THE GANDHIGRAM RURAL INSTITUTE (DEEMED TO BE UNIVERSITY)

GANDHIGRAM - 624302

(Ministry of Education, Govt. of India)

Accredited by NAAC with 'A' Grade (3rd cycle)

Department of Mathematics

B.Sc. Degree (Mathematics)

Pre-Requisite: Mathematics as a subject of study at the Higher Secondary level.

Revised Syllabus with effect from 2021 – 2022 onwards

CURRICULUM WITH OUTCOME BASED EDUCATION (OBE)

Name of the School	:	School of Sciences
Department	:	Department of Mathematics
Academic Programme offered	:	B.Sc. Mathematics, B.Sc. B.Ed. Mathematics (Integrated), M.Sc. Mathematics and Ph. D. Mathematics

I. VISION :

- Science & Technology Enabled Rural Development throughteaching and research in Mathematical Sciences

II. MISSION :

- Proficiency in research and teaching
- Research studies in International standards and to urge the need for practical significance

III. PROGRMME CODE : MATU

IV. PROGRAMME : B. Sc. Mathematics

V. PROGRAMME EDUCATIONAL OBJECTIVES (PEO) OF B.SC. MATHEMATICS:

PEO 1: Demonstrate proficiency in mathematics and allied fields by exhibiting the required knowledge of the mathematical concepts so as to secure appropriate placement and studies.

PEO 2: To develop further career through learning research and extension.

PEO 3: To demonstrate the needed skills for analysis, data interpretation and methodologies as appropriate to the domain of maths.

PEO 4: To address the needs of society by applying the knowledge and leadership so as to seek solutions for society / industry.

PEO 5: Select higher studies in Mathematics and other inter-disciplinary programmes and enable to get employed in private and public sectors

VI. GRADUATE ATTRIBUTES

GA1: Reasoning Ability
GA2: Analytical Ability
GA3: Communication Skill
GA4: Computational Skill

VII. PROGRAMME OUTCOMES (PO)

PO1: Have the potential to face all competitive exams in public and private sectors.

PO2: Possess the ability to do higher studies in premier institutions

PO3: Posses the computational skills to solve related problems in science and engineering

PO4: Have the ability to develop mathematical models related to real life situations

PO5: Identifying and solving problems arising in social science, business and banking based on quantitative techniques.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Acquire skills in basic concepts of algebra, real and complex analysis, number theory, Optimization theory

PSO2: Become proficient in differential and integral calculus and familiar with applications of ODE & PDE.

PSO3: Gain knowledge in 2D and 3D geometrical objects using various metrics and solving mechanical and physical problems through geometrical and graphical way.

PSO4: Analyze numerical and statistical data of population dynamics of real life situations

PSO5: Proficient in soft skills and Computing skills for solving complex mathematical problems.

Name of the Programme	**B.Sc. Mathematics**						
Year of Introduction	1976			Year of Revision		2021	
Semester-wise Courses and Credit distribution	I	II	III	IV	V	VI	Total
No. of Courses	8	9	8	7	6	7	45
No. of Credits	24	24	22	22	20	24	136

Category	Course Code	Course Title	Number of Credits	Lecture Hours per week	Exam Duration (Hrs.)	Marks		
						C.F.A	E.S.E	Total
Semester-I								
Language	21TAMU0101/ 21MALU0101/ 21HIDU0101/ 21FREU0101	Language I (Tamil/Hindi/ Malayalam/French)	3	3	3	40	60	100
	21ENGU01F1	Language II English	3	3	3	40	60	100
Core Course	21MATU0101	Classical Algebra	4	4	3	40	60	100
	21MATU0102	Theory of Equations & Trigonometry	4	4	3	40	60	100
Allied Course	21MATU01B1	Introduction to Office Automation and Programming in Python (Theory)	3	3	3	30	45	75
	21MATU01B2	Introduction to Office Automation and Programming in Python (Practical)	1	2	3	15	10	25
Foundation Course	21NSSU0001/ 21FATU0001/ 21SPOU0001	NSS/FA/Sports	1	1	-	50	-	50
	21YOGU0001	Yoga	1	1	-	50	-	50
	21EVSU0001	Environmental Studies	3+1	4	-	40	60	100
		TOTAL	**24**					

Semester-II								
Language	21TAMU0202/ 21MALU0202/ 21HIDU0202/ 21FREU0202	Language I (Tamil/Hindi/Malayalam/ French)	3	3	3	40	60	100
	21ENGU02F2	Language II English	3	3	3	40	60	100
	21CTAU0001/ 21CHIU0001/ 21CMLU0001	Core Hindi/Core Tamil/Core Malayalam	2	2	2	20	30	50
Core Course	21MATU0203	Mathematical Statistics	3	3	3	40	60	100
	21MATU0204	Calculus-I	3	3	3	40	60	100
Allied Course	21MATU02B3	Object Oriented Programming with C++(Theory)	3	3	3	30	45	75
	21MATU02B4	Object Oriented Programming with C++(Practical)	1	2	3	15	10	25
Foundation Course	21GTPU0001	Gandhi's Life, Thought and Work	2	2	2	20	30	50
	21EXNU0001	Extension Education	2	2	--	20	30	50
Skill Development Course	21ENGU00C1	Communication and Soft Skills	2	2	--	50	--	50
		TOTAL	**24**					
Semester-III								
Language	21TAMU0303/ 21MALU0303/ 21HIDU0303/ 21FREU0303	Language I (Tamil/Hindi/ Malayalam/French)	3	3	3	40	60	100
	21ENGU03F3	Language II English	3	3	3	40	60	100
	21CTAU0002 / 21CHIU0002 / 21CMLU0002	Core Tamil/Core Hindi/ Core Malayalam	2	2	2	20	30	50
Core Course	21MATU0305	Calculus-II	4	4	3	40	60	100

Allied Course	21PHYU03A1 21MATU03B5	1.Allied Physics-I(or) 2.Allied Statistics-I**	3	3	3	40	60	100
	21PHYU03A3 21MATU03B7	1.Allied Physics-I (Practical)* (or) 2.Allied Statistics-I (Practical)**	1	3	--	--	--	--
Computer Skill	21MATU03C1	Programming with JAVA	3	3	3	40	60	100
	21MATU03C2	Programming with JAVA(Pratical)	1	2	3	15	10	25
Foundation Course	21SHSU0001	Shanthi Sena	1	1	--	50	--	50
Value Added Course	21MATU3VA1	Vedic Mathematics	--	--	--	--	--	--
Extension	21EXNU03V1	Village Placement Programme	2	--	--	50	--	50
		TOTAL	**22**					
Semester – IV								
Core Course	21MATU0406	Abstract Algebra	4	4	3	40	60	100
	21MATU0407	Sequences and Series	3	3	3	40	60	100
	21MATU0408	Differential Equations	4	4	3	40	60	100
Allied Course	21PHYU04A2 21MATU04B6	1.Allied Physics-II (or) 2.Allied Statistics-II**	3	3	3	40	60	100
	21PHYU04A3 21MATU04B7	1.Allied Physics-II (Practical) (or) 2.Allied Statistics-II (Practical)**	1	3	3	60	40	100
Electives	21MATU04DX	Discipline Centric Elective	3	3	3	40	60	100
	21MATU04GX	Generic Elective	3	3	3	40	60	100
Modular Course	21GTPU00H1	Human Values and Professional Ethics	1	1	--	50	--	50
Value Added Course	21MATU4VA2	Mathematics for Computer Science	--	--	--	--	--	--
		TOTAL	**22**					
Semester – V								
Core Course	21MATU0509	Linear Algebra	4	4	3	40	60	100
	21MATU0510	Real Analysis	4	4	3	40	60	100
	21MATU0511	Linear Programming	4	4	3	40	60	100
Electives	21MATU05DX	Discipline Centric Elective	3	3	3	40	60	100
	21MATU05GX	Generic Elective	3	3	3	40	60	100
Skill Based Elective	21MATU05S1	Quantitative Skills	2	2	--	20	30	50

Value Added Course	21MATU5VA3	Introduction to R Software	--	--	--	--	--	--
		TOTAL	**20**					

Semester – VI								
Core Course	21MATU0612	Complex Analysis	4	4	3	40	60	100
	21MATU0613	Graph Theory	4	4	3	40	60	100
	21MATU0614	Mechanics	4	4	3	40	60	100
	21MATU0615	Operations Research	4	3	3	40	60	100
Modular Course	21MATU06MX	Modular Course	2	2	--	50	--	50
	21MATU06MX	Modular Course	2	2	--	50	--	50
Project	21MATU0616	Project	4	8	--	40	40+ 20	100
Value Added Course	21MATU6VA4	Mathematical Typesetting LaTex	--	--	--	--	--	--
		TOTAL	**24**					
		GRAND TOTAL	**136**					

Note: * End Semester Examination at the end of the Second Semester.

** Course will be offered only when two sections are allotted.

DISCIPLINE CENTRIC ELECTIVES:

(21MATU04DX/ 21MATU05DX)

Semester -IV

1. 21MATU04D1 Analytical Geometry
2. 21MATU04D2 Financial Mathematics
3. 21MATU04D3 Any course from MOOC / SWAYAM / NPTEL

Semester -V

1. 21MATU05D4 Numerical Methods
2. 21MATU05D5 Introduction to Actuarial Science
3. 21MATU05D6 Any course from MOOC / SWAYAM / NPTEL

GENERIC ELECTIVES

(For other departments):

Semester –IV

1. 21MATU04G1 Basic Numerical Methods
2. 21MATU04G2 Differential Equations for Engineers

Semester –V

1. 21MATU05G3 Quantitative Aptitude
2. 21MATU05G4 Verbal and Nonverbal Reasoning

MODULAR COURSES: (21MATU06MX)

Semester -VI

1. Fuzzy Set Theory
2. Partial Differential Equations
3. Mathematical Skills
4. Speed Arithmetic

2. Mathematics for Computer Science
3. Introduction to R Software
4. Mathematical Typesetting LaTex

VALUE ADDED COURSES

1. Vedic Mathematics

ABSTRACT	
Course type	**Total number of Courses**
Core Course	15
Discipline Centric Elective Course	02
Generic Elective Course	02
Allied Course	04
Modular Course	02
Foundation Course	06
Language	08
Soft Skills	01
Computer Skill	01
Skill Based Elective	01
Human Values and Professional Ethics	01
Project	01
Extension (VPP)	01
Value Added Course	04

Semester	I	Course Code	21MATU0101
Course Title	CLASSICAL ALGEBRA		
No. of. Credits	4	No. of. contact hours per week	4
New Course/ Revised Course	Revised Course	If revised, Percentage of Revision effected (Minimum 20%)	60%
Category	Core Course		
Scope of the Course	• Basic Skill		
Cognitive Levels addressed by the course	• Knowing matrices, relations, and sets. (K-1) • Understanding functions and inequalities (K-2). • Applying number theory concepts and Congruence relations to solve problems. (K-3) • Analyzing cardinality of sets(K-4) • Evaluating eigen values and eigen vectors of matrices (K-5)		
Course Objective	The Course aims to impart skills in the various applications of algebraic methods.		

Unit	Content	No. of. Hours
I	Basic terminologies – Operations on sets – Family of sets – Power sets – Cartesian product of sets.	13
II	Basic definitions: one-one, onto functions and bijections – Composition of functions – Inverse of a function – Image of subsets under functions – Inverse image of subsets under functions.	13
III	Relation on sets – Types of relations – Equivalence relations – Equivalence classes and partitions of a set – The induction principle – Sets with same cardinality – Finite sets – Countable sets – Comparing cardinality.	13
IV	Types of matrices- Operations on Matrices- Inverse Matrix Solution of simultaneous equations- Rank of a matrix- Homogeneous and Non-homogeneous linear equations- Eigen values and Eigen vectors- Cayley-Hamilton theorem.	12
V	Prime Numbers and Composite Numbers - Euler's function - Divisibility and Congruence relations - Fermat's theorem - Wilson's theorem.	13

<table>
<tr><td rowspan="3">References</td><td>Text Books:
1. Ajit Kumar, S. Kumaresan, & Bhaba Kumar Sarma, A Foundation Course in Mathematics, Narosa Publishers, New Delhi, 2018.
Unit 1: Chapter 2
Unit 2: Chapter 3
Unit 3: Chapter 4, Chapter 5 (sec 5.1), and Chapter 6.
2. T. K. Manicavachagom Pillay, T. Natarajan, K. S. Ganapathy, Algebra, Vol. 2, S. Viswanathan Publications (India) Pvt. Ltd., Chennai, 2012.
Unit 4: Chapter 2
Unit 5: Chapter 5.</td></tr>
<tr><td>Reference Books:
1. A Shen and NK Vereshchagin, Basic Set Theory, AMS Students Mathematical Library, USA, 2002.
2. Paul R. Halmos, Naive Set Theory, Springer, New York, 1974.
3. David M. Burton, Elementary Number Theory, 7th Edition, McGraw Hill, New Delhi, 2012.
4. S. Arumugam & A. T. Isaac, Modern Algebra, SciTech Publications, India Pvt. Ltd., Chennai, 2003.
5. S. Narayanan & T. K. Manicavachagom Pillay, Modern Algebra, Vol-I, S. Viswanathan Pvt. Ltd., Chennai, 1997.
6. Seymour Lipschutz, Set Theory & Related Topics, Schaum's outlines, 2nd Edition, Tata McGraw Hill, New Delhi, 2005.
7. Arumugam & Issac, Classical Algebra, New gamma Publishing house, Tirunelveli, 2003.
8. S.B. Malik, Basic Number Theory, 2nd Edition, Vikas Publishing House Pvt. Ltd., New Delhi, 2009.</td></tr>
<tr><td>E- Resources:
1. http://nptel.ac.in/courses/109104124/
2. https://nptel.ac.in/courses/111/106/111106142/
3. https://nptel.ac.in/courses/111/105/111105112/
4. www.maths.manchester.ac.uk/~avb/0n1_pdf/0N1_All.pdf
5. https://4dspace.mtts.org.in/expository-articles-list.php</td></tr>
<tr><td>Course Outcomes</td><td>On completion of the course students should be able to
CO1: solve problems in matrices.
CO2: explain the basic concepts of set theory.
CO3: analyze various types of functions.
CO4: identify lub, glb of sets and inequalities.
CO5: explain the knowledge of basic concepts of number theory.</td></tr>
</table>

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2
CO2	3	2	2	2	3
CO3	3	3	2	3	2
CO4	3	1	2	2	2
CO5	3	3	2	2	3

Semester	I	Course Code	21MATU0102
Course Title	THEORY OF EQUATIONS AND TRIGONOMETRY		
No. of. Credits	4	No. of. contact hours per week	4
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	35%
Category	Core Course		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Knowing the basic concepts of equations, roots, remainder theorem, relations between roots and coefficients and symmetric functions of roots.(K-1) • Understanding the transformation of equations, reciprocal equations, diminishing and increasing by given quantity, form of the quotient and remainder when a polynomial is divided by a binomial and removal of terms.(K-2) • Applying the Descartes' rule of signs, Rolle's theorem, Strum's theorem - Newton's method of divisors and Horner's method to find the nature of roots of the given equation.(K-3) • Evaluating the values of $cosn\theta$, $sinn\theta$ and $tann\theta$, Powers of sines and cosines of θ, Expansions of $sin^n\theta$, $cos^n\theta$, $sin\theta$ and $cos\theta$ and solved their related problems. (K-5) • Analyzing the Hyperbolic functions, Inverse hyperbolic functions, and Logarithm of complex quantities.(K-4)		
Course Objective	The Course aims to learn techniques of solving algebraic and trigonometric equations.		

Unit	Content	No. of. Hours
I	Theory of Equations: Remainder Theorem - Fundamental Theorem of Algebra - Relations between roots and coefficients - Symmetric functions of roots - Sum of the powers of the roots of an equation - Newton 's theorem on the sum of the	13

	powers of the roots.	
II	Transformation of Equations - Reciprocal Equations - To increase or decrease the roots of a given equation by a given quantity - Form of the quotient and remainder when a polynomial is divided by a binomial - Removal of terms - To form an equation whose roots are any power of the roots of a given equation	13
III	Descartes' rule of signs - Rolles' Theorem - Strum's Theorem - Newton's Method of Divisors - Horner's Method.	12
IV	Trigonometry: Expansion of $cosn\theta$, $sin\, n\theta$ and $tan\, n\theta$ - Powers of sines and cosines of θ - Expansions of$sin^n\theta$, $cos^n x$, $sin\, \theta$ and $cos\, \theta$ - Expansions of $sin\, \theta$ and $\cos\theta$ in a series of ascending powers of θ.	13
V	Hyperbolic functions - Relation between hyperbolic functions - Inverse hyperbolic functions - Logarithm of Complex Quantities.	13
References	**Text Books:** T. K. ManicavachagomPillay, T. Natarajan& K. S. Ganapathy, **Algebra, Vol. 1**, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai, 2019. Unit 1: Chapter 6, Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14. Unit 2: Chapter 6, Sections 15, 16, 17, 18, 19, 20. Unit 3: Chapter 6, Sections 24, 25, 27, 29.4, 30. S. Narayanan & T. K. ManicavachagomPillay, **Trigonometry**, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai, 2018. Unit 4: Chapter III, Sections 1, 2, 4, 5. Unit 5: Chapter IV, Sections 1, 2(2.1, 2.2, 2.3) & Chapter V, Section 5 (Only).	
	Reference Books: Arumugam&Issac, **Theory of Equations, Theory of Numbers and Trigonometry**, New Gamma Publishing House, Tirunelveli, 2011.	
	E- Resources: https://www.youtube.com/watch?v=V4fCrkWJ8tc https://www.youtube.com/playlist?list=PLOnJQiDsowoiyJH7qgTXkLjeVOzlVvumh https://cosmolearning.org/courses/trigonometry-complex-numbers/	
Course Outcomes	On completion of the course students should be able to CO1: utilize basic concepts of roots and coefficients of equation to solve algebraic equations. CO2: solve various problems in transformation of equations. CO3: apply Newton's and Horner's method to solve various equations. CO4: assess trigonometric functions and related problems. CO5: identify various types of hyperbolic functions.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	3
CO2	3	1	3	2	3
CO3	3	2	2	3	2
CO4	3	2	3	2	2
CO5	3	2	1	3	2

Semester	I	Course Code	21MATU01B1
Course Title	INTRODUCTION TO OFFICE AUTOMATION AND PROGRAMMING IN PYTHON(THEORY)		
No. of. Credits	3	No. of. contact hours per week	3
New Course/ Revised Course	Revised Course	If revised, Percentage of Revision effected (Minimum 20%)	60%
Category	Allied Course – Theory		
Scope of the Course	• Employability • Skill Development		
Cognitive Levels addressed by the course	• Understand basic components of computer (K-2) • Applying MS Word to prepare documentation (K-3) • Analysing real time data using MS Excel (K-4) • Creating numerical and graphical representation of data (K-6) • Remembering the basic tokens of Python (K-1)		
Course Objective	The Course aims to provide hands-on use of MS Office applications with Word and Excel. Also, to develop basic knowledge in programming with Python.		

Unit	Content	No. of. Hours
I	Word Processing using MS WORD: Word processing - Advantages - MS WORD - Definition. Document: Create - save - Printing - Resave - Close- Exiting word. Editing: Opening document - cursor movement - selecting text - deleting - undo redo - Moving text - Copying text. Formatting text: Font - paragraph formatting - bullets & numbering – getting help - find and replace text - spell checking and correction - grammar checking - auto correct- auto text - using thesaurus - using tabs - defining & changing page setup - page print options. Tables: creating &formatting, multiple columns. Math equations and typesetting in MS Word.	12

II	MS-EXCEL: Introduction to worksheet and Excel - Definitions - Advantages - Organization of worksheet area - entering information - number - Formula - save - data alignment - editing - range - definition - specifying - changing column width - row height - centering cell across column, hiding columns and rows - moving and copying data - inserting and deleting rows and columns-Formatting the worksheet - printing - setting up page and margin defining header and footer - print options. Chart: creation - changing type - resize and move - controlling the appearance - modifying - deleting - printing - naming ranges - using statistical, Mathematical, and financial functions - using drawing tool bar.	12
III	Python: Identifiers - Keywords - Statements and Expressions - Variables - Operators - Precedence and Associativity - DataTypes - Indentation - Comments - Reading Input and Output - Type Conversions.	8
IV	Control Flow Statements: The if decision flow statement - The if…else decision flow statement - The if…elif…else decision flow statement - Nested if statement - while loop - for loop - the continue and break statement - catching exceptions using try and exceptstatement.	8
V	Functions: Build in functions - commonly used modules - function definition and calling the function - there turn statement and void function - scope and life time of variables - default parameter - keyword arguments - *args and **kwargs- command line. arguments.	8
References	**TextBooks:** 1. SanjaySaxena,**MS-Office-2000** foreveryone,VikasPublishingHousePvt. Ltd., New Delhi, 2000. Unit1:PartII&III Unit 2: Part IV. 2. S.GowrishankarandA.Veena,**IntroductiontoPythonProgramming**,CRC Press, 2019. Unit3:Chapter2 Unit4:Chapter3 Unit5:Chapter5.	
	E- Resources: 1. https://nptel.ac.in/courses/106/106/106106212/ 2. https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-cs21/	

Course Outcomes	On completion of the course students should be able to CO1: prepare documents using MS word CO2: analyze real time data using MS excel CO3: process data input output using Python CO4: solve decision making problems CO5: write Python programs for complex problems.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	2	3
CO2	3	2	2	2	3
CO3	3	3	3	1	1
CO4	2	3	1	2	2
CO5	3	1	3	3	3

Semester	I	Course Code	21MATU01B2
Course Title	INTRODUCTION TO OFFICE AUTOMATION AND PROGRAMMING IN PYTHON(PRACTICAL)		
If revised, Percentage of Revision effected (Minimum 20%)	50%		
No. of. Credits	1	No. of. contact hours per week	2
Category	Allied Course – Practical		

List of Practical	No. of. Hours
1. Typesetting mathematical equations in MS word. 2. Designing of Advertisement/ Bill for a company in MS Word. 3. Preparing a communication letter and send it to many people using mail merge in MS Word. 4. Generating salary slip of a company in MS Excel. 5. Calculating total earnings of a company in MS Excel. 6. Preparing stock record of a company using MS Excel. 7. Calculating payment due of selling products in a company using MS Excel. 8. Python program to read the marks of five subjects and	16

	findthe average of them. 9. Python program to read the Richter magnitude value from the user and display the result using if ... el, if ... else statement. 10. Python program to print the sum of the series. 11. Python program to find the largest of three numbers using functions. 12. Python program using functions to find the value of nPr and nCr. 13. Python program using functions to finds the area of a pentagon. 14. Python program using functions to display Pascal's triangle. 15. Python program using functions to print harmonic progression series and its sum till N terms.	

Semester	**II**	Course Code	**21MATU0203**
Course Title	**MATHEMATICAL STATISTICS**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed by the course	• Knowing the sampling & sampling distributions (K-1) • Understanding the random variables and distribution function (K-2). • Applying the measures of central tendency (K-3). • Analyzing the theoretical distributions (K-4). • Evaluating the regression & correlation equations (K-5).		
Course Objective	The Course aims to impart skills in various applications of statistical methods.		

UNIT	Content	No. of Hours
I	Measures of Central Tendency - Arithmetic mean, Geometric mean, Media, Mode, Harmonic mean - Measures of Dispersion - Range, Quartile deviation, mean deviation,	14 hours

	standard deviation, root mean square deviation, coefficient of correlation - Moments - Karl Pearson's coefficients - Skewness and Kurtosis - Examples and properties.	
II	Theory of Probability: Definition - Axioms - Addition and Multiplication Theorems - Examples and properties– Conditional Probability - Baye's Theorem on conditional probability - Boole's inequality	12 hours
III	Random variables - Discrete and Continuous - Definition of Probability Mass Function and Density Function - Distribution Functions - Examples andProperties - Mathematical Expectations - Moment Generating Functions -Cumulant generating function - properties of c.g.f - Characteristic function - properties	14 hours
IV	Theoretical distributions - Discrete: Binomial Distribution and Poisson distribution: Moments of binomial distribution - Recurrence formula for binomial distribution - Mean, standard deviation, mode of a Poisson distribution - Additive properties of independent poisson variates - cumulants of poisson distribution -Poission distribution as alimiting case of binomial distribution - Continuous: Normal Distribution Properties and Applications - moment generating function of normal distribution, mean, mode, variance - Area property of a normal distribution - Fitting of normal distribution - By area method - by ordinates of the normal curve method - standard normal variate	12 hours
V	Curve Fitting by the Method of Least Squares - Fitting a straight line - fitting a second degree parabola - Correlation - Karl Pearson's coefficient of correlation - Rank correlation - Spearman's formula - Regression - Equations of Regression Lines - Regression coefficients -Angle between Regression Lines - Correlation coefficient for a bivariate frequency distribution	12 hours
References	**Text Books:** 1. S. Arumugam & A. Thangapandi Isaac, **Statistics**, New Gamma Publishing House, Tirunelveli, 2006. Unit 1: Chapter 1: Sections 1.0 -1.4; Chapter 2: Section 2.0-2.5; Chapter 3: Sections: 3.0 - 3.2; Chapter 4: Sections: 4.0 - 4.2. Unit 2: Chapter 11: Sections: 11.0 -11.2. Unit 3: Chapter 12: Sections 12.0 -12.5. Unit 4: Chapter 13: Sections 13.0-13.3.	

	Unit 5: Chapter 5: Section 5.0, 5.1; Chapter 6: Section 6.0 - 6.3
	Reference Books: 1. J.N. Kapoor & H.C. Saxena, **Mathematical Statistics**, S. Chand & Co Pvt. Ltd., New Delhi, 1994. 2. S. C. Gupta & V. K. Kapoor, **Fundamentals of Mathematical Statistics**, S. Chand & Sons Pvt. Ltd., New Delhi, 1994.
	E- Resources: 1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ma22/ 2. https://nptel.ac.in/courses/108/106/108106106/
Course Outcomes	On completion of the course students should be able to CO1: analyze the given data by using statistical methods. CO2: explain the basic concepts of probability and related results. CO3: employ different probabilistic methods to solve problems arise in different situations. CO4: design and evaluate hypothesis tests. CO5: apply sampling techniques to real life situations.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	3	3	2
CO2	1	1	2	3	3
CO3	2	2	2	3	3
CO4	1	1	2	3	3
CO5	1	1	2	2	3

Semester	**II**	Course Code	**21MATU0204**
Course Title	**CALCULUS-I**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	**NEW COURSE**	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Remember the techniques of calculus in Differentiation and Integration (K-1) • Understand the behaviour of limits of functions on the Real line (K-2)		

<table>
<tr><td></td><td colspan="2">

- Evaluate the derivative of Real valued functions (K-5)
- Applying the derivatives to analyse the properties of functions (K-3 &K-4)
- Evaluate integration of functions (K-5)

</td></tr>
<tr><td>Course Objective</td><td colspan="2">The Course aims to learn the different concepts of differential and integral calculus.</td></tr>
<tr><td>Unit</td><td>Content</td><td>No. of. Hours</td></tr>
<tr><td>I</td><td>Limits and Continuity: Limits (An Intuitive Approach) - Computing Limits – Computing Limits: End Behaviour – Limits - Continuity.</td><td>8</td></tr>
<tr><td>II</td><td>The Derivative: The Derivative - Techniques of Differentiation – Derivative of Trigonometric functions – The Chain Rule – Implicit Differentiation.</td><td>8</td></tr>
<tr><td>III</td><td>The Derivative in Graphing and Applications: Analysis of Functions I: Increase, Decrease, and Concavity - Analysis of FunctionsII: Relative Extrema; First and Second Derivative Tests - Analysis of Functions III: Applying Technology and the Tools of Calculus - Absolute Maxima and Minima - Rolle's Theorem; Mean - ValueTheorem.</td><td>10</td></tr>
<tr><td>IV</td><td>Integration: The Indefinite Integral; Integral Curves and Direction Fields - Integration by Substitution - The Definite Integral - The Fundamental Theorem of Calculus - Evaluating Definite Integrals by substitution.</td><td>12</td></tr>
<tr><td>V</td><td>Exponential, Logarithmic and Inverse Trigonometric Functions: Inverse Function - Exponential and Logarithmic Functions - Derivatives and Integrals Involving Exponential and Logarithmic Functions - Derivatives and Integrals Involving Inverse Trigonometric Functions - L'Hospital's Rule; Indeterminate Forms.</td><td>10</td></tr>
<tr><td rowspan="2">References</td><td colspan="2">Text Books:
1. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus, 7th Edition, Wiley India Pvt. Ltd. New Delhi, 2002.
Unit 1: Chapter 2: Section 2.1 – 2.5
Unit 2: Chapter 3: Section 3.2 – 3.6,
Unit 3: Chapter 4: Section 4.1- 4.3, 4.5, 4.8
Unit 4: Chapter 5: Section 5.2, 5.3, 5.5, 5.6, 5.8
Unit 5: Chapter 7: Section 7.1-7.3, 7.6, 7.7</td></tr>
<tr><td colspan="2">Reference Books:
1. James Stewart, Calculus - Early Transcendentals, 7e, Cengage Learning Pvt. Ltd, New Delhi, 2012.
2. George B. Thomas, JR &Ross L. Finney, Calculus and Analytic Geometry, Sixth edition, Narosa Publishing House, New Delhi, 1986.
3. Thomas & Fenny, Calculus, 9th Ed. Pearson, USA, 2002.
4. Courant, R., and F. John, Introduction to Calculus and Analysis, Volume I,</td></tr>
</table>

	Springer, New York, 1999. 5. Courant, R., and F. John, **Introduction to Calculus and Analysis**, Volume II, Springer, New York, 1999.
	E- Resources: 1. https://nptel.ac.in/courses/111/104/111104144/ 2. https://onlinecourses.nptel.ac.in/noc21_ma61/course 3. https://nptel.ac.in/courses/111/104/111104144/ 4. https://nptel.ac.in/courses/111/106/111106146/
Course Outcomes	On completion of the course students should be able to CO1: find limits of functions. CO2: understand the geometry of differentiation and integration. CO3: analyse the characteristics of functions. CO4: compute definite integrals. CO5: solve differentiation and integration of functions involving logarithmic and exponential functions.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	1
CO2	3	1	1	2	2
CO3	3	3	2	3	2
CO4	2	2	3	1	2
CO5	3	1	2	2	1

Semester	**II**	Course Code	**21MATU02B3**
Course Title	**OBJECT ORIENTED PROGRAMMING WITH C++ (THEORY)**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	**Allied Course – Theory**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Internship		
Cognitive Levels addressed by the course	• Identify basic input/output, tokens, operators, and functions through C++. • Create objects and classes. • Constructing relationships between classes and objects.		

<table>
<tr><td></td><td colspan="2">

- Use function templates and class templates in a program.
- Design Object Oriented Programs using class, inheritance diagrams.

</td></tr>
<tr><td>Course Objective</td><td colspan="2">The Course aims to develop programming skills in C++ and its object-oriented programming concepts.</td></tr>
<tr><td>Unit</td><td>Content</td><td>No. of. Hours</td></tr>
<tr><td>I</td><td>What is C++ - Applications of C++ - A simple C++ program - An example with class - tokens - keywords - Identifiers and constants - basic, user defined, derived data types - Storage classes - symbolic constants - type compatibility - declaration of variables - dynamic initialization of variables.</td><td>10</td></tr>
<tr><td>II</td><td>Operator in C++ - scope resolution, member differencing, memory management operators - manipulators - type cast operator – the main function - function prototyping - call by reference - return by reference - Inline functions - default, constant arguments- recursion- - function overloading - math library functions.</td><td>10</td></tr>
<tr><td>III</td><td>C structure - specifying a class - defining member function - a C++ program with class making an outside function inline - nesting of member function - private member function - array within class - static data members - static member functions - array of objects - objects as function arguments - friendly functions</td><td>10</td></tr>
<tr><td>IV</td><td>Constructors – parameterized constructors - multiple constructors in a class - constructors with default arguments - dynamic initialization of objects - copy constructor - dynamic constructors – destructors - defining operator overloading - overloading unary, binary operators.</td><td>9</td></tr>
<tr><td>V</td><td>Defining derived classes - single inheritance - multilevel inheritance - multiple inheritance-hierarchical inheritance - hybrid inheritance - virtual base class - abstract classes - constructors in derived classes.</td><td>9</td></tr>
<tr><td rowspan="2">References</td><td colspan="2">Text Books:
1. E. Balagurusamy, Object Oriented Programming with C++, Fifth edition, Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 2011.
Unit 1: Chapters: 2.1 - 2.5, 3.1- 3.12,
Unit 2: Chapters: 4.1-4.10 & 4.12.
Unit 3: Chapters: 5.1- 5.9.
Unit 4: Chapters: 6.1-6.8, 6.11, 7.2-7.5.
Unit 5: Chapters: 8.1-8.11.</td></tr>
<tr><td colspan="2">Reference Books:
1. V. Ravichandran, Programming with C++, Second Edition Tata McGraw - Hill, New Delhi, 2006.
2. H. Schildt, The complete Reference of C++, Tata-McGraw-Hill publishing</td></tr>
</table>

	Company Ltd. New Delhi, 2003.
	E- Resources: 1. https://onlinecourses.nptel.ac.in/noc21_cs02/preview
Course Outcomes	On completion of the course students should be able to CO1: formulate object-oriented programming concept. CO2: utilize the C++ tokens and operators. CO3: apply C++ class declaration and definition and its objects in software. CO4: design constructors, destructors, and operator overloading. CO5: apply the concept of inheritance in Software problems.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	3	3
CO2	2	2	3	2	2
CO3	1	2	1	2	3
CO4	1	2	2	1	3
CO5	1	3	1	2	2

Semester	**II**	Course Code	**21MATU02B4**
Course Title	**OBJECT ORIENTED PROGRAMMING WITH C++ (PRACTICAL)**		
If revised, Percentage of Revision effected (Minimum 20%)	25%		
No. of. Credits	**1**	No. of. contact hours per week	**2**
Category	**Allied Course – Practical**		

Unit	Content	No. of. Hours
	1. List the prime numbers in each range. 2. Display Fibonacci series. 3. Sorting given list of names in alphabetical order. 4. Sorting given list of numbers in ascending order. 5. Read and display for a given matrix of any order. 6. Compute simple and compound interest values. 7. Computer biggest among three numbers. 8. Compute biggest among N integers.	16

	9. Compute factorial of a given number using recursive function. 10. Write a program to swap the values using functions. 11. Print perfect squares in each range. 12. Write a program to solve a quadratic equation and test with three types of roots. 13. Write a program to calculate the following functions to 0.0001% accuracy. $\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \cdots$ $SUM = 1 + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{3}\right)^3 + \left(\frac{1}{4}\right)^4 + \cdots$ $cosx = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \cdots$ 14. Write a program to calculate variance and SD of N numbers. 15. Write a program to read two matrices and compute matrix multiplication using functions. 16. Prepare employee details using class with array of objects. 17. Program to illustrate objects as function arguments. 18. Program to illustrate parameterized constructors. 19. Program to illustrate multiple constructors in a class. 20. Show by a suitable program: how the unary minus operator is overloaded? 21. Show by a suitable program: how the binary operator is overloaded? 22. Prepare student mark list by using multilevel inheritance. 23. Program to illustrate multiple inheritance. 24. Prepare student mark list by using hybrid inheritance. 25. Prepare student mark list by using the concept of virtual base class.	

Semester	**III**	Course Code	**21MATU0305**
Course Title	**CALCULUS-II**		
No. of. Credits	**4**	No. of. contact hours per week	**4**
New Course/ Revised Course	**NEW COURSE**	If revised, Percentage of Revision effected	--

		(Minimum 20%)	
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Remembering limits and graphs of functions of single variables(K-1) • Understanding the limits and derivatives of functions of several variables (K-2) • Applying partial derivatives to find the maxima & minima of functions of several variables (K-3) • Analyse vector fields and line integrals over higher dimensional space (K-4). • Evaluating double integral and triple integrals by applying Green's and Stokes's Theorem(K-4 &K-5)		
Course Objective	The Course aims to learn the different concepts of differential and integral calculus.		
Unit	**Content**		**No. of. Hours**
I	Vector Functions: Vector Functions and Space Curves – Derivatives and Integrals of Vector Functions – Arc Length and Curvature - Functions of Several Variables - Limits and Continuity.		14
II	Partial Derivative: Partial Derivatives - The Chain Rule – Directional Derivatives and the Gradient Vector – Maximum and Minimum Values - Lagrange Multipliers.		14
III	Multiple Integrals: Double Integrals over Rectangles - Iterated Integrals - Double Integrals over General Regions - Triple Integrals.		12
IV	Vector Calculus: Vector Fields - LineIntegrals - The Fundamental Theorem of Line Integrals - Green's Theorem.		12
V	Vector Calculus (Continued): Curl and Divergence - Surface Integrals - Stokes' Theorem - The Divergence Theorem.		12
References	**TextBooks:** 1. James Stewart, Calculus-EarlyTranscendentals, 7e, Cengage Learning Private Ltd, New Delhi, 2012. Unit1: Chapter13: Section13.1–13.3, Chapter14: Section14.1, 14.2. Unit2: Chapter14: Section14.3,14.5– 14.8. Unit3: Chapter15: Section15.1-15.3,15.6, 15.7. Unit4: Chapter16: Section16.1-16.4. Unit5: Chapter16: Section16.5,16.7-16.9.		

	Reference Books: 1. Howard Anton, Irl C. Bivens, Stephen Davis, **Calculus**, 7th Edition, Wiley India Pvt. Ltd., New Delhi 2002. 2. George B. Thomas, JR & Ross L. Finney, **Calculus and Analytic Geometry**, Sixth edition, Narosa Publishing House, New Delhi, 1986. 3. M.D. Weir, J. Hass, F.R. Giordano, **Thomas' Calculus**, 11th Edition, Pearson Education, USA, 2008. 4. Thomas & Fenny, **Calculus**, 9th Ed. Pearson, USA, 2002. 5. Courant, R., and F. John, **Introduction to Calculus and Analysis**, Volume I, Springer, New York, 1999. 6. Courant, R., and F. John, **Introduction to Calculus and Analysis**, Volume II, Springer, New York, 1999.
	E- Resources: 1. https://nptel.ac.in/courses/111/104/111104144/ 2. https://nptel.ac.in/courses/111/107/111107108/ 3. https://nptel.ac.in/courses/111/106/111106146/
Course Outcomes	On completion of the course students should be able to CO1: Compute limits, partial derivatives, directional derivatives, gradient of functions of several variables. CO2: Applying partial derivatives to find extremum of functions of several variables. CO3: Compute Double/ Trible integrals. CO4: Construct vector fields on higher dimensional spaces. CO5: Compute Curl, Divergence and surface integrals.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	1
CO2	3	3	3	1	1
CO3	3	2	1	1	1
CO4	3	3	2	2	2
CO5	3	2	2	2	1

Semester	III	Course Code	21MATU03B5
Course Title	ALLIED STATISTICS-I		
No. of. Credits	3	No. of. contact hours per week	3
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Allied Course (Theory)		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the course	• Remember the concept of attributes, hypothesis and sampling distributionsχ^2 test and goodness of fit (K-1). • Understand the methods the techniques of analysis and variance, statistical inference (K-2) • Apply the technique of analysis of variance for some statistical problems(K-3). • Analyze the variance and coding of data by using χ^2 test (K-4). • Evaluate the significance for large samples and small samples (K-5) • Create statistical models for real world situations and solve them using these techniques (K-6)		
Course Objective	The Course aims to impart deep knowledge about statistical methods.		

Unit	Content	No. of. Hours
I	Association of Attributes: Introduction - Difference between correlation and association - Notation and Terminology - Consistency of data - association and dissociation - methods of studying association.	10
II	Statistical inference-Tests of hypotheses: Introduction-standard error and sampling distribution-estimation – some problems.	10
III	Statistical inference- Tests of hypotheses (continued): test of significance for large samples Test of significance for small samples – simple poblems.	9
IV	χ^2test and goodness of fit: Introduction-χ^2 defined-conditions for applying χ^2 test-Yates' corrections-Uses of χ^2 test-additive property of χ^2- Chi-square for specified value of population variance and it's applications - Miscellaneous illustrations.	9
V	Analysis of variance-assumptions in analysis of variance-technique of analysis of variance-coding of data-analysis of variance in two-way classification model - Miscellaneous illustrations.	10

References	**Text Books:** 1. S.P. Gupta, **Statistical Methods**, Sultan Chand & Sons, New Delhi, 2001. Unit I: Page number 477-499. Unit II: Page number 881-901. Unit III: Page number 901-929. Unit IV: Page number 953-972. Unit V: Page number 1009-1038.
	Reference Books: 1. S. C. Gupta and V. K. Kapoor, **Fundamentals of Mathematical Statistics**, Sultan Chand & Sons, New Delhi, 1994. 2. Chung, **Elementary Probability Theory with Stochastic Process**, Narosa publishing House, New Delhi, 1993. 3. J. N. Kapoor and H. C. Saxena, **Mathematical Statistics**, Sultan Chand & Sons, New Delhi, 1994.
	E- Resources: 1. https://nptel.ac.in/courses/111105041/ 2. https://nptel.ac.in/courses/111105090/
Course Outcomes	On completion of the course students should be able to CO1: analyze the concept about the methods of attributes. CO2: compute standard error and sampling distribution. CO3: predict the occurrence of null and alternative hypotheses. CO4: analyze the given data using Chi-square test. CO5: estimate the variance and coding of data.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	3	3
CO2	2	2	3	2	2
CO3	1	2	1	2	3
CO4	1	2	2	1	3
CO5	1	2	2	3	3

Semester	III	Course Code	21MATU03C1
Course Title	PROGRAMMING WITH JAVA (THEORY)		
No. of. Credits	3	No. of. contact hours per week	3
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	Computer Skill		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability • Entrepreneurship		
Cognitive Levels addressed by the course	• Identify Classes, objects, and methods to define a class, Operators and expressions, Accessing interface variables (K-1). • Understanding decision making with looping and branching using control statements (K-2). • Applying Java applets to create Web pages to contain animated graphics or interactive content (K-3). • Analyzing graphics programming with geometry and statistical data (K-4). • To create geometrical shapes (K-5).		
Course Objective	The Course aims to develop object-oriented programming skills in JAVA and its applications in web page designing, geometry and graphical representation of statistical data.		

Unit	Content	No. of. Hours
I	Overview of java language: Introduction - Simple java program - An application with two classes - Java program structure - Java tokens - Java statements - implementing a java program - Java virtual machine - Command line arguments: Constants, Variables and Data types - declaration of variables giving values to variables - Scope of variables - Symbolic constants - Type casting - Getting values of variables - Standard default values- Some selected programs for practical.	10
II	Operators and Expressions: Arithmetic operators - Relational operators - Logical operators -Assignment operators - Increment and decrement operators- Conditional operators - Bitwise operators - Special operators- - Arithmetic expressions -Evaluation of expressions - Precedence of Arithmetic operators - Type conversion in expressions - Operator precedence and associativity –Decision making and Branching: Decision making with if statement - Simple if statement - The if.... else statement - Nesting of if else statements - The else if ladder - Switch statement –The? operator- Some selected programs for practical.	10

III	Decision making and Looping: The while statement - The do statement - the for statement - Jumps in loops - Labeled loops. Classes, Objects and Methods Defining a Class - Adding variables - Adding methods - Creating Objects - Accessing Class members - Constructors -Methods. Overloading - Static members- Nesting of methods - Inheritance: Extending a class - Overriding methods - Final variables and methods - final classes - finalizer methods - Abstract methods and classes - visibility control - Arrays - One dimensional. Arrays - Creating an array -Two-dimensional array - Strings - Vectors - wrapper Classes.	10
IV	Interfaces: Defining interfaces - Extending interfaces - Implementing interfaces -Accessing interface variables - Packages: Java API Packages - Using system packages - Naming conventions - Creating packages - Accessing a package -Using a package - adding a class to a package - Hiding classes- Some selected programs for practical –	9
V	Applet Programming: Introduction - How applets differ from applications - Preparing to write applet - Building applet code - Applet life cycle - Creating an executable applet - Designing a web page - Applet tag - Adding applet to HTML File - Running the Applet -More about applet tag - Displaying numerical values- Getting input from the user. Graphics Programming: Introduction - The Graphics class - Lines and Rectangles - Circles and Ellipses - Drawing arcs - Drawing polygons -. Line graphs - Using control loops in applets - Drawing bar charts- Some selected programs for practical.	9
References	**Text Books:** 1. E. Balagurusamy, **Programming with Java**, Sixth Edition, McGraw - Hill Education (India) Pvt. Ltd., Chennai, 2019. Unit 1: Chapters 3, 4 Unit 2: Chapters 5, 6 Unit 3: Chapters 7, 8, 9 Unit 4: Chapters 10, 11 Unit 5: Chapters 14, 15.	
	Reference Books: 1. H. Sehildt, **JAVA2: The Complete Reference**, Fourth Edition, TMH Publishing Company, New Delhi, 2001. 2. C. Xavier, **Programming with JAVA 2**, SciTech Publications, Chennai, 2000.	
	E- Resources: 1. https://nptel.ac.in/courses/106/105/106105191/	

Course Outcomes	On completion of the course students should be able to CO1: create Java programs and implement java tokens. CO2: solve problems using Java operators and expressions. CO3: demonstrate decision making and looping in programs. CO4: critique the concept of interfaces. CO5: apply the applet and graphics programming with geometry and statistical data analysis.

Mapping of Cos with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	3	4	5
CO2	1	2	2	3	3
CO3	2	2	1	3	2
CO4	3	2	3	2	3
CO5	2	1	2	2	2

Semester	**III**	Course Code	**21MATU03C2**
Course Title	**PROGAMMING WITH JAVA (PRACTICAL)**		
If revised, Percentage of Revision effected (Minimum 20%)	25%		
No. of. Credits	**1**	No. of. contact hours per week	**2**
Category	**Computer Skill**		
List of Practical			**No. of. Hours**
	Practical related to Programming with Java Practical related to Programming with Java Programming with Java 1. Write a program to determine the sum of harmonic series 2. Write a program to convert the given temperature in Fahrenheit to Celsius 3. Write a program to perform any 5 math functions 4. Write a program to solve two linear equations with		

	two unknowns 5. Prepare your house EB bill according to unit price of reading range by TNEB 6. Display Floyd's triangle 7. Compute power of 2 using for loop 8. Reverse the digits using while loop 9. Write a program that computes and prints a table of factorials for any given m. 10. Write a program to compute sum of digits of a given integer 11. Write a program using do….while loop to calculate and print first m Fibonacci numbers 12. Program to illustrate Class 13. Program to illustrate Constructors 14. Program to illustrate method overloading 15. Program to illustrate static members 16. Program to illustrate inheritance concept 17. Write a program to sort a list of numbers 18. Write a program to perform matrix multiplication 19. Write a program for alphabetical ordering of strings 20. Write a program to calculate compound interest value by using wrapper class methods 21. Prepare student mark list by implementing multiple inheritance using interfaces 22. Program to illustrate packages 23. Develop an applet that receives three numeric values as input from the user and then displays the largest value on the screen. Write a HTML page and test the applet. 24. Applet program to display bar chart for the following data: Year : 2010 2011 2012 2013 2014 2015 Turnover : 110 150 100 170 190 120 (Rs. Crores) 25. Write applets to draw the following shapes: a) Cone b) Cylinder c) Cube d) Square inside a circle e) Circle inside a square	16

Semester	IV	Course Code	21MATU0406
Course Title	ABSTRACT ALGEBRA		
No. Of. Credits	4	No. Of. Contact hours per week	4
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	45%
Category	Core Course		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Knowing the basic properties of groups, subgroups, rings, ideals, and fields. • Understanding the order of elements in a group, cosets, normal subgroups, and isomorphism of groups as well as rings. • Using Lagrange's theorem to find the properties of subgroups of a group and find the order of an element of a group. • Testing of isomorphism of groups and rings. • Investigate the properties of permutation groups and some special types of rings. • Constructing Cayley Table, subgroups, subrings, ideals in groups and rings.		
Course Objective	The Course aims to provide some knowledge about various algebraic structures.		

UNIT	Content	No. of Hours
I	Groups: Introduction - Definition and examples - Elementary properties of a group - Equivalent definition of a group - Permutation groups - permutation multiplication - Cycles and transpositions - Alternating groups.	13 hours
II	Subgroups - examples - criteria for subgroups - intersection, union and product of subgroups - Cyclic groups - examples - properties of cyclic groups - structure of finite and infinite cyclic groups - Generators of cyclic groups - Order of an element - Cosets and Lagrange's theorem - Applications of Lagrange's theorem - Euler's theorem - Fermat's theorem.	14 hours
III	Normal subgroups and quotient groups - Isomorphism – Examples - Some results on isomorphism - Structure of isomorphic groups - non isomorphic groups - Cayley's theorem – Homomorphisms - Examples - Elementary properties of homomorphisms - Types of homomorphisms - Fundamental theorem of Homomorphism of groups.	13 hours
IV	Rings: Definition and examples - Ring of Guassian integers - Elementary properties of rings - Boolean rings - Isomorphism - Type of rings :Commutative rings - Ring with identity - Ring with	12 hours

	unit element - Skew field-Field - Integral domain - Characteristic of a ring - Examples - elementary results - Subring - examples - Criteria of subrings	
V	Ideals - examples - principal ideals - Quotient rings - Maximal and prime ideals - Homomorphism of rings - Fundamental theorem of Homomorphism of rings	12 hours
References	**Text Books:** 1. S. Arumugam & A. T. Isaac, **Modern Algebra**, SciTech Publications (India) Pvt. Ltd., Chennai, 2003. Unit 1: Chapter 3: Sections 3.0, 3.1, 3.2, 3.3, 3.4 Unit 2: Chapter 3: Sections 3.5, 3.6, 3.7, 3.8 Unit 3: Chapter 3: Sections 3.9, 3.10, 3.11 Unit 4: Chapter 4: Sections 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 Unit 5: Chapter 4: Sections 4.7, 4.8, 4.9, 4.20	
	Reference Books: 1. S. Narayanan & T. K. Manicavachagom Pillay, Modern **Algebra, Vol. II**, S. Viswanathan Pvt. Ltd., Chennai, 1997. 2. John. B. Fraleigh, **A First Course in Abstract Algebra**, 7th edition, Addison-Wesley Publications, US, 2003.	
	E- Resources: 1. https://nptel.ac.in/courses/111/106/111106113/ 2. https://nptel.ac.in/courses/111/105/111105112/	
Course Outcomes	On completion of the course students should be able to CO1: analyze the basic properties of groups and subgroups. CO2: identify the types of homomorphism and use them to classify groups. CO3: apply the theorems to study the structure of groups. CO4: outline the basic properties of rings, fields, and integral domains. CO5: utilize the algebraic methods for solving problems.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	2
CO2	3	1	1	1	2
CO3	3	2	1	1	2
CO4	3	1	1	1	2
CO5	3	2	3	2	2

Semester	IV	Course Code	21MATU0407
Course Title	SEQUENCES AND SERIES		
No. of. Credits	3	No. of. contact hours per week	3
New Course/ Revised Course	Revised Course	If revised, Percentage of Revision effected (Minimum 20%)	90%
Category	Core Course		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Remembering the basic concepts of Real number system (K-1) • Remembering the basic concepts of bounded, monotonic, convergent, divergent, and oscillating sequences (K-1). • Understanding and analysing the algebra of limits, behaviour of monotonic sequences, sub-sequences and limit points (K-2 & K-4). • Applying the Comparison test, Kummer's test, Root test and Condensation test to test the convergences and divergenceof series (K-3).		
Course Objective	The Course aims to enhance basic skills in the areas of sequences and series.		

Unit	Content	No. of. Hours
I	Axioms and Properties of Real Numbers: The field axioms – The order axioms – Bounded sets, LUB and GLB – The completeness axiom (existence of LUB's) – Dual of the completeness axiom (existence of GLB's) – Archimedean property – Bracket function – Density of the rationals – Square roots – Absolute value.	10
II	Sequences: Sequences – Limit points of a sequence – Limit-inferior and Superior – Convergent sequences – Non-convergent sequences.	9
III	Sequences (Continued): Cauchy's general principle of convergence –Algebra of Sequences–Some important Theorems–Monotonic Sequences.	9
IV	Infinite Series: Introduction – Positive term series – Comparison tests for positive term series – Cauchy's root test – D'Alembert's ratio test - Raabe's test.	10
V	Infinite Series (Continued): Logarithmic test – Integral test – Gauss's test – Series with arbitrary terms – Rearrangement of terms.	10
References	**Text Books:** 1. Sterling K. Berberian, **A First Course in Real Analysis**, Springer Verlag, New York, 1994. Unit 1: Chapter 1 & Chapter 2 (sec 2.1-2.4, 2.8, 2.9).	

	2. S C Malik, SavithaArora, **Mathematical Analysis** (Fifth Edition), New Age International Publishers,2017. Unit 2: Chapter 3 (sec 1 to5) Unit 3: Chapter 3 (sec 6 to9) Unit 4: Chapter 4 (sec 1 to6) Unit 5: Chapter 4 (sec 7 to 11)
	Reference Books: 1. R. G. Bartle & D.R. Sherbert, **An Introduction to Real Analysis**, John Wiley & Sons, New York,1982. 2. N. P. Bali, **Real Analysis**, An imprint of Laxmi Publications Pvt. Ltd., New Delhi,2005. 3. Richard R. Goldberg, **Methods of Real Analysis**, Oxford & IBH Publishing CO. PVT. LTD., New Delhi,1970. 4. S. K. Mapa, **Introduction to Real Analysis**, 8th Edition, Sarat Book House, Kolkata, 2014. 5. Ajith Kumar and S. Kumaresan, **A Basic Course in Real Analysis**, CRC Press, Boca Raton,2015.
	E- Resources: 1. http://nptel.ac.in/courses/109104124/ 2. https://nptel.ac.in/courses/111/106/111106142/ 3. https://nptel.ac.in/courses/111/105/111105112/ 4. https://nptel.ac.in/courses/111/106/111106053/ 5. https://nptel.ac.in/courses/111/101/111101134/ 6. www.maths.manchester.ac.uk/~avb/0n1_pdf/0N1_All.pdf 7. https://4dspace.mtts.org.in/expository-articles-list.php 8. https://www.maths.ed.ac.uk/~v1ranick/papers/matrices.pdf
Course Outcomes	On completion of the course students should be able to CO1: find LUB/ GLB of sets of real numbers. CO2: analyse the behaviour of sequences. CO3: compute the limit of convergent sequences. CO4: applying various test to test the convergence of series. CO5: compute the limit of convergent series.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	2
CO2	3	2	2	2	1
CO3	3	2	3	2	1

CO4	3	2	2	1	2
CO5	3	3	2	2	1

Semester	**IV**	Course Code	**21MATU0408**
Course Title	**DIFFERENTIAL EQUATIONS**		
No. of. Credits	**4**	No. of. contact hours per week	**4**
New Course/ Revised Course	Revised Course	If revised, Percentage of Revision effected (Minimum 20%)	90%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Remembering the different types of differential equations (K-1) • Understanding the initial/ Boundary value problems and existence of solutions(K-2) • Applying various methods to solve first/second order differential equations(K-3) • Analyse the conditions for the existence of solutions of differential euqations (K-4) • Construct solutions of differential equations by applying Laplace Transforms (K-3 & K-6)		
Course Objective	The Course aims to introduce the basic concepts of differential equations and the Laplace Transform.		

Unit	Content	No. of. Hours
I	Differential Equations and Their Solutions: Classification of Differential Equations; Their Origin and Application - Solutions – Initial – Value Problems – Boundary – value Problems, and Existence of Solutions.	13
II	First - Order Equations for Which Exact Solutions Are Obtainable: Exact Differential Equations and Integrating Factors - Separable Equations and Equations Reducible to This Form – Linear Equations and Bernoulli Equations.	14
III	Explicit Methods of Solving Higher - Order Linear Differential Equations: Basic Theory of Linear Differential Equations - The Homogeneous Linear Equations with Constant Coefficients - The Method of Undetermined Coefficients.	12
IV	Explicit Methods of Solving Higher - Order Linear Differential Equations (Continued): Variation of Parameters - The Cauchy – Euler Equation – Statements and Proofs of Theorem on the Second – Order Homogeneous Linear Equation.	13

<table>
<tr><td>V</td><td>The Laplace Transform: Definition, Existence, and Basic Properties of the Laplace Transformation (Theorems without Proof) - The Inverse Transform and the Convolution (Theorems without Proof) - Laplace Transform Solution of Linear Differential Equations with Constant Coefficients –Laplace Transform Solutions of Linear Systems.</td><td>12</td></tr>
<tr><td rowspan="3">References</td><td colspan="2">TextBooks:
1.Shepley L. Ross, Differential Equations, Third Edition, Wiley India Pvt. Ltd.,New Delhi, 2004.
Unit1:Chapter1
Unit2:Chapter2:Section2.1-2.3.
Unit3:Chapter4:Section4.1–4.3.
Unit4:Chapter4:Section4.4–4.6.
Unit5:Chapter9.</td></tr>
<tr><td colspan="2">Reference Books:
1. William E. Boyce, Richard C. Diprima, Elementary Differential Equations and Boundary Value Problems, 9th Ed., Wiley India Pvt. Ltd., New Delhi, 2017.
2. Richard Bronson, Gabriel Costa, Schaum's Outline of Differential Equations, 4th Edition (Schaum's Outlines), USA, 2014.
3. Braun, M. Differential Equations and Their Applications, 4th Ed., Springer, USA, 2011.
4. Kreyszig, E., Advanced Engineering Mathematics, 10th edition. John Wiley & Sons, USA, 2010.
5. Philip Dyke, An Introduction to Laplace Transforms and Fourier Series, Springer, New York, 2014.
6. M. D. Raisinghania, Advanced Differential Equations, S. Chand Publications, New Delhi 2004.</td></tr>
<tr><td colspan="2">E- Resources:
1. https://onlinecourses.nptel.ac.in/noc21_ma09/course
2. https://onlinecourses.nptel.ac.in/noc21_ma69/course
3. https://nptel.ac.in/courses/122/107/122107037/
4. https://nptel.ac.in/courses/111/106/111106100/
5. https://nptel.ac.in/courses/111/108/111108081/</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">On completion of the course students should be able to
CO1: solve boundary/initial value problems.
CO2: determine solutions of second order linear homogeneous, non-homogeneous differential equations with constant coefficients.
CO3: determine solutions of Cauchy- Euler equation.
CO4: determine the conditions for the existence of solutions of second order differential equations.</td></tr>
</table>

	CO5: estimate the solutions by applying Laplace transform methods.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	1	2
CO2	3	3	2	2	1
CO3	2	3	2	1	2
CO4	3	3	3	1	1
CO5	3	3	2	2	1

Semester	**IV**	Course Code	**21MATU04B6**
Course Title	**ALLIED STATISTICS-II**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	**Allied Course (Theory)**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the course	• Remember the concept of moment generating functions, Chebyshev's inequality and various types of continuous probability distribution (K-1). • Understand the methods of applying Vital statistics, characteristics functions, the weak law of large numbers, and the properties of various continuous probability distributions (K-2). • Apply the Chebyshev's inequality to check the convergence in probability (K-3). • Apply Vital statistics to find the measurement of fertility and mortality, and the reproduction rates (K-3). • Analyze the convergence in probability (K-4) • Evaluate the moments of various orders (K-5). • Create a statistical model of a real-world situation and use the distribution to solve it (K-6).		
Course Objective	The Course aims to impart deep knowledge about statistical methods.		

Unit	Content	No. of. Hours
I	Generating functions and Law of large numbers: Moment generating functions-cumulants-characteristic functions.	10
II	Generating functions and Law of large numbers (continued): Chebychev's inequality-convergence in probability- weak law of large numbers.	9
III	Special continuous probability distributions: Rectangular (or uniform) distribution-triangular distribution-gamma distribution-beta distribution of first kind-beta distribution of second kind.	10
IV	Special continuous probability distributions (continued): Exponential distribution-standard Laplace distribution- Cauchy distribution. Interpolation and Extrapolation: Introduction – Significance of interpolation and extrapolation – Methods of Interpolation – Extrapolation – Miscellaneous Illustration	9
V	Vital Statistics: Introduction-vital statistics defined-uses of vital statistics-methods of obtaining vital statistics-measurement of fertility-reproduction rates-measurement of mortality. Index Numbers: Use of Index Numbers – Methods of Constructing Index Number – Quantity or Volume Index Number – Base Shifting Method	10
References	**Text Books:** 1. S. C. Gupta and V. K. Kapoor, **Fundamentals of Mathematical Statistics**, Sultan Chand & Sons, New Delhi, 1994. Unit 1: page numbers 7.1-7.17 Unit 2: page numbers 7.24-7.39 Unit 3: page numbers 9.29 -9.50 Unit 4: page numbers 9.50-9.55, 9.58-9.63 2. S.P. Gupta, **Statistical Methods**, Sultan Chand & Sons, New Delhi, 2001. Unit 4: Page Number 673 – 694 Unit 5: Page : 515-540; Page numbers 711-736.	
	Reference Books: 1. Chung, **Elementary Probability Theory with Stochastic Process**, Narosa publishing House, New Delhi, 1993. 2. J. N. Kapoor and H. C. Saxena, **Mathematical Statistics**, Sultan Chand & Sons, New Delhi, 1994.	
	E- Resources:	
Course Outcomes	On completion of the course students should be able to CO1: compute the moments of various orders.	

	CO2: analyze the convergence in probability. CO3: identify the special types of continuous probability distributions. CO4: formulate the different factors that vary with respect to time. CO5: apply the various methods of statistics in real life data.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	3	1
CO2	3	2	1	3	2
CO3	2	2	2	3	3
CO4	2	2	1	3	3
CO5	2	2	1	3	2

Semester	**III & IV**	Course Code	**21MATU04B7**
Course Title	**ALLIED STATISTICS (PRACTICAL)**		
If revised, Percentage of Revision effected (Minimum 20%)	25%		
No. of. Credits	**1**	No. of. contact hours per week	**2**
Category	**Allied Course (Practical)**		

List of Practical	**No. of. Hours**
1. Drawing bar charts, Pie diagrams, Histograms, Pictograms, 3-D bars, and other related diagrams. 2. Construct bi variate frequency distribution for the Students age classification. 3. Drawing graphs of frequency curves, frequency polygons, Normal probability curve, cumulative distribution curves, probability curves for different distributions. 4. Computation of Mean, Variance, Skewness and Moments, Kurtosis measures. 5. Computation of Moment generating functions, characteristic functions, cumulants and related measures. 6. Computation of Covariance, Correlation Coefficient, Equations of Regression lines and curves. 7. Computing F-ratio and preparation of Analysis of variance tables.	16

	8. Computation of Index Numbers. 9. Analysis of time series: Introduction-time series-components of a time series-measurement of trends. 10. Computation of body mass index of students. 11. Execution of ANOVA, two – way ANOVA and ANCOVA with SPSS. 12. Non Parametric statistics with spss.	

Semester	**V**	Course Code	**21MATU0509**
Course Title	**LINEAR ALGEBRA**		
No. of. Credits	**4**	No. of. contact hours per week	**4**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Recognizing the basic properties of vector spaces, inner product spaces. • Interpreting the concepts of linear algebra from a geometric point of view. • Solving simultaneous linear equations, finding eigenvalues and eigenvectors, the inverse of a matrix by using Cayley Hamilton Theorem. • Examining the linear independence and orthogonality of a set of vectors. • Constructing linearly independent sets, basis, subspaces, linear transformations in a vector space.		
Course Objective	The Course aims to introduce the fundamentals of vector spaces.		
UNIT	**Content**		**No. of Hours**
I	Vector Spaces: Introduction - Definition and examples - Elementary properties of vector spaces - Subspaces - Examples - Intersection, union and sum of subspaces - Direct sum of subspaces - quotient spaces		12 hours
II	Linear transformation - Types of linear transformations - Examples - Image of a subspace under a linear transformation - Fundamental theorem of linear transformation - First isomorphism theorem - Span of a set - Examples - properties - Linear independence - finite dimensional vector spaces - Examples - Basic properties of		13 hours

	Linearly independent sets and Linearly dependent set	
III	Basis and dimension-Maximal linearly independent set - minimal generating set - Dimension of quotient spaces - Dimension of Sum of subspaces - Rank and nullity - Matrix of a linear transformation - Linear transformation corresponding to a matrix - Examples - Vector Space of linear trnaformations	14 hours
IV	Inner product spaces: Introduction - Definition and examples - Properties of inner product spaces - norm of a vector - Schwarz inequality - Orthogonality - Orthogonal Complement	12 hours
V	Elementary transformations - Rank of a matrix - Simultaneous linear equations - Characteristic equation and Cayley Hamilton Theorem - Eigen values and eigen vectors.	13 hours
References	**Text Books:** 1. S. Arumugam & A. T. Isaac, **Modern Algebra**, SciTech Publications (India) Pvt. Ltd., Chennai, 2003. Unit 1: Chapter 5: Sections 5.0, 5.1, 5.2. Unit 2: Chapter 5: Sections 5.3, 5.4, 5.5. Unit 3: Chapter 5: Sections 5.6, 5.7, 5.8. Unit 4: Chapter 6: Sections 6.0, 6.1, 6.2, 6.3. Unit 5: Chapter 7: Sections 7.4, 7.5, 7.6, 7.7, 7.8.	
	Reference Books: 1. S. Narayanan & T. K. Manicavachagom Pillay, **Modern Algebra**, Vo1 III, S. Viswanathan Pvt. Ltd., Chennai, 1997. 2. S. Kumaresan, **Linear Algebra: A Geometric Approach**, Prentice Hall of India, 2006. 3. Vivek Sahai & Vikas Bist, **Linear Algebra**, Narosa Publishing House, New Delhi, 2002.	
	E- Resources: 1. https://onlinecourses.nptel.ac.in/noc18_ma13	
Course Outcomes	On completion of the course students should be able to CO1: explain the basic properties of vector spaces. CO2: identify the concepts of linear algebra in geometric point of view. CO3: create the linear transformations as matrix form. CO4: apply the tools of linear algebra to solve the system of equations. CO5: design the applications of linear algebra in many branches of Mathematics.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	1	3
CO2	3	2	3	2	3
CO3	3	2	2	1	3
CO4	3	3	2	1	3
CO5	3	3	2	2	3

Semester	V	Course Code	21MATU0510
Course Title	REAL ANALYSIS		
No. of. Credits	4	No. of. contact hours per week	4
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	Core Course		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Understanding metric spaces by remembering basic concepts of sets and functions (K-1 & K-2). • Analysing properties of open, closed, connected and compact sets in metric spaces(K-4). • Applying the property of compact sets to study uniformly continuous(K-3). • Constructing everywhere discontinuous functions on the real line (K-6) • Computing the definite integrals of functions (K-6)		
Course Objective	The Course aims to impart concepts about sets with metric and related properties.		

Unit	Content	No. of. Hours
I	Limit of a function on the realline - Metric spaces - Limits in metric spaces - Functions continuous at a point on the real line - Functions continuous on a metric space.	14
II	Open sets - Closed sets - Discontinuous function on R- More about open sets.	12
III	Connected sets - Bounded sets and totally bounded sets - Complete metric spaces - Compact metric spaces - Continuous functions on compact metric spaces - Continuity of the inverse function, Uniform continuity.	14
IV	Definition of the Riemann integral - Existence of the Riemann integral - Properties of the Riemann integral - Derivatives -	13

	Rolle's theorem - Thela wof the mean - Fundamental theorem of calculus - Improperintegrals.	
V	The elementary functions - Taylor series - Hyperbolic functions - The exponential function - The Logarithmic function - Definition of x^a - The trigonometric functions - Taylor theorem - L'Hosptial rule.	11
References	**TextBooks:** 1. Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 1970. Unit1:Section4.1-4.3,5.1-5.3. Unit2:Section5.4-5.6,6.1. Unit3:Section6.2-6.8 Unit4:Section7.2-7.9. Unit5:Section 8.1-8.5, 8.6	
	Reference Books: 1. N. P. Bali, **Real Analysis**, An imprint of Laxmi Publications Pvt. Ltd., New Delhi, 2005. 2. Sterling K. Berberian, **A First Course in Real Analysis**, Springer, New York, 2004. 3. S. Arumugam& A. Thangapandi Isaac, **Modern Analysis**, New Gamma Publishing House, Palayamkottai, 2002. 4. Robert G. Bartle and Donald R. Sherbert, **Introduction to Real Analysis**, John Wiley & Sons, New Delhi, 1982. 5. S. C. Malik & Savita Arora, **Mathematical Analysis**, New Age International LTD., New Delhi, 1992.	
	E- Resources: 1. https://nptel.ac.in/courses/111/106/111106142/ 2. https://www.youtube.com/watch?v=md5UCR7mcIY&list=PLbMVogVj5nJSxFihV-ec4A3z_FOGPRCo-	
Course Outcomes	On completion of the course students should be able to CO1: understand the geometrical view of metric spaces with different metrics. CO2: identify open, closed, connected and compact sets and its properties in metric spaces. CO3: construct continuous and discontinuous functions on metric spaces. CO4: distinguish continuous and uniformly continuous functions CO5: evaluate integration of bounded functions.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	3	2	1
CO2	3	3	3	1	2

CO3	3	3	3	1	1
CO4	3	1	3	2	1
CO5	3	2	3	1	1

Semester	V	Course Code	21MATU0511
Course Title	LINEAR PROGRAMMING		
No. of. Credits	4	No. of. contact hours per week	4
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the course	• Knowing the basic concepts of mathematical formulation of LPP and solving the linear programming problems using graphical method, simplex method, Big M method and two-phase method. • Understanding the concept of duality in Linear Programming, General Primal-Dual pair, formulating a dual problem and dual simplex method. • Applying the North-West Corner rule and Vogel's approximation method to find an initial basic feasible solution. • Evaluating the processing 'n' jobs through two machines, processing 'n' jobs through k machines and processing 2 jobs through k machines. • Analyzing the two-person zero-sum games, the MAXIMIN-MINIMAX principle, graphical solution of $2 \times n$ and $m \times 2$ games and dominance property.		
Course Objective	The Course aims to impart the basic concepts and applications of linear programming.		

Unit	Content	No. of. Hours
I	Linear Programming Problem - Mathematical Formulation of LPP and Problems – Illustration on Mathematical Formulation of LPP - Graphical Solution Method – General Linear Programming Problem - Simplex Method – Big M Method - Two Phase Method – Degeneracy in Linear Programming – Solution of Simultaneous Linear Equation – Inverting a Matrix Using Simplex Method – Application of Simplex Method	13
II	Introduction – General Primal - Dual pair - Duality in Linear Programming: Introduction – General Primal-Dual Pair – Formulating a Dual Problem - Duality and Simplex Method --	13

	Economic Interpretation of Duality - Dual Simplex Method –Post Optimal Analysis: Changing objective function Coefficients, c_j's – Structural Changes – Applications of Post optimal Analysis	
III	Transportation Problem (TP): Existence of Solution in T.P. – Transportation table - Mathematical Formulation of TP - Finding an Initial Basic Feasible Solution using North West Corner Rule and Vogel's approximation method –Transportation Algorithm (MODI Method) – Degeneracy in T.P. - Unbalanced Transportation Problems. Assignment Problems (AP):Solution Methods of Assignment Problems - Assignment algorithm– Dual Assignment Method - The Travelling Salesman Problem	13
IV	Sequencing Problem: Introduction - Problem of Sequencing – Basic Terms used in Sequencing – Processing 'n' Jobs through Two Machines– Processing 'n' Jobs through k Machines- Processing 2 Jobs through k machines – Dynamic Programming: Introduction – The Recursive Equation Approach	13
V	Games and Strategies: Introduction – Two-Person Zero-Sum Games –Some Basic Terms – The MAXIMIN-MINIMAX Principle - Games without Saddle Points-Mixed Strategies - Graphical Solution of $2 \times n$ and $m \times 2$ Games - Dominance Property – Arithmetic Method for $n \times n$ Games – General Solution of $m \times n$ Rectangular Games – Limitations and Extensions Replacement Problem and System Reliability: Replacement of Equipment/ Asset that deteriorates gradually - Replacement of Equipment that fails Suddenly	12
References	**Text Books:** 1. Kanti Swarup, P. K. Gupta & Man Mohan, **Operations Research**, Sultan Chand & Sons, New Delhi, Eighteenth Thoroughly Revised Edition, 2015. Unit 1: Chapter 2: Sections 2:3, 2.4, Chapter 3: Sections 3.2, Chapter 4: Sections 4.3, 4.4. Unit 2: Chapter 5: Sections 5.1, 5.2, 5.3, 5.7, 5.9. Unit 3: Chapter 10: Sections 10.1, 10.2, 10.9(1&3), 10.13, 10.15, Chapter 11: Sections 11.2, 11.3, 11.7. Unit 4: Chapter 12: Sections 12.1, 12.2, 12.3, 12.4, 12.5, 12.6. Unit 5: Chapter 17: Sections 17.1, 17.2, 17.3, 17.4, 17.5, 17.6, 17.7.	
	Reference Books: 1. P. K. Gupta & D. S. Hira, **Operations Research**, S. Chand & Company Ltd., New Delhi, 2013.	

	2. J. K. Sharma, **Operations Research theory and its applications**, 2nd Edition, Macmillan, New Delhi, 2006. 3. R. Panneerselvam, **Operations Research**, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
	E- Resources: 1. https://nptel.ac.in/courses/112106134/ 2. https://nptel.ac.in/courses/111105039/ 3. https://nptel.ac.in/courses/110/106/110106062/
Course Outcomes	On completion of the course students should be able to CO1: formulate a linear programming problem and solve them graphically and simplex method. CO2: explain the concepts of duality programming. CO3: analyze the different aspects of transportation problems and also assignment problems. CO4: develop, organize, evaluate short, long-term processes, and solve problems. CO5: utilize the acquired knowledge of basics in game theory.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	2	3
CO2	3	2	3	1	3
CO3	3	2	2	3	1
CO4	3	2	3	2	1
CO5	3	2	1	3	2

Semester	**V**	Course Code	**21MATU05S1**
Course Title	**QUANTITATIVE SKILLS**		
No. of. Credits	**2**	No. of. contact hours per week	**2**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	**Skill Based Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the course	• Knowing various concepts like simplifications, problems on numbers and tabulation for competitive exams. • Understanding different topics like Time and work, percentages. • Applying Logical deduction, Alphabet Test and Group discussion real life		

	situations.	
Course Objective	The Course aims to impart skills in numerical and quantitative techniques.	
Unit	**Content**	**No. of. Hours**
I	H.C.F and L.C.M of Numbers- decimal fractions- simplifications- square roots and cube roots- average- Problems on Numbers- Problems on Ages, Surds, and Indices.	6
II	Tabulation- Bar graphs- Pie charts- Line graphs- Permutation and combinations-Probability- true discount- Banker's discount- Heights and distances.	7
III	Percentages- Profit and Loss- Ratio-Proportion- Partnership- Chain Rule- Pipes and cisterns- Time and Work- Time and Distances.	6
IV	Boats and Streams- Problems on Trains - Coding and decoding.	7
V	Blood Relations- Logical Venn Diagram- Alphabet Test.	6
References	**Text Books:** 1. R.S. Agarwal, **Quantitative Aptitude**, Revised and Enlarged Edition, S. Chand & Company Ltd., New Delhi, 2017. Unit 1: Chapters 2-9, Unit 2: Chapters 36-39, 30-34, Unit 3: Chapters 11-18, Unit 4: Chapters 19, 20. 2. R.S. Agarwal, **A Modern Approach to Verbal Reasoning**, (Fully solved), Revised Edition 2018, Chand & Company Ltd., New Delhi, 2012. Unit 4: Section I: Chapters 4 Unit 5: Section I: Chapter 5, 9, 10.	
	E- Resources: 1. https://www.youtube.com/playlist?list=PLpyc33gOcbVA4qXMoQ5vmhefTruk5t9lt	
Course Outcomes	On completion of the course students should be able to CO1: evaluate various real-life situations by resorting to Analysis of key issues and factors. CO2: apply graphs, charts, and probability techniques on various problems. CO3: discuss the problems on relations, coding and decoding. CO4: demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	1
CO2	2	2	2	3	1
CO3	2	1	2	3	2
CO4	2	1	2	2	3

Semester	VI	Course Code	21MATU0612
Course Title	COMPLEX ANALYSIS		
No. of. Credits	4	No. of. contact hours per week	4
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	Core Course		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Understanding analytic, harmonic, and conformal mapping (K-1). • Understanding bilinear transformations –Cross Ratio-Fixed points of bilinear transformations (K-1). • Applying Cauchy's Theorem and Cauchy's Integral formula to evaluate integral of complex functions (K-3). • Identifying singular points of complex functions using Laurent's series and classifying the singular points (K-4). • Evaluating indefinite integrals of complex functions using Residue Theorem(K-5).		
Course Objective	The Course aims to introduce the concepts of complex numbers and analytic functions.		

Unit	Content	No. of. Hours
I	Functions of complex variables-Limits - Continuous functions-Differentiability - Cauchy Riemann Equation – Analytic functions - Harmonic function - Conformal mapping.	13
II	Elementary mappings - Bilinear transformations – Cross Ratio-Fixed points of bilinear transformations - Some special bilinear transformations.	12
III	Integration in the Complex plane - Cauchy's theorem - Cauchy's Integral formula - Cauchy's Integral formula for higher derivatives - Liouville's theorem - Maximum modulus theorem.	13
IV	Sequences and series of functions – Power series-Taylor's and Laurent's series – Zeros of an analytic functions- Singular points -	15

	Types of singularities.	
V	Residues – Cauchy's Residue theorem – Evaluation of definite integrals.	11
References	**Text Books:** 1. S. Arumugam, A. Thangapandi Isaac & A. Somasundaram, **Complex Analysis**, SciTech Publications India, Pvt. Ltd., Chennai, 2002. Unit 1: Chapter 2 (Sections 2.0-2.9) Unit 2: Chapter 3 (Sections 3.0-3.5), Chapter 5 (Sections 5.0-5.7) Unit 3: Chapter 6 (Sections 6.0-6.4) Unit 4: Chapter 4 (Sections 4.0-4.4), Chapter 7 (Sections 7.0-7.4) Unit 5: Chapter 8 (Sections 8.0-8.3)	
	Reference Books: 1. S. Narayanan & T.K. Manicavachagom Pillay, **Complex Analysis**, S. Viswanathan Publishers, Chennai, 1997. 2. S. Ponnusamy, **Foundations of Complex Analysis**, 2ndEdition, Narosa Publication, New Delhi, 2005. 3. R. V. Churchill & J.W. Brown, **Complex Variables and Applications**, 5thEdition, McGraw Hill, Singapore, 1990.	
	E- Resources: 1. https://nptel.ac.in/courses/111107056/ 2. https://cosmolearning.org/courses/advanced-complex-analysis-i/	
Course Outcomes	On completion of the course students should be able to CO1: outline the basic concepts of analytic function and its properties. CO2: explain about conformal and bilinear transformation. CO3: compare the integration of complex valued function with real valued function. CO4: predict the series of analytic function. CO5: apply the integration of complex function to find residues.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	1	1
CO2	3	3	3	1	1
CO3	3	2	3	2	1
CO4	3	3	3	1	1
CO5	3	3	3	1	1

Semester	VI	Course Code	21MATU0613
Course Title	GRAPH THEORY		
No. of. Credits	4	No. of. contact hours per week	4
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	20%
Category	Core Course		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the course	• Knowing the applications of graphs in real life. • Applying many concepts needs based situations. • Implement algorithms in various fields.		
Course Objective	The Course aims to acquire knowledge of fundamentals of graphs and its applications.		

Unit	Content	No. of. Hours
I	Graphs and Subgraphs: Introduction - Definition and examples - Degree - Four color problem - The Konigsberg Bridge Problem - Subgraphs - Isomorphism - Independentsetsand coverings – Intersection graphs and line graphs - Matrices - Operations on graphs.	14
II	Degree Sequences: Introduction - Degree sequences - Graphic sequences - Connectedness: Introduction - Walks, trails, and paths - Connectedness and components - Blocks - Connectivity.	12
III	Eulerian and Hamiltonian graphs: Introduction - Eulerian Graphs - Hamiltonian graphs - Trees: Introduction - Characterization of trees - Centre of a tree.	13
IV	Matchings: Introduction - Matchings - Matchings in bipartite graphs - Planarity: Introduction –Definition and properties - Characterization of Planar Graphs – Thickness - Crossing and Outer Planarity.	12
V	Colourability: Introduction - Chromatic number and chromaticindex - Five Color Problem -Directed graphs: Introduction - Definitions and basic properties – paths and connections - Digraphs and Matrices - Tournaments.	13

References

Text Books:

1. S. Arumugam & S. Ramachandran, **Invitation to Graph Theory**, SciTech Publications (India) Pvt. Ltd., Chennai, 2001.

Unit1: Chapter 1:Sections 1.1, 1.2 &Chapter 2:Sections 2.0 –2.9

Unit2: Chapter3: Sections3.0 –3.2 &Chapter4:Section4.0 –4.4

Unit3: Chapter5: Sections5.0 –5. 2&Chapter6: Section6.0 –6.2

Unit4: Chapter7: Sections 7.0– 7.2 &Chapter 8: Section8.0- 8.3

Unit5: Chapter9: Sections9.0- 9.2&Chapter10: Section10.0–10.4 0

	Reference Books: 1. J.A. Bondy & U.S.R. Murty, **Graph Theory with Applications**, Elsevier, New York, 1976. 2. S.A. Choudam, **A First course in Graph Theory**, Macmillian India Ltd., New Delhi, 2007. 3. J. Clark & D.A. Holton, **A First Look at Graph Theory**, Allied Publishers, New Delhi, 1995.
	E- Resources: 1. https://nptel.ac.in/courses/111/106/111106102/ 2.https://nptel.ac.in/courses/111/106/111106050/
Course Outcomes	On completion of the course students should be able to CO1: explain the different models of a graph. CO2: outline various parameters of graphs. CO3: analyze various properties of graphs. CO4: apply graph theoretic methods to solve different real-life problems. CO5: demonstrate various graph structures in network models.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	2	3
CO2	2	3	3	3	1
CO3	3	2	2	2	1
CO4	1	1	2	3	3
CO5	3	2	1	2	3

Semester	**VI**	Course Code	**21MATU0614**
Course Title	**MECHANICS**		
No. of. Credits	**4**	No. of. contact hours per week	**4**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	50%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Knowing about forces, velocity, acceleration, moments, couples, friction etc., in trigonometrically and geometrically(K-1). • Understanding Newton's laws of motion and equilibrium of forces acting on a rigid body(K-2).		

	• Applying geometrical concepts in parallel forces, moments, and couples in physics problems(K-3). • Analyses for Newton's laws of motion and projectiles(K-4). • Create new problems in motion under action of central forces(K-6).	
Course Objective	The Course aims to learn the application of geometric and trigonometric properties in equilibrium and motion of particles.	
Unit	**Content**	**No. of. Hours**
I	Basic Concepts and Principles - Forces acting at a Point - Lami's Theorem and Applications - Parallel Forces - Like and Unlike Parallel Forces - Moment of a force - Couples – Related problems.	14
II	Equilibrium of Three Forces acting on a rigid body - Friction - Laws of Friction - Angle of Friction - Cone of Friction - Properties and related simple problems.	12
III	Motion in a Straight line under uniform acceleration - Newton's Laws of motion. Projectiles: Definition - Path of Projectile - Properties and Problems.	14
IV	Impulse and Impact: Collision of Elastic Bodies – Direct and Oblique Impact – Loss of Kinetic Energy – Related Properties and simple problems.	12
V	Central Orbits: Motion under the action of Central Forces - Properties and Related Problems - Differential Equation of Central Orbit - Pedal Equation of Central Orbit - Velocities in a Central Orbit - Law of Forces - Properties and Related Problems.	12
References	**Text Books:** 1. M. K. Venkataraman, **Statics**, Agasthiar Publications, Trichy, 2004. Unit 1: Chapters 2, 3, 4 Unit 2: Chapters 5, 7 2. M. K. Venkataraman, **Dynamics**, Agasthiar Publications, Trichy, 2004. Unit 3: Chapter 3: section 3.22, Chapter 4: Section 4.3, Chapter 6: Sections (6.1 to 6.11) Unit 4: Chapter 8 Unit 5: Chapter 11	
	Reference Books: 1. T. K. Manicavachagom Pillay, **Statics**, S. Viswanathan & Co., Chennai, 1980. 2. S. Narayanan, **Dynamics**, S. Chand & Co., New Delhi, 1980.	
Course Outcomes	On completion of the course students should be able to CO1: apply geometrical concepts in parallel forces, moments, and couples. CO2: evaluate static equilibrium of three forces acting on a rigid body and friction. CO3: explain Newton's laws of motion and projectiles. CO4: analyze the effects of collision of elastic bodies. CO5: predict the motion under action of central forces.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	3	3
CO2	2	2	3	2	2
CO3	3	2	1	2	3
CO4	3	2	2	1	3
CO5	1	3	1	2	2

Semester	**VI**	Course Code	**21MATU0615**
Course Title	**OPERATIONS RESEARCH**		
No. of. Credits	**4**	No. of. contact hours per week	**4**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	**Core Course**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the course	• Knowing the basic concepts of decision analysis, decision-making process, decision-making environment, decision under uncertainty and decision under risk (K-1). • Understanding the queuing theory, operating characteristics of a queuing system, probability distributions in queuing systems and classification of queuing models (K-2). • Applying the Economic Order Quantity (EOQ) to solve the inventory problems (K-3). • Evaluating the problems of replacement of equipment/asset that deteriorates gradually, replacement of equipment that fails suddenly (K-5). • Analyzing the critical path analysis and probability considerations in PERT (K-4).		
Course Objective	The Course aims to impart mathematical modelling skills through operations research techniques.		
Unit	**Content**		**No. of. Hours**
I	Markov Analysis: Markov Processes – State and transition Probabilities – Characteristic of Markov Process Decision Analysis: Introduction – Decision Making Problem – Decision Making Process – Decision		13

	Under Risk – Decision Tree Analysis – Decision – Making With Utilities	
II	Queuing Theory: Introduction – Queuing System – Operating Characteristics of a Queuing System – Probability Distributions in Queuing System – Classification of Queuing Models – Definitions of Transient and Steady States – Poisson Queuing system – Poisson Queuing Systems – Non – Poisson Queuing Systems	13
III	Inventory Control: The Concept of Economic Order Quantity (EOQ) – Deterministic Inventory Problems with No Shortages – Deterministic Inventory Problems with Shortages – Problems of EOQ with Price Breaks – Multi – Item Deterministic Problems – Dynamic Order Quantity – Selective Inventory Control Techniques	13
IV	Replacement Problems: Requirement and Promotion Problem – Equipment Renewal Problem – Reliability and System Failure rates . Simulation: Introduction – Simulation Models – Monte – Carlo Simulation – Simulation in Investment and Budgeting – Simulation of Networks	12
V	Network Scheduling by PERT/CPM: Introduction – Network: Basic Components – Logical Sequencing – Rules for Network Construction – Critical Path Analysis – Probability Considerations in PERT – Distinguish between PERT and CPM – Applications of Network Techniques – Advantages of Network Techniques – Limitations and Difficulties in Using Network– Project Cost – Time Cost Optimization Algorithm – Linear Programming Formulation	13
References	**Text Books:** 1. Kanti Swarup, P. K. Gupta & Man Mohan, **Operations Research**, Eighteenth Thoroughly Revised Edition, Sultan Chand & Sons, New Delhi, 2015. Unit 1: Chapter 16: Sections 16.1, 16.2, 16.3, 16.4, 16.5, 16.6. Unit 2: Chapter 21: Sections 21.1, 21.2, 21.4, 21.6, 21.7, 21.8, 21.9 (First Three Models only). Unit 3: Chapter 19: Sections 19.1, 19.2, 19.3, 19.4, 19.6, 19.7, 19.9, 19.10, 19.11. Unit 4: Chapter 18: Sections 18. 1, 18.2 and 18.3. Unit 5: Chapter 25: Sections 25.1, 25.2, 25.3, 25.4, 25.6, 25.7.	
	Reference Books: 1. P. K. Gupta & D. S. Hira, **Operations Research**, S. Chand and Company Ltd., New Delhi, 2013. 2. J. K. Sharma, **Operations Research theory and Its Applications**, 2ndEdition,	

	Macmillan India Limited, 2003. **E- Resources:** 1. https://nptel.ac.in/courses/112106134/ 2. https://nptel.ac.in/courses/111105039/
Course Outcomes	On completion of the course students should be able to. CO1: demonstrate knowledge of the major concepts of decision theory and decision-making process. CO2: identify the basic analysis of queuing systems. CO3: apply the basic various inventory models in real life problems. CO4: identify the system reliability and specific types of simulation. CO5: critique the role and application of PERT/CPM for project scheduling.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	3	2
CO2	3	2	2	2	1
CO3	2	2	2	1	3
CO4	3	2	2	3	1
CO5	2	3	2	2	1

Semester	**VI**	Course Code	**21MATU06M1**
Course Title	**FUZZY SET THEORY**		
No. of. Credits	**2**	No. of. contact hours per week	**2**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	**Modular Course**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Know various definitions of fuzzy sets, membership functions and identify basic standard operations such as complement, union, intersection, composition, and other operations in Fuzzy Set theory(K-1). • Applying fuzzy concepts to solve real life problems and using fuzzy relations to create fuzzy Graphs(K-3). • Deriving the characteristics and classifying the fuzzy relation(K-4).		

Course Objective	The Course aims to impart basic concepts of fuzzy sets and fuzzy relations.	
Unit	**Content**	**No. of. Hours**
I	Fuzzy Sets: Sets- Basic definition - types - Expanding Concepts of Fuzzy Set -Standard Operation of Fuzzy Set- Fuzzy Complement – Fuzzy Union– Fuzzy Intersection – Other Operations in Fuzzy Set – norms-conorms-applications	16
II	Fuzzy Relation and Composition: Fuzzy Relation-Basic definition-Examples– Extension of Fuzzy set - Fuzzy Graph and Relation: Fuzzy Graph – Characteristics - Classification- Other Fuzzy Relations-simple problems.	16
References	**Text Books:** 1. Kwang H. Lee, First Course on Fuzzy Theory and Applications, Springer, New York, 2005. Unit 1: Chapter 1: Sections 1.4-1.6; Chapter 2: Sections 2.1 - 2.6 Unit 2: Chapter 3: Sections 3.3 - 3.4; Chapter 4: Sections 4.1 - 4.4	
	Reference Books: 1. G. J. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic, Prentice-Hall India, 1995. 2. H. J. Zimmermann, Fuzzy Set Theory and Its Applications, Springer, 2001. 3. Didier Dubois and Henri Prade, Fuzzy Sets and Systems: Theory and Applications, Academic Press, 1980.	
	E- Resources: 1. https://nptel.ac.in/courses/111/102/111102130/ 2. https://nptel.ac.in/courses/108/104/108104157/	
Course Outcomes	On completion of the course students should be able to CO1: recognize the concept of fuzzy sets and its properties. CO2: distinguish fuzzy sets from crisp sets. CO3: apply various operations on fuzzy sets. CO4: analyze the fuzzy graphs and fuzzy relations.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	2	2	3
CO2	3	3	1	1	2
CO3	1	2	3	3	3
CO4	2	3	1	2	2

Semester	VI	Course Code	21MATU06M2
Course Title	PARTIAL DIFFERENTIAL EQUATIONS		
No. of. Credits	2	No. of. contact hours per week	2
New Course/ Revised Course	NEW COURSE	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	Modular Course		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Understanding the Cauchy problem on first order PDE (K-2). • Applying various methos to find solutions of first order PDE(K-3). • Analyse the solutions of first order PDE (K-4). • Evaluate the compatibility of the first order PDE (K-5)		
Course Objective	The Course aims to impart the fundamental problem-solving skills in PDE.		

Unit	Content	No. of. Hours
I	Partial Differential Equations (PDE) Forming a PDE - Lagrange Method of solving Linear Equations - Standard forms of PDE - Charpits Method.	16
II	Fourier series: Expansion of a function - Dirichlet's Conditions - Determining the Fourier Coefficients- Odd and Even Functions - Half Range Sine Series - Half Range Cosine Series.	16

References

Text Books:

1. S. Narayanan & T.K. Manickavachagom Pillay, **Differential Equations and its Applications,** S. Viswanathan Pvt. Ltd., Chennai, 2013.
   Unit 1: Chapter XII
2. T. Veerarajan, **Transforms and Partial Differential Equations**, Tata McGraw Hill Education Private Ltd., New Delhi, 2012.
   Unit 2: Chapter 1-Section 1.1 – 1.9

Reference Books:

1. T. Amarnath, **An Elementary Course in Partial Differential Equations**, Narosa Publishers, New Delhi, 1997.
2. M. D. Raisinghania, **Advanced Differential equations**, S. Chand Publications, New Delhi, 2004.

E- Resources:

1. https://nptel.ac.in/courses/122107037/14
2. https://nptel.ac.in/courses/111107111/

Course Outcomes	On completion of the course students should be able to CO1: find integral surfaces passing through the given curve.

	CO2: solve first order PDE. CO3: find Surface orthogonal to a given system of surfaces. CO4: verify given system is compatible or not. CO5: classify second order PDE

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	1
CO2	3	2	2	2	1
CO3	2	3	2	1	1
CO4	3	3	3	2	1
CO5	2	1	3	2	1

Semester	**VI**	Course Code	**21MATU06M3**
Course Title	**MATHEMATICAL SKILLS**		
No. of. Credits	**2**	No. of. contact hours per week	**2**
New Course/ Revised Course		If revised, Percentage of Revision effected (Minimum 20%)	25%
Category	**Modular Course**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Knowing Allegation, Simple and Compound Interest (K-1). • Understanding the concepts volume and surface Areas - Odd man out and series (K-2).		
Course Objective	The Course aims to impart mathematical competitive skills.		

Unit	Content	No. of. Hours
I	Allegation or mixture – Simple Interest – Compound Interest – Area – Real life applications.	16
II	Volume and surface Areas - Calendar - Odd man out and series – Simple problems.	16
References	**Text Books:** 1. R.S. Agarwal, **Quantitative Aptitude**, 7th Revised Edition, S. Chand and Company Ltd, New Delhi, 2015. Unit 1: Section1, Topic 20,21,22,24 Unit 2: Section1, Topic 25, 27, 35	

	Reference Books: 1. Abhijit Guha, **Quantitative Aptitude for MBA Entrance Examinations**, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2006
	E- Resources: 1. https://www.youtube.com/watch?v=ARSxlUX1yWw
Course Outcomes	On completion of the course students should be able to CO1: compute simple & compound interest. CO2: evaluate area and volume of different geometrical shapes.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	2	3
CO2	2	1	2	2	2

Semester	**VI**	Course Code	**21MATU06M4**
Course Title	**SPEED ARITHMETIC**		
No. of. Credits	**2**	No. of. contact hours per week	**2**
New Course/ Revised Course	**NEW COURSE**	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Modular Course**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Knowing Allegation, Simple and Compound Interest. • Understanding the concepts volume and surface Areas - Odd man out and series.		
Course Objective	The Course aims to impart mathematical competitive skills.		

Unit	Content	No. of. Hours
I	Fractions and decimals-Divisibility test and Remainder rules-Multiplication and division of numbers-HCF & LCM-Square, Cube numbers.	16
II	Series- Linear Equations-Powers and roots-Ratio, Proportion and Partnership-Relation between CI and SI.	16
References	**Text Books:** 1. Ashish Agarwal, **Quick Arithmetic,** S. Chand and Company Ltd, New Delhi, 2004.	

	Unit 1: Sections 2, 3, 4, 5, 6. Unit 2: Sections 8, 9, 11, 12, 21.
	Reference Books: 1. R.S. Agarwal, **Quantitative Aptitude**, 7th Revised Edition, S. Chand and Company Ltd, New Delhi, 2015.
	E- Resources: 1. https://www.youtube.com/watch?v=ARSxlUX1yWw
Course Outcomes	On completion of the course students should be able to CO1: compute simple & compound interest. CO2: evaluate area and volume of different geometrical shapes.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	2	3
CO2	2	1	2	2	2

Semester	**VI**	Course Code	**21MATU04D1**
Course Title	**ANALYTICAL GEOMETRY 3D**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Discipline Centric Elective**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Understanding the representation of basic curves in polar coordinates (K-2) • Analysing the Conics and properties (K-3) • Analysing equations of a circle on a sphere and intersection of two spheres (K-3). • Remembering the basic concepts of Cartesian coordinates and apply them in finding Directions cosines (K-1 & K-3) • Evaluating the angle between two planes and length of perpendicular from a point on the plane(K-5).		
Course Objective	The Course aims to study the various properties of geometrical figures in two dimensions and three dimensions.		
Unit	**Content**		**No. of. Hours**

I	Polar Equations: Representation of basic curves in polar coordinates. General equation of Conic: Tracing the Conic - Properties and its applications.	10
II	Rectangular Cartesian co-ordinates: Direction cosines of a line: Co-ordinates – Projections – Direction Cosines.	10
III	The Plane: Equations of Plane – Angle between planes – Length of perpendicular from a point on the plane.	9
IV	The Straight Line: Equation of the straight line – coplanar lines – skew lines – intersection of three planes.	10
V	The Sphere: Equation of Sphere – Equation of a circle on a sphere – intersection of two spheres.	9
References	**Text Books:** 1. T. Natarajan & T. K. Manicavachagom Pillay, **Analytical Geometry 2D**, S. Viswanathan Pvt. Ltd., Chennai, 2001. Unit 1: Chapter IX (up to section 9), X (up to section 8). 2. T. Natarajan & T. K. Manicavachagom Pillay, **Analytical Geometry 3D**, S. Viswanathan Pvt. Ltd., Chennai, 2001. Unit 2: Chapter I. Unit 3: Chapter II. Unit 4: Chapter III. Unit 5: Chapter IV.	
	Reference Books: 1. George B. Thomas, JR & Ross L. Finney, **Calculus and Analytic Geometry**, Sixth edition, Narosa Publishing House, New Delhi, 1986. 2. S. Arumugam & Issac, **Analytical Geometry 3D and Vector Calculus**, New Gamma Publications, Palayamkottai, 1997.	
	E- Resources: 1. https://nptel.ac.in/Aeronautical/Applied%20Mathematics-1/index.php 2. https://freevideolectures.com/course/2776/ma-141-analytic-geometry-and-calculus-i 3. https://cosmolearning.org/courses/mah-by-fives-trigonometry-502/ 4. https://cosmolearning.org/courses/pre-calculus-6-9-trigonometry-review/	
Course Outcomes	On completion of the course students should be able to CO1: discuss conics in polar co-ordinates. CO2: outline planes and its properties as 3-dimensional objects. CO3: apply the concepts of skew lines and spheres in geometrical problems. CO4: solve problems related to geometry of two dimension and three dimensions.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	1	2
CO2	3	2	3	1	1
CO3	3	3	2	2	1
CO4	2	3	3	1	2

Semester	IV	Course Code	21MATU04D2
Course Title	FINANCIAL MATHEMATICS		
No. of. Credits	3	No. of. contact hours per week	3
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	Discipline Centric Elective		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the course	• Knowing the concepts of life insurance and their types. • Understanding net premium reserves. • Applying the mathematics concepts in the compound interest. • Analyzing the regression terms in life insurance. • Evaluate the total claim amount in a portfolio.		
Course Objective	The Course aims to impart mathematical concepts related to finance and insurance.		

Unit	Content	No. of. Hours
I	Mathematics of Compound interest - Mathematical base of life contingencies - effective interest rate, nominal interest rate - continuous payments, interest in advance - perpetuities - annuities - repayment of debit- internal rate of return future life time of a life aged x - the model - force of mortality - analytical distribution of T – the curate future life time of (x) - Life table -Probabilities of deaths for fraction of a year.	9
II	Life insurance - insurance types - whole life and term insurance – pure Endowment - Endowments - insurance, payable at the moment of death- general type of life insurance - variable life insurance - recursive formula. Life annuities - elementary life annuities - payment made more frequently than once a year - variables life annuities - types of life annuities - recursive formula - inequalities - Payment starting at non-integral age. Net premium	10

	- elementary forms of insurance - whole life - Term insurance, pure Endowment - Endowments - deferred life annuities - premium paid m times year - general type of life insurance - policies with premium refund - stochastic interest.	
III	Net premium reserves - examples - recursive consideration - survival risk - net premium risk of a whole life insurance - net premium reserve at fractional duration - allocations of overall loss to policy year - conversion of an insurance - Technical gain - procedure for pure endowment - continuous model - multiple decrements model - forces of decrement - curate life time of (x), general type of insurance, net premium reserve - continuous model. Multiple life insurance - Joint life status – simplification- last survivor status general symmetric status - Schuette-Nesbitt formula - asymmetric annuities- asymmetric insurances.	10
IV	The total claim amount in a portfolio - normal approximations - calculation of total claim amount distribution - compound Poisson approximation - recursive calculation of compound Poisson distribution - reinsurance stop-loss reinsurance - expense loading – introduction expenses loaded premium - expense loaded premium reserves - estimating probabilities of death - problem description - classical method - Alternative solution - maximum likelihood method - statistical inference - Bayesian approach - multiple causes of decrement - interpretation of result.	10
V	Applications in regression analysis - Functional form -dummy variable - distributed log model - forecasting - binary choice model - interpretation of binary choice model - solved problems.	9
References	**Text Books:** 1. Hans U. Gerber, **Life Insurance Mathematics**, Third edition, Springer Verlag, New York 1997. Chapters: 1-11. 2. D. Salvalore&D.Reagle, **Statistics and Economics**, Schaum's outline Series, Tata McGraw Hill, New Delhi, 2005. Chapter 8 only.	
	E- Resources: 1. https://cosmolearning.org/video-lectures/introducion-financial-mathematics/ 2. https://freevideolectures.com/course/2055/mathematical-methods-for-engineers-ii/14	

Course Outcomes	On completion of the course students should be able to CO1: explain advanced topics in the area of financial mathematics and actuarial analysis and their applications. CO2: differentiate between simple and compound interest and extrapolate the advantages and disadvantages of each in specific situations.

	CO3: apply computational tools efficiently and correctly and verify solutions in terms of the context. CO4: calculate effectively to define the changes that occur over a period. CO5: discuss the methods of correlation and regression to analyse and interpret a given data set and make predictions.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	3	3	3
CO2	1	1	2	3	2
CO3	1	2	2	3	3
CO4	1	1	2	2	3
CO5	1	2	3	2	3

Semester	**V**	Course Code	**21MATU05D4**
Course Title	**NUMERICAL METHODS**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	**Discipline Centric Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development		
Cognitive Levels addressed by the course	• Knowing the basic concepts errors in numerical calculations, the bisection method, the method of false position, iteration method, Newton-Rapson method and finding solutions of algebraic and transcendental equations K-1). • Understanding the forward differences, backward differences, central differences, Gauss's central difference formula, Stirling's formula, Lagrange's interpolation formula (K-2). • Applying the trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule - Romberg integration to find the approximate solution (K-3). • Evaluating the problems of Gauss elimination method, Gauss-Jordan method, Modification of the Gauss Method to compute the Inverse - Jacobi's method - Gauss - Seidel method (K-5). • Analyzing the solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta		

	Methods and Milne's Predictor -Corrector Method (K-6).	
Course Objective	The Course aims to develop efficient algorithms for solving problems in Science, Engineering and Technology.	
Unit	**Content**	**No. of. Hours**
I	Errors in Numerical Calculations: Errors and their computations - A general error formula – Error in a series Approximation - Solution of Algebraic and Transcendental equations: The Method of False position - Iteration method - Newton - Raphson method - Ramanujan's Method - Secant Method - Muller's Method.	9
II	Interpolation: Errors in Polynomial Interpolation-Finite differences - Forward Differences - BackwardDifferences-CentralDifferences - Symbolic Relations and Separation of Symbols - Newton's Formulae for Interpolation - Gauss's central difference formulae - Stirling's formula - Bessel's formula - Everett's Formula – Interpolation with unevenly spaced points: Lagrange's interpolation formula - Lagrange's Inverse Interpolation.	9
III	Numerical Differentiation: Derivatives using Newton's Forward Difference Formula – Derivatives using Newton's Backward Difference Formula – Derivatives using Stirling's Formula – Maxima and Minima of Tabulated Function. Numerical Integration:- Trapezoidal Rule - Simpson's 1/3 Rule - Simpson's 3/8 Rule - Bool's and Weddle's rules - Cubic Splines –Romberg Integration - Euler - Maclaurin Formula.	9
IV	Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss - Jordan method - Modification of the Gauss Method to compute the Inverse - Jacobi's method – Gauss – Seidel method - Matrix Eigenvalue Problem.	9
V	Numerical Solutions of Ordinary Differential Equations: Solutionby Taylor's series - Picard's method of successive approximations - Euler's Method – Modified Euler's Method - Runge-Kutta Methods - Adams - Moulton Method- Milne's Predictor – Corrector Method – Galerkin's Method.	12
References	**Text Books:** 1. S. S. Sastry, **Introductory Methods of Numerical Analysis**, Fifth Edition, PHI Learning Pvt. Ltd., New Delhi, 2015. Unit1: Chapter 1: Section1.3to 1.5,Chapter 2: Section2.1,2.3 to2.8 Unit2: Chapter 3: Section3.2,3.3.1to 3.3.4, 3.6,3.7.1, 3.7.2 to 3.7.4,3.9.1 Unit3: Chapter 6: Section6.2, 6.3, 6.4.1 to6.4.6, 6.5 Unit4: Chapter 7: Section7.5.1, 7.5.3,7.5.4,7.6,7.7 Unit5: Chapter 8:Section8.2, 8.3, 8.4,8.4.2,8.5, 8.6.1, 8.6.2,8.10.3.	

	Reference Books: 1. Gerald &Wheatly, **Applied Numerical Analysis**, Sixth Edition, Pearson Education Pvt. Ltd., New Delhi, 2002. 2. S. Arumugam, A. Thangapandi Isaac & A. Somasundaram, **Numerical Methods**, SciTech Publications Pvt. Ltd., Chennai, 2001. 3. V. N. Vedamurthy & N. Ch. S. N. Iyengar, **Numerical Methods**, Vikas Publishing House Pvt. Ltd. New Delhi, 2000.
	E- Resources: 1. https://nptel.ac.in/courses/111/107/111107105/
Course Outcomes	On completion of the course students should be able to CO1: solve the interpolation problems. CO2: identify the basic concept of numerical differentiation and integration, principle of least squares. CO3: analyze the different aspects of numerical solution of algebraic and Transcendental equations. CO4: evaluate the solutions of simultaneous linear equations. CO5: discuss the role and application of numerical solution of ordinary differential equations.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	3	3	2
CO2	3	2	1	2	1
CO3	2	1	3	2	3
CO4	3	2	1	3	2
CO5	2	3	2	2	1

Semester	**V**	Course Code	**21MATU05D5**
Course Title	**INTRODUCTION TO ACTUARIAL SCIENCE**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Discipline Centric Elective**		
Scope of the Course	• Skill Development		
Cognitive Levels addressed by the course	• Knowing the widening scope of Actuarial Theory. • Understanding the General characteristics of foreign currency bonds. • Applying investment and valuation.		

	• Analyzing investment risk. • Evaluating portfolio selection techniques and investment modelling.	
Course Objective	The Course aims to impart various concepts related to insurance.	
Unit	**Content**	**No. of. Hours**
I	The widening scope of Actuarial Theory and practice: Introduction – Financial Intermediaries -their role in resolving the "constitutional weakness" - Functional Approach to the Analysis of Intermediaries - Intermediating function If Banks, insurance, unit Trust and mutual funds. Banks, Insurance Companies and Pension Funds: Fundamental Similarities and Differences- Banks loans, Credit Risk and Insurance -The Evolving Relationship Banking and Insurance - Some examples of the Evolving Product Links between Banks and Non-banks – conclusion.	9
II	Investment and Valuation: Introduction-Cash Instruments-General Characteristics-Specific Cash instruments and Valuation Issues-Risk Characteristics – General Characteristics of conventional Bonds- Government Bonds-Corporate Bonds – Bond Valuation- Economic Analysis-Risk Characteristics-General Characteristics of Index Linked Bonds - Valuation - Economic Analysis - Risk Characteristics – Estimating Market Expectations of Inflation using Market Information.	9
III	General Characteristics of Foreign Currency Bonds: Valuation-Economic Analysis - Risk Characteristics. General Characteristics of Equity Investment: Equity Valuation- Economic Analysis - Risk Analysis. Real Estate Investment: Valuation - Economic Analysis - Risk Analysis. International Equity Investment: International Equity Valuation - Economic Analysis - Risk Analysis - Derivatives - General Characteristics – Valuation - Risk Characteristics.	9
IV	Investment Risk: Introduction-Utility theory and Risk measures - Relating Utility Functions to Risk Aversion and the Risk Premium -Summary Risk Measures – Standard Deviation of Returns-Downside/Shortfall Risk Measures-Value at Risk-Practical Issues when Calculating VAR- Tail Loss-Combining Risk and Return Measures – Coherent Risk Measures- The use of Shortfall Constraints.	9
V	Portfolio selection Techniques and Investment Modeling: Introduction – Immunization - Derivation of Conditions - Observation on the Theory of Immunization-The usefulness of Immunization in Practice-Modern Portfolio Theory – Portfolio Diversification-Efficient Portfolios-Capital Market Line- The Capital Asset Pricing Model. Modern Portfolio Theory: Insights and Limitations - Extension of Portfolio Theory to Include	12

	Actuarial Liabilities-Portfolio Optimization in the Presence of Liabilities-Connection between Redington and the Wise-Willkie Approach-Generalization of Portfolio Optimization in the Presence of Liabilities-Portfolio Selection in an Asset/Liability Framework using a Generalized Approach to Risk.	
References	**Text Books:** 1. Philip Booth, Modern Actuarial Theory and Practice, Second Edition, Chapman and Hall / CRC, New York, 2004. Chapter 1: Section 1.1 to. 1.11, Chapter 2: Section 2.1 to 2.9, Chapter 4: Section 4.1 to 4.6, Chapter 5: Section 5.1 to 5.4.	
	E- Resources: 1. https://www.edx.org/course/introduction-actuarial-science-anux-anu-actuarialx-1 2. https://www.my-mooc.com/en/mooc/introduction-actuarial-science-anux-anu-actuarialx-1/	
Course Outcomes	On completion of the course students should be able to CO1: discuss the actuarial profession, what actuaries do, and how they do it. CO2: explain how liabilities in general insurance and life insurance are modelled and evaluated. CO3: predict the importance of life insurance. CO4: develop the critical and analytical thinking skills necessary for success in the profession. CO5: apply the quantitative skills to problems in finance that normally involve risk or uncertainty.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	3	3	3
CO2	2	1	3	3	3
CO3	1	2	3	3	3
CO4	1	2	2	3	3
CO5	1	1	2	3	3

Semester	IV	Course Code	21MATU04G1
Course Title	BASIC NUMERICAL METHODS		
No. of. Credits	3	No. of. contact hours per week	3
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	Generic Elective		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the course	• Knowing forward interpolation and backward interpolation (K-1). • Understanding Numerical Differentiation through Newton's formula, Gauss's formula (K-2). • Applying Taylor's series method - Euler's method - Modified Euler to solve ODE (K-3). • Evaluate the Solution to Simultaneous Linear Equation (K-5).		
Course Objective	The Course aims to develop efficient algorithms for solving problems in Science, Engineering and Technology.		

Unit	Content	No. of. Hours
I	Interpolation: Differences - relation between differences and derivatives - differences of polynomial - Newton's formula for forward interpolation - Backward interpolation - Central differences - Gauss's forward formula - backward formula and Stirling's interpolation formula.	11
II	Numerical Differentiation: Newton's formula, Gauss's formula for first and second derivatives. Numerical Integration: General quadrature formula - Trapezoidal rule - Simpson's rule - Weddle's rule. Curve Fitting: Principles of least squares - Fitting a straight line - A parabola and exponential curve.	10
III	Numerical Algebra and Transcendental Equation: Finding approximate values of the roots Iteration method - Bisection method - Newton Raphson method – Regula Falsi method. Difference Equation: order and degree- Linear difference equation - Complementary function - homogeneous linear equation.	9
IV	Solution to Simultaneous Linear Equation: Back substitution - Gauss elimination method, Gauss - Jordon method. Iterative methods: Gauss - Jacobi's iteration method – Gauss –Seidel iterative Method - Iterative Method for Eigen values - Power Method - Jacobi Method.	9

V	Numerical Solution of Ordinary Differential Equations: Taylor's series method - Euler's method – Modified Euler's method-Runge – Kutta method of second and fourth order. Numerical Solution of Partial Differential Equations: Difference Quotients - Elliptic Equations - Poisson's Equation - Bender - Schmidt Method - Crank - Nicholson Difference Method - Hyperbolic Equations.	9
References	**Text Books:** 1. P. Kandasamy, K. Thilagavathy& K. Gunavathi, **Numerical Methods**, S. Chand & Company Ltd., New Delhi, 2012. Unit1: Chapters 5, 6,7 Unit2: Chapters1, 9 Unit3: Chapter3,10 Unit4: Chapter4,13 Unit5: Chapter11,12	
	Reference Books: 1. A. Singaravelu, **Numerical Methods**, Meenakshi Publications, Chennai, 1992. 2. S. Arumugam, **Numerical Methods,** 2nd edition, SciTech Publications (India) Pvt Ltd., Chennai, 2010.	
Course Outcomes	On completion of the course students should be able to CO1: evaluate different kinds of problems in real life situation by interpolation methods. CO2: discuss numerical differentiation and integration. CO3: outline algebraic and transcendental equations. CO4: evaluate systems of simultaneous equations. CO5: assess numerical solution of ordinary differential equations.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	2	3	2
CO2	2	3	2	2	3
CO3	1	3	2	3	1
CO4	1	3	2	3	2
CO5	2	3	1	3	1

Semester	IV	Course Code	21MATU04G2
Course Title	**Differential Equations for Engineers**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	**NEW COURSE**	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Generic Elective**		
Scope of the Course	• Basic Skill / Advanced Skill • Skill Development • Employability		
Cognitive Levels addressed by the course	• Knowing simplest type of differential equations (K-1). • Applying differential equations to solve various problems in various fields (K-3) • Performing second order odes with constant coefficients (K-3) • Applying inhomogeneous first order differential equations in circuit problems (K-3)		
Course Objective	The Course aims to develop and apply various types of differential equations in different fields of science and engineering		

Unit	Content	No. of. Hours
I	Introduction to odes: The simplest type of differential equations, The Euler Method, Separable Equations, Linear Equations	11
II	Applications: Compound Interest, Chemical Reactions, Terminal Velocity, Escape Velocity, RC Circuit, The Logistic Equation	10
III	Second order odes, constant coefficients: The Euler Method, Principle of Superposition, The Wronskian, Homogeneous odes, Inhomogeneous odes	9
IV	Inhomogeneous linear first order odes revisited, Resonances, Applications: RLC Circuit, Mass on a Spring, Pendulum	9
V	Laplace Transform: Definition and Properties, Solution of initial value problems, Heaviside and Dirac Delta Functions	9

References	**Text Books:** 1. Jeffrey, R. Chasnov, **Differential Equations**, Hong Kong, 2021. Unit 1: Chapters 1 (sec 1.1), Chapter 2 (sec 2.1-2.3) Unit 2: Chapters 2 (sec 2.4) Unit 3: Chapter 3 (sec 3.1-3.5) Unit 4: Chapter 3 (sec 3.6-3.8) Unit 5: Chapter 4 (sec 4.1-4.3)
	Reference Books: 1. William E. Boyce, Richard C. Diprima, **Elementary Differential Equations and Boundary Value Problems**, 9th Ed., Wiley India Pvt. Ltd., New Delhi,

	2017. 2. Richard Bronson, Gabriel Costa, **Schaum's Outline of Differential Equations**, 4th Edition (Schaum's Outlines), USA, 2014. 3. Braun, M. **Differential Equations and Their Applications**, 4th Ed., Springer, USA, 2011.
Course Outcomes	On completion of the course students should be able to CO1: identify and solve different types of differential equations CO2: apply differential equations to solve real life problems. CO3: analyse second order odes and its solutions. CO4: solve circuit problems by means of inhomogeneous differential equations CO5: perform the solution of odes by using Laplace transform

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	3	3	2
CO2	2	3	2	2	3
CO3	1	3	2	3	1
CO4	2	3	2	3	3
CO5	2	3	2	3	1

Semester	**V**	Course Code	**21MATU05G3**
Course Title	**QUANTITATIVE APTITUDE**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	30%
Category	**Generic Elective**		
Scope of the Course	• Skill Development • Employability		
Cognitive Levels addressed by the course	• Knowing various concepts like simplifications, problems on numbers and tabulation for competitive exams (K-1). • Understanding different topics like Time and work, percentages (K-2). • Applying Logical deduction, Alphabet Test and Group discussion real life situations. (K-3)		

Course Objective	The Course aims to impart skills in numerical and quantitative techniques.	
Unit	**Content**	**No. of. Hours**
I	H.C.F and L.C.M of Numbers- decimal fractions- simplifications- square roots and cube roots- average- Problems on Numbers- Problems on Ages, Surds, and Indices.	10
II	Tabulation- Bar graphs- Pie charts- Line graphs- Permutation and combinations-Probability- true discount- Banker's discount- Heights and distances.	10
III	Percentages- Profit and Loss- Ratio-Proportion- Partnership- Chain Rule- Pipes and cisterns- Time and Work- Time and Distances.	9
IV	Boats and Streams- Problems on Trains- Coding and decoding.	9
V	Blood Relations- Logical Venn Diagram- Alphabet Test.	10
References	**Text Books:** 1. R.S. Agarwal, **Quantitative Aptitude, Revised and Enlarged Edition**, S. Chand & Company Ltd., New Delhi, 2017. Unit 1: Chapters 2-9, Unit 2: Chapters 36-39, 30-34, Unit 3: Chapters 11-18, Unit 4: Chapters 19, 20. 2. R.S. Agarwal, **A Modern Approach to Verbal Reasoning, (Fully solved), Revised Edition 2018,** Chand & Company Ltd., New Delhi, 2012. Unit 4: Section I: Chapters 4 Unit 5: Section I: Chapter 5, 9, 10.	
Course Outcomes	On completion of the course students should be able to CO1: evaluate various real-life situations by resorting to Analysis of key issues and factors. CO2: apply graphs, charts, and probability techniques on various problems. CO3: discuss the problems on relations, coding and decoding. CO4: demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	1
CO2	2	2	2	3	1
CO3	2	1	2	3	2
CO4	2	1	2	2	3
CO5	3	2	2	3	1

Semester	V	Course Code	21MATU05G4
Course Title	**Verbal and Nonverbal Reasoning**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	**NEW COURSE**	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Generic Elective**		
Scope of the Course	• Skill Development • Employability		
Cognitive Levels addressed by the course	• Knowing various concepts about general mental ability like analogy, classification (K-1) • Analysing direction problems and performing mathematical operations (K-4) • Evaluating nonverbal reasoning problems like mirror and water image problems (K-5)		
Course Objective	The Course aims to impart skills in verbal and nonverbal reasoning techniques.		

Unit	**Content**	**No. of. Hours**
I	Verbal Reasoning: General Mental Ability- Analogy, Classification, Series completion,	10
II	Puzzle Test, Sequential output tracing, Direction sense test	10
III	Number, ranking and time sequence test, mathematical operations	9
IV	Non Verbal Reasoning: Series, Analogy, Classification, Analytical Reasoning	9
V	Mirror image, Water image, Embedded figures, Completion of incomplete pattern, Figure matrix	10

References	**Text Books:** 1. R.S. Aggarwal, **A Modern Approach to Verbal and Nonverbal Reasoning**, S. Chand & Company Ltd., New Delhi, 2007. Unit 1: Section I(1-3), Unit 2: Section I(6-8), Unit 3: Section I(11&12), Unit 4: Part II(1-4), Unit 5: Part II(5-9)
Course Outcomes	On completion of the course students should be able to CO1: evaluate various real-life situations by resorting to Analysis of key issues and factors. CO2: analyse direction problems and perform mathematical operations CO3: discuss the problems on nonverbal reasoning problems like series,

	classification CO4: evaluate problems involving mirror image, water image and figure matrix

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	1
CO2	2	3	2	3	3
CO3	2	1	2	3	2
CO4	2	2	2	1	3

Semester	**III**	Course Code	**21MATU03A1**
Course Title	**MATHEMATICS- I**		
No. of. Credits	**3**	No. of. contact hours per week	**3**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	80%
Category	**Allied Course (B.Com)**		
Scope of the Course	• Basic Skill		
Cognitive Levels addressed by the course	• Knowing correlation. • Understanding the variations. • Applying the growth rate &growth index. • Analyzing data collection. • Evaluation of mean, median mode.		
Course Objective	The Course aims to impart the fundamental concepts of statistical techniques.		

Unit	Content	No. of. Hours
I	Statistics: Introduction – Growth – Meaning – Statistics as data – Theoretical Questions - Importance, Functions, Limitations- Collection of Data-Primary and Secondary Data Sources – Framing a Questionnaire Sample Questionnaire - Sampling Design – Finite and Infinite Population – Hypothetical and Existent Population – Random Sampling – The Law of Statistical Regularity – The Law of Inertia of Large Numbers -Classification, Tabulation – Meaning of Classification – Geographical Classification – Frequency Distribution – Cumulative Frequency Distribution – Two Way Frequency distribution –Diagrammatic representation – Types of Diagram – Theoretical Questions.	10

II	Measures of Central Tendencies: Meaning – Characteristics of typical Average – Mathematical Characteristics - Arithmetic Mean,Discrete Series – Continuous Series – Charlier's Accuracy Check – Cumulative Series - Geometric Mean - Harmonic Mean – Comparison of Averages – List of Formulae – Questions – Objective type Questions - Median and Mode.	10
III	Measures of Dispersion: Concept of Variation – Purpose of Measuring – Variation – Properties -Range, Mean Deviation, Quartile Deviation – Short cut method of computations – Continuous Series - Standard Deviation – Charlier's Check of Accuracy – Mean Deviation – Comparison between Mean deviation and Standard deviation - Co-efficient of Variation – Theoretical Questions	10
IV	Correlation: Meaning and Definition-Scatter Diagram-Karl Pearson's Co-efficient of Correlation- Interpretation of Correlation – Coefficient of Determination - Rank Coefficient of Correlation –Concurrent Deviation Regression: Correlation and Regression – Difference between two – Method of Studying Regression – Mathematical Properties - Linear Regression-Simple Problems.	9
V	Index Numbers: Method of construction-Aggregative & Relative Types-Cost of living Index- Growth Rate and Growth Index-Time Series- Definition-Applications.	9
References	**Text Books:** 1. RSN Pillai & Bhagavathi, **Statistics**, S. Chand & Company Ltd, New Delhi 2012. Unit 1: Chapters 3, 4, 5, 6, 7 Unit 2: Chapter 9 Unit 3: Chapters 10, 11 Unit 4: Chapters 12, 13 Unit 5: Chapter 14.	
	Reference Books: 1. P.R. Vittal, **Business Mathematics and Statistics**, Margham Publications, Chennai, 2015. 2. P. Navnitham, **Business Mathematics & Statistics,** Jai Publishers, Trichy, 2019.	
Course Outcomes	On completion of the course students should be able to CO1: explain basic data collection statistical techniques. CO2: evaluate various types of mean, median and mode. CO3: assess Measures of Dispersion. CO4: compare correlation and regression. CO5: analyze the concepts of Index Numbers.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	3	3	3
CO2	1	1	2	3	3
CO3	1	1	3	3	3
CO4	2	2	3	3	3
CO5	2	1	3	3	3

Semester	IV	Course Code	21MATU04A2
Course Title	MATHEMATICS- II		
No. of. Credits	3	No. of. contact hours per week	3
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	75%
Category	Allied Course (B.Com.)		
Scope of the Course	• Basic Skill		
Cognitive Levels addressed by the course	• Knowing matrices. • Understanding the application of business economic problems. • Applying interest in real life. • Analyzing linear programming. • Evaluating assignment problem.		
Course Objective	The Course aims to gain basic knowledge about mathematical and operations research techniques.		

Unit	Content	No. of. Hours
I	Set Theory: Sets and Operations on Sets – Subsets – Disjoint sets – Properties of Set Containment – Operations on Sets: Union of Sets – Properties of Union Operation – Distributive Law – Complement of a sets – Symmetric Difference – Principle of Duality – Solved Example	9
II	Simple and Compound Interest: Effective Rate and Nominal Rate of Interest-Depreciation: Straight line method, Balancing Method and Annuities-Discounting.	9
III	Matrix: Introduction – Algebra of Matrices – Types of Matrices – The inverse of a Matrices – Elementary Transformation – Rank of	10

	a Matrix – Simultaneous Linear equations – Eigen Values and Eigen Vectors	
IV	Linear Programming Problem: Introduction – Graphical Solution Method – General Linear Programming Problem – Simplex Method - Feasible solution, Unbounded Solution, Infeasible solution	10
V	Transportation Problem: Introduction – LP Formulation of the transportation Problem – Existence of Solution in T.P. – Duality in T.P. – The transportation Table – Loops in Transportation Tables – Triangular Basis in a T.P. –Transportation Algorithm Assignment Problem: Introduction – Mathematical Formulation of the Problem – Solution Methods of A.P. – Special Cases in A.P. – A Typical A.P. – Dual of the Assignment Problem – The travelling Salesman Problem	10
References	**Text Books:** 1. P. Navnitham, **Business Mathematics & Statistics**, Jai Publishers, Trichy, 2019. Unit 1,2,3 & 4 2. Prem Kumar Gupta & D. S. Hira, **Operations Research**, S. Chand & Company Ltd, New Delhi, 2008. . Unit 5: Chapter 3, Sec 3.1 – 3.6; Chapter 10, Sec10.1 – 1014, Chapter 11: Sec. 11.1 – 11.7	
	Reference Books: 1. P.R. Vittal, **Business Mathematics**, Margham Publications, Chennai, 2015. 2. S. P. Gupta & P. K. Gupta, **Business Statistics and Business Mathematics,** Sultan Chand & Sons, 2009.	
Course Outcomes	On completion of the course students should be able to CO1: discuss the basic set theory. CO2: evaluate the problems in simple and compound Interest. CO3: critique the concepts of matrix theory. CO4: formulate and solve linear programming problem. CO5: optimize the transportation and assignment problem.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	2	3	3
CO2	1	1	2	2	3
CO3	2	2	3	3	3

CO4	2	3	3	2	3
CO5	1	2	3	3	3

Semester	I	Course Code	**21MATU01A1**
Course Title	**ALLIED MATHEMATICS – I**		
No. of. Credits	**4**	No. of. contact hours per week	**4**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	**Allied Course (B.Sc., Physics/Chemistry Major)**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• gain knowledge of Binomial series and Exponential series • acquire basic knowledge of Types of Matrices and Evaluation of Eigen values and Eigen vectors. • become proficient in Successive Differentiation. • acquire skills of applications of Curvature, Evolutes and Involutes. • gain concepts of Definite integral		
Course Objective	The Course aims to impart different concepts of algebra and calculus.		

Unit	**Content**	**No. of. Hours**
I	Power series: Binomial series, Exponential series, and Logarithmic series – simple problems.	14
II	Types of Matrices: Elementary transformation – Rank of a matrix – Test of Consistency of Equations using ranks – Characteristic equation – elementary transformation - Cayley – Hamilton theorem – Evaluation of eigen values and eigen vectors.	14
III	Successive Differentiation – Leibnitz's theorem – simple problem– Applications of Differential Calculus: Rate of change of variables – Velocity - Acceleration – Maxima and Minima-simple applications.	12
IV	Curvature – Radius of Curvature and Centre of Curvature – Evolutes and Involutes-ellipse-sphere.	12
V	Indefinite integral-Definite integral: Properties of definite integral – Integration by parts – Reduction formulae –Integration as process of summation. Evaluation of double- triple integral – Area-volumes	12
References	**Text Books:** 1. Arumugam & Isaac, **Ancillary Mathematics**, New Gamma Publishing House, Palayamkottai, 2002. 2. S. Narayanan & T.K. Manicavachagom Pillai, **Ancillary Mathematics**, S.	

	Viswanathan Pvt. Ltd., Chennai, 2002.
	Reference Books: 1. S. Narayanan & T.K. Manicavachagom Pillay, **Calculus**, Vol. I, S. Viswanathan Pvt. Ltd., Chennai, 2003. 2. T. K. Manicavachagom Pillay, T. Natarajan & K.S. Ganapathy, **Algebra**, Vol-I, S. Viswanathan Pvt. Ltd., Chennai, 2003.
Course Outcomes	On completion of the course students should be able to CO1: evaluate binomial series and exponential series. CO2: assess basic knowledge of Types of Matrices and Evaluation of Eigenvalues and Eigenvectors. CO3: discuss the successive Differentiation. CO4: explain the applications of Curvature, Evolutes, and Involutes. CO5: analyze the properties of definite integral.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	3	1
CO2	2	2	2	2	2
CO3	3	3	1	3	2
CO4	3	2	1	3	2
CO5	3	3	2	1	1

Semester	I	Course Code	**21MATU01A3**
Course Title	**ALLIED MATHEMATICS-I**		
No. of. Credits	**4**	No. of. contact hours per week	**4**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	60%
Category	**Allied Course (B.Sc. Geology)**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Understanding the basic concepts of sets and functions. • Identifying straight lines circles in planes and characterizing it. • Identifying parabolas and ellipses in planes and characterizing it. • Understanding the basic concepts of matrices and classifying its types. • Solving systems of equations by applying matrix theory.		

Course Objective	The Course aims to learn the techniques of fundamentals of mathematics.	
Unit	**Content**	**No. of. Hours**
I	Set Theory: Sets and Operations on Sets – Subsets – Disjoint sets – Properties of Set Containment – Operations on Sets: Union of Sets – Properties of Union Operation – Distributive Law – Complement of a sets – Symmetric Difference – Principle of Duality – Solved Example	12
II	Finite State Machine: Introduction – Transition Table – Transition Diagram – Finite State Machine – Equivalence of Finite State Machine – Covering – Finite State Homomorphism – Formal Language – Finite Automata – Mon – Deterministic Finite Automata – Finite Automata with Outputs	13
III	Elementary Combinatorics: Basics of Counting – Permutations and Combinations – Permutations with Like Elements – Combinations – Power sets – Basic Identities – Binomial Theorem	13
IV	Matrices: Concept- notation- order- equality- types of matrices- zero matrix- transpose of a matrix- symmetric and skew symmetric matrices. Addition, multiplication, and scalar multiplication of matrices- Related problems.	14
V	Determinants: Determinant of a square matrix (up to 3 x 3 matrices), properties of determinants- Adjoint and inverse of a square matrix-Solving system of linear equations in two or three variables using inverse of a matrix.	12
References	**Text Books:** 1. P.R. Vittal, **Business Mathematics,** Margham Publications, Chennai 1995. Unit-1: Chapter -1 Unit-2: Chapter -12 (Page No. 338-385) Unit-3: Chapter -12 (Page No. 886-416) Unit-4: Chapter-14 (Page No. 595-623) Unit-5: Chapter-14 (Page No. 623-653)	
	Reference Books: 1. Seymour Lipschutz, **Set theory & Related Topics**, Schaum's outlines, 2nd Edition, Tata McGraw Hill, New Delhi, 2005. 2. Arumugam & Issac, **Classical Algebra**, New gamma Publishing house, Tirunelveli, 2003. 3. S. Narayanan & T. K. Manicavachagom Pillay, **Analytical Geometry 2D**, S. Viswanathan Pvt. Ltd., Chennai, 2001. 4. R. Jayaprakasa Reddy and Y. Mallikarjuna Reddy, **A Text Book of Business**	

	Mathematics, Ashish Publishing House, New Delhi, 2002.
Course Outcomes	On completion of the course students should be able to CO1: explain the basic concepts of set theory and functions. CO2: describe the basic concepts of straight lines and circles as 2-dimensional objects. CO3: interpret parabola and ellipse as 2-dimensional objects. CO4: assess the problems in matrices and determinants.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	3	1	2
CO2	1	1	3	1	1
CO3	1	1	3	1	1
CO4	2	2	2	1	2
CO5	2	2	2	1	2

Semester	**II**	Course Code	**21MATU02A2**
Course Title	**ALLIED MATHEMATICS – II**		
No. of. Credits	**4**	No. of. contact hours per week	**4**
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	40%
Category	**Allied Course (B.Sc., Physics/Chemistry Major)**		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Knowing trigonometry function. • Understanding the hyperbolic functions. • Applying the differential equations in Laplace & their inverse transforms. • Analysing the differential equation of first order and higher degree. • Evaluating the integrals using Gauss's stokes' and green's theorem.		
Course Objective	The Course aims to impart different concepts of trigonometry, differential equation, and vector calculus.		
Unit	**Content**		**No. of. Hours**
I	Trigonometry: Expansion of trigonometric functions—simple applications and problems.		14

II	Hyperbolic functions – simple problems – Logarithmic functions– Exponential functions simple applications.	14
III	Differential equations of first order and higher degree (Equation solvable for p, x, y, including Clairaut's form) – Solving second and third order linear equations with constant coefficients – particular integral of simple functions	12
IV	Laplace transforms – Standard forms – Inverse transforms – Solving first order differentiable equations using Laplace functions.	12
V	Vector Calculus: Gradient, Curl, and Divergence of vector – Gauss's, Stoke's and Green's theorems (without proof) – Evaluating double and triple integrals.	12
References	**Text Books:** 1. Arumugam & Isaac, **Ancillary Mathematics**, New Gamma Publishing House, Palayamkottai, 2002. 2. T.K. Manicavachogom Pillay, T. Natarajan & K.S. Ganapathy, **Calculus Vol**. II, Vol. III, S.ViswanathanPvt. Ltd., Chennai, 2003. 3. S. Narayanan & T.K. Manicavachogom Pillay, **Trigonometry**, S. Viswanathan Pvt. Ltd., Chennai, 2003.	
	Reference Books: 1. S. Narayanan & T.K. Manicavachogom Pillay, **Ancillary Mathematics**, S. Viswanathan Pvt. Ltd., Chennai, 2002.	
Course Outcomes	On completion of the course students should be able to CO1: evaluate series of trigonometric functions. CO2: determine the hyperbolic functions and Logarithm of Complex numbers. CO3: identify and solve different types of ODEs. CO4: apply Laplace and Inverse Laplace transforms to solve ODE. CO5: compute vector integrals using Gauss's, Stokes, and Green's theorems.	

Mapping of COs with PSOs

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	3
CO2	3	2	2	2	1
CO3	3	3	2	2	1
CO4	3	2	3	2	1
CO5	3	2	3	2	1

Semester	II	Course Code	21MATU02A4
Course Title	ALLIED MATHEMATICS-II		
No. of. Credits	4	No. of. contact hours per week	4
New Course/ Revised Course	--	If revised, Percentage of Revision effected (Minimum 20%)	70%
Category	Allied Course (B.Sc. Geology)		
Scope of the Course	• Basic Skill / Advanced Skill		
Cognitive Levels addressed by the course	• Understanding the basic concepts of statistics. • Understanding the basic concepts of derivatives and interpreting them geometrically. • Understanding the basic concepts of integration of functions and evaluating its integral value. • Understanding the fundamentals of LPP and applying them to solve real life problems. • Understanding the fundamentals of Numerical methods and apply them to solve real life problems.		
Course Objective	The Course aims to learn the fundamentals of statistics, calculus, linear programming, and numerical methods.		

Unit	Content	No. of. Hours
I	Statistics: Introduction – Growth – Meaning – Statistics as data – Theoretical Questions - Importance, Functions, Limitations- Collection of Data-Primary and Secondary Data Sources –Framing a Questionnaire Sample Questionnaire - Sampling Design – Finite and Infinite Population – Hypothetical and Existent Population – Random Sampling – The Law of Statistical Regularity – The Law of Inertia of Large Numbers -Classification, Tabulation – Meaning of Classification – Geographical Classification – Frequency Distribution – Cumulative Frequency Distribution – Two Way Frequency distribution –Diagrammatic representation – Types of Diagram – Theoretical Questions.	13
II	Differentiation: Limits of functions- Definition of derivative – Differentiation of trigonometric, inverse trigonometric and logarithmic functions-Differentiation of Implicit functions- Parametric Differentiation- Successive Differentiation.	14
III	Integration: Definition of integration-Standard rules on integration-Integration by substitution-Integration of rational functions- Integration by partial fractions-Integration by parts.	13

IV	Linear Programming Problem: Introduction – Graphical Solution Method – General Linear Programming Problem – Simplex Method - Feasible solution, Unbounded Solution, Infeasible solution.	12
V	Numerical Differentiation: Newton's formula, Gauss's formula for first and second derivatives. Numerical Integration: General quadrature formula - Trapezoidal rule – Simpson's rule- Weddle's rule. Curve Fitting: Principles of least squares - Fitting a straight line - A parabola and exponential curve.	12
References	**Text Books:** 1. S. C. Gupta and V. K. Kapoor, **Fundamentals of Mathematical statistics**, Sultan Chand &Sons, New Delhi, 1994. Unit 1: Chapter -2 2. P.R. Vittal, **Business Mathematics**, Margham Publications, Chennai 1995. Unit 2: Chapter 13 (Page No. 434-502) Unit 3: Chapter 13 (Page No. 535-579) Unit 4: Chapter 16 (Page No. 676-729) Unit 5: Chapter 22.	
	Reference Books: 1. S. Arumugam & A. Thangapandi Isaac, **Statistics**, New Gamma Publishing House, 2006. 2. George B. Thomas, JR & Ross L. Finney, **Calculus and Analytic Geometry**, Sixth Edition, Narosa Publishing House, New Delhi, 1986. 3. R. Jayaprakasa Reddy and Y. Mallikarjuna Reddy, **A Text Book of Business Mathematics**, Ashish Publishing House, New Delhi, 2002.	
Course Outcomes	On completion of the course students should be able to CO1: demonstrate basic knowledge of fundamentals of statistics. CO2: discuss the differentiation and its applications. CO3: acquire basic knowledge of integration. CO4: formulate a linear programming problem and solve them graphically and simplex method. CO5: apply numerical techniques to solve interpolation problems.	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	1	3	2
CO2	2	3	2	2	1
CO3	2	3	2	2	1
CO4	3	1	1	3	2
CO5	3	1	1	3	2

Semester	III	Course Code	21MATU03VA1
Course Title	VEDIC MATHEMATICS		
No. of. Credits	2	No. of. contact hours per week	2
New Course/ Revised Course	NEW COURSE	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	Valued Added Course		
Scope of the Course	• Skill Development		
Cognitive Levels addressed by the course	• Remembering the basic rules of finding the square and square root of numbers (K-1) • Understanding the Vedic Sutras and apply them to find Square and square root of numbers. (K-2 & K-3) • Remembering the basic rules of finding the cube and cubic root of numbers (K-1) • Understanding the Vedic Sutras and apply them to find Cube and Cubic root of numbers. (K-2 & K-3)		
Course Objective	The Course aims to impart skills on solving numerical problems.		

Unit	Content	No. of. Hours
I	Square: Introduction -An interesting pattern-Relation between triangular number and square number-Vedic mathematic for squaring-Ekddhikena Purvena-Anurapyena-Yavaddunam and Duplex methods-Its meaning and applications. Square Root: Introduction-Aryabhatta's method to find the square root-Fundamental rules to extract the square root of a number- Duplex Vedic method for finding square root-Square root of an irrational number.	16
II	Cube: Introduction-Properties of cubic number-Algebraic method to find the cube-Different Vedic Sutras-Anurepyena, Nikilam, Ekadhikena Purvena and Yavadunam-Its meaning and Applications. Cube Root: Introduction-Vedic method to find cube root of any number less than 7 digit-Vedic method to extract the Cubic root of any number having 7, 8 or 9 digits.	16
References	Text Books: 1. Rajesh Kumar Thakur, **Vedic Mathematics,** Unicorn Books, New Delhi, 2015.	
	Reference Books: 1. R.S. Agarwal, **Quantitative Aptitude**, Revised and Enlarged Edition, S. Chand & Company Ltd., New Delhi, 2017.	

	E- Resources:
Course Outcomes	On completion of the course students should be able to CO1: find the square of a number using Vedic Sutras CO2: find the square root of numbers. CO3: find Cube and cubic roots of numbers.

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	1	2	3
CO2	1	2	3	1	2
CO3	1	2	1	2	3

Semester	**IV**	Course Code	21MATU04VA2
Course Title	**MATHEMATICS FOR COMPUTER SCIENCE**		
No. of. Credits	2	No. of. contact hours per week	2
New Course/ Revised Course	**NEW COURSE**	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Value Added Course**		
Scope of the Course	• Skill Development • Employability		
Cognitive Levels addressed by the course	• Understanding the basic concepts of number system • Create truth table for various problems • Apply combinatorics techniques to solve problems		
Course Objective	The Course aims to develop and apply various types of number system and logical truth tables		
Unit	**Content**		**No. of. Hours**
I	Numbers: Counting- Sets of Numbers- Zero- Negative Numbers- Observation and Axioms- The Base Number		--

	System- Types of Number- Prime Numbers- Infinity	
II	Logic: Truth Tables- Logical Premises- Set Theory. Combinatorics: Permutations- Permutations of Multisets- Combinations.	--
References	**Text Books:** 1. Vince, John. **Foundation mathematics for computer science**, Second Edition, Springer Nature Switzerland, 2020. Unit 1: Chapter 2 Unit 2: Chapter 4 & 5	
	Reference Books: 1. Eric Lehman, F Thomson Leighton and Albert R Meyer, **Mathematics for Computer Science**, 12th Media Services, USA, 2017.	
	E- Resources: 1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/	
Course Outcomes	On completion of the course students should be able to CO1: acquire basic knowledge of number system. CO2: formulate various truth tables. CO3: apply number system and logical truth tables in computer programming	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	3	3	2
CO2	2	2	2	2	1
CO3	2	3	3	2	1

Semester	V	Course Code	21MATU05VA3
Course Title	**INTRODUCTION TO R SOFTWARE**		
No. of. Credits	2	No. of. contact hours per week	2
New Course/ Revised Course	**NEW COURSE**	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Value Added Course**		
Scope of the Course	• Skill Development • Employability		
Cognitive Levels addressed by the course	• Understanding the basic concepts of R Software (K-1) • Perform data manipulation (K-4)		
Course Objective	The Course aims to learn basic concepts in R Software and develop operations on vectors and matrices		

Unit	Content	No. of. Hours
I	Basic Concepts and Data Organisation: Your First Session- Date in R	--
II	Data Manipulation, Functions: Operations on Vectors, Matrices and Lists- Logical and Relational Operations- Operations on Sets- Extracting and Inserting Elements	--

References

Text Books:

1. Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, **The R Software- Fundamentals of Programming and Statistical Analysis**, Springer New York, 2013.
   Unit 1: Chapter 3
   Unit 2: Chapter 5: Section 5.1 - 5.4

Reference Books:

1. Norman Matloff, **The Art of R Programming: A Tour of Statistical Software Design**, William Pollock, San Francisco, 2011.

E- Resources:

1. https://nptel.ac.in/courses/111/104/111104100/

Course Outcomes	On completion of the course students should be able to CO1: acquire basic knowledge in R programming. CO2: analyse data manipulation and functions CO3: apply logical and relational operations to solve problems

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	1	2	3	2
CO2	3	3	1	2	2
CO3	3	3	2	2	1

Semester	**VI**	Course Code	21MATU06VA4
Course Title	**MATHEMATICAL TYPESETTING LATEX**		
No. of. Credits	2	No. of. contact hours per week	2
New Course/ Revised Course	**NEW COURSE**	If revised, Percentage of Revision effected (Minimum 20%)	--
Category	**Value Added Course**		
Scope of the Course	• Skill Development • Employability		
Cognitive Levels addressed by the course	• Understanding the basic concepts of LaTex Software • Perform data manipulation		
Course Objective	The Course aims to learn basic concepts in LaTex and utilize it in report writing and mathematical typesetting		
Unit	**Content**		**No. of. Hours**
I	LaTex on Windows: Report Writing- Letter Writing- Mathematical Typesetting- Numbering Equations- Tables and		--

	Figures- Beamer	
II	Bibliography- Feedback Diagrams with Maths- Writing Style Files in LaTex.	--
References	**Text Books:** 1. Michel Goossens, **The LaTeX companion**, Second Edition, Pearson Education, Boston, 2004. 2. Frank Mittelbach, Michel Goossens, and Sebastian Rahtz, **The LaTex Graphics Companion: Illustrating Documents with TeX and PostScript,** Pearson Education, Boston, 2008.	
	E- Resources: 1. https://www.youtube.com/watch?v=IO5Dzq2QdGg&list=PL7WFbgpeASD14Ar7zbES-IwvO-ooN-dGa	
Course Outcomes	On completion of the course students should be able to CO1: acquire basic knowledge in LaTex software. CO2: create tables and figures through LaTex CO3: apply LaTex to develop bibliography	

Mapping of COs with PSOs

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	1
CO2	2	1	2	2	2
CO3	1	3	2	3	2