coefficients		
1.4	Linear differential equations with variable coefficients	Identify a linear differential equation with Variable coefficient	K3
1.5	Special methods of finding particular integral	Solve Differential equations with different forms of X	K3
II	**Exact differential equations**		
2.1	Exact differential equations	Define an Exact differential equation	K1
2.2	conditions of integrability of Mdx + Ndy = 0	Construct the condition of integrability	K6
2.3	Practical rule for solving an exact differential equation	List the rules for solving an Exact differential equation	K4

2.4	Rules for finding integrating factors	Formulate rules for finding integrating factors	K6
2.5	Equations of the first order but of higher degree	List types of equations of first order but of higher degree	K4
2.6	Solvable for x, y, dy/dx	Solve equations of the form f(x,y,p)=0 and solve for x, y, dy/dx	K3
2.7	Clairaut's form	Define Clairaut's form to solve the special case	K1
2.8	Equations that do not contain x, y explicitly and homogeneous in x and y	Solve equations that do not contain x and y explicitly	K3
III	**Partial Differential Equations**		
3.1	Derivation of partial differential equations by elimination of constants and arbitrary functions	Design PDE by elimination of constants	K6
3.2	Derive PDE by elimination of constants	List the different integrals of PDE	K4
3.3	Standard types of first order equations	Create the standard types of first order equations	K6
3.4	Standard I, II, III, IV	Solve the standard types of first order equations	K3
3.5	Equations reducible to the standard forms	Identify the equations reducible to standard forms	K3
3.6	Lagrange's equation	Solve Lagrange's equations	K3
IV	**Laplace Transforms**		
4.1	Laplace Transforms	Define Laplace Transforms	K1
4.2	Sufficient conditions for the existence of the Laplace Transforms	Identify the condition for existence of Laplace transforms	K3
4.3	Laplace Transforms of periodic functions	Evaluate the Laplace transforms for periodic functions	K5
4.4	General theorems	List various theorems on Laplace transforms	K4
4.5	Evaluation of certain integrals using Laplace Transforms	Identify certain integrals and solve using Laplace transform	K3
V	**Inverse Laplace Transforms**		
5.1	Inverse transforms of functions	Define inverse Laplace transforms	K1
5.2	Method of partial fractions	Evaluate Laplace transforms using the method of Partial fractions	K5
5.3	Application of Laplace Transforms to solve ordinary differential equations	Apply Laplace transforms to solve Ordinary differential equations	K3

4. MAPPING SCHEME (POs, PSOs AND COs)

U14MA304	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	H	L	H	L	L	L	M	-	M	M	H	L
CO2	L	L	L	H	L	M	-	M	-	H	M	H	L
CO3	L	M	M	M	L	L	-	L	-	M	L	L	L
CO4	-	-	-	-	-	L	-	L	-	L	-	L	L
CO5	M	-	L	L	L	L	-	L	-	L	L	L	-
CO6	M	M	M	H	L	M	-	M	-	M	M	M	L

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. P. Ambika

Allied course III: MATHEMATICAL STATISTICS I

Semester: III **Course Code: U17MAS31**

Credits: 4 **Hours/Week: 4**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
CO1	Analyse statistical data using the measure of central tendency, measures of dispersion, skewness, and kurtosis.	**K4**	**I**
CO2	Apply the basic probability rules under additive and multiplication laws, illustrating independent and mutually exclusive events	**K3**	**II**
CO3	Identity the characteristics of different discrete and continuous distribution.	**K2**	**II**
CO4	Distinguish various density function and find mathematical expectation, moments, and characteristics function.	**K5**	**III**
CO5	Determine expectation, variance and moment generating function of continuous random variable.	**K5**	**IV**
CO6	Evaluate the correlation and regression.	**K5**	**V**

2A. SYLLABUS

Unit I: Measure of Central Tendency **(12 hours)**

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 **(12 hours)**

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 **(12 hours)**

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 **(12 hours)**

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

Unit V: Bivariate Frequency Distribution **(12 hours)**

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.

B. TOPICS FOR SELF STUDY

Sl. No.	Topics	Web Links
1	Transformation of Random Variables	https://wwwf.imperial.ac.uk/~ayoung/m2s1/M2S12011.PDF
2	Central limit theorem	https://www.probabilitycourse.com/chapter7/7_1_2_central_limit_theorem.php
3	Geometric Distribution	https://opentextbc.ca/introbusinessstatopenstax/chapter/geometric-distribution/
4	Uniform distribution	https://learn.lboro.ac.uk/archive/olmp/olmp_resources/pages/workbooks_1_50_jan2008/Workbook38/38_2_unifm_dist.pdf

C. TEXTBOOK(s)

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

D. REFERENCE BOOKS

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.

E. WEB LINKS

1. https://onlinecourses.swayam2.ac.in/cec20_ma01/preview
2. https://nptel.ac.in/courses/111/105/111105041/

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit / Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Measures of central tendency**		
1.1	Arithmetic mean	Recall basic statistical measures and summarize	K1
1.2	Median	Find median of Statistical data	K1
1.3	Mode	Find mode of Statistical data	K1
1.4	Geometric mean	Define Geometric mean	K1
1.5	Harmonic Mean	Define Geometric mean	K1
1.6	Measures of dispersion	Illustrate measures of dispersion and solve the problems utilizing the definitions and formulae.	K4

1.7	Skewness	Analyse the measure of symmetricity.	K4
1.8	Kurtosis	Illustrate the measures of kurtosis	K2
II	**Probability**		
2.1	Probability and mathematical notation	Illustrate with examples and summarize the probability axioms and the mathematical notations.	K3
2.2	Baye's theorem	Apply Baye's theorem to solve problems	K3
2.3	Random variable	Explain random variable	K2
2.4	Distribution Functions	Define Distribution Function.	K2
2.5	Continuous random variable	Evaluate the values of Continuous random variable	K5
2.6	Discrete random variable	Evaluate the values of Discrete random variable	K5
III	**Distributions**		
3.1	Joint Probability function.	Classify the probability mass function and probability density function	K3
3.2	Conditional probability function	Explain conditional probability function	K2
3.3	Probability distribution	Explain probability distribution function	K2
3.4	Density function	Define density function	K1
3.5	Independent random variables	Explain the definitions and properties for two-dimensional random variable on joint distribution function.	K2
3.6	Conditional probability density function	Interpret conditional probability density function	K2
3.7	Mathematical expectation	Obtain the expectation of the random variable.	K5
3.8	Covariance	Evaluate covariance of probability mass function	K5
IV	**Expectation of a continuous random variable**		
4.1	Continuous expectation	Explain the definition and properties and theorems of the expectation of continuous random variable	K2
4.2	Conditional expectation	Explain conditional expectation	K2
4.3	Variance	Determine variance of the function	K5
4.4	Moment generating function,	Determine moment generating function	K5
4.5	Cumulants	Find cumulants	K1
V	**Correlation and Regression**		
5.1	Bi-variate distribution and	Classify Bi-variate distribution, correlation; scatter diagram and Karl Pearson coefficient of correlation.	K3
5.2	correlation (including Karl Pearson coefficient of correlation)	Evaluate Coefficient of Correlation	K5
5.3	Bi-variate frequency distribution	Evaluate the problems on rank correlation, regression and lines of regression.	K5

5.4	Properties and theorems	List out properties	K1
5.5	Problems on rank correlation	Evaluate rank correlation	K5
5.6	Problems on regression	Explain the regression of two lines and estimate unknown values from known	K5

4. MAPPING SCHEME (POs, PSOs AND COs)

U17MAS31	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	H	H	H	H	M	M	-	H	H	H	H
CO2	H	H	H	H	H	H	M	H	-	H	M	M	H
CO3	H	H	H	H	H	H	M	M	-	H	M	H	M
CO4	H	H	H	H	H	H	M	M	-	H	-	M	M
CO5	H	H	H	H	H	H	H	M	-	H	M	M	H
CO6	H	H	H	H	H	H	H	H	-	H	H	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mrs. A. Leonishiya

Core Course V: THEORY OF EQUATIONS AND FOURIER SERIES

Semester: IV **Course Code: U16MA405**

Credits: 5 **Hours/Week: 6**

1. COURSE OUTCOMES

After the completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
CO1	Relation between the roots and coefficients of a polynomial equation	**K5**	**I**
CO2	Identify reciprocal equations from polynomial equations and apply relevant methods to solve them	**K3**	**II**
CO3	Apply rules of signs to find the real roots and imaginary roots of a polynomial equation.	**K3**	**III**
CO4	Determine the transformed equation by increasing or decreasing the roots of the given equation.	**K3**	**III**
CO5	Explain periodic functions and find Fourier series expansion for them	**K5**	**IV**
CO6	Distinguish between odd and even functions and apply the formulae to find the Fourier series expansion accordingly	**K4**	**V**

2A. SYLLABUS

Unit I: Relation between roots and coefficients of polynomial equations (18 hours)

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 (18 hours)

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: Different methods for finding real and imaginary roots (18 hours)

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.

Unit IV: Periodic function and Fourier Series expansion (18 hours)

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

Unit V: Half-range Fourier cosine and sine series (18 hours)

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

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links
1	A first course in the theory of equations	https://www.gutenberg.org/files/29785/29785-pdf.pdf
2	One Dimensional wave Equations	https://ocw.mit.edu/courses/mathematics/18-303-linear-partial-differential-equations-fall-2006/lecture-notes/waveeqni.pdf
3	Real world examples of quadratic equations	https://www.mathsisfun.com/algebra/quadratic-equation-real-world.html
4.	One Dimensional Heat Equations	https://math.libretexts.org/Bookshelves/Differential_Equations/the_heat_equation

C. TEXTBOOK(s)

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

D. REFERENCE BOOKS

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

E. Web Links:

1. https://nptel.ac.in/courses/111/106/111106111/
2. https://nptel.ac.in/courses/111/101/111101117/

3. SPECIFIC LEARING OUTCOMES (SLOs)

Unit / Section	Course Contents	Learning Outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Relation between roots and coefficients of polynomial equations**		
1.1	Relations between the roots and coefficients	Relate the roots and coefficients of a polynomial equation	K2
1.2	Symmetric functions of the roots	Explain symmetric functions of the roots	K2
1.3	Sum of the powers of the roots	Find the sum of powers of the roots	K1
1.4	Newton's theorem.	Apply Newtons' theorem to find the sum of powers of the roots	K3

II	**Transformations of equations**		
2.1	Transformations of equations	Define reciprocal equation	K1
2.2	Reciprocal equations	Resolve the reciprocal equation	K4
2.3	Diminishing and increasing the roots	Identify the transformed equation by diminishing or increasing the roots by a given quantity	K2
2.4	Finding quotient and remainder when a polynomial is divided by a binomial	Determine the quotient and remainder when a polynomial is divided by the other polynomial	K4
2.5	Removal of terms	Develop a method to remove a term from the equation.	K5
III	**Different methods for finding real and imaginary roots**		
3.1	Formation of equation whose roots are any power of the roots of a given equation	Deduce an equation whose roots are the squares or cubes of the roots of a given equation	K5
3.2	Transformation in general	Review the method to transformation of equations in general	K6
3.3	Descartes' rule of signs	Classify the real and imaginary roots by applying Descartes's rule of signs	K4
3.4	Horner's Method.	Apply Horner's method to find a real root of the given equation	K3
IV	**Periodic function and Fourier Series expansion**		
4.1	Definition of Fourier series Finding Fourier series expansion of a periodic function with period 2π	Understand periodic function	K2
4.2	Finding Fourier series expansion of a periodic function with period 2π	Design Fourier series expansion of given function	K5
4.3	Odd and even functions.	Differentiate odd and even functions	K4
V	**Half-range Fourier cosine and sine series**		
5.1	Half Range Fourier series	Express half range Fourier series for the given function	K2
5.2	Development in cosine and sine series	Develop Fourier cosine and sine series for the given function	K5
5.3	Change of interval.	Construct Fourier series for the given periodic function with period $2l$	K5
5.4	Combination of series.	Deduct Fourier series for the given function from the combination of series	K5

4. MAPPING SCHEME (POs, PSOs AND COs)

U16MA405	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	M	L	L	M	L	-	-	M	H	H	M
CO2	H	M	M	L	L	M	L	-	-	M	M	-	M
CO3	H	M	M	L	L	L	M	-	-	L	L	M	L
CO4	H	L	L	-	-	M	M	-	-	L	M	L	L
CO5	M	-	-	-	-	-	-	L	-	-	L	-	L
CO6	M	-	L	-	M	-	L	-	-	-	L	L	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. P. Ambika

Allied course IV: MATHEMATICAL STATISTICS II

Semester: IV **Course Code: U17MAS42**

Credits: 4 **Hours/Week: 6**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
1	Apply the theoretical discrete and Continuous distribution	K3	I
2	Analyze the Normal, Gamma, Beta, Exponential, Chi-square distributions.	K4	II
3	Identify Sampling, Parameter and Statistic, Estimators, Rao-Cramer inequality.	K3	III
4	Evaluate Test of significance, Null hypothesis, Sampling distributions.	K5	IV
5	Evaluate Chi-Square probability cure, Chi-Square distribution, F-Statistic, ANOVA (one way classification).	K5	V
6	Evaluate Samplings, Null hypothesis, Test of significance, Chi – Square distribution	K5	V

2A. SYLLABUS

Unit I: Discrete and Continuous distributions **(18 hours)**

Bernoulli distribution – Binomial distribution – Poisson distribution - Rectangular distribution

Unit II: Normal, Gamma, Beta, Exponential Distribution **(18 hours)**

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, Parameter and Statistic **(18 hours)**

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 **(18 hours)**

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 **(18 hours)**

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

B. TOPICS FOR SELF STUDY:

S. No.	Topics	Web Links
1	Mathematical statistics II	https://stat.ethz.ch/~geer/mathstat.pdf
2	Mathematical Statistics and Applications	http://elearn.luanar.ac.mw/odl/public/Files/Mathematical%20statistics%20with%20applications.pdf
3	Fundamentals of Mathematical Statistics	https://www.dcpehvpm.org/E-Content/Stat/FUNDAMENTAL%20OF%20MATHEMATICAL%20STATISTICS-S%20C%20GUPTA%20&%20V%20K%20KAPOOR.pdf
4	Probability and Mathematical statistics	https://www.researchgate.net/publication/272237355_Probability_and_Mathematical_Statistics

C. TEXTBOOK(s)

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

D. REFERENCE BOOKS

1. Perumal Mariappan, Statistics for Business, 1st Edition, CRC Press Taylor & Francis Group Boca Raton London New York, 2019; ISBN: 978 – 1 – 138 – 33617 - 9.
2. A.M. Mood, F.A. Graybill and O.C. Boses, Introduction to Theory of Statistics, McGraw Hill,1974.
3. Rahatgi U.K., An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern,1984.

E. WEB LINKS

1. https://swayam.gov.in/
   (i) https://onlinecourses.swayam2.ac.in/cec21_ma04/preview
   (ii) https://onlinecourses.nptel.ac.in/noc21_ma34/preview
2. https://nptel.ac.in/
   (i) https://onlinecourses-archive.nptel.ac.in/

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/ Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Discrete and Continuous distributions**		
1.1	Bernoulli distribution	Understanding Bernoulli distribution	K2

1.2	Binomial distribution	Understanding Binomial distribution	K2
1.3	Poisson distribution	Understanding Poisson distribution	K2
1.4	Rectangular distribution.	Understanding Rectangular distribution	K2
II	**Normal, Gamma, Beta, Exponential Distribution**		
2.1	Normal distribution	Analyze the Normal distribution	K4
2.2	Gamma distribution	Analyze the Gamma distribution	K4
2.3	Beta distribution of first and second kind	Analyze the Beta distribution of first and second kind	K4
2.4	Exponential distribution	Analyze the Exponential distribution	K4
2.5	Chi – square variate	Explain Chi-Square variate	K2
2.6	Derivation of the Chi-Square distribution	Evaluate derivation of the Chi-Square distribution	K5
2.7	MGF of Chi-Square distribution	Evaluate MGF of Chi-Square distribution	K5
III	**Sampling, Parameter and Statistic**		
3.1	Sampling introduction	Understanding Sampling introduction	K2
3.2	Types of Sampling	Understanding Types of Sampling	K2
3.3	Parameter and Statistic	Understanding Parameter and Statistic	K2
3.2	Introduction to theory of estimation	Explain Introduction to theory of estimation.	K2
3.5	Characteristics of estimators	Explain Characteristics of estimators	K3
3.6	Rao-Cramer inequality	Analyzing the Rao-Cramer inequality	K4
IV	**Test of Hypothesis**		
4.1	Test of significance	Evaluate Test of significance	K5
4.2	Null hypothesis	Evaluate Null hypothesis	K5
4.3	Error in sampling	Evaluate Error in sampling	K5
4.2	Critical region and level of significance	Evaluate Critical region and level of significance	K5
4.5	Test of significance for large samples	Evaluate Test of significance for large samples	K5
4.6	Sampling of attributes	Evaluate Sampling of attributes	K5
V	**Test of Statistics**		
5.1	Chi – square probability curve	Understanding Chi-square probability cure	K2
5.2	Application of Chi-square distribution	Evaluate Application of Chi-square distribution	K5
5.3	Student's 't'-statistic	Evaluate Student's 't' statistic	K5
5.4	Student's F-statistic	Evaluate Student's F statistic	K5
5.5	ANOVA (one way classification)	Evaluate ANOVA (one way classification)	K5

4. MAPPING SCHEME (POs, PSOs AND COs)

U17MAS42	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	-	L	-	M	M	-	M	M	M	L
CO2	H	M	-	-	-	M	L	M	-	-	-	M	-
CO3	H	M	L	L	L	-	-	M	-	M	-	M	M
CO4	H	H	M	-	M	L	M	M	-	M	M	-	-
CO5	H	M	L	L	M	L	L	-	-	L	L	M	L
CO6	H	M	M	-	M	L	-	M	-	M	L	-	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. M. Suresh kumar

Allied Practical – Mathematical Statistics III

Sem: IV **Course Code: U20MA4P1**

Credit: 2 **Hours/Week: 4**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO 1	Download and install R and R Studio	**K2**	**I**
CO 2	Learn to apply R programming for data processing	**K2**	**II**
CO 3	Develop codes using R for analyzing statistical data	**K3**	**III**
CO 4	Produce data visualizations using packages	**K3**	**II**
CO 5	Compute basic summary statistics	**K3**	**V**
CO 6	Use different modules of R for different applications to analyse data.	**K4**	**IV**

2A. SYLLABUS

Unit I (12 hours)

1. Calculation of measures of central tendency
2. Calculation of measures of dispersion
3. Calculation of Skewness and Kurtosis
4. Import data from excel

Unit II (12 hours)

5. Graphical display of data
6. Analyzing data using tables
7. Expectations of discrete and continuous random variables
8. Binomial, Normal and Poisson Distributions

Unit III (12 hours)

9. One sample t – test
10. Independent sample t – test
11. Dependent sample t – test

Unit IV (12 hours)

12. One-way Between -Groups ANOVA

13. Two-way Between -Groups ANOVA

14. Chi – square test of independent samples

Unit V (12 hours)

15. Bi-variate correlation

16. Partial correlation

17. Rank correlation

18. Linear regression

19. Performing Statistics using R- Packages

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Data Management with repeats, sorting, ordering and lists.	https://onlinecourses.nptel.ac.in/noc21_ma75/preview
2	Robust error handling in R	https://www.youtube.com/watch?v=WjtXc4OXZuk
3	Proper design of Functions	http://home.iitk.ac.in/~shalab/swayamprabha/rsw/sp-rsw-lect-8.pdf

C. 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.

D. WEB LINKS:

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview

2. https://www.digimat.in/nptel/courses/video/111104100/L01.html

3. https://cse.iitkgp.ac.in/~dsamanta/courses/da/resources/slides/04Programming%20with%20R.pptx

3. SPECIFIC LEARNING OUTCOMES (SLO)

S. No.	Lab Exercises	Learning outcomes	Bloom's Taxonomy Level of Transaction
1	Calculation of measures of central tendency	To construct data tables that facilitate the calculation of mean, median, mode, and range	K3
2	Calculation of measures of dispersion	To compute and explain the range, the interquartile range, the standard deviation, and the variance	K3

3.	Calculation of Skewness and Kurtosis	To distinguish between a symmetrical and a skewed distribution and compute coefficient of kurtosis	K4
4	Import data from excel	To understand how to read and import spreadsheet files using basic R and packages.	K2
5.	Graphical display of data	To understand the graphical display of data like histogram, pie chart etc…	K2
6	Analyzing data using tables	To analyze data using tables	K4
7.	Expectations of discrete and continuous random variables	To calculate expectations of discrete and continuous random variables	K3
8	Binomial, Normal and Poisson Distributions	To distinguish Binomial, Poisson and Normal Distributions	K4
9	One sample t – test, Independent sample t – test, Dependent sample t – test	To understand Statistical differences between the means of two groups	K2
10	One-way Between Groups ANOVA, Two-way Between Groups ANOVA	To know how to do the calculations which enable you to draw conclusions about variance found in data sets	K1
11	Chi – square test of independent samples	To compute the chi-square goodness-of-fit test and interpret the results.	K3
12	Partial correlation, Rank correlation, Linear regression	To describe the difference between 'correlation' and 'regression'.	K1
13	Performing Statistics using R-Packages	To learn how to use R – packages for performing statistics	K3

4. MAPPING SCHEME (COs, POs AND PSOs)

U20MA4P1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	M	L	L	L	L	L	M	L	L	L
CO2	M	M	M	H	M	M	L	-	-	H	H	L	L
CO3	M	H	M	H	M	H	M	-	-	M	H	M	L
CO4	M	M	L	H	M	H	L	-	-	M	M	M	L
CO5	M	H	M	H	M	M	M	L	L	M	M	H	M
CO6	L	H	L	M	M	M	M	L	L	M	M	M	L

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. M. Joseph Paramasivam

Core Course VI: ALGEBRA

Semester: V **Course Code: U16MA506**

Credits: 6 **Hours/Week: 6**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Analyze of groups, Subgroups, Cyclic groups, Order of an element, Cosets and Lagrange's Theorems.	**K4**	**I**
CO2	Analyze Normal subgroups and Quotient groups	**K4**	**II**
CO3	Identify different algebraic structure of Isomorphism and Homomorphism	**K3**	**II**
CO4	Analyze Rings and Fields and Homomorphism of Rings.	**K4**	**III**
CO5	Analyze Vector Spaces, Subspaces, Linear Transformations, Span of a set, Linear independence.	**K4**	**IV**
CO6	Evaluating Basis and Dimension, Rank and Nullity, Matrix of a Linear Transformation	**K5**	**V**

2A. SYLLABUS

Unit I: Groups **(18 Hours)**

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

Unit II: Normal Subgroups and Quotient Groups **(18 Hours)**

Normal subgroups and Quotient groups -Isomorphism and Homomorphism.

Unit III: Rings and Ideals **(18 Hours)**

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 and Linear Transformation **(18 Hours)**

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

Unit V: Basis and Matrix of a Linear Transformation **(18 Hours)**

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

B. TOPICS FOR SELF STUDY:

S. No.	Topics	Web Links
1	Algebra	https://www.math.ucdavis.edu/~linear/linear-guest.pdf
2	Elements of Mathematics Algebra	http://www.cmat.edu.uy/~marclan/TM/Algebra%20i%20-%20Bourbaki.pdf
3	Beginning and Intermediate Algebra	http://www.wallace.ccfaculty.org/book/Beginning_and_Intermediate_Algebra.pdf

4	Basic Algebra	http://www.wallace.ccfaculty.org/book/Beginning_and_Intermediate_Algebra.pdf

C. TEXTBOOK(s)

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

D. REFERENCE BOOKS

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, 1983.

E. WEB LINKS:

1. https://swayam.gov.in/
   (i) https://onlinecourses.nptel.ac.in/noc21_ma03/preview
   (ii) https://onlinecourses.nptel.ac.in/noc21_ma32/preview
2. https://nptel.ac.in/

   (i) https://docs.google.com/spreadsheets/d/e/2PACX-1vQOHER38F_mi8Nj0n4NOrrvIigNWQcyBiPtSRjj1gvRiaxL4py3UYem0o8nP0LLKk78qfC2bdedBTaw/pubhtml

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/ Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Groups**		
1.1	Groups	Explain the definition of groups	K2
1.2	Subgroups	Understanding the concepts of Subgroups	K2
1.3	Cyclic groups	Classify the concepts of Cyclic groups	K4
1.4	Order of an element	Identify an Order of an element	K3
1.5	Cosets	Classify the concepts of groups	K4
1.6	Lagrange's Theorem	Explain Lagrange's Theorem	K2
II	**Normal Subgroups and Quotient groups**		
2.1	Normal subgroups	Explain the definition of Normal groups	K2
2.2	Quotient groups	Explain the definition of Quotient groups	K2
2.3	Isomorphism	Analyze Isomorphism	K4
2.4	Homomorphism	Analyze Homomorphism	K4
III	**Rings and Ideals**		
3.1	Rings	Explain the definition of Rings	K2
3.2	Fields	Explain the definition of Rings	K2
3.3	Elementary properties of Rings and Isomorphism	Understanding Elementary properties of Rings and Isomorphism	K2
3.4	Ideals	Explain the definition of Ideals	K2

3.5	Quotient rings	Explain the definition of Quotient rings	K2
3.6	Homomorphism of Rings Triple integral	Analyze Homomorphism of Rings Triple integrals	K4
IV	**Vector Spaces and Linear Transformation**		
4.1	Vector Spaces	Explain the definition of Vector Spaces	K2
4.2	Subspaces	Explain the definition of Subspaces	K2
4.3	Linear Transformations	Classify the Linear Transformations	K4
4.4	Span of a set	Classify the Span of a set	K4
4.5	Linear independence	Analyze Linear independence	K4
V	**Basis and Matrix of a Linear Transformation**		
5.1	Basis and Dimensions – Rank and Nullity	Explain the definition of Basis	K2
5.2	Dimensions	Explain the definition of Dimensions	K2
5.3	Rank	Evaluate Rank	K5
5.4	Nullity	Evaluate Nullity	K5
5.5	Matrix of a Linear Transformation	Evaluate Matrix of a Linear Transformation	K5

4. MAPPING SCHEME (POs, PSOs AND COs)

U16MA506	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	H	-	L	M	L	H	-	H	H	M	-
CO2	H	M	H	-	L	M	L	H	-	H	H	M	-
CO3	H	M	H	-	L	M	L	H	-	H	H	M	-
CO4	H	M	H	-	L	M	L	H	-	H	H	M	-
CO5	H	M	H	-	L	M	L	H	-	H	H	M	-
CO6	H	M	H	-	L	M	L	H	-	H	H	M	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. N. Lakshmi Narayanan

Core Course VII: REAL ANALYSIS

Semester: V **Course Code: U16MA507**

Credits: 6 **Hours/Week: 6**

1. COURSE OUTCOMES:

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Describe fundamental properties of the real numbers that lead to the development of real analysis	**K5**	**I**
CO2	Illustrate the properties of continuous function using limit function	**K3**	**II**
CO3	Study the algebra of derivatives	**K6**	**III**
CO4	Construct the mathematical proof of Mean value theorem by using the derivatives and continuous functions	**K4**	**IV**
CO5	Explain the Riemann integral	**K4**	**V**
CO6	Explain the concept of fundamental theorem.	**K5**	**V**

2A. SYLLABUS

Unit I: Real number system **(18 Hours)**

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 **(18 Hours)**

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

Unit III: Derivability **(18 Hours)**

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

Unit IV: Mean value theorems **(18 Hours)**

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

Unit V: Riemann Integration **(18 Hours)**

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.

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Lebesgue integral	https://ocw.mit.edu/courses/mathematics/18-125-measure-and-integration-fall-2003/lecture-notes/
2	Lebesgue dominated theorem	https://ocw.mit.edu/courses/mathematics/18-125-measure-and-integration-fall-2003/lecture-notes/
3	Improper Riemann integral	https://www.sciencedirect.com/topics/mathematics/improper-integral
4	Levi monotone convergence theorem	http://mathonline.wikidot.com/levi-s-monotone-convergence-theorems

C. TEXTBOOK(s)

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)

D. 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, 2002.

E. WEB LINKS:

1. https://nptel.ac.in/courses/111/106/111106053/

2. https://onlinecourses.nptel.ac.in/noc21_ma04/preview

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit/ Section	Course Content	Learning outcomes	Bloom's Taxonomy Level of Transaction
I	**Real number system**		
1.1	Real number system	Remember; apply the properties of real numbers.	K3
1.2	Field axioms.	Explain field axioms with operation addition and multiplication	K2
1.3	Order relations in R.	Compare order relations between pairs of real numbers	K5
1.4	Absolute Value of a real number and its properties	Understand and apply of absolute value of real number	K3
1.5	Supremum and infimum of a set	Measure supremum and infimum of a set	K5
1.6	Order Completeness property	Analyze order completeness property	K4

1.7	Countable and uncountable sets.	Relate mathematical proofs of countable and uncountable sets.	K4
II	**Continuous functions**		
2.1	Limit of functions.	Recall limit of functions	K1
2.2	Algebra of limits	Analyze operations of limits	K4
2.3	Continuity of function	Describe the definition of continuity of function and analyze the definition geometrically	K4
2.4	Types of discontinuties.	Classify point of discontinuous function	K4
2.5	Elementary properties of continuous functions	Explain the properties of continuous function	K2
2.6	Uniform continuity of a function.	Analyze uniform continuous function of function	K5
III	**Derivability**		
3.1	Differentiability of a function	Measure the basic idea of differentiability of a function	K5
3.2	Derivability and continuity	Compare derivability and continuity function	K5
3.3	Algebra of derivatives	Explain mathematical proof by using derivatives.	K5
34	Inverse function theorem:	Prove inverse function theorem	K4
3.5	Darboux's theorem on derivatives.	Analyze the darboux's theorem	K4
IV	**Mean value theorems**		
4.1	Rolle's theorem on derivatives	Estimate numerical remainder using Rolle's theorem.	K5
4.2	Taylor's theorem with Remainder.	Determine remainder using Taylor's theorem	K5
4.3	Mean value theorems on derivatives	Evaluate numerical remainder using Mean value theorem.	K5
4.4	Power series	Interpret the power series of standard function	K5
V	**Riemann Integration**		
5.1	Riemann Integration	Simplify numerical solutions of Riemann Integration.	K4
5.2	Darboux's theorem conditions for Integrability	Explain Darboux's theorem using Integrability definition.	K5
5.3	Integrability of continuous functions	Inspect continuity and monotonic functions	K4
5.4	Monotonic functions	Understand the concept of monotonic function	K2
5.5	Integral functions	Analyze integral function	K4

5.6	Continuity and derivability of integral functions.	Examine the properties of Riemann integrable functions.	K4
5.7	The first mean value theorem	Remember and apply the fundamental theorem of integration.	K3
5.8	The fundamental theorem of calculus.	Interpret the proof of fundamental theorem using by integrable function	K2

4. MAPPING SCHEME (POs, PSOs AND COs)

U16MA507	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	L	-	M	M	M	M	L	M	L	M	L
CO2	L	M	M	-	L	M	M	H	L	M	L	M	L
CO3	M	M	M	L	L	L	M	M	L	M	L	M	L
CO4	M	M	M	L	H	M	M	M	-	M	M	M	-
CO5	M	M	L	-	L	M	M	H	L	H	M	M	-
CO6	M	M	M	L	M	M	M	M	-	L	L	M	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. K. Mariappa

Core Course VIII: Mechanics

Semester: V **Course Code: U14MA508**

Credits: 5 **Hours/Week: 6**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	know various methods of finding the resultant of a finite number of forces and methods of resolving forces	K2	I
CO2	understand the effect of different types of forces acting at a point in equilibrium	K5	II
CO3	resolve a given force and find equation of catenary	K5	II
CO4	analyse the motion of a projectile	K3	III
CO5	know the various properties of motion of a projectile, a simple harmonic motion and orbital motion	K4	III, IV
CO6	analyse simple harmonic and orbital motions	K6	V

2A. SYLLABUS

Unit I: Theorems on Statics **(18 Hours)**

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

Unit II: Moments **(18 Hours)**

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.

Unit III: Projectiles in Dynamics **(18 Hours)**

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

Unit IV: Simple Harmonic Motion **(18 Hours)**

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: Velocity and Acceleration **(18 Hours)**

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

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Law of parallelogram of forces	https://blog.oureducation.in/to-verify-the-law-of-parallelogram-of-forces/
2	Equation to common catenary	https://www.math24.net/equation-catenary/

3	Projectiles	https://en.wikipedia.org/wiki/Projectile
4	Simple Harmonic Motions	https://www.britannica.com/science/simple-harmonic-motion

C. TEXTBOOK(s):

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

D. REFERENCE BOOKS:

1. K. ViswanathNaik, M. S. Kasi, Statics, Emerald Publishers, 2000.
2. K. ViswanathNaik, M. S. Kasi, Dynamics, Emerald Publishers, 2001.

E. WEB LINKS:

1. https://www.britannica.com/science/mechanics
2. https://www.dictionary.com/browse/mechanics

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit/ Section	Course Content	Learning outcomes	Bloom's Taxonomy Level of Transaction
I	**Theorems on Statics**		
1.1	Law of parallelogram of forces	Define Resultant and components of forces using Law of parallelogram of forces	K1
1.2	Lami's theorem	Analyse Lami's theorem and Solve related examples	K4
1.3	Resolution of forces	Apply the Theorem on resolved parts	K3
II	**Moments**		
2.1	Like parallel forces	Explain about Like parallel forces	K2
2.2	Unlike parallel forces	Explain about Unlike parallel forces	K2
2.3	Moments	Define Moments	K1
2.4	Varigon's theorem of moments	Explain about Varigon's theorem of moments	K2
2.5	Generalized theorem of moments	Explain about Generalized theorem of moments	K2
2.6	Equation to common catenary	Analyse the Geometrical properties of common catenary	K4
III	**Projectiles**		
3.1	Projectiles	Define Projectiles	K1
3.2	Path of a projectile	Find Path of a projectile	K1
3.3	Time of flight	Construct the Time of flight	K3
3.4	Horizontal range	Find Horizontal range	K1
3.5	Motion of a projectile up an inclined plane	Explain Motion of a projectile up an inclined plane	K5
IV	**Simple Harmonic Motion**		
4.1	Definition of Simple Harmonic Motion	Define S.H.M.	K1

4.2	Geometrical representation of S.H.M.	Define Geometrical representation of S.H.M.	K1
4.3	Composition of S.H.M. of the same period and in the same line	Analyze the Composition of S.H.M. of the same period and in the same line	K4
4.4	Composition of S.H.M's of the same period in two perpendicular directions	Analyze the Composition of S.H.M's of the same period in two perpendicular directions	K4
V	**Velocity and Acceleration**		
5.1	Radial and transverse components of velocity and acceleration	Define Radial and transverse components of velocity and acceleration	K1
5.2	Differential equation of a central orbit	Construct the Differential equation of a central orbit	K6
5.3	Given the orbit to find the law of force	Develop the law of force when the orbit is given	K3
5.4	Given the law of force to find the orbit	Develop the orbit when the law of force is given	K3

4. MAPPING SCHEME (POs, PSOs AND COs)

U14MA508	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	-	L	M	M	L	-	H	M	M	L
CO2	H	H	M	-	L	M	M	L	-	H	M	M	L
CO3	M	M	M	-	L	M	M	L	-	M	M	M	L
CO4	H	H	M	-	L	M	M	L	-	H	M	M	L
CO5	M	M	M	-	L	M	M	L	-	M	M	M	L
CO6	H	H	M	-	L	M	M	L	-	H	M	M	L

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. M. Joseph Paramasivam

Core Course IX: NUMERICAL METHODS

Semester: V **Course Code: U14MA509**

Credits: 4 **Hours/Week: 5**

1. Course Outcomes:

At the end of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Solve algebraic and transcendental equations using appropriate methods	K3	I
CO2	Determine the solution for system of algebraic equations by various methods	K5	II
CO3	Classify various interpolation methods	K4	III
CO4	Work out numerical differentiation and integration whenever and wherever usual methods are not applicable	K4	IV
CO5	Work numerically on the ordinary differential equations using different methods	K3	V
CO6	Evaluate derivative at a value using an appropriate numerical method	K6	V

2A. SYLLABUS

Unit I: Introduction to numerical analysis (15 Hours)

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 (15 Hours)

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 (15 Hours)

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 (15 Hours)

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 (15 Hours)

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

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Liebmann's iteration process	https://nptel.ac.in/courses/111/105/111105038/
2	Bender Schmidt method	http://numericalmethods.eng.usf.edu
3	Crank Nicholson's Scheme	https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/2018/NumericalSolutionofPDE-Unit-3.pdf
4.	Explicit scheme	https://nptel.ac.in/courses/111/105/111105038/

C. TEXTBOOKS

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

D. 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.

E. WEB LINKS

1. https://nptel.ac.in/courses/111/107/111107105/

2. https://onlinecourses.swayam2.ac.in/cec20_ma18/preview

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit/ Section	Course Content	Learning outcomes	Bloom's Taxonomy Level of Transaction
I	**Introduction to numerical analysis**		
1.1	The solution of Algebraic and Transcendental Equations	Summarize an algebraic and transcendental equations	K1
1.2	Bisection Method	Inspect the method of bisection	K4
1.3	Iteration Method	Explain Iteration method	
1.4	Regula Falsi Method	Compute the solution by using Regula Falsi method	K4
1.5	Newton Raphson Method	Estimate the solution by Newton Raphson method	K5
II	**Solution of simultaneous linear algebraic equations**		

2.1	Introduction of Simultaneous equations.	Recall simultaneous equations.	K1
2.2	Gauss Elimination Method	Solve the simultaneous equation by Gauss elimination method.	K5
2.3	Gauss- Jordan Method.	Evaluate the simultaneous equations by Gauss Jordan method.	K5
2.4	Gauss Jacobi method	Estimate the solution by using Gauss Jacobi method in simultaneous equations.	K5
2.5	Gauss Seidel Method	Estimate the solution by using Gauss Jacobi method in simultaneous equations.	K5
III	**Finite differences**		
3.1	Finite differences.	Identify the basic idea of finite differences	K3
3.2	Differences of a polynomial	Inspect the polynomial by difference method	K4
3.3	Factorial polynomial	Discover the solution of polynomial by factorial method	K4
3.4	Newton's forward interpolation Formula.	Justify the solution of polynomial by using Newton's forward interpolation formula.	K5
3.5	Newton's backward interpolation Formula	Determine the solution of polynomial by using Newton's forward interpolation formula	K5
3.6	Lagrange's Interpolation Formula.	Inference the Lagrange's interpolation method	K4
3.7	Inverse Interpolation Formula	Inspect the inverse interpolation formula	K4
IV	**Numerical differentiation and integration**		
4.1	Newton's formula to compute the derivative	Examine numerical differentiation using either forward difference formula or backward difference formula.	K4
4.2	A general quadrature formula	Construct the solution of polynomial	K3
4.3	Trapezoidal Rule	Evaluate the concept of numerical integration of a definite integral for a given function from a given set of tabular values.	K5
4.4	Simpson's One-Third Rule	Develop the solution of numerical integration	K3
4.5	Simpson's three-eighth Rule.	Examine the solution of numerical integration	K4
V	**Numerical solution of ordinary differential equation**		
5.1	Taylor series method	Solve differential equation by Taylor series method	K3

5.2	Euler Method	Solve Euler method	K4
5.3	Runge Kutta Method	Construct the solution of Differential Equation using R-K Method	K6
5.4	Predictor corrector methods	Compare the solution of a given problem and confirm it with its corrector value	K4

4. MAPPING SCHEME (POs, PSOs AND COs)

U14MA509	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	H	M	H	H	L	-	H	H	H	H
CO2	H	M	H	H	M	H	H	L	-	H	H	M	M
CO3	H	M	M	H	M	H	M	M	-	H	H	M	M
CO4	H	M	M	H	M	H	M	L	-	H	H	M	H
CO5	H	M	M	H	M	H	M	L	-	H	H	M	H
CO6	H	H	M	H	M	M	M	L	-	H	H	M	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. K. Mariappa

Core Project: PROJECT

Semester: V **Course Code: U16MA5PJ**

Credits: 3 **Hours/Week: 5**

Core Course X: COMPLEX ANALYSIS

Semester: VI **Course Code: U16MA610**

Credits: 6 **Hours/Week: 6**

1. COURSE OUTCOMES:

At the end of the course, the students will be able to

CO. No	Course Outcomes	Level	Unit Covered
CO1	Analyze the concept of analytic function on complex plane	K4	I
CO2	Analyze the effect of bilinear transformation on complex plane.	K4	II
CO3	Evaluate complex integrals for entire functions using Cauchy's Integral Formula.	K5	III
CO4	Express a complex function as a Taylor series, power series and Laurent series.	K5	IV
CO5	Classify the singularities of a complex function	K4	IV
CO6	Evaluate Contour integrals using the Residue theorem	K5	V

2A. SYLLABUS

Unit I: Analytic Functions **(20 Hours)**

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

Unit II: Bilinear Transformation **(15 Hours)**

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

Unit III: Complex Integration **(20 Hours)**

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

Unit IV: Series Expansions **(15 Hours)**

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

Unit V: Residues **(20 Hours)**

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

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Conformal mappings	https://www.youtube.com/watch?v=s2RJeBfDaqw
2	Stereographic Projection	https://nptel.ac.in/courses/111/103/111103070/
3	Power Series	https://nptel.ac.in/courses/122/104/122104017/

4	Wave function as a complex valued function	https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/video-lectures/part-1/

C. TEXTBOOK

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

D. REFERENCES BOOKS

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 2003.

3. Ruel V. Churchill, James Ward Brown, Complex Variables and Application, McGraw Hill Publishing Company, 5th Edition 1990.

E. WEB LINK:

1. https://nptel.ac.in/courses/111/103/111103070/

2. https://www.digimat.in/nptel/courses/video/111106084/L01.html

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit	Course Content	Learning Outcomes	Bloom's Taxonomic levels of Transaction
I	**Analytic Function**		
1.1	Continuous functions	Explain the concept of continuous function in complex plane.	K2
1.2	Differentiability	Examine the derivability of a given complex function	K4
1.3	Cauchy-Riemann Equations	Analyze the characteristics of C-R equation.	K4
1.4	Analytic functions	Examine the analyticity of the given function	K4
1.5	Harmonic Functions	Determine harmonic conjugate function by Milne-Thomson method	K5
II	**Bilinear Transformation**		
2.1	Elementary Transformations	Classify the elementary transformations.	K4
2.2	Bilinear Transformations	Construct the bilinear transformation that maps one region to another region.	K3
2.3	Cross Ratio	Construct bilinear transformation through cross ratio	K3
2.4	Fixed Points of Bilinear Transformation	Categorize the transformation based on the fixed points of the transformation	K5
2.5	Some special Bilinear Transformation	Determine the general form of the transformations which maps the real axis onto itself; the unit circle onto itself; the real axis onto the unit circle.	K5
III	**Complex Integration**		

3.1	Definite Integral	Evaluate the integral of a complex valued function.	K3
3.2	Cauchy's theorem	Explain the consequences of the Cauchy's theorem.	K5
3.3	Cauchy's Integral Formula	Apply the integral formula for solving contour integrals.	K3
3.4	Higher derivatives	Prove that an analytic function has derivatives of all orders	K5
IV	**Series Expansions**		
4.1	Taylor's series	Express a complex valued function as a Taylor's series	K4
4.2	Laurent's Series	Express a complex valued function as a Taylor's series	K4
4.3	Zeros of an analytic function	Illustrate zeros of an analytic function	K2
4.4	Singularities	Categorize the types of singularities and poles.	K4
V	**Calculus of Residues**		
5.1	Residues	Determine the residue values for the given function	K5
5.2	Cauchy's Residue Theorem	Apply residue theorem for evaluating contour integrals through the calculation of residues.	K3
5.3	Evaluation of Definite Integrals	Evaluate certain types of real definite integrals using residues	K5

4. MAPPING SCHEME (POs, PSOs AND COs)

U16MA610	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	L	L	H	-	L	-	M	H	-	M	H	L	-
CO2	M	H	H	-	M	-	L	H	-	M	M	L	-
CO3	M	M	M	-	M	-	L	H	-	L	M	L	-
CO4	M	-	M	-	L	-	M	H	-	M	H	L	-
CO5	L	-	M	-	L	-	L	M	-	L	H	M	-
CO6	M	M	H	-	M	-	M	M	-	M	H	M	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. M. Evangeline Jebaseeli

Core Course XI: DISCRETE MATHEMATICS

Semester: VI **Course Code: U16MA611**

Credits: 5 **Hours/Week: 6**

1. COURSE OUTCOMES:

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	solve various types of recurrence relations	**K3**	**I**
CO2	classify various types of recursive functions	**K4**	**II**
CO3	analyze lattices as algebraic structures	**K4**	**III**
CO4	simplify logical functions by using Karnaugh maps	**K5**	**IV**
CO5	explain the basics of information and coding theories	**K2**	**V**
CO6	explain the notion of information in a mathematically sound way	**K2**	**V**

2A. SYLLABUS

Unit I: Recurrence Relations and Solutions **(17 Hours)**

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 and Recursive Functions **(18 Hours)**

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

Unit III: Lattices **(20 Hours)**

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

Unit IV: Boolean Algebra **(20 Hours)**

Boolean Algebra – Boolean Polynomials – Karnaugh Map.

Unit V: Coding Theory **(15 Hours)**

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.

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Introduction to Discrete Structures in Computer Science	An Introduction to Discrete Structures

2	Lattice Based Cryptography	A Brief Book on Lattice Based Cryptography
3	Advanced Topics in Cryptography	An Overview of Cryptography

C. TEXTBOOK:

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

D. REFERENCE BOOKS:

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.

E. WEB LINKS:

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

3. SPECIFIC LEARNING OUTCOMES (SLOs):

Unit/ Section	Course Contents	Learning Outcomes	Bloom's Taxonomic Levels of Transaction
I	**Recurrence Relations and Solutions**		
1.1	Recurrence – An Introduction	Explain the concept of recursion	K2
1.2	Polynomials and their Evaluations	Illustrate a polynomial in telescopic form	K2
1.3	Recurrence Relations	Construct a recurrence relation for a given function	K3
1.4	Solution of finite order homogeneous (linear) relations	Solve recurrence relation using algorithms	K3
1.5	Solution of non-homogeneous relations	Solve the recurrence relation using the given procedure	K3
II	**Generating Functions and Recursive Functions**		
2.1	Generating functions	Find the generating function for a given relation	K3
2.2	Primitive recursive function	Identify a primitive recursive function	K3
2.3	Recursive and partial recursive function	Identify a partial recursive function	K3
III	**Lattices**		
3.1	Lattices	Analyze the conceptual background needed to identify discrete structure	K4
3.2	Hasse diagrams	Construct a diagram for a given poset	K3
3.3	Properties of Lattices	Explain various properties of lattices	K2
3.4	Lattice through algebraic operation	Explain the discrete structure using algebraic operation	K5

3.5	New lattices	Construct new lattices using appropriate operations	K3
3.6	Product of two lattices	Illustrate how two lattices can be multiplied	K2
3.7	Modular and distributive lattices	Identify whether a given lattice is modular or distributive	K3
IV	**Boolean Algebra**		
4.1	Boolean algebra	Explain special type of lattice which is involved in logical operations	K2
4.2	Boolean polynomials	Construct Boolean polynomials for a given Boolean function	K3
4.3	Karnaugh maps	Build the pictorial method to minimize the Boolean expressions	K3
V	**Coding Theory**		
5.1	Introduction to coding theory	Explain how mathematics is involved in coding theory	K2
5.2	Definition of hamming distance	Explain the basic ideas of encryption	K2
5.3	Encoding a message	Define an encoding function which is used to encrypt a message	K2
5.4	Group codes	Identify whether a encoding function is group code or not	K3
5.5	Procedure for generating group codes	Demonstrate the general procedure to create a group code	K2
5.6	Decoding and error correction	Define a decoding function to decrypt an encoded message	K3
5.7	An example of a single error correcting code	Construct a single error correcting code	K5

4. MAPPING SCHEME (POs, PSOs AND COs)

U16MA611	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	H	H	L	M	H	L	H	-	H	H	H	L
CO2	M	H	H	L	M	H	L	H	-	H	H	M	L
CO3	H	H	H	L	L	H	M	H	-	H	M	M	L
CO4	M	H	H	M	L	H	L	H	-	H	M	M	L
CO5	H	H	M	H	H	H	H	H	-	H	H	H	M
CO6	H	H	H	H	H	H	M	M	-	M	H	M	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. F. Yoshva Genesis

CORE COURSE XII: ELEMENTARY NUMBER THEORY

Semester: VI **Course Code: U16MA612**

Credits: 5 **Hours/Week: 6**

1. COURSE OUTCOMES:

At the end of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Recall absolute value, Divisibility of integers, GCD and LCM	**K1**	**I**
CO2	Explain Division algorithm and Euclidean algorithm	**K2**	**I**
CO3	Apply Euclid's theorem and Unique factorization theorem	**K3**	**II**
CO4	Categorize the numbers as Perfect, Abundant, deficient, amicable, and Triangular of numbers	**K4**	**III**
CO5	Interpret the complete residue system and linear congruency of integers	**K5**	**IV**
CO6	Discuss the Fermat's theorem, Wilson's theorem, and Lagrange's theorem	**K6**	**V**

2A. SYLLABUS

UNIT I: Division Algorithm and Euclidean Algorithm (18 Hours)

Absolute value-Divisibility of integers-Division Algorithms-Greatest common divisor-Euclidean algorithm-Least common multiple.

UNIT II: Unique Factorization Theorem and Arithmetic functions (18 Hours)

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: Euclid's theorem and Euler Function, Greatest Integer Functions (18 Hours)

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

UNIT IV: Complete Residue System and Divisibility Test (18 Hours)

Congruence - Residues-Residue classes-complete residue system-Reduced residue system-Magic number- Divisibility tests-linear congruence.

UNIT V: Fermat's theorem, Wilson's theorem and Lagrange's theorem (18 Hours)

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

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Integers	https://nptel.ac.in/content/storage2/111/101/111101137/MP4/mod01lec01.mp4
2	Computing the GCD and Euclid's lemma	https://nptel.ac.in/content/storage2/111/101/111101137/MP4/mod01lec05.mp4

3	Fundamental Theorem of Arithmetic	https://nptel.ac.in/content/storage2/111/101/111101137/MP4/mod02lec06.mp4
4	Residue Class Modulo n	https://nptel.ac.in/content/storage2/111/101/111101137/MP4/mod02lec10.mp4

C. TEXTBOOK(s):

1. S. Kumaravelu and Susheela Kumaravelu, Elements of Number Theory, Nagarcoil, January 2002.

D. REFERENCE BOOKS:

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

E. WEB LINKS:

1. https://swayam.gov.in/nd1_noc19_cs51
2. https://nptel.ac.in/courses/111/103/111103020/

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/Section	Course Contents	Learning Outcomes	Bloom's Taxonomy Level of Transactions
I	**Division Algorithm and Euclidean Algorithm**		
1.1	Absolute value, Divisibility of integers	The student should be able to recall absolute value, divisibility of integers	K1
1.2	Division Algorithm	illustrate the division algorithm	K2
1.3	Euclidean algorithm	apply the Euclid's algorithm	K3
1.4	Greatest Common Divisor, Least Common Multiple	determine GCD and LCM	K5
II	**Unique Factorization Theorem and Arithmetic functions**		
2.1	Euclid's theorem	explain the Euclid's theorem	K2
2.2	Unique factorization theorem	apply the Unique factorization theorem	K3
2.3	Positional representation of numbers, Divisors of an integer	analyze the positional representation of integer	K4
2.4	Arithmetic functions, Product of divisors	explain the arithmetic function	K5
III	**Euclid's theorem and Euler Function, Greatest Integer Functions**		
3.1	Perfect numbers, Abundant and Deficient	define the different types of numbers	K1
3.2	Amicable numbers and Triangular numbers	classify the different types of numbers	K4

3.3	Euler's function and Greatest integer function	determine the Euler's function and Greatest integer function	K5
IV	**Complete Residue System and Divisibility Test**		
4.1	Congruence, Residues	demonstrate the congruency and residues among numbers	K2
4.2	Residue classes, Complete Residue System and Reduced Residue System	construct CRR and RRS	K3
4.3	Magic numbers, Divisibility tests, Linear congruences	determine multiplicative inverses, modulo n and use to solve linear congruences	K5
V	**Fermat's theorem, Wilson's theorem and Lagrange's theorem**		
5.1	Fermat's theorem, Euler's extension of Fermat' theorem	explain Fermat's theorem and Euler's Extension of Fermat's theorem	K2
5.2	Wilson's theorem, Lagrange's theorem	Discuss the Wilson's theorem and Lagrange's theorem	K5

4. MAPPING SCHEME (POs, PSOs and COs

U16MA612	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	M	M	L	L	M	H	H	-	H	H	H	L
CO2	M	H	M	M	L	M	H	M	-	M	M	M	M
CO3	M	H	M	L	L	M	M	L	-	M	H	H	M
CO4	M	H	M	L	L	M	H	M	-	M	H	M	M
CO5	H	H	H	M	M	L	M	M	-	H	H	M	L
CO6	H	H	M	M	M	L	M	L	-	L	H	H	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. M. Muthuvel

Elective II: MATHEMATICAL MODELLING

Semester: VI **Course Code: U16MA6:2**

Credits: 5 **Hours/Week: 6**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No	Course Outcomes	Level	Unit
CO1	Analyze the behavior of a dynamic system through mathematical models in terms of ordinary differential equations	**K4**	**I, II**
CO2	Discuss the problem of global stability in population Dynamics	**K6**	**II**
CO3	Discuss the motion of particles in space	**K6**	**III**
CO4	Construct mathematical modelling through difference equation for the problem occur in mathematics, statistics and in actuarial science	**K6**	**IV**
CO5	Solve typical problem situations which can be modelled through graphs	**K6**	**V**
CO6	Understand the applications of differential equations, difference equations and graph theory in Mathematical modelling.	**K2**	**I - V**

2A. SYLLABUS

UNIT I: Mathematical Modelling Through Ordinary Differential Equations of First Order (18 Hours)

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: Mathematical Modelling Through Systems of Ordinary Differential Equations of First Order (18 Hours)

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

UNIT III: Mathematical Modelling Through Ordinary Differential Equations of Second Order (18 Hours)

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

UNIT IV: Mathematical Modelling Through Difference Equations (18 Hours)

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

UNIT V : Mathematical Modelling Through Graphs (18 Hours)

Modelling 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.

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Discrete Time Linear Models in Population Dynamics - I	https://nptel.ac.in/content/storage/111/107/111107113/MP4/mod01lec02.mp4
2	Discrete Time Linear Models in Population Dynamics - II	https://nptel.ac.in/content/storage/111/107/111107113/MP4/mod01lec03.mp4
3	Discrete Time Linear Age Structured Models	https://nptel.ac.in/content/storage/111/107/111107113/MP4/mod01lec04.mp4
4	Continuous Time Models in Population Dynamics - I	https://nptel.ac.in/content/storage/111/107/111107113/MP4/mod03lec13.mp4
5	Continuous Time Models in Population Dynamics - II	https://nptel.ac.in/content/storage/111/107/111107113/MP4/mod03lec14.mp4

C. TEXTBOOK(s):

1. 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

D. REFERENCE BOOKS:

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.

E. WEB LINKS:

1. https://nptel.ac.in/courses/111/107/111107113/
2. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ma18/
3. http://www.digimat.in/nptel/courses/video/111107113/L12.html

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit / Section	Course Content	Learning outcomes	Bloom's Taxonomy Level of Transaction
I	**Mathematical Modeling Through Ordinary Differential Equations of First Order**		
1.1	Linear Growth and Decay Models	Discuss the population growth and decay model	K6
1.2	Growth of science and scientists	Apply the growth population in dynamic system	K3
1.3	Effects of Immigration and Emigration on population size	Apply the growth of populations of bacteria and micro-organisms	K3
1.4	Radio-Active Decay	Estimate the age of the solar system	K6

1.5	Decrease of Temperature	Discover the model for temperature decay	K4
1.6	Change of Price of a Commodity	Identifying the change of commodity price	K3
1.7	Non-Linear growth and decay models	Discuss about the logistic law of population growth	K6
1.8	Rate of Dissolution	Compare the concentration of solute and maximum concentrate	K4
1.9	Diffusion of glucose or a medicine in the bloodstream	Examine the distribution of drug in human body	K4
II	**Mathematical Modeling Through Systems of Ordinary Differential Equations of First Order**		
2.1	Prey-predator models	Discuss about the stability of the species	K6
2.2	Competition models	Analyze the competition model through system of differential equations	K4
2.3	Multi species models	Discuss the stability of a position of equilibrium	K6
2.4	Simple epidemic models	Discuss the role of epidemic modeling in public health policy and resource allocation	K6
2.5	A model for diabetic-mellitus.	Examine the compensation of the glucose- insulin system in health through differential equation	K4
III	**Mathematical Modeling Through Ordinary Differential Equations of Second Order**		
3.1	Need for the Study of Motion Under Central Forces	Explain the motion of the particle moving under central force	K2
3.2	Components of Velocity and Acceleration Vectors along Radial and Transverse Directions	Invent the Velocity and Acceleration Vectors along Radial and Transverse Directions	K6
3.3	Motion under a central force	Discuss the equation of the path by a particle moving under a central force	K6
3.4	Motion Under the Inverse Square Law	Construct the model for inverse square Law	K6
3.5	Kepler's Laws of Planetary Motions	Analyze the Kepler's law of planetary motion through ordinary differential equation	K4
3.6	Circular Motion	Discuss the motion of the particle in a circular motion through ordinary differential equation	K6
3.7	Circular Motion of Satellites	Formulate artificial satellite motion	K6
3.8	Elliptic motion of Satellites	Discuss the motion of the particle in elliptic motion	K6
3.9	Rectilinear motion	Propose the concepts of position distance travelled, velocity and speed	K6
IV	**Mathematical Modeling Through Difference Equations**		

4.1	Linear difference equation	Explain the method of solving linear difference equations	K5
4.2	Obtaining Complementary function by use of matrices	Solve the algebraic equations with real and imaginary roots	K6
4.3	Solution of Linear Difference Equations by Using Laplace Transform	Build Laplace transform method to solve difference equation	K3
4.4	The Harrod model	Illustrate the role of savings and investment in the growth process	K2
4.5	The Cob-web model	Discuss the cobweb theory in economic model	K6
4.6	Applications to Actuarial Science	Relationship between the statistics and actuarial science	K4
V	**Mathematical Modeling Through Graphs**		
5.1	Seven bridge problem	Discovered a technique for solving many problems	K4
5.2	Representing results of tournament	Apply to real life problem	K3
5.3	Genetic graph	Apply the genetic model in scientific area	K3
5.4	Senior Subordinate Relationship	Discuss the relationship of senior with subordinate	K6
5.5	Food Web	Explain the status of the species by food web model	K2
5.5	Communication network	Explain the communication network between the individuals through graphs	K4
5.6	Matrices Associated with a Directed Graph	Explain the matrix associated with graph	K2
5.7	Application of Directed Graphs to Detection of clique	Apply the directed graph to find the number of cliques	K3
5.8	Balance of signed graphs	Determine the condition for a graph to be balanced	K5

MAPPING SCHEME (CO, PO, PSO)

U16MA6:2	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	M	-	M	-	M	-	-	L	M	M	H	L
CO2	M	M	-	M	M	M	-	-	L	-	M	L	L
CO3	M	M	-	M	M	-	M	-	M	M	L	M	L
CO4	M	M	L	M	-	-	M	-	L	M	M	M	H
CO5	M	M	M	M	M	-	-	-	L	M	M	M	M
CO6	M	M	M	M	M	-	M	-	M	M	M	M	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. J. Maria Felicit

Elective Course III: Operations Research

Semester: VI **Course Code: U20MA6:3**

Credits: 5 **Hours/Week: 6**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO 1	Understand the system of a business organization and converting the given problem into Linear Programming Problem, Transportation problem	**K2**	**I, II, III**
CO 2	Solve Linear Programming Problem using Simplex method, Big M method and Two-Phase method.	**K3**	**II**
CO 3	Solve Transportation problems which arises in industries / business organizations in such a way that to reduce transportation cost.	**K3**	**III**
CO 4	Analyze the given assignment problems and assign persons or machines to complete tasks in such a way that to reduce man hours or cost.	**K4**	**III**
CO 5	Determine the project duration using critical path and network diagram	**K5**	**IV**
CO 6	Estimate economic order quantity for given problems	**K6**	**V**

2A. COURSE CONTENT

UNIT I: Linear Programming Problem **(18 Hours)**

Introduction – The history of Operations Research – The meaning of Operations Research – Models of Operations Research – Scope of Operations Research – Phases of Operations Research – Limitations of Operations Research - The Linear Programming Problem – Introduction – General Model of an LPP – Characteristics of a LPP – Assumptions of a LPP - Formulation of an LPP – Standard form of an LPP – Solution to an LPP – Types of possible Solution to an LPP – Convex Set and Extreme Points – Graphical Solution to an LPP..

UNIT II: Solution of LPP **(18 Hours)**

Simplex Method – Big M Method – Two Phase Method – The Duality Concept in a Linear Programming Problem - Dual Simplex Method.

UNIT III: Transportation and Assignment Problem **(18 Hours)**

Transportation Problem – Introduction – Conversion of TP into an Equivalent LPP form – Formulation of a Transportation Problem – Concepts of Feasibility Basicness, and degeneracy in the Solution – Methods used to find the solution to a TP – Description of various methods to find the initial basic feasible solution – Stepping Stone Method/ Modified Distributive Method – Assignment Problem – Introduction – General Model of the assignment problem – Conversion into an Equivalent LPP – Solution to the assignment problem.

UNIT IV: PERT and CPM **(18 Hours)**

PERT – CPM – Introduction – Method for Construction of a Network – Numbering the nodes – Critical Path Method – Project Evaluation review technique.

UNIT V: Inventory Control **(18 Hours)**

Inventory Control – Introduction – Variables related to Inventory Control – Merits and Demerits of Inventory – Classification of Inventory Models – Economic Order Quantity – General Notation used in the Inventory Control – Model I – Model II – Model III – Model IV – Model V – Model VI – Inventory Problems with uncertain demand – Inventory Problems with Price Breaks – Multi Item Deterministic Model – Probabilistic Inventory Model – Selective Inventory Management Technique.

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Additional Simplex Algorithm	http://library.lol/main/E3AA251DD5BF0EAF1D5005717559F374
2	Post optimal Analysis	http://library.lol/main/E3AA251DD5BF0EAF1D5005717559F374
3	Goal Programming	https://www.youtube.com/watch?v=2e1dZpOk3Zc
4	Decision Making	https://www.youtube.com/results?search_query=decision+making++iit+

C. TEXTBOOK(s):

1. P. Mariappan, "Operations Research Methods and Applications", New century Book House, 2002.

D. REFERENCE BOOKS:

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.

E. WEB LINKS:

1. https://nptel.ac.in/courses/111/107/111107128/

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit/ Section	Course Content	Learning outcomes	Bloom's Taxonomy Level of Transaction
I	**INTRODUCTION TO LINEAR PROGRAMMING PROBLEM**		
1.1	Introduction and History of Operation Research	Understand the history of operations research for effective decision making	K2
1.2	Models of Operations Research	Explain the models of Operations Research	K2
1.3	Scope of Operations Research	Explain the scope of Operations Research	K2
1.4	Phases of Operations Research	Understand the phases of operations research	K2
1.5	Limitations of Operations Research	Understand the limitations of operations research	K2

1.6	Introduction to the Linear Programming Problem (LPP)	Explain the concept of LPP	K2
1.7	Characteristics of a LPP	Describe the characteristics of L.P.P	K1
1.8	Assumptions of a LPP	List out the assumptions of LPP	K1
1.9	Formulation of a LPP	Formulate real world problems as LPP.	K5
1.10	Standard form of an LPP	Describe the standard form of LPP	K1
1.11	Solution to an LPP and Types of possible solutions to an LPP	Understand the solution to a L.P.P and types of possible solutions.	K2
1.12	Convex set and Extreme points	To describe the basic concept of convex set and extreme points.	K1
1.13	Graphical solution to an LPP.	Determine the optimal solution to LPP by using Graphical method	K6
II	**SOLUTION TO LINEAR PROGRAMMING PROBLEM**		
2.1	Simplex Method	Determine the optimal solution to LPP using Simplex Method	K6
2.2	Big M Method	Determine the optimal solution to LPP using Big–M method,	K6
2.3	Two Phase Method	Determine the optimal solution to LPP using Two phase method	K6
2.4	Dual Simplex Method.	Determine the optimal solution to LPP using Dual Simplex Method.	K6
2.5	The Duality Concept in a Linear Programming Problem	explain the relationship between linear program and its dual.	K2
III	**TRANSPORTATION PROBLEMS AND ASSIGNMENT PROBLEMS**		
3.1	Introduction to Transportation problem	Understand the concept of Transportation Problem	K2
3.2	Conversion of Transportation Problem into an Equivalent LPP form	Converting a Transportation Problem into an equivalent LPP form	K2
3.3	Formulation of a Transportation Problem	Demonstrate real world problem as a Transportation problem	K5
3.4	Concepts of Feasibility Basicness, and degeneracy in the Solution	Understand the concept of degeneracy in solution	K2
3.5	Methods used to find the solution to a TP	Determine the optimal solution to Transportation Problem using Stepping Stone Method/Modified Distributive Method	K6
3.6	Description of various methods to find the initial basic feasible solution	Describe the initial basic feasible solution using(i) row minima/column minima method (ii) Vogal's approximation Methods (iii)	K6

		Least cost cell method (iv) North west corner cell method	
IV	**PERT-CPM METHODS**		
4.1	Introduction to Construction of a Network and numbering the nodes	Understand the concept of network construction.	K2
4.2	Critical Path Method (CPM)	Estimate the duration of a project.	K6
4.3	PERT(Program Evaluation Review Technique) Method	Analyze a project schedule and to explain the significance of various kinds of floats involve in a project network	K4
V	**INVENTORY CONTROL**		
5.1	Introduction to Inventory Control and variables related to inventory control	Explain the concept of inventory control.	K2
5.2	Merits and Demerits of Inventory	Understand the Merits and Demerits of Inventory models	K2
5.3	Classification of Inventory Models	Classify the inventory models	K2
5.4	Economic Order Quantity for Model I	Determine the Economic Order Quantity for the Inventory Model-I	K6
5.5	Economic Order Quantity for Model II	Determine the Economic Order Quantity for the Inventory Model-II	K6
5.6	Economic Order Quantity for Model III	Determine the Economic Order Quantity for the Inventory Model-III	K6
5.7	Economic Order Quantity for Model IV	Determine the Economic Order Quantity for the Inventory Model-IV	K6
5.8	Economic Order Quantity for Model V	Determine the Economic Order Quantity for the Inventory Model-V	K6
5.9	Economic Order Quantity for Model VI	Determine the Economic Order Quantity for the Inventory Model-VI	K6
5.10	Inventory Problems with uncertain demand	Solve inventory problems with uncertain demand	K3
5.11	Inventory Problems with Price Breaks	Solve Inventory Problems with Price Breaks	K3
5.12	Multi Item Deterministic Model	Solve problems based on multi-item Deterministic Model	K3
5.13	Probabilistic Inventory Model	Determine the Economic Order Quantity for the Probabilistic Inventory Model	K6
5.14	Inventory Management Technique	Understand the concept of inventory management technique.	K2

4. MAPPING SCHEME (COs, Pos AND PSOs)

U20MA6:3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	H	L	M	H	M	M	L	M	M	M	M	H
CO2	L	H	L	L	H	M	M	L	M	L	M	M	H
CO3	M	H	L	L	H	M	M	L	M	L	M	L	H
CO4	M	H	L	L	H	L	M	L	M	L	M	L	H
CO5	M	H	L	M	H	L	M	L	M	L	M	L	H
CO6	L	H	L	M	H	L	M	L	M	L	M	L	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT

METHODSDIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion,Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. B. Venkatesh

Elective Course II - Graph Theory

Semester: VI **Course Code:**

Credits: 5 **Hours/Week: 6**

General objectives:

On completion of this course, the learner will

1. be able to understand 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

Graphs and Simple Graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex, Degrees – Paths and Connections – Cycles. Trees – Cut edges and bonds, Cut vertices, Cayley's formula.

Unit II

Connectivity, Blocks, Euler Tours, Hamilton cycles.

Unit III

Edge Chromatic number, Vizing's Theorem, Independent Sets, Ramsey's Theorem – Turan's Theorem.

Unit IV

Chromatic number, Brook's theorem, Hajos conjucture, Chromatic Polynomials, Girth and Chromatic number, Plane and Planar Graphs, Dual Graphs – Euler's formula.

Unit V

The Five Colour Theorem and Four Colour Conjecture, Directed Graphs, Directed Paths – Directed Cycles.

Text Book

Bondy, J.A.& Murthy, U.S.R., Graph Theory with Applications, The Mac Millan Press Ltd., 1976.

Unit I Chapter 1 § 1.1 – 1.7 & Chapter 2 § 2.1 – 2.4
Unit II Chapter 3 § 3.1, 3.2 & Chapter 4 § 4.1 & 4.2
Unit III Chapter 6 § 6.1, 6.2 & Chapter 7 § 7.1 – 7.3
Unit IV Chapter 8 § 8.1 – 8.5 & Chapter 9 § 9.1 – 9.3
Unit V Chapter 9 § 9.6 & Chapter 10 § 10.1 – 10.3

References

1. Harary, Graph Theory, Narosha Publishing House, New Delhi, 1988.
2. Arumugam, S & Ramachandran, S., Invitation to Graph Theory, New Gamma Publishing House, Palayamkottai, 1993.

Extra Credit Course II - Information Theory

Semester: VI **Course Code: U20MA6:5**

Credits: 5 **Hours/Week: 6**

General objectives & Learning outcomes:

On completion of this course, the learner will

1. know the classification of channels and their information processes.
2. be able to understand the basic concepts of information theory and coding theory.

Unit I

Measure of Information – Axioms for a measure of uncertainty. The Shannon entropy and its properties. Joint and conditional entropies. Transformation and its properties.

Unit II

Noiseless coding – Ingredients of noiseless coding problem. Uniquely decipherable codes. Necessary and sufficient condition for the existence of instantaneous codes. Construction of optimal codes.

Unit III

Discrete Memory less Channel-Classification of channels. Information processed by a channel. Calculation of channel capacity. Decoding schemes. The ideal observer. The fundamental theorem of information theory and its strong and weak converses.

Unit IV

Continuous Channels – The time-discrete Gaussian channel. Uncertainty of an absolutely continuous random variable. The converse to the coding theorem for time-discrete Gaussian Channel. The time-continuous Gaussian channel. Band-limited channels.

Unit V

Some imuitive properties of measure of entropy-Symmetry, normalization, expansibility, boundedness, recursivity maximality, stability, additivity, subadditivity, nonnegative, continuity, branching etc. and interconnections among them. Axiomatic characterization of Shannon entropy dur to Shannon and Fadeev.

References

1. R.Ash, Information Theory, Inter science Publishers, New York, 1965.
2. F.M.Reza, An Introduction to Information Theory, McGraw-Hill Book Company Inc.,1961.
3. J.Aczel and Z.Daroczy, On Measures of Information and Their Characterization, Academic Press, New York,1975.

UG - Non-Major Elective Courses (NMEC)

(Offered to Students of other Disciplines)

Sem.	Course	Code	Title	Hrs./ week	Credits	Marks		
						CIA	ESA	TOTAL
III	NMEC - I	U14MA3E1	Mathematics for Competitive Examinations	2	2	25	75	100
IV	NMEC - II	U14MAPE2	Statistical Applications (Practical's)	2	2	40	60	100

NMEC Course I: MATHEMATICS FOR COMPETITIVE EXAMINATIONS

Semester: I **Course Code: U14MA3E1**

Credits: 2 **Hours/Week: 2**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
CO1	Find LCM and HCF for given numbers	K1	I
CO2	Find Square roots and Cube roots	K2	II
CO3	Solve problems on partnership	K2	II
CO4	Solve the problems on profit and loss, Time and Distance	K2	III
CO5	Solve the problems on trains, boats, and Streams	K2	IV
CO6	Find simple and compound interest problems	K2	V

2A. SYLLABUS

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.

B. TOPICS FOR SELF STUDY:

S. No.	Topics	Web Links
1	Number series	https://careerdost.in/aptitude-questions/number-series
2	Probability	https://www.youtube.com/watch?v=fTfIfkVifrs
3	Height and Distance	https://questionpaper.org/height-and-distance/
4	Discount	https://www.toppr.com/guides/quantitative-aptitude/profit-and-loss/discounts-and-marked-price/

C. TEXTBOOK:

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

D. WEB LINKS:

1. https://sucessguru.com/objective-arithmetic-for-competitive-examinations-pdf/
2. https://sscresult.in/tag/objective-arithmetic-by-rs-aggarwal-free-download-pdf/

3. SPECIFIC LEARNING OUTCOMES (SLOs):

Unit/Section	Course Content	Learning Outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Number System**		
1.1	Numbers	Know about the number system	K1
1.2	LCM and HCF	Find the LCM and HCF of given numbers	K2
1.3	Decimal	Find the decimal value for fraction	K2
1.4	Fractions	Find the fraction value for decimals	K2
1.5	Simplification	Find simplified format of numbers	K2
II	**Roots and Average**		
2.1	Square root	Find square root of the numbers	K1
2.2	Cube roots	Find cube roots of the numbers	K1
2.3	Percentage	Find the percentage for the given value	K2
2.4	Average	Find the average of the distribution	K2
2.5	Ratio and Proportions	Find ratios and Proportions of the numbers	K2
2.6	Partnership	Find the shares for the partners in the business	K2
III	**Profit and Loss, Time and Distance**		
3.1	Profit and Loss	Find profit or loss, profit or loss percentage and C.P or S.P of the product	K2
3.2	Time and work	Find the time or work done by the persons.	K2
3.3	Pipes and cisterns	Solve the problem using pipes and cisterns concept	K2
3.4	Time and distance	Find time and distance of the given problem	K2
IV	**Problems on Trains and ages**		
4.1	Train Problems	Find length of the train or platform and time taken to cover the distance	K2

4.2	Boat and Steams problems	Find the upstream and downstream of the boat	K2
4.3	Number problems	Solve the number problems	K2
4.4	Age problems	Find the age of any person using the information	K2
V	**Interest Problems**		
5.1	Simple Interest	Find the simple interest or rate of interest and principal amount or number of years	K2
5.2	Compound Interest	Find the Compound interest or rate of interest and principal amount or number of years	K2
5.3	Volumes	Find the volumes of different shapes	K2
5.4	Areas	Find the Area of different shapes	K2

4. MAPPING SCHEME (POs, PSOs and COs

U14MA3E1	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PSO1**	**PSO2**	**PSO3**	**PSO 4**
CO1	H	H	M	-	H	H	H	-	-	H	M	H	M
CO2	H	H	M	-	H	H	H	-	-	H	M	H	H
CO3	H	H	M	-	H	H	H	-	-	H	M	H	H
CO4	H	H	M	-	H	H	H	-	-	H	M	H	H
CO5	H	H	M	-	H	H	H	-	-	H	M	H	H
CO6	H	H	M	-	H	H	H	-	-	H	M	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mrs. B. Abinaya

NMEC – II – Statistical Applications (Practical)

Sem. IV **Course Code: U14MAPE2**

Credits: 2 **Hours/Week: 2**

1. COURSE OUTCOMES

After the successful completion of this course the students will be able to

CO. No.	Course Outcomes	Level
CO 1	Download and install R and RStudio	**K2**
CO 2	Learn to apply R programming for data processing	**K2**
CO 3	Develop codes using R for analyzing statistical data	**K3**
CO 4	Produce data visualizations using packages	**K3**
CO 5	Compute basic summary statistics	**K3**
CO 6	Use different modules of R for different applications to analyse data.	**K4**

2A. SYLLABUS

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

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Data Management with repeats, sorting, ordering and lists.	https://onlinecourses.nptel.ac.in/noc21_ma75/preview
2	Robust error handling in R	https://www.youtube.com/watch?v=WjtXc4OXZuk
3	Proper design of Functions	http://home.iitk.ac.in/~shalab/swayamprabha/rsw/sp-rsw-lect-8.pdf

C. 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.

D. WEB LINKS:

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview

2. https://www.digimat.in/nptel/courses/video/111104100/L01.html

3. https://cse.iitkgp.ac.in/~dsamanta/courses/da/resources/slides/04Programming%20with%20R.pptx

3. SPECIFIC LEARNING OUTCOMES (SLO)

S. No.	Lab Exercises	Learning outcomes	Bloom's Taxonomy Level of Transaction
1	Calculation of measures of central tendency	To construct data tables that facilitate the calculation of mean, median, mode, and range	K3
2	Calculation of measures of dispersion	To compute and explain the range, the interquartile range, the standard deviation and the variance	K3
3	Graphical display of data	To understand the graphical display of data like histogram, pie chart etc…	K2
4	Analyzing data using tables	To analyze data using tables	K4
5	Binomial, Normal and Poisson Distributions	To distinguish Binomial, Poisson and Normal Distributions	K4
6	Coefficient of variation	To analyze Coefficient of variation	K4
7	Measures of skewness	To distinguish between a symmetrical and a skewed distribution and compute co-efficient of kurtosis	K4
8	Calculation of correlation coefficient	To analyze correlation coefficient	K4
9	Rank Correlation	To analyze Rank correlation	K4
10	Finding Regression lines	To compute Regression lines	K3

4. MAPPING SCHEME (COs, POs AND PSOs):

U14MAPE2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	L	L	M	L	L	L	L	L	M	L	L	L
CO2	M	M	M	H	M	M	L	-	-	H	H	L	L
CO3	M	H	M	H	M	H	M	-	-	M	H	M	L
CO4	M	M	L	H	M	H	L	-	-	M	M	M	L
CO5	M	H	M	H	M	M	M	L	L	M	M	H	M
CO6	L	H	L	M	M	M	M	L	L	M	M	M	L

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. M. Joseph Paramasivam

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	U16MAPS3	Programming in C (Linux OS)	2	2	40	60	100

SBEC Course I: MATHEMATICS FOR COMPETITIVE EXAMINATIONS

Semester: I **Course Code: U14MA1S1**

Credits: 2 **Hours/Week: 2**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to:

CO. No.	Course Outcomes	Level	Unit
CO1	Find LCM and HCF for given numbers	**K1**	**I**
CO2	Find Square roots and Cube roots	**K2**	**II**
CO3	Solve problems on partnership	**K2**	**II**
CO4	Solve the problems on profit and loss, Time and Distance	**K2**	**III**
CO5	Solve the problems on trains, boats, and Streams	**K2**	**IV**
CO6	Find simple and compound interest problems	**K2**	**V**

2A. COURSE CONTENT

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.

B. TOPICS FOR SELF STUDY:

S. No.	Topics	Web Links
1	Number series	https://careerdost.in/aptitude-questions/number-series
2	Probability	https://www.youtube.com/watch?v=fTfIfkVifrs
3	Height and Distance	https://questionpaper.org/height-and-distance/

4	Discount	https://www.toppr.com/guides/quantitative-aptitude/profit-and-loss/discounts-and-marked-price/

C. TEXTBOOK:

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

D. WEB LINKS:

1. https://sucessguru.com/objective-arithmetic-for-competitive-examinations-pdf/
2. https://sscresult.in/tag/objective-arithmetic-by-rs-aggarwal-free-download-pdf/

3. SPECIFIC LEARNING OUTCOMES (SLOs):

Unit/Section	Course Content	Learning Outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Number System**		
1.1	Numbers	Know about the number system	K1
1.2	LCM and HCF	Find the LCM and HCF of given numbers	K2
1.3	Decimal	Find the decimal value for fraction	K2
1.4	Fractions	Find the fraction value for decimals	K2
1.5	Simplification	Find simplified format of numbers	K2
II	**Roots and Average**		
2.1	Square root	Find square root of the numbers	K1
2.2	Cube roots	Find cube roots of the numbers	K1
2.3	Percentage	Find the percentage for the given value	K2
2.4	Average	Find the average of the distribution	K2
2.5	Ratio and Proportions	Find ratios and Proportions of the numbers	K2
2.6	Partnership	Find the shares for the partners in the business	K2
III	**Profit and Loss, Time and Distance**		
3.1	Profit and Loss	Find profit or loss, profit or loss percentage and C.P or S.P of the product	K2
3.2	Time and work	Find the time or work done by the persons.	K2
3.3	Pipes and cisterns	Solve the problem using pipes and cisterns concept	K2
3.4	Time and distance	Find time and distance of the given problem	K2
IV	**Problems on Trains and ages**		

4.1	Train Problems	Find length of the train or platform and time taken to cover the distance	K2
4.2	Boat and Steams problems	Find the upstream and downstream of the boat	K2
4.3	Number problems	Solve the number problems	K2
4.4	Age problems	Find the age of any person using the information	K2
V	**Interest Problems**		
5.1	Simple Interest	Find the simple interest or rate of interest and principal amount or number of years	K2
5.2	Compound Interest	Find the Compound interest or rate of interest and principal amount or number of years	K2
5.3	Volumes	Find the volumes of different shapes	K2
5.4	Areas	Find the Area of different shapes	K2

4. MAPPING SCHEME (POs, PSOs and COs)

U14MA1S1	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PSO1**	**PSO2**	**PSO3**	**PSO 4**
CO1	H	H	M	-	H	H	H	-	-	H	M	H	M
CO2	H	H	M	-	H	H	H	-	-	H	M	H	H
CO3	H	H	M	-	H	H	H	-	-	H	M	H	H
CO4	H	H	M	-	H	H	H	-	-	H	M	H	H
CO5	H	H	M	-	H	H	H	-	-	H	M	H	H
CO6	H	H	M	-	H	H	H	-	-	H	M	H	H

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mrs. B. Abinaya

SBEC Course II - Introduction to Scientific Computing (OCTAVE)

Semester: III **Course Code: U16MAPS2**

Credit: 2 **Hours/Week: 2**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Exercise Covered
CO1	Create, initialize, and display simple variables and simple strings and use simple formatting for variable.	K6	1
CO2	Evaluate basic operations on matrices.	K5	1, 2
CO3	Classify different subplots from a given plot and colour plot data.	K4	3
CO4	Explain conditional statements and different type of loops based on simple examples.	K2	4, 5, 6, 7
CO5	Develop OCTAVE codes to solve algebraic equations.	K3	8, 9
CO6	Illustrate using different modules of OCTAVE to solve algebraic differential equations.	K2	10, 11

2A. SYLLABUS

Ex. No.	Exercise
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

B. TOPICS FOR SELF-STUDY

Topics	Weblinks
GNU Octave for computations and plotting	https://nptel.ac.in/courses/113/101/113101002/
Numerical Integration	https://nptel.ac.in/courses/113/101/113101002/
Graphics	http://math.jacobs-university.de/oliver/teaching/iub/resources/octave/octave-intro/octave-intro.html#SECTION00050000000000000000

Control structures	http://math.jacobs-university.de/oliver/teaching/iub/resources/octave/octave-intro/octave-intro.html#SECTION00050000000000000000

3. SPECIFIC LEARNING OUTCOMES (SLO)

Ex. No.	Lab Exercises	Learning Outcomes	Highest Bloom's Taxonomy Level of Transaction
1	Matrix manipulations such as multiplication, inverse, determinant, random, magic etc.	Create single dimension / multi-dimension arrays, and arrays with specific values like array of all ones, all zeros, array with random values within a range, or a diagonal matrix.	K6
2	Solving system of linear equations.	Solve simple matrix operation to solve system of linear equations	K3
3	To plot 2D and 3D graphs.	Create various type of plots/charts	K6
4	Solving quadratic equations.	Explain coding to solve quadratic equations	K2
5	Write an OCTAVE program to check the given string is palindrome or not.	Construct coding on palindrome	K6
6	To find the binomial coefficients nCr	Discuss conditional statement for finding binominal coefficient	K6
7	Program to generate Fibonacci numbers.	Build loops to generate Fibonacci numbers	K3
8	Program to solve an algebraic equation using bisection method.	Develop coding for bisection method	K6
9	Program to solve an algebraic equation using Newton Raphson method.	Develop coding for Newton Raphson method	K6
10	Solving first order Ordinary Differential Equations	Explain coding for solving differential equations of first order	K2
11	Solving second order Ordinary Differential Equations	Explain coding for solving differential equations of second order	K2

4. MAPPING SCHEME (COs, POs AND PSOs)

U16MAPS2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	-	H	L	L	L	-	-	L	M	-	-
CO2	H	H	L	H	-	M	L	-	-	M	H	-	-
CO3	M	M	-	H	-	-	L	-	-	L	H	-	-
CO4	M	H	-	H	-	L	M	-	-	M	H	L	L
CO5	H	H	M	H	M	M	M	-	-	H	H	M	M
CO6	H	H	M	H	M	M	M	-	-	H	H	M	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. M. Antony Raj

SBEC Course III – Programming in C (Linux OS)

Sem: V **Course Code: U16MAPS3**

Credits: 2 **Hours/Week: 2**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Exercise
CO 1	Describe the advantages of working in Linux Operating System	**K2**	**-**
CO 2	Develop program for solving algebraic equations	**K3**	**1,2**
CO 3	Develop C coding for solving numerical integral problems	**K3**	**3,4**
CO 4	Solve Initial Value Problems numerically using C programming	**K3**	**5,6**
CO 5	Solve Boundary Value Problems numerically using C programming	**K3**	**7**
CO 6	Construct programs using C for numerical computing in Linux OS	**K6**	**-**

2A. SYLLABUS

Unit I (4 hours)

Introduction to C programming in Linux Operating system.

Unit II (6 hours)

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

Unit III (7 hours)

Numerical Integration by using Trapezoidal and Simpson's method.

Unit IV (7 hours)

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

Unit V (6 hours)

Solving boundary value problem by using finite difference method.

B. TOPICS FOR SELF-STUDY:

S. No.	Topics	Web Links
1	Programming in C: Nested loops	http://www.nptelvideos.com/lecture.php?id=6601
2	Problem Solving through Programming in C: 2-D Array Operation	https://nptel.ac.in/courses/106/105/106105171/
3	Problem Solving through Programming in C: Sorting Methods	https://nptel.ac.in/courses/106/105/106105171/

4	Programming in C: Functions - Introduction	http://www.nptelvideos.com/lecture.php?id=6610

C. TEXTBOOK

1. E. Balagurusamy, Programming in ANSI C, Tata McGraw Hill Publishing Pvt.Ltd., second edition, 2nd reprint 2001.

D. REFERENCES

1. Christopher Negus, Linux Bible, Wiley Publishing, Inc., 2005 Edition.
2. Samuel D. Conte, Carl de Boor, Elementary Numerical Analysis – An Algorithmic Approach, International Student Edition, McGraw-Hill Book Company,2000.
3. T. Veerarajan and T. Ramachandran, Numerical Methods With Programs in C and C++, Tata McGraw-Hill Publishing Company Limited, 2004.

E. WEB LINKS:

1. https://nptel.ac.in/courses/106/105/106105171/
2. https://nptel.ac.in/courses/106/105/106105171/
3. https://nptel.ac.in/courses/106/105/106105085/

3. SPECIFIC LEARNING OUTCOMES (SLO)

S. No.	Lab Exercises	Learning outcomes	Bloom's Taxonomy Level of Transaction
1	C programs in Linux OS	To construct simple programs in Linux OS	K6
2	Solving Algebraic equations by Bisection method	To develop C coding for solving algebraic equations by Bisection method	K3
3.	Solving Algebraic equations by Newton's method	To develop C coding for solving algebraic equations by Newton's method	K3
4	Solving Numerical Integration Problems by Trapezoidal method	To develop C coding for Numerical integration	K3
5	Solving Numerical Integration Problems by Simpson's Method	To develop C coding for Numerical integration	K3
6	Initial Value Problems by Euler method	to construct C programs for solving IVP by Euler method	K3
7	Initial Value Problems by RK method	to construct C programs for solving IVP by RK 4th order	K3
8	Boundary Value Problems	To develop C coding for Numerical integration	K3
9	Finite Difference Method	to construct C programs for solving BVP by Finite Difference Method	K3

4. MAPPING SCHEME (COs, POs AND PSOs)

U16MAPS3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	-	-	H	-	-	L	-	-	L	H	-	L
CO2	M	L	-	H	L	-	M	-	-	L	H	L	M
CO3	M	L	-	H	L	-	M	-	-	L	H	L	M
CO4	M	L	-	H	L	-	M	-	-	L	H	L	M
CO5	M	L	-	H	L	-	M	-	-	L	H	L	M
CO6	L	M	-	H	L	-	M	-	-	L	H	L	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. M. Evangeline Jebaseeli

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

2020 – 2021

Allied Mathematics Courses offered to students of Undergraduate Programme in Physics

(For the candidates admitted from the year 2020 onwards)

Sem.	Course	Code	Title	Hrs./ week	Credits	Marks		
						CIA	ESA	Total
I	I	U20MAY11	Algebra, Calculus and Analytical Geometry of 3D	5	4	25	75	100
II	II	U20MAY22	Vector Calculus and Trigonometry	4	4	25	75	100
II	III	U20MAY23	Differential Equations, Laplace Transforms and Fourier Series	4	4	25	75	100

Allied Course – I ALGEBRA, CALCULUS AND ANALYTICAL GEOMETRY OF 3D

Semester: I **Course Code: U20MAY11**

Credits: 4 **Hours/Week: 5**

1. COURSE OUTCOMES:

After the Successful Completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Evaluate the Eigenvalues and Eigen vectors of the matrices.	**K5**	**I**
CO2	Analyze functions using limit, Derivatives.	**K4**	**II**
CO3	Estimate the curvature and radius of curvature.	**K5**	**II**
CO3	Evaluate the definite integrals using properties.	**K5**	**III**
CO4	Analyze the Line, plane, circle and sphere	**K4**	**IV**
CO6	Relationship between plane and sphere	**K4**	**V**

2A. SYLLABUS

Unit I: Algebra **(15 Hours)**

Eigen Values and Eigen Vectors – Cayley – Hamilton Theorem – Diagonalisation of Matrices.

Unit II: Calculus **(15 Hours)**

Leibnitz's formula for n^{th} derivative of a product – Curvature and Radius of Curvature – Cartesian formula for Radius of Curvature.

Unit III: Definite Integrals **(15 Hours)**

Properties of Definite Integrals - Reduction Formulae for $\int e^{ax} x^n dx, \int_{\frac{\pi}{2}}^{\pi} \sin^n x\, dx, \int \cos^n x\, dx,$ 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.

Unit IV: Analytical Geometry Three Dimensions **(15 Hours)**

Straight Line – Equation of a Straight-Line Condition for a Straight Line to lie on a given Plane – condition for coplanarity – shortest distance between two straight lines.

Unit V: Geometrical Representation of the circle and Sphere **(15 Hours)**

Sphere – standard equation – length of the tangent from any point – Equation of a tangent Plane – condition for the plane to touch the Sphere – intersection of a Plane and a Sphere – intersection of two spheres – Equation of Sphere passing through a given Circle.

B. TOPICS FOR SELF STUDY

S. No	Topics	Web Links
1.	Eigen Values and Eigen Vectors of Matrices.	https://math.mit.edu/~gs/linearalgebra/ila0601.pdf
2	Cayley – Hamilton Theorem and Diagonalization of Matrices.	https://freevideolectures.com/course/3382/linear-algebra-i/29
3	Application of Integral Calculus	https://www.askiitians.com/iit-study-material/iit-jee-mathematics/integral-calculus/
4	Analytical geometry in three dimensions	https://learn.careers360.com/maths/three-dimensional-geometry-chapter/

C. TEXTBOOK(s)

1. Dr. P. Mariappan and others, Algebra, Calculus and Analytical Geometry of 3D,1st Edition, New Century Book House, Pvt. Ltd, Chennai.

D. REFERENCE BOOKS

1. T.K. ManichavasagamPillai, T. Natarajan and K.S. Ganapathy, Algebra (Vol.II), S. ViswanathanPvt. Ltd, Reprint,2004.
2. S. Narayanan and T.K. Manichavasagam Pillay, Calculus (Vol-I, II), S. Viswanathan Printers and Publishers, Reprint,2003
3. Vittal. P. R, Allied Mathematics, Margham Publications, Chennai, Reprint 2000.
4. M.K. Venkataraman, Engineering Mathematics, National Publishing Company, 1999.

E. WEB LINKS

1. https://nptel.ac.in/courses/111/106/111106051/
2. https://nptel.ac.in/courses/111/101/111101115

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/ Sections	Course Content	Learning Outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Algebra**		
1.1	Eigen value and Eigen vectors of Matrices.	Define Eigen value and Eigen vectors.	K1
1.2	Eigen values and eigen vectors of the matrices	Find the eigen values and eigen vectors of the matrices	K1
1.3	Cayley-Hamilton theorem	Justify the Cayley-Hamilton theorem	K5
1.4	Integral power and inverse of the matrices.	Find the integral power and inverse of the matrices.	K1
1.5	Diagonalization of matrices	Formulate the Diagonalization of matrices	K6

II	**Calculus**		
2.1	Leibnitz formula for n^{th} derivative.	Analyze the higher derivatives	K5
2.2	Higher Derivative	Find out the derivative of the given function.	K1
2.3	Curvature and radius of curvature.	Define curvature and radius of curvature.	K1
2.4	Cartesian formula for radius of curvature	Formulate the Cartesian formula for radius of curvature	K6
2.5	Curvature,and radius of curvature	Estimate the curvature and radius of curvature.	K5
III	**Definite Integrals**		
3.1	Definite Integrals	Define the definite Integrals	K1
3.2	Properties of definite integrals	Prove the Properties of definite integrals	K5
3.3	Properties of definite integrals	Evaluate the definite integrals	K5
3.4	Reduction Formula	Define Reduction Formula	K1
3.5	Reduction Formula	Evaluate the definite integral using reduction formula	K5
IV	**Analytical Geometry of Three Dimensions**		
4.1	Straight Line	Find the Equation of a Straight Line.	K1
4.2	Condition for a Straight Line	Find the Condition for a Straight Line to lie on a given Plane	K1
4.3	Straight Line	Discuss the condition for a Straight Line to lie on a given Plane	K5
4.4	Coplanar	Condition for coplanarity.	
4.5	Shortest distance between two lines	Condition for Shortest distance between two lines	K1
4.6	Shortest distance between two lines	Find the Shortest distance between two lines	K1
V	**Geometrical Representation of the circle and Sphere**		
5.1	Sphere	Find the equation of the sphere	K1
5.2	Length of the tangent from any point.	Find the Length of the tangent from any point.	K1
5.3	Equation of a tangent plane	Find the Equation of a tangent plane	K1
5.4	Plane to touch a sphere	State the condition for a plane to touch a sphere	K2
5.5	Intersection of a Plane and a sphere	Test for intersection of a Plane and a sphere	K1
5.6	Great Circle.	Find the equation of Sphere passing through a given Circle.	K1

4. MAPPING SCHEME (POs, PSOs AND COs)

U20MAY11	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	-	M	M	-	M	-	H	M	M	-
CO2	H	M	M	-	H	M	M	H	-	M	M	M	L
CO3	H	M	-	-	H	M	M	M	-	M	M	M	L
CO4	H	M	M	-	M	-	L	M	-	M	M	M	L
CO5	H	M	L	-	-	M	M	-	-	M	M	H	L
CO6	H	M	M	-	M	M	M	M	-	L	M	H	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. M. Suresh kumar

Allied Course II: VECTOR CALCULUS AND TRIGONOMETRY

Semester: II **Course Code: U20MAY22/U20MAC22**

Credits: 4 **Hours/Week: 4**

1. COURSE OUTCOMES

After the successful completion of this course the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Determine the maximum value of directional derivative	**K5**	**I**
CO2	Evaluate the divergence and curl of vector functions	**K5**	**I**
CO3	Evaluate the Line integral, Surface integral and Volume integral	**K5**	**II**
CO4	Apply Green's theorem, Stoke's theorem and the Divergence theorem to compute integrals	**K3**	**III**
CO5	Simplify the expansion of various trigonometrical functions	**K4**	**IV**
CO6	Relationship between the circular and hyperbolic functions and separate into real and imaginary parts of trigonometric functions	**K4**	**V**

2A. SYLLABUS

Unit I: Vector Differentiation **(12 Hours)**

Scalar and Vector Point Functions – Direction and Magnitude of gradient – Maximum value of Directional derivative – Divergence and Curl – Definitions (Solenoidal and Irrotational Vectors) – Vector Identities – Formulainvolving Operator ∇ twice.

Unit II: Vector Integration **(10 Hours)**

Vector integration – Line integration – Surface integral – Volume integral.

Unit III: Theorems On Integrals **(14 Hours)**

Verification of Gauss divergencetheorem – Stokes theorem – Green's theorem.

Unit IV: Trigonometry **(14 Hours)**

Expansions for $\sin n\theta$, $\cos n\theta$, when n is a positive integer $\tan n\theta$ when n is a positive integer – Expansion for $\tan(\theta_1+\theta_2+.....+\theta_n)$ – Expansions for $\cos^n\theta$ and $\sin^n\theta$ in terms of multiple of θ – Expansions of $\sin\theta$, $\cos\theta$ and $\tan\theta$ in terms of θ .

Unit V: Hyperbolic Functions **(10 Hours)**

Euler's formula – Hyperbolic functions – Relation between the circular and hyperbolic functions – Inverse hyperbolic functions $\sinh^{-1}x$, $\cosh^{-1}x$ and $\tanh^{-1}x$ in terms of logarithmic functions – Separation into real and imaginary parts of $\sin(x+iy)$, $\cos(x+iy)$, $\tan(x+iy)$, $\sinh(x+iy)$, $\cosh(x+iy)$, $\tanh(x+iy)$ and $\tan^{-1}(x+iy)$.

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links
1	Chain Rule with more variables	Vector and Multi-variable Calculus
2	Two-Dimensional Flux	Double and Triple integrals, and Vector Calculus in 2- and 3-space.
3	Extended Greens Theorem	Multivariable-Calculus-theorem-boundaries-with-multiple-pieces
4	Derivatives of Hyperbolic Functions	https://tutorial.math.lamar.edu/classes/calci/DiffHyperFcns.aspx

C. TEXTBOOK(s)

1. Dr. P. Mariappan and Others, Vector Calculus and Trigonometry, New Century Book House, Pvt. Ltd, Chennai.

D. REFERENCE BOOKS

1. S. Narayanan and T.K. ManickavasagamPillai, Ancillary Mathematics, Vol. III, S. Viswanathan Pvt. Ltd., Reprint 1999.
2. S. Narayanan and T.K. ManickavasagamPillai, Trigonometry, S. Viswanathan Pvt. Ltd., Reprint 2004.
3. P. Duraipandian, LaxmiDuraipandian and Paramasivan, Trigonometry, Emerald Publishers, Reprint 1999.

E. WEB LINKS

1. Swayam: Vector Calculus By Prof. Hari Shankar Mahato | IIT Kharagpur
2. Whitman.edu : Hyperbolic Functions

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/ Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Vector Differentiation**		
1.1	Scalar and Vector Point Functions	Define Scalar and Vector Point Functions	K1
1.2	Gradient and Directional Derivative	Evaluate the directional derivatives and gradient	K5
1.3	Divergence and Curl	Determine the Divergence and Curl	K5
1.4	Vector Identities	Explain the Vector Identities	K2
1.5	Formula involving Operator ∇ twice	Interpret the formula involving operator ∇ twice	K2
II	**Vector Integration**		
2.1	Vector integration	Explain the concept of the vector integration	K2
2.2	Line integral	Evaluate the line integral.	K5
2.3	Surface integral	Evaluate the Surface integral	K5
2.4	Volume integral	Evaluate the Volume integral	K5
III	**Theorems on Integrals**		
3.1	Gauss divergence theorem	Apply Gauss Divergence theorem to find the value of the integrals	K3

3.2	Stokes theorem	Apply Stokes theorem to find the value of the integrals	K3
3.3	Green's theorem	Apply Green's theorem to find the value of the integrals	K3
IV	**Trigonometry**		
4.1	Expansion of sin $n\theta$ and cos $n\theta$	Discuss expansion of circular functions sin $n\theta$, cos $n\theta$ as a series.	K6
4.2	Expansion of tan $n\theta$ in powers of tanθ	Discuss expansion of circular function tan $n\theta$ in powers of tanθ	K6
4.3	Expansions for $\cos^n\theta$ when n is a positive integer	Discuss expansion of $\cos^n\theta$ when n is a positive integer	K6
4.4	Expansions for $\sin^n\theta$ when n is a positive integer	Discuss expansion of $\sin^n\theta$ when n is a positive integer	K6
V	**Hyperbolic Functions**		
5.1	Euler's formula and Hyperbolic functions	Define Euler's formula and Hyperbolic functions	K1
5.2	Relation between the circular and hyperbolic functions	Relationship between circular and hyperbolic functions	K4
5.3	Inverse hyperbolic functions $\sinh^{-1}x$, $\cosh^{-1}x$ and $\tanh^{-1}x$in terms of logarithmic functions	Identify the inverse hyperbolic functions in terms of logarithmic functions.	K3
5.4	Separation into real and imaginary parts of sin(x+iy), cos(x+iy), tan(x+iy), sinh(x+iy), cosh(x+iy), tanh(x+iy) and $\tan^{-1}$(x+iy).	Categorize the real and imaginary parts of sin(x+iy), cos(x+iy), tan(x+iy), sinh(x+iy), cosh(x+iy), tanh(x+iy) and $\tan^{-1}$(x+iy).	K4

4. MAPPING SCHEME (POs, PSOs AND COs)

U20MAY22/U20MAC22	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	L	M	L	-	-	L	L	-	L	L	M	L
CO2	H	L	L	L	-	-	L	L	-	L	L	M	L
CO3	M	L	M	-	-	-	L	L	-	L	L	M	L
CO4	H	L	L	L	-	-	L	M	-	L	L	M	L
CO5	M	-	L	-	-	-	L	M	-	L	L	M	L
CO6	H	-	L	-	-	-	L	M	-	L	L	M	L

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. B. Sathish kumar

Allied Course: III Differential Equations, Laplace Transforms and Fourier Series

Semester: II **Course Code: U20MAY23**

Credits: 4 **Hours/Week: 4**

1. COURSE OUTCOMES

After the successful completion of this course the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Solve the First Order and Higher Degree Ordinary Differential Equations	**K3**	**I**
CO2	Solve specific types of partial differential equations by Appropriate method	**K3**	**II**
CO3	Discuss the properties and general theorems of the Laplace Transform.	**K6**	**III**
CO4	Solve differential and integral equations using Laplace transforms.	**K3**	**III**
CO5	Apply Laplace Transform technique to solve initial value problems	**K3**	**IV**
CO6	Express Fourier Series for a given periodic function.	**K2**	**V**

2A. SYLLABUS

Unit I: Ordinary Differential Equations (12 Hours)

Ordinary Differential Equations – First Order and Higher Degree – Equation solvable for $\frac{dy}{dx}$ - Equation solvable for y – Equation solvable for x (simple problems only) – Clairaut 's Form (simple case only).

Unit II: Partial Differential Equations (12 Hours)

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.

Unit III: Laplace Transform (11 Hours)

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

Unit IV: Inverse Laplace Transform (13 Hours)

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.

Unit V: Fourier Series (12 Hours)

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

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links
1	Parabolic, Elliptic and Hyperbolic Differential Equations	SWAYAM: Course on Applications of ODE
2	One Dimensional Wave and Heat Equation	NPTEL: A course on mathematical methods and its applications by Dr. P. N. Agrawal, Department of mathematics, Roorkee
3	Laplace transforms of Heaviside unit step function, Dirac Delta function	https://nptel.ac.in/courses/111/107/111107098/
4	Applications of Laplace transform	NPTEL: Applications in science and technology of LT

C. TEXTBOOK(s)

1. Dr. R. GethsiSharmila and Others, Differential Equations, Laplace Transforms and Fourier Series, New Century Book House, Pvt. Ltd, Chennai.

D. REFERENCE BOOKS

1. S. Narayanan and T.K. ManickavasagamPillai, Calculus (Vol. III), S. Viswanathan Printers and Publishers, Reprint 2004.
2. Vittal P.R., Allied Mathematics, Margham Publications, Chennai, Reprint 2000.

E. WEB LINKS

1. SWAYAM: Course on Partial Differential Equations by Alaka Das,Jadavpur University

2. NPTEL: Course on Laplace Transform by Department of Mathematics, IMSc

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/ Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Ordinary Differential Equations**		
1.1	Ordinary Differential Equations – First Order and Higher Degree	Solve first order and higher degree ordinary differential equations.	K3
1.2	Equation solvable for $\frac{dy}{dx}$	Solve the differential equations using equations solvable for $\frac{dy}{dx}$	K3
1.3	Equation solvable for x	Determine the solution of the differential equations using equations solvable for x	K6
1.4	Equation solvable for y	Determine the solution of the differential equations using equations solvable for y	K6
1.5	Clairaut's Form	Find the solution of the given differential equation	K1
II	**Partial Differential Equations**		

2.1	Derivation of Partial Differential Equations byof elimination arbitrary constants	Formulate the Partial Differential Equation byof elimination arbitrary constants.	K6
2.2	Derivation of Partial Differential Equations byof elimination arbitrary functions	Formulate the Partial Differential Equation byof elimination arbitrary functions	K6
2.3	Classification of Integrals	Classify the Integrals	K2
2.4	Some standard types of First Order Partial Differential Equations	Solve the partial differential equations using appropriate method	K3
2.5	Other standard forms	Solve the partial differential equations using appropriate method	K3
III	**Laplace Transform**		
3.1	Definition of Laplace Transforms	Define Laplace Transform	K1
3.2	Condition for the existence of the Laplace Transforms	Discuss the conditions for the existence of the Laplace Transforms	K2
3.3	Properties of Laplace Transforms	Discuss the basic properties of Laplace Transforms	K2
3.4	Some standard functions of Laplace Transform	Solve the Differential Equations using Laplace Transform	K3
3.5	Some general theorems of Laplace Transform	Interpret the general theorems of Laplace Transform	K5
3.6	Evaluation of integrals using Laplace Transform	Evaluate the integrals using Laplace Transform	K5
IV	**Inverse Laplace Transform**		
4.1	Definition of Inverse Laplace Transforms	Define the Inverse Laplace Transforms	K1
4.2	Shifting theorem for Inverse Laplace Transform	Interpret the shifting theorem for inverse Laplace Transforms	K2
4.3	Method of partial fraction can be used to find the Inverse Laplace Transform of certain functions	Determine the inverse transform of certain functions by using the method of partial fraction.	K6
4.4	Theorems – special cases	Solve some special types of problems using Laplace Transforms.	K3
4.5	Applications to solutions of differential equations	Apply Laplace transform technique to solve initial value problems	K3
V	**Fourier Series**		
5.1	Fourier Series	Define Fourier Series	K1
5.2	To determine the values of a_0, a_n *and* b_n - Bernoulli's formula	Determine the values of the constant a_0, a_n *and* b_n	K6
5.3	Fourier Series of even and odd functions	Determine the Fourier series expansion of a given even and odd functions	K6
5.4	Properties of odd and even functions and Fourier Series of even and odd functions.	Discussthe properties of even and odd functions and solve problems.	K2
5.5	Half range Fourier Series	Define half range Fourier Series	K1

5.6	Development in cosine series	Develop the given function in cosine series	K3
5.7	Development in sine series	Develop the given function in sine series	K3

4. MAPPING SCHEME (POs, PSOs AND COs)

U20MAY23	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	M	M	-	M	M	-	-	M	M	H	M
CO2	M	H	M	M	-	-	M	-	-	H	H	M	M
CO3	H	H	H	-	-	-	-	-	-	H	H	M	-
CO4	H	H	M	M	-	-	-	-	-	H	H	M	-
CO5	M	H	H	M	-	-	-	-	-	H	H	M	-
CO6	H	H	M	M	-	-	-	-	-	H	H	-	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Ms. R. Praveena

Under-Graduate Programme

Allied Mathematics Courses

(Chemistry)

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

2020 – 2021

Allied Mathematics Courses offered to students of Undergraduate Programme in Chemistry

(For the candidates admitted from the year 2020 onwards)

Sem.	Course	Code	Title	Hrs./ week	Credits	Marks		
						CIA	ESA	Total
I	I	U20MAC11	Algebra and Calculus	5	4	25	75	100
II	II	U20MAC22	Vector Calculus and Trigonometry	4	4	25	75	100
II	III	U20MAC23	Differential Equations and Laplace Transforms	4	4	25	75	100

Allied Course I: Algebra and Calculus

Semester: I **Course Code: U20MAC11**

Credits: 4 **Hours/Week: 5**

1. COURSE OUTCOMES

After successful completion of the course, the students will be able to

Co. No.	Course Outcomes	Level	Unit
CO1	Determine the Eigenvalues and Eigen vectors.	**K5**	**I**
CO2	Apply Cayley-Hamilton theorem and diagonalization process to calculate the higher powers and inverse of a given matrix	**K3**	**I**
CO3	Determine the n^{th} derivative of a given function using Partial Fractions and De-Moivre's Theorem.	**K5**	**II**
CO4	Determine the curvature, evolutes and envelopes of certain curves.	**K5**	**III**
CO5	Solve the integrals of polynomials and trigonometrical functions.	**K3**	**IV**
CO6	Interpret the relationships between Beta and Gamma functions	**K5**	**V**

2A. SYLLABUS

Unit I: Eigenvalues and Eigen vectors **(15 Hours)**

Eigen values and Eigen vectors – Cayley - Hamilton Theorem – Diagonalisation of matrices (problems only)

Unit II: Successive Differentiation **(15 Hours)**

Differentiation – Definition - Rules for differentiation – Standard forms – Successive differentiation – n^{th} derivatives – Standard forms – Use of Partial fractions – Application of De-Moivre's theorem – Trigonometrical transformations.

Unit III: Differential calculus – Curvature **(15 Hours)**

Leibnitz's theorem (statement only) on the n^{th} differential co-efficient of the product of two functions of x (problems only) – curvature and radius of curvature – cartesian formula for radius of curvature.

Unit IV: Integration **(15 Hours)**

Introduction – Methods of Integration – Integrals of the functions involving $a^2 \pm x^2$ - Integrals of functions of the form $\int f(x)^n f'(x)dx$ – Definite Integrals – Properties of definite integrals - Reduction formulae for the three definite integrals :

$\int_0^\infty e^{-ax} x^n$, $\int_0^{\pi/2} \sin^n nx\, dx$ and $\int_0^{\pi/2} \cos^n nx\, dx$ where n is a positive integer. (Problems only)

Unit V: The Beta and Gamma functions **(15 Hours)**

The Gamma and Beta functions – Gamma function – recurrence formulae for $\Gamma(n)$ - connection between gamma function and factorials – Beta function – relation between beta and gamma functions – applications of Beta and Gamma functions.

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links
1	Quadratic forms	https://www.youtube.com/watch?v=yuE86XeGhEA
2	Evolutes and Involutes	https://www.youtube.com/watch?v=Yh1TQcS_byE
3	Successive differentiation	https://nptel.ac.in/courses/111/105/111105122/
4	Differentiation under integral sign	https://nptel.ac.in/courses/111/105/111105122/

C. TEXTBOOK(s)

1. Dr P Mariappan and Others, Algebra, Calculus and Analytical Geometry of 3D, 1st Edition, New Century Book House, Pvt. Ltd, Chennai.

   Unit I — Chapter 1

   Unit II & Unit III — Chapter 2

   Unit IV — Chapter 3

   Unit V — Chapter 4

D. REFERENCE BOOKS

1. T. K. Manichavasagam Pillai, T. Natarajan & K. S. Ganapathy, Algebra (Vol.II), S.Viswanathan Pvt. Ltd.Reprint 2004.
2. S. Narayanan and T. K. ManichavasagamPillai, Calculus (Vol. I, II) Viswanathan Printers and Publishers, Reprint 2003.
3. M. K. Venkataraman, Engineering Mathematics, National Publishing Company, 1999.

E. WEB LINKS

1. **https://nptel.ac.in/courses/111/105/111105121/**
2. **https://nptel.ac.in/courses/111/105/111105122/**
3. **https://freevideolectures.com/course/4545/nptel-mechanics-materials/52**

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/Section	Course contents	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Eigenvalues and Eigen vectors**		
1.1	Eigen values and Eigen vectors	Make use of the properties of Eigen values, Eigen vector	K3
1.2	Cayley-Hamilton Theorem	Evaluate the higher powers and inverse of a matrix.	K5
1.3	Diagonalisation of matrices	Compute the diagoalisation of a matrix	K5

II	**Successive Differentiation**		
2.1	Differentiation – Definition	Define the derivative	K1
2.2	Rules for differentiation	Explain the concept of Rules for differentiation	K2
2.3	Standard forms	Determine the derivative of some standard functions	K5
2.4	Successive differentiation –n^{th} derivative standard forms	Find the n^{th} derivative using successive differentiation	K1
2.5	Use of Partial fractions, Applilcation of De-Moivre's theorem	Estimate the derivative of some special functions using De-Moivre's theorem	K5
2.6	Trigonometrical transformations	Make use of Trigonometrical transformations	K3
III	**Differential calculus - Curvature**		
3.1	Leibnitz's theorem on the n^{th} differential co-efficient of the product of two functions of x	Apply the Leibnitz formula to find the higher derivative.	K3
3.2	Curvature	Evaluate radius of curvature.	K5
3.3	Radius of curvature	Caculate the radius curvature of any curve	K5
3.4	Cartesian formula for radius of curvature.	Estimate the radius of curvature in cartesian co-ordinates.	K5
IV	**Integration**		
4.1	Introduction – Methods of Integration	Recall the methods of solving integrals	K2
4.2	Integrals of the functions involving $a^2 \pm x^2$	Solve the integrals of the form $a^2 \pm x^2$	K3
4.3	Integrals of functions of the form $\int f(x)^n f'(x)dx$	Solve the integrals of the form $\int f(x)^n f'(x)dx$	K3
4.4	Definite Integrals –Properties of definite integrals	Recall the properties of definite integrals	K2
4.5	Reduction formulae for the three definite integrals: $\int e^{-ax}x^n dx$, $\int \sin^n x\, dx$, $\int \cos^n x dx$, where n is a positive integer.	Apply reduction formula to Calculate the integrals of the form $\int e^{-ax}x^n dx$, $\int \sin^n x\, dx$, $\int \cos^n x dx$ using reduction formula	K3
V	**The Beta and Gamma functions**		
5.1	The Gamma functions	Explain the properties of Gamma functions	K2
5.2	Recurrence formulae for Gamma $\Gamma(n)$	Summarize the Recurrence formulae for Gamma $\Gamma(n)$	K2
5.3	connection between gamma function and factorials	Interpret relation between Gamma function and Factorials	K2

5.4	Beta function	Explain the properties of Beta function	K2
5.5	Relation between beta and gamma functions	Interpret relation between the Beta and Gamma functions	K5
5.6	Applications of Beta and Gamma functions	Apply the properties of Beta Gamma function	K3

4. MAPPING SCHEME (POs, PSOs AND COs)

U20MAC11	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	H	M	L	L	M	L	M	-	H	M	H	L
CO2	M	H	M	L	L	M	L	M	-	H	M	H	L
CO3	M	M	M	L	L	M	-	M	-	H	M	H	L
CO4	M	M	L	L	L	M	-	M	-	H	M	H	L
CO5	M	H	M	L	L	M	-	M	-	H	M	H	L
CO6	M	M	M	L	L	M	-	M	-	H	M	H	L

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. N. Geetha

Allied Course II: VECTOR CALCULUS AND TRIGONOMETRY

Semester: II **Course Code: U20MAC22**

Credits: 4 **Hours/Week: 4**

1. COURSE OUTCOMES

After the successful completion of this course the students will be able to

Co. No.	Course Outcomes	Level	Unit
CO1	Determine the maximum value of directional derivative	**K5**	**I**
CO2	Evaluate the divergence and curl of vector functions	**K5**	**I**
CO3	Evaluate the Line integral, Surface integral and Volume integral	**K5**	**II**
CO4	Apply Green's theorem, Stoke's theorem and the Divergence theorem to compute integrals	**K3**	**III**
CO5	Simplify the expansion of various trigonometrical functions	**K4**	**IV**
CO6	Relationship between the circular and hyperbolic functions and separate into real and imaginary parts of trigonometric functions	**K4**	**V**

2A. SYLLABUS

Unit I: Vector Differentiation **(12 Hours)**

Scalar and Vector Point Functions – Direction and Magnitude of gradient – Maximum value of Directional derivative – Divergence and Curl – Definitions (Solenoidal and Irrotational Vectors) – Vector Identities – Formula involving Operator ∇ twice.

Unit II: Vector Integration **(10 Hours)**

Vector integration – Line integration – Surface integral – Volume integral.

Unit III: Theorems On Integrals **(14 Hours)**

Verification of Gauss divergence theorem – Stokes theorem – Green's theorem.

Unit IV: Trigonometry **(14 Hours)**

Expansions for $\sin n\theta$, $\cos n\theta$, when n is a positive integer $\tan n\theta$ when n is a positive integer – Expansion for $\tan(\theta_1+\theta_2+.....+\theta_n)$ – Expansions for $\cos^n\theta$ and $\sin^n\theta$ in terms of multiple of θ – Expansions of $\sin\theta$, $\cos\theta$ and $\tan\theta$ in terms of θ .

Unit V: Hyperbolic Functions **(10 Hours)**

Euler's formula – Hyperbolic functions – Relation between the circular and hyperbolic functions – Inverse hyperbolic functions $\sinh^{-1}x$, $\cosh^{-1}x$ and $\tanh^{-1}x$ in terms of logarithmic functions – Separation into real and imaginary parts of $\sin(x+iy)$, $\cos(x+iy)$, $\tan(x+iy)$, $\sinh(x+iy)$, $\cosh(x+iy)$, $\tanh(x+iy)$ and $\tan^{-1}(x+iy)$.

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links
1	Chain Rule with more variables	Vector and Multi-variable Calculus

2	Two-Dimensional Flux	Double and Triple integrals, and Vector Calculus in 2- and 3-space.
3	Extended Greens Theorem	Multivariable-Calculus-theorem-boundaries-with-multiple-pieces
4	Derivatives of Hyperbolic Functions	https://tutorial.math.lamar.edu/classes/calci/DiffHyperFcns.aspx

C. TEXTBOOK(s)

1. Dr. P. Mariappan and Others, Vector Calculus and Trigonometry, New Century Book House, Pvt. Ltd, Chennai.

D. REFERENCE BOOKS

1. S. Narayanan and T.K. ManickavasagamPillai, Ancillary Mathematics, Vol. III, S. Viswanathan Pvt. Ltd., Reprint 1999.
2. S. Narayanan and T.K. ManickavasagamPillai, Trigonometry, S. Viswanathan Pvt. Ltd., Reprint 2004.
3. P. Duraipandian, LaxmiDuraipandian and Paramasivan, Trigonometry, Emerald Publishers, Reprint 1999.

E. WEB LINKS

1. SWAYAM: Vector Calculus By Prof. Hari Shankar Mahato | IIT Kharagpur

2. Whitman.edu :Hyperbolic Functions

3. SPECIFIC LEARNING OUTCOMES (SLO)

Unit/ Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Vector Differentiation**		
1.1	Scalar and Vector Point Functions	Define Scalar and Vector Point Functions	K1
1.2	Gradient and Directional Derivative	Evaluate the directional derivatives and gradient	K5
1.3	Divergence and Curl	Determine the Divergence and Curl	K5
1.4	Vector Identities	Explain the Vector Identities	K2
1.5	Formulainvolving Operator ∇ twice	Interpret the formula involving operator ∇ twice	K2
II	**Vector Integration**		
2.1	Vector integration	Explain the concept of the vector integration	K2
2.2	Line integral	Evaluate the line integral.	K5
2.3	Surface integral	Evaluate the Surface integral	K5
2.4	Volume integral	Evaluate the Volume integral	K5
III	**Theorems on Integrals**		
3.1	Gauss divergencetheorem	Apply Gauss Divergence theorem to find the value of the integrals	K3

3.2	Stokes theorem	Apply Stokes theorem to find the value of the integrals	K3
3.3	Green's theorem	Apply Green's theorem to find the value of the integrals	K3
IV	**Trigonometry**		
4.1	Expansion of $\sin n\theta$ and $\cos n\theta$	Discuss expansion of circular functions $\sin n\theta$, $\cos n\theta$ as a series.	K6
4.2	Expansion of $\tan n\theta$ in powers of $\tan\theta$	Discuss expansion of circular function $\tan n\theta$ in powers of $\tan\theta$	K6
4.3	Expansions for $\cos^n\theta$ when n is a positive integer	Discuss expansion of $\cos^n\theta$ when n is a positive integer	K6
4.4	Expansions for $\sin^n\theta$ when n is a positive integer	Discuss expansion of $\sin^n\theta$ when n is a positive integer	K6
V	**Hyperbolic Functions**		
5.1	Euler's formula and Hyperbolic functions	Define Euler's formula and Hyperbolic functions	K1
5.2	Relation between the circular and hyperbolic functions	Relationship between circular and hyperbolic functions	K4
5.3	Inverse hyperbolic functions $\sinh^{-1}x$, $\cosh^{-1}x$ and $\tanh^{-1}x$ in terms of logarithmic functions	Identify the inverse hyperbolic functions in terms of logarithmic functions.	K3
5.4	Separation into real and imaginary parts of $\sin(x+iy)$, $\cos(x+iy)$, $\tan(x+iy)$, $\sinh(x+iy)$, $\cosh(x+iy)$, $\tanh(x+iy)$ and $\tan^{-1}(x+iy)$.	Categorize the real and imaginary parts of $\sin(x+iy)$, $\cos(x+iy)$, $\tan(x+iy)$, $\sinh(x+iy)$, $\cosh(x+iy)$, $\tanh(x+iy)$ and $\tan^{-1}(x+iy)$.	K4

4. MAPPING SCHEME (POs, PSOs AND COs)

U20MAC22	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	L	M	L	-	-	L	L	-	L	L	M	-
CO2	H	L	L	L	-	-	L	L	-	L	L	M	-
CO3	M	L	M	-	-	-	L	L	-	L	L	M	-
CO4	H	L	L	L	-	-	L	M	-	L	L	M	-
CO5	M	-	L	-	-	-	L	M	-	L	L	M	-
CO6	H	-	L	-	-	-	L	M	-	L	L	M	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. B. Sathish kumar

Allied Course III: DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

Semester: II **Course Code: U20MAC23**

Credits: 4 **Hours/Week: 4**

1. COURSE OUTCOMES

After the successful completion of this course the students will be able to

Co. No.	Course Outcomes	Level	Unit
CO1	Solve the First Order and Higher Degree Ordinary Differential Equations	**K3**	**I**
CO2	Formulate the Partial Differential Equations by elimination of arbitrary constants and functions	**K6**	**II**
CO3	Solve the First Order Partial Differential Equations of some standard types	**K3**	**II**
CO4	Discuss the properties and general theorems of the Laplace Transform	**K6**	**III**
CO5	Solve ordinary differential equations using Laplace transforms	**K3**	**IV**
CO6	Determine the concept of Inverse Laplace transforms and its applications.	**K5**	**V**

2A. SYLLABUS

Unit I: Ordinary Differential Equations **(13 Hours)**

Ordinary Differential Equations – First Order and Higher Degree–Equation solvable for $\frac{dy}{dx}$- Equation solvable for y - Equation solvable for x (simple problems only) – Clairaut's Form.

Unit II: Partial Differential Equations **(13 Hours)**

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: Laplace Transform **(12 Hours)**

Definition – Condition for the existence of the Laplace Transforms – Properties of Laplace Transforms – Some general theorems.

Unit IV: Inverse Laplace Transform **(14 Hours)**

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: Applications of Laplace Transform **(8 Hours)**

Special cases–Application to solutions of Differential Equations.

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links
1	Fronius Series solution: An Advanced Series Solution	SWAYAM: Course on Applications of ODE
2	Parabolic, Elliptic and Hyperbolic Differential Equations	SWAYAM: Course on Applications of PDE
3	One Dimensional Wave and Heat Equation	SWAYAM: Method and Applications of DE
4	Applications of Laplace transform	NPTEL: Applications in science and technology of LT

C. TEXTBOOK(s)

1. Dr. R. Gethsi Sharmila and Others, Differential Equations, Laplace Transforms and Fourier Series, New Century Book House, Pvt. Ltd, Chennai.

D. REFERENCE BOOKS

1. S. Narayanan and T.K. ManickavasagamPillai, Calculus (Vol. III), S. Viswanathan Printers and Publishers, Reprint 2004.
2. Vittal P.R., Allied Mathematics, Margham Publications, Chennai, Reprint 2000.

E. WEB LINKS

1. SWAYAM: Ordinary and Partial Differential Equations and Applications By Prof. P. N. Agarwal, Prof. D. N. Pandey | IIT Roorkee

2. NPTEL: Laplace transforms By Prof. Indrava Roy, Department of Mathematics, IMSc.

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/ Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Ordinary Differential Equations**		
1.1	Ordinary Differential Equations – First Order and Higher Degree	Solve first order and higher degree ordinary differential equations.	K3
1.2	Equation solvable for $\frac{dy}{dx}$	Discuss the solution of a differential equation.	K6
1.3	Equation solvable for x	Discuss the solution of a differential equation.	K6
1.4	Equation solvable for y	Discuss the solution of a differential equation.	K6
1.5	Clairaut's Form	Discuss the solution of a differential equation.	K6
II	**Partial Differential Equations**		
2.1	Derivation of Partial Differential Equations by elimination of arbitrary constants	Construct the Partial Differential Equation by elimination of arbitrary constants.	K3
2.2	Derivation of Partial Differential Equations by elimination of arbitrary functions	Construct the Partial Differential Equation by elimination of arbitrary functions	K3

2.3	Classification of Integrals	Classify the Integrals	K2
2.4	Some standard types of First Order Partial Differential Equations	Solve the standard types of First Order Partial Differential Equations, reduce equations to standard forms and hence solve using Lagrange's and Charpit's method.	K3
2.5	Other standard forms	Analyze the other standard forms	K4
III	**Laplace Transform**		
3.1	Definition of Laplace Transforms	Define the Laplace Transform	K1
3.2	Condition for the existence of the Laplace Transforms	Understand the existence of the Laplace Transforms	K2
3.3	Properties of Laplace Transforms	Infer the basic properties of Laplace Transforms	K2
3.4	Derivatives of Laplace Transform	Find the Derivatives of Laplace Transform	K1
3.5	Some standard functions of Laplace Transform	Solve the Differential Equations by Laplace Transform	K3
3.6	Some general theorems of Laplace Transform	Discuss the general theorems of Laplace Transform	K6
3.7	Evaluation of integrals using Laplace Transform	Evaluate the integrals using Laplace Transform	K5
IV	**Inverse Laplace Transform**		
4.1	Definition of Inverse Laplace Transforms	Define the Inverse Laplace Transforms	K6
4.2	Shifting theorem for Inverse Laplace Transform	Interpret the shifting theorem for inverse Laplace Transforms	K5
4.3	Method of partial fraction can be used to find the Inverse Laplace Transform of certain functions	Apply the partial fraction to find the Inverse Laplace Transform	K3
V	**Applications Of Laplace Transform**		
5.1	Special problems	Solve some special problems using Laplace Transforms.	K3
5.2	Application to solutions of Differential Equations	Find the solutions of Differential Equations	K5
5.3	Solving ordinary differential equations using Laplace Transform	Evaluate differential equations using Laplace Transforms.	K5

4. MAPPING SCHEME (POs, PSOs AND COs)

U20MAC23	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	L	M	L	-	-	L	L	-	L	L	M	-
CO2	H	L	M	M	-	-	L	L	-	L	L	M	-
CO3	M	L	M	L	-	-	L	L	-	L	L	M	-
CO4	M	-	L	-	-	-	L	L	-	L	L	M	-
CO5	M	-	L	-	-	-	L	M	-	L	L	M	-
CO6	M	-	L	-	-	-	L	M	-	L	L	M	-

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. B. Sathish kumar

Under-Graduate Programme

Allied Mathematics Courses

(Computer Science / Computer Applications)

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

2020 – 2021

Allied Mathematics Courses offered to students of Undergraduate Programme in Computer Science/Computer Applications

(For the candidates admitted from the year 2020 onwards)

Sem.	Course	Code	Title	Hrs./week	Credits	Marks		
						CIA	ESA	TOTAL
I	I	U20MAZ11	Operations Research	5	4	25	75	100
II	II	U20MAZ22 / U20MAA22	Numerical Methods	4	4	25	75	100
II	III	U20MAZ23 / U20MAA23	Probability & Statistics	4	4	25	75	100

Allied Course I: OPERATIONS RESEARCH

Semester: I **Course Code: U20MAZ11**

Credits: 4 **Hours/Week: 5**

1. COURSE OUTCOMES

After the successful completion of this course the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Explain the meaning of Operations Research and how to use it	K2	I
CO2	Solve a Linear Programming Problem using various method	K6	II
CO3	Solve a Transportation Problem using various method	K6	III
CO4	Explain about Assignment Problems	K5	IV
CO5	Analyse the Network Model	K4	V
CO6	Discuss the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools to be used in each type	K6	I, II, III, IV ,V

2A. COURSE CONTENT

UNIT I: Introduction to OR **(12 Hours)**

Introduction to Operations Research – Linear programming problem - Introduction – General model of theLPP – Characteristics of an LPP – Assumptions of Linear Programming – Formulation of an LPP- StandardForm of an LPP - Solution to an LPP – Types of possiblesolutions to an LPP – Convex set and Extreme points- Graphical solution to an LPP – Simplexmethods.

UNIT II: Types of LPP **(12 Hours)**

Big–M method – Two phase method.

UNIT III: Transportation Problem **(12 Hours)**

Transportation Problem – Introduction – Conversion of a TP into an LPP Form – Formulation of a Transportation Problem - Concepts of Basicness, and Degeneracy in the solution – Methods used to find the solution to a Transportation Problem– Description of various methods to find the Initial Basic Feasible Solution – Stepping Stone Method/ Modified Distributive Method.

UNIT IV: Assignment Problem **(12 Hours)**

Assignment Problem – Introduction – General Model of the Assignment Problem – Conversion into an Equivalent LPP – Solution to the Assignment Problem.

UNIT V: PERT & CPM **(12 Hours)**

PERT - CPM - Introduction – Method for Construction of a Network – Numbering the nodes – Critical Path Method (CPM) – Project Evaluation Review Technique (PERT).

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links
1	Duality Concept in Linear Programming Problem	https://nptel.ac.in/courses/111/102/111102012/#

2	Sensitivity Analysis	https://www.youtube.com/watch?v=St5zxHwe_zPI
3	Sequencing and Scheduling	https://youtu.be/BSY3LvlQLNc
4	Game Theory	https://nptel.ac.in/courses/109/103/109103021/

C. TEXTBOOK(s)

1. Dr P. Mariappan, Operations Research – An Introduction, , Pearson; 1 edition (May 1, 2013), ISBN-10: 8131799344, ISBN-13: 978-8131799345, ASIN: B00FJVEVEQ
   Ch – 2 [2.1 to 2.11]
   Ch – 2 [2.12, 2.13]
   Ch – 4 [4.1 to 4.7]
   Ch – 5 [5.1 to 5.4]
   Ch – 6 [6.1 to 6.7]

D. REFERENCE BOOKS

1. Kanti Swarup, Operations Research, Sultan Chand & Sons, 1980, ISBN: 8170142164, 9788170142164.

E. WEB LINKS

1. https://nptel.ac.in/courses/110/106/110106062/
2. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/ Section	Course Content	Learning Outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Introduction to Operations Research and Linear Programming Problem [LPP]**		
1.1	Introduction to Operations Research	Recall the concepts of Operations research	K1
1.2	General model of the LPP	Explain LPP's general structure	K2
1.3	Characteristics of an LPP	Tell the Characteristics of an LPP	K1
1.4	Assumptions of Linear Programming	Illustrate the assumptions of LPP	K2
1.5	Formulation of an LPP	Develop LPP	K3
1.6	Standard Form of an LPP	Demonstrate the standard form of LPP	K2
1.7	Solution to an LPP	Solve LPP	K3
1.8	Types of possible solutions to an LPP	Identify various solutions of an LPP	K3
1.9	Graphical solution to an LPP	Formulate LPP & Solve using Graphical Method	K6
1.10	Simplex methods	Formulate LPP & Solve using Simplex Method	K6

II	**Solving Methods for Linear Programming Problem [LPP]**		
2.1	Big–M method	Formulate LPP & Solve using Big M Method	K6
2.2	Two-Phase method	Formulate LPP & Solve using Two-Phase Simplex Method	K6
III	**Transportation Problems [TP]**		
3.1	Introduction to Transportation Problems	Recall about Transportation Problem	K1
3.2	Conversion of a TP into an LPP Form	Explain the conversion of TP into LPP	K2
3.3	Formulation of a Transportation Problem	Construct Transportation Problem	K3
3.4	Concepts of Basicness, and Degeneracy in the solution	Examine the various types of solutions of TP	K4
3.5	Methods used to find the solution to a Transportation Problem	Solve TP	K6
3.6	Description of various methods to find the Initial Basic Feasible Solution	Discuss various methods to solve TP	K6
3.7	Stepping Stone Method/ Modified Distributive Method.	Solve TP	K5
IV	**Assignment Problems [AP]**		
4.1	Introduction to Assignment Problem	Recall Assignment Problem	K1
4.2	General Model of the Assignment Problem	Explain the general structure of AP	K2
4.3	Conversion into an Equivalent LPP	Explain the conversion of AP into LPP	K2
4.4	Solution to the Assignment Problem.	Solve AP	K6
V	**Network Problems**		
5.1	Introduction to Network Models	Demonstrate Network Model	K2
5.2	Method for Construction of a Network	Construct a Network	K3
5.3	Numbering the nodes	Mark the numbers of each nodes	K5
5.4	Critical Path Method (CPM)	Formulate Network Problems & Solve using CPM	K6
5.5	Project Evaluation Review Technique (PERT)	Formulate Network Problems & Solve using PERT	K6

4. MAPPING SCHEME (POs, PSOs AND COs)

U20 MAZ 11	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	L	-	-	L	M	M	-	-	M	M	M	L
CO2	H	H	M	-	M	H	H	L	-	H	H	H	H
CO3	H	H	M	-	H	H	H	L	-	H	H	H	H
CO4	H	H	M	-	H	H	H	L	-	H	H	H	H
CO5	H	H	M	-	H	H	H	L	-	H	H	H	H
CO6	H	H	M	-	H	H	H	L	L	H	H	M	M

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. M. Antony Raj

Allied II: NUMERICAL METHODS

Semester: II **Course Code: U20MAZ22/U20MAA22**

Credits: 4 **Hours/Week: 4**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Solve algebraic and transcendental equation using an appropriate numerical method	**K6**	**I**
CO2	Determine the roots of an equation using numerical methods	**K5**	**I**
CO3	Solve linear system of equations using a suitable numerical method	**K6**	**II**
CO4	Estimate an error analysis for a given numerical method	**K5**	**III**
CO5	Solve ordinary differential equations using numerical methods	**K6**	**V**
CO6	Evaluate derivative at a value using an appropriate numerical method in various research problem	**K5**	**I-V**

2A. SYLLABUS

UNIT I: The Solution of Numerical Algebraic and Transcendental

equations **(12 Hours)**

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 **(12 Hours)**

Solution of simultaneous linear algebraic equations – Direct method – Gauss Elimination method – Iterative methods – Gauss Seidel method.

UNIT III: Interpolation **(12 Hours)**

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

UNIT IV: Numerical Integration **(12 Hours)**

Numerical Integration – Trapezoidal rule, Simpson's one-third rule

UNIT V: Numerical Solution of Ordinary Differential Equations **(12 Hours)**

Numerical solution of ordinary differential equations – Euler's method – Modified Euler's method – Runge Kutta 2nd order – Runge Kutta 4th order (Problems only)

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links

1	Dufort Frankel Explicit Scheme	https://nptel.ac.in/courses/111/107/111107063/
2	Neumann Method	https://nptel.ac.in/courses/111/107/111107063/
3	Crank-Nicholson Difference Method	https://nptel.ac.in/courses/111/107/111107063/
4	Explict Scheme	https://nptel.ac.in/courses/111/107/111107063/

C. TEXTBOOK(s)

1. P. Kandasamy, K. Thilagavathy, K. Gunavathy, Numerical Methods, S. Chand & Company Ltd, Reprint 2009.

D. REFERENCE BOOKS

1.S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India Private Limited, 2005.

E. WEB LINKS

1. https://nptel.ac.in/courses/127/106/127106019/

2. https://nptel.ac.in/courses/122/106/122106033/

3. https://nptel.ac.in/courses/111/107/111107107/

4. https://nptel.ac.in/courses/111/107/111107105/

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/ Section	Course Content	Learning outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**The Solution of Numerical Algebraic and Transcendental equations**		
1.1	Solution of algebraic and transcendental equations	Develop the concept various technical methods of finding roots of a transcendental or polynomial equations	K6
1.2	Bisection method	Build the method for finding roots of a non-linear equation	K6
1.3	Iteration method	Evaluate the approximate roots of non-linear equation	K5
1.4	Regula Falsi method	Estimate the bound for roots of non-linear equation	K5
1.5	Newton Raphson Method.	Improve the accuracy of roots using other methods	K6
II	**Solution of Simultaneous Linear Algebraic Equations**		
2.1	Direct method	Solve system of linear algebraic equations	K6
2.2	Gauss elimination method	Solve system of algebraic linear equations using matrices.	K6
2.3	Gauss Iterative method	Develop the ability to formulate and solve problems approximate	K6
2.4	Gauss-Seidal method	Improve the Gauss iterative method and find better	K6

		approximation	
III	**Interpolation**		
3.1	Interpolation	Construct a function which closely fits given n- points in the plane by using interpolation method	K6
3.2	Gregory-Newton forward interpolation formulae	Estimate the value of a function for any intermediate value of the independent variable	K6
3.3	Gregory-Newton backward interpolation formulae	Build a method similar to forward interpolation	K3
3.4	Lagrange's interpolation formula	Estimate the value of a mathematical function, for any intermediate value of the independent variable.	K6
3.5	Inverse interpolation formulae.	Determine the value of the independent variable for given value of functions	K5
IV	**Numerical Integration**		
4.1	Trapezoidal rule	Determine the approximate value of definite integral by using trapezoidal rule	K5
4.2	Simpson's one third rule	Formulate the method to find approximate value of definite integral	K6
V	**Numerical Solution of Ordinary Differential Equations**		
5.1	Euler's method	Determine the numerical solution of ordinary differential equation with first order convergence	K5
5.2	Modified Euler's method	Solve ordinary differential equation using modified Euler method	K6
5.3	Runge-Kutta 2 nd order Runge-Kutta 4 th order	Make use of Taylor expansion to find approximate solution of ordinary differential equation	K3

4. MAPPING SCHEME (POs, PSOs AND COs)

U20MAZ22/U20MAA22	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	M	-	M	H	M	H	-	H	M	M	-
CO2	H	M	M	-	-	M	M	-	-	H	M	H	-
CO3	H	M	M	-	-	M	-	-	-	H	-	M	M
CO4	M	H	-	-	M	-	-	-	-	M	-	M	-
CO5	H	M	-	M	M	-	M	-	-	H	-	M	-
CO6	H	H	-	M	M	M	-	-	L	M	M	M	L

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Dr. J. Maria Felicit

Allied Course III: PROBABILITY AND STATISTICS

Semester: II **Course Code: U20MAZ23/U20MAA23**

Credits: 4 **Hours/Week: 4**

1. COURSE OUTCOMES

After the successful completion of this course, the students will be able to

CO. No.	Course Outcomes	Level	Unit
CO1	Evaluate the range, mean deviation and standard deviation.	K5	I
CO2	Analyze measures of Skewness based on moments and measures of kurtosis.	K4	II
CO3	Evaluate correlation and regression co-efficient between two data sets.	K5	III
CO4	Apply the basic theorem on probability and random variables	K3	IV
CO5	Relationships between Binomial, Poisson and Normal distribution.	K4	V
CO6	List the properties of Normal distribution and area of normal curve.	K4	V

2A. SYLLABUS

Unit I: Measures of Dispersion **(12 Hours)**

Range-The mean deviation-The standard deviation- difference between mean and standard deviation- calculation of standard deviation of variation.

Unit II: Measures of Skewness and Kurtosis **(12 Hours)**

Skewness - (without derivations) - measure of skewness based on moments - kurtosis- measures of kurtosis.

Unit III: Correlation and Regression **(12 Hours)**

Correlation: Karl Pearson's coefficient of correlation - Spearman's rank Correlation coefficient (formula alone)- correlation coefficient-Regression – regression equations of Y on X –regression equations of X on Y.

Unit IV: Probability and Random Variables **(12 Hours)**

Classical or a priori probability-axiomatic approach to probability- calculation of probability- Theorems of probability-conditional probability- Bayes' theorem - Mathematical expectation - Random variable and probability distribution.

Unit V: Discrete and Continuous Distribution **(12 Hours)**

Binomial distribution- Poisson Distribution-definition- relation between Binomial, Poisson and Normal distribution-properties of normal distribution- Area under the Normal curve.

B. TOPICS FOR SELF STUDY

S. No.	Topics	Web Links
1	Special continuous probability distribution.	https://nptel.ac.in/courses/111/104/111104032/

2	Two dimensional random variables.	https://nptel.ac.in/courses/111/104/111104032/
3	Testing hypothesis.	https://nptel.ac.in/courses/103/106/103106120/
4	Non-parametric test.	https://nptel.ac.in/courses/111/102/111102143/

C. TEXTBOOK(s)

1. Perumal Mariappan, Statistics for Business, 1st Edition, CRC Press Taylor & Francis Group, Boca Raton London Newyork, 2019

D. REFERENCE BOOKS

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, fourteenth edition, (2004).

E. WEB LINKS

1. https://onlinecourses.swayam2.ac.in/cec20_ma01/preview
2. https://nptel.ac.in/courses/111/105/111105041/

3. SPECIFIC LEARNING OUTCOMES (SLOs)

Unit/ Section	Course Contents	Learning Outcomes	Highest Bloom's Taxonomic Level of Transaction
I	**Measures of Dispersion**		
1.1	Range	Define range.	K1
1.2	Mean deviation	Define mean deviation.	K1
1.3	Standard deviation	Evaluate the standard deviation.	K5
1.4	Difference between Mean and Standard deviation	Distinguish between Mean and Standard Deviation.	K4
1.5	Calculation of Standard deviation of variation	Evaluate the Standard deviation of variation	K5
II	**Measures of Skewness and Kurtosis**		
2.1	Skewness	Define Skewness	K1
2.2	Measures of Skewness based on moments	Measures of Skewness based on moments	K5
2.3	Kurtosis	Define Kurtosis	K1
2.4	Measures of kurtosis	Measures of Kurtosis	K5
III	**Correlation and Regression**		
3.1	Correlation	Define the correlation	K1
3.2	Karl Pearson's coefficient of correlation	Evaluate the Karl Pearson's coefficient of correlation	K5
3.3	Spearman's rank correlation	Evaluate the spearman's rank correlation	K5
3.4	Correlation coefficient	Determine the correlation coefficient	K5
3.5	Regression	Define regression	K1
3.6	Regression equations of Y on X	Estimate the regression equations of Yon X	K5
3.7	Regression equations of X on Y	Estimate regression equations of X on Y	K5
IV	**Probability and Random Variables**		

4.1	Axiomatic approach to probability	Define axiomatic approach to probability	K1
4.2	Classical or priori probability	Define classical probability	K1
4.2	Calculation of probability	Evaluate the probability	K5
4.3	Theorems of probability	Apply the basic theorems of probability	K3
4.4	Conditional probability	Evaluate the conditional probability	K5
4.5	Baye's theorem	Apply Baye's theorem	K3
4.6	Mathematical expectation	Define mathematical expectation	K1
4.7	Random variable	Define two types of random variables	K1
4.8	Probability distribution	Define two types of probability distribution	K1
V	**Discrete and Continuous Distribution**		
5.1	Binomial distribution,	Define binomial distribution	K1
5.2	Poisson distribution	Define Poisson distribution	K1
5.3	Relation between Binomial, Poisson and Normal distributions	Compare the binomial and Poisson and normal distributions	K4
5.4	Properties of normal distribution	List the properties of normal distribution	K4
5.5	Area under the normal curve	Determine area of normal curve	K5

4. MAPPING SCHEME (POs, PSOs AND COs)

U20MAZ23/U20MAA23	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	-	L	L	M	L	-	L	M	M	M	L
CO2	L	M	L	M	L	L	L	L	-	M	H	L	L
CO3	M	L	L	M	L	L	L	L	L	H	M	L	L
CO4	L	M	L	L	-	L	L	L	-	M	M	L	L
CO5	L	L	-	M	L	L	-	-	L	L	M	L	L
CO6	L	M	L	M	L	L	-	L	L	M	M	L	L

L-Low M-Moderate H- High

5. COURSE ASSESSMENT METHODS

DIRECT:

1. Continuous Assessment Test: T1, T2 (Theory & Practical Components): Closed Book
2. Open Book Test.
3. Cooperative Learning Report, Assignment, Group Presentation, Group Discussion, Project Report, Seminar, Quiz (written).L
4. Pre-Semester & End Semester Theory Examination

INDIRECT:

1. Course end survey (Feedback)

NAME OF THE COURSE COORDINATOR: Mr. C. Madhubalan

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

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-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 Information, 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

UG – Skill Based Courses (SBC)

Sem.	Course	Code	Title	Hrs./ week	Credit	Marks		
						CIA	ESA	TOTAL
IV	SBC– I	U21LFS41	Life Skills	2	1	100	-	100

LIFE SKILLS

Semester IV **Course code: U21LFS41**

Credit 1 **Hours/Week: 2**

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 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**