ST. XAVIER'S COLLEGE (AUTONOMOUS)
Palayamkottai - 627 002

(Recognized as "College with Potential for Excellence" by UGC)
(Re-accredited with "A^{++}" Grade with a CGPA of 3.66)

SYLLABUS

B.Sc. MATHEMATICS

(w.e.f June 2021)

Syllabus-2021

Programme : B.Sc. Mathematics
Programme Code : UMT

Program Specific Outcomes:

Students will

1. develop an appreciation of the basic concepts of Calculus, Analytical Geometry, Trigonometry, Classical Algebra, Abstract Algebra, Real, Modern and Complex Analysis, Differential Equations, Numerical Methods, Mechanics, Optimization techniques, Statistics, C++/Python and Graph Theory.
2. develop a quest for knowledge which will pave way for doing Mathematics by students themselves.
3. learn many mathematical structures
4. gain the confidence to work in a team
5. construct and express logical arguments
6. develop generic skills that will pave way for their career.

Programme Outline:

Sem	Part	Status	Course Code	Title of the Paper	Hrs	Cdts
I	I	I Lang.	21 UGT 11	General Tamil – I	6	3
			21 UGH 11	Hindi – I		
			21 UGF 11	French – I		
	II	II Lang.	21 UGE 11	General English – I	6	3
	III	Core-1	21 UMT 11	Differential and Integral Calculus	6	5
	III	Allied-1 T	21 UPHA 11	Physics – I	4	4
	III	Allied-1 P	21 UPHA 12	Physics Practical – I	2	1
	IV	NME-1	21 UNM 11	Choose a course offered by other dept. /Numerical ability I (for other students)	2	2
	IV	SBE-1	21 USB 11	Integrated Personality Development	2	2
	IV	VE	21 UVE 11	Religion/Ethics	2	2
				Sub Total	**30**	**22**
II	I	I Lang.	21 UGT 21	General Tamil – II	6	3
			21 UGH 21	Hindi – II		
			21 UGF 21	French – II		
	II	II Lang.	21 UGE 21	General English – II	6	3
	III	Core-2	21 UMT 21	Set Theory, Theory of Equations and Trigonometry	6	5
	III	Allied-2 T	21 UPHA 21	Physics – II	4	4
	III	Allied-2 P	21 UPHA 22	Physics Practical– II	2	1
	IV	NME-2	21 UNM 21	Choose a course offered by other dept. /Numerical ability II (for other students)	2	2
	IV	SBE-2	21 USB 21	Life Issues and Coping Skill Development	2	2
	IV	SBE-3	21 USB 22	Professional English for Mathematics	2	2
				Sub Total	**30**	**22**
III	I	I Lang.	21 UGT 31	General Tamil – III	6	3
			21 UGH 31	Hindi – III		
			21 UGF 31	French – III		
	II	II Lang.	21 UGE 31	General English – III	6	3
	III	Core-3	21 UMT 31	Sequences and Series	6	5
	III	Allied-3	21 UMTA 31	Statistics-I	6	5
	IV	SBE-4	21 USB 31	Human Rights and Social Analysis	2	2
	IV	SBE-5	21 USB 32	Techniques in Reasoning / Bio-Statistics (to Mathematics major only)	2	2
	IV	EVS	21 UES 31	Environmental Studies	2	2
				Sub Total	**30**	**22**

Sem	Part	Status	Course Code	Title of the Paper	Hrs	Cdts
IV	I	I Lang.	21 UGT 41	General Tamil – IV	6	3
			21 UGH 41	Hindi – IV		
			21 UGF 41	French – IV		
	II	II Lang.	21 UGE 41	General English – IV	6	3
	III	Core-4 T	21 UMT 41	C and C++	4	4
		Core-4 P	21 UMT 42	C and C++ Practical	2	1
	III	Allied-4	21 UMTA 41	Statistics-II	5	5
	III	Elect-1	21 UMTE 41	Analytical Geometry and Vector Calculus / Number Theory	5	4
	IV	SBE-6	21 USB 41	Mathematics for competitive exams (to other Major)	2	2
				Sub Total	**30**	**22**
V	III	Core-5	21 UMT 51	Abstract Algebra	6	6
	III	Core-6	21 UMT 52	Real Analysis	6	5
	III	Core-7	21 UMT 53	Differential Equations and Fourier Series	6	5
	III	Core-8	21 UMT 54	Mechanics	6	5
	III	Elect-2	21 UMTE 51	Linear Programming and Game Theory / Operations Research	6	5
				Sub Total	**30**	**26**
VI	III	Core-9	21 UMT 61	Linear Algebra and Lattices	6	5
	III	Core-10	21 UMT 62	Modern Analysis	6	5
	III	Core-11	21 UMT 63	Complex Analysis	6	5
	III	Core-12	21 UMT 64	Graph Theory	6	5
	III	Elect-3	21 UMTE 61	Astronomy/ Numerical Methods / Discrete Mathematics	6	5
				Sub Total	**30**	**25**
III & IV	Extension Activities			STAND		1
Grand Total					**180**	**140**

Extra Credit Courses

Sem.	Part	Course Code	Title of the Paper	Cdts
I	V	21 UME 11	Set Theory	4
II	V	21 UME 21	Analytical Geometry of Two Dimension	4
III	V	21 UME 31	Python	4
III	V	21 UME 32	R Programming	4
III	V	21 UME 33	Classical Algebra	4
IV	V	21 UME 41	Data Analytics	4
IV	V	21 UME 42	Statistical Methods	4
V	V	21 UME 51	Quantitative Aptitude	4
VI	V	21 UME 61	Differentiation and Integration	4

DIFFERENTIAL AND INTEGRAL CALCULUS
(Course Code: 21 UMT 11)

Semester - I	Core -1	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the students will be able to

CO 1. recall the basic formulae in differentiation (K1)
CO 2. discuss radius of curvature and evolutes using various methods (K2)
CO 3. use the Leibnitz theorem to find derivatives (K3)
CO 4. determine integration using beta and gamma functions (K3)
CO 5. demonstrate the applications of differentiation and Jacobians (K3)
CO 6. evaluate multiple integrals (K5).

UNIT- I:

Higher Derivatives – n^{th} Derivative and Leibnitz theorem – Partial Differentiation – Euler's Theorem

(**Part – I Chapter 2: Sections 2.11 – 2.15)**

UNIT- II:

Tangent and normal- Polar curves - *p* - *r* Equations - Curvature

(Part - I Chapter 3: Sections 3.1 – 3.4)

UNIT- III:

Evolutes – Envelopes - Jacobians

(Part - I Chapter 3: Sections 3.5 - 3.7 and 3.9)

UNIT- IV:

Evaluation of Definite Integral - Integration by parts - Reduction formulae - Integration as the limit of a sum

(Part -II Chapter 2: Sections 2.6 – 2.9)

UNIT- V:

Double and Triple integrals - Beta and Gamma functions.

(**Part -II Chapters 3 and 4: Sections 3.1 – 3.3 and 4.1)**

Text book:

S. Arumugam and A. Thangapandi Isaac, Calculus, New Gamma Publishing House, 2011.

Reference books:

1. Howard Anton, Irl Bivens and Stephen Davis, Calculus, 7th Edition, Wiley India Pvt. Ltd., 2007.
2. Mohammed Arif, Calculus, Narosa Publishing house, 2014.
3. Tom M. Apostol, Calculus, Wiley Student Edition, 2011.
4. J.P Singh, Calculus, Ane Books Pvt. Ltd., 2010.

PHYSICS – I
(Course Code: 21 UPHA 11)

Semester - I	Allied - I T	Hours -4	Credits - 4

Course Outcomes : At the end of the course the students will be able to

CO1 : understand the fundamental concepts of properties of matter
CO2 : understand the principles and development in properties of matter and Heat Thermodynamics
CO3 : understand Specific heat capacity of various liquid
CO4 : understand the differences between surface tension and viscosity
CO5 : understand the various sources and resources of energy

Unit I Elasticity

Elasticity - bending of beams - expression for bending moment - uniform bending - theory - twisting couple on a cylindrical wire (Torsion) - expression for couple per unit twist - work done - torsion pendulum - experiment to determine rigidity modulus of a wire using torsion pendulum - Acceleration due to gravity - compound pendulum - theory and experiment.

Unit II Surface tension

Surface tension - excess of pressure over curved surface - drop weight method - coefficient of viscosity and its dimension. Stokes formula for viscous drag - experiment to determine the coefficient of viscosity of a highly viscous liquid - flow of liquid through a uniform capillary tube - method of dimensions - Poiseuille's method.

Unit III Specific heat

Specific heat capacity - Callendar and Barnes continuous flow method Variation of specific heat capacity of solids with temperature - Variation of atomic heat of solids with temperature - Theory of specific heats - Einstein's theory - Debye's theory

Unit IV Thermal conductivity

Lees' disc experiment to determine the thermal conductivity of a bad conductor (cardboard only) - analogy between heat flow and electric current Weidmann-Franz law - Newton's law of cooling - experimental verification - Experiment to determine the specific heat capacity of a liquid - concept of pressure, volume and temperature of a gas - mean free path - expression for mean free path, viscosity, thermal conductivity.

Unit V Energy resources

Energy resources - coal, oil and natural gas - energy released in molecular fission and fusion - nuclear reactor - non conventional energy sources - wind energy - tidal energy - wave energy - photo voltaic effect solar cell - solar ponds.

TEXT BOOKS:

1. A. Ubald Raj & G. Jose Robin - Properties of Matter and Optics, Indra Publications, 1st Edition.
2. A. Ubald Raj & G. Jose Robin - Allied Physics Vol. II (Thermal Physics and Sound), Indra Publications, 1st Edition.

REFERENCE BOOKS:

1. N. Sundararajan, George Thomas, Syed Azeez - College Physics Vol. I, United Publishers, 1st Edition.
2. Ubald Raj & G. Jose Robin - Oscillations, Properties of Matter and Energy Physics and Optics and Spectroscopy - Indra Publication, 1st Edition.
3. Brij Lal - Heat and TYhermodynamics and Statistical Physics, S. Chand & Company, 2010.
4. R. Murugesan - Properties of matter, S. Chand & Company, 2010.

PHYSICS PRACTICAL – I
(Course Code: 21 UPHA 12)

Semester - I	Allied - I P	Hours- 2	Credit - 1

1. Compound pendulum -Determination of 'g'
2. Uniform bending (Scale & telescope) -Young's modulus
3. Surface tension -Drop weight method
4. Viscosity -Stoke's method
5. Viscosity -Constant pressure head method
6. Newton's law of cooling -Verification
7. Newton's law of cooling -speciic heat capacity of a liquid
8. Comparison of viscosities of two liquids
9. Torsion pendulum -Rigidity modulus
10. Lee's disc method - Thermal conductivity of a bad conductor

NUMERICAL ABILITY - I
(Course Code: 21 UNM 11)

Semester - I	NME -1	Hours - 2	Credits - 2

Course Outcomes: By the end of the course the student will be able to

CO 1. recall the basic formula to solve the day today problems (K1)
CO 2. discuss HCF and LCM of numbers (K2)
CO 3. apply BODMAS rule to solve the problems (K3)
CO 4. outline the basic concepts related to numerical problems (K4)
CO 5. compare the relation between the percentage, ratio and proportion (K5)
CO 6. build the mental ability to face the competitive examination (K6)

Eligibility: All UG students except from the Department of Mathematics

UNIT- I:

Numbers (test of divisibility) - HCF and LCM of numbers.

(Chapters 1 and 2)

UNIT- II:

Decimal fractions (operations on decimal fractions, some basic formulae) - Simplification (BODMAS rule)

(Chapters 3 and 4)

UNIT- III:

Square roots and cube roots - Surds and indices.

(Chapters 5 and 9)

UNIT- IV:

Average, Problems on numbers and ages,

(Chapters 6, 7 and 8)

UNIT- V:

Percentage - Ratio and proportion - Chain rule.

(Chapters 10,12 and 14)

Text Book:

R. S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand and company ltd., 2014.

Reference Books:

1. Topic-wise solved papers for IBPS/SBI Bank PO/ Clerk prelims and Mains (Quantitative Aptitude – 2010-16), Disha publication.
2. Quantitative Aptitude, P. Gupta, Unique publishers.

SET THEORY, THEORY OF EQUATIONS AND TRIGONOMETRY
(Course Code: 21 UMT 21)

Semester - II	Core - 2	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the student will be able to

CO 1. recall the foundation of sets, relations and mappings (K1)
CO 2. describe the relation between the roots and the coefficients of equation (K2)
CO 3. explain hyperbolic functions and their properties (K2)
CO 4. solve the equations using various methods (K3)
CO 5. apply De Moivre's theorem to solve the problems. (K3)
CO 6. formulate algebraic equations using trigonometric functions (K6)

Unit- I:

Relations - Equivalence relations – Partial order - Functions.

(Text book 1: Chapter 2: Sections 2.1-2.4)

Unit-II:

Formation of equations - Relation between roots and coefficients - Sum of powers of roots - Reciprocal equations

(Text book 1: Sections 5.1- 5.4)

Unit- III:

Transformation of equations - Multiple roots - Nature and position of roots - Horner's and Newton's method to find a root of the equation correct to two places of decimals.

(Text book 1: Sections 5.5- 5.7 and 5.10)

Unit - IV:

Complex Numbers – De Moivre's theorem - Problems - Expansions of $\cos n\theta$, $\sin n\theta$, $\tan n\theta$, $tan\,(A+B+C+\cdots)$ - Examples on formation of equation- Powers of sines and cosines of θ in terms of functions of multiples of θ

(**Text book 2: Chapter 2 sections 1- 3)**

Unit- V:

Expansions of $sin\theta$ and $cos\theta$ in series of ascending powers of θ - limits of expressions of sines and cosines - Hyperbolic functions - Inverse hyperbolic functions – Examples - Logarithms of complex quantities

(Text book 2: Chapters 3 - 5)

Text books:

1. S. Arumugam and A. Thangapandi Isaac, Set Theory, Number System and Theory of Equations, New Gamma Publishing House, 1997.
2. S. Narayanan and T.K Manicavachagom Pillay, Trigonometry (for B.Sc., Mathematics Major classes), S. Viswanathan Publishers Pvt. Ltd., 2012.

Reference books:

1. M. D Raisinghania and R. S Aggarwal, A Text book on Trigonometry, S.Chand and Company Ltd., 1985
2. M.L. Khanna, Trigonometry, Jai Prakash Nath and company, Educational publishers, 1988
3. R.S Aggarwal, A Text book on Modern Algebra, S. Chand and Company Pvt. Ltd., 1988

PHYSICS – II
(Course Code: 21 UPHA 21)

Semester - II	Allied - 2 T	Hours - 4	Credits - 4

Course Outcomes: At the end of the course the students will be able to

CO1. understand the basic Principles and application of electricity, optics, electronics and relativity

CO2. understand the essence of coulomb's law and electric field.

CO3. understand the differences between self induction and mutual induction of the coil

CO4. understand the basics of electronics

CO5. understand the differences between general and special theory of relativity.

Unit I: Electrostatics

Coulomb's law - Electric field - electric field due to a point charge - electric dipole - electric flux – Gauss law - applications - electric field due to a charged conducting sphere (point inside and outside) - uniformly charged cylinder (line charge) - electric potential - potential difference - relation connecting electric field and electric potential at a point - equipotential surface.

Unit II: AC Circuits

Self induction of a coil - calculation of self inductance of a long straight solenoid - alternating current - calculation of average value of alternating current - Phase difference between current and voltage in alternating circuits - LR circuit - LCR series resonance circuit - LCR parallel resonance circuit.

Unit III: Electronics

Junction diode - biasing - pn diode equation - volt-amp characteristics - zener diode - experiment - uses - voltage regulator using zenor diode - the junction transistor - voltage divider biasing - transistor amplifier - CE mode feedback - principle Barkhaysan criterion for oscillations - Colpit's oscillator.

Unit IV: Optics

Interference - air wedge - Newton's rings - Diffraction of light - experiment to determine the wavelength of monochromatic light using plane trans- mission grating - polarization - double refraction - Nicol prism - production of plane, circularly, elliptically polarized light.

Unit V: Relativity

Frame of reference - Michelson and Morley experiment - special theory of relativity - Lorentz transformation equation - velocity transformation equations - relativistic velocity addition - length contraction - time dilation - variation of mass with velocity (Qualitative Explanation only) - Einstein's mass energy relation.

TEXT BOOK:

1. A. Ubald Raj & G. Jose Robin - Allied Physics Vol. I - Indra Publication 1st Edition.

REFERENCE BOOKS:

1. N. Sundararajan, George Thomas, Syed Azeez - College Physics Vol. II United Publishers, 1st Edition, 2009.
2. N. Sundararajan, George Thomas, Syed Azeez - College Physics Vol. III United Publishers, 1st Edition, 2009.
3. A. Ubald Raj & G. Jose Robin - Relativity, Wave Mechanics and Nuclear Physics, Indra Publication 1st Edition, 2009.
4. N. Subramanyam, Brij Lal, M.N. Avadhanulu - A Textbook of Optics, S. Chand & Company Ltd., 23rd Edition, 2006.

Physics Practical – II
(Course Code: 21 UPHA 22)

Semester - II	**Allied - 2 P**	**Hours - 2**	**Credit - 1**

1. Grating - Oblique incidence
2. Air wedge - Thickness of a wire
3. Series resonance
4. Parallel resonance
5. Newton's Rings
6. Zener diode characteristics
7. Diode rectifier
8. Single stage amplifier
9. Colpit's Oscillator
10. Transistor characteristics – CE mode

NUMERICAL ABILITY - II
(Course Code: 21 UNM 21)

Semester - II	NME - 2	Hours - 2	Credits – 2

Course Outcomes: By the end of the course the student will be able to

CO 1. describe the specific knowledge of profit and loss (K1)
CO 2. explain the concepts of pipes and cisterns (K2)
CO 3. solve problems related to time and distance (K3)
CO 4. analyze the concepts of Time and Work (K4)
CO 5. compare between the simple interest and compound interest (K5)
CO 6. build mental ability to approach the competitive examination (K6)

Eligibility: All UG students except from the Department of Mathematics

Unit - I:

Profit and loss - Partnership

(Chapters 11 and 13)

Unit- II:

Time and work - Pipes and cisterns.

(Chapters 15 and 16)

Unit- III:

Time and distance - Problems on trains - Boats and streams.

(Chapters 17, 18 and 19)

Unit- IV:

Simple Interest - Compound Interest

(Chapters 21 and 22)

Unit- V:

Area - Volume and surface areas

(Chapters 24 and 25)

Text Book:

R.S. Aggarwal, Quantitative Aptitude for competitive Examinations, S. Chand and company Ltd., 2014.

Reference Books:

1. Topic-wise solved papers for IBPS/SBI Bank PO/ Clerk prelims and Mains (Quantitative Aptitude – 2010-16), Disha publication.
2. P. Gupta, Quantitative Aptitude, Unique publishers.

PROFESSIONAL ENGLISH FOR MATHEMATICS
(Course code: 21 USB 22)

Semester - II	SBE - 3	Hours - 2	Credits - 2

OBJECTIVES:

- To develop the language skills of students by offering adequate practice in professional contexts.
- To enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students
- To focus on developing students' knowledge of domain specific registers and the required language skills.
- To develop strategic competence that will help in efficient communication
- To sharpen students' critical thinking skills and make students culturally aware of the target situation.

Course Outcomes: By the end of the course the students will be able to

CO 1. recognize their own ability to improve their own competence in using the language
CO 2. use language for speaking with confidence in an intelligible and acceptable manner
CO 3. understand the importance of reading for life
CO 4. read independently unfamiliar texts with comprehension
CO 5. understand the importance of writing in academic life
CO 6. write simple sentences without committing error of spelling or grammar

(Outcomes based on guidelines in UGC LOCF – Generic Elective)

NB: All four skills are taught based on texts/passages.

UNIT 1: COMMUNICATION

Listening: Listening to audio text and answering questions - Listening to Instructions
Speaking: Pair work and small group work.
Reading: Comprehension passages –Differentiate between facts and opinion
Writing: Developing a story with pictures.
Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 2: DESCRIPTION

Listening: Listening to process description -Drawing a flow chart.
Speaking: Role play (formal context)
Reading: Skimming/Scanning- Reading passages on products, equipment and gadgets.
Writing: Process Description –Compare and Contrast Paragraph-Sentence Definition and Extended definition- Free Writing.
Vocabulary: Register specific -Incorporated into the LSRW tasks.

UNIT 3: NEGOTIATION STRATEGIES

Listening: Listening to interviews of specialists / Inventors in fields (Subject specific)
Speaking: Brainstorming. (Mind mapping). Small group discussions (Subject-Specific)
Reading: Longer Reading text.
Writing: Essay Writing (250 words)
Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 4: PRESENTATION SKILLS

Listening: Listening to lectures.
Speaking: Short talks.
Reading: Reading Comprehension passages
Writing: Writing Recommendations Interpreting Visuals inputs
Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 5: CRITICAL THINKING SKILLS

Listening: Listening comprehension- Listening for information.
Speaking: Making presentations (with PPT- practice).
Reading: Comprehension passages –Note making. Comprehension: Motivational article on Professional Competence, Professional Ethics and Life Skills
Writing: Problem and Solution essay– Creative writing –Summary writing
Vocabulary: Register specific - Incorporated into the LSRW tasks

Course Material:

English for Physical Sciences, Tamil Nadu State Council for Higher Education (TANSCHE)

SEQUENCES AND SERIES
(Course Code: 21 UMT 31)

Semester - III	Core - 3	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the student will be able to

CO 1. describe various types of sequence (K2)
CO 2. discuss the behaviour of alternating series using various tests (K2)
CO 3. demonstrate various inequalities and their applications (K3)
CO 4. use sub-sequences to find the limits of sequences (K3)
CO 5. apply various tests to check the convergence of series (K3)
CO 6. analyze the properties of monotonic sequences. (K4)

Unit – I:

Triangle inequality - arithmetic, geometric and harmonic means - Cauchy-Schwarz inequality, Weierstrass inequalities, miscellaneous problems.

(Chapter: 2)

Unit – II:

Sequences - bounded sequences - monotonic sequences - convergent sequences - divergent and oscillating sequences - the algebra of limits.

(Chapter 3: Sections 3.1 - 3.6)

Unit – III:

Behaviour of monotonic sequences - some theorems on limits - subsequences - limit points - Cauchy sequences - the upper and lower limits of a sequence.

(Chapter 3: Sections 3.7 - 3.12)

Unit – IV:

Infinite series - comparison test - D'Alembert's ratio test (without proof) - root test and condensation test - integral test.

(Chapter 4: Sections 4.1, 4.2, 4.4 and 4.5)

Unit – V:

Alternating series - absolute convergence - test for convergence of series of arbitrary terms - multiplication of series - power series.

(Chapter 5: Sections 5.1- 5.3, 5.5 and 5.6)

Text book:

Dr. S. Arumugam and A. Thanga Pandi Issac, Sequences and Series, New gamma publishing House, Palayamkottai, 2010.

Reference books:

1. Ajit Kumar and S. Kumaresan, Real Analysis, second Indian reprint, CRC Press, 2015
2. S.C Malik, Principles of Real Analysis, first edition, New Age International Private Limited.

STATISTICS - I
(Course Code: 21 UMTA 31)

Semester - III	Allied - 3	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the student will be able to:

CO 1. recall the fundamental properties of probability theory (K1)
CO 2. discuss discrete and continuous random variables (K2)
CO 3. illustrate different probability distributions (K3)
CO 4. apply discrete probability distributions to solve problems (K3)
CO 5. apply continuous probability distributions to solve problems (K3)
CO 6. analyze various characteristics of expectation and variance (K4)

Unit-I:

Basic Terminology - Axiomatic approach to probability – Some Theorems on Probability – Conditional probability- Multiplication Theorem of Probability –Independent Events- Pairwise Independent Events - Baye's theorem

(Chapter 3: Section3.3-3.5, 3.8 (Except 3.8.3, 3.8.4), 3.9 (Except 3.9.2), 3.10-3.12, 3.15, Chapter 4: Section 4.2 (Except 4.2.1))

Unit-II:

Random variable - Distribution function - Discrete random variable- Continuous random variable – Two-dimensional random variable.

(**Chapter 5: Section 5.1-5.5 (Except 5.5.6-5.5.7))**

Unit-III:

Mathematical expectation – Expected value of function of a random variable – Properties of expectation – Properties of variance - Covariance - Moment generating function – Cumulants

(Chapter 6: Section 6.1 - 6.6. Chapter 7: Section 7.1 – 7.2)

Unit-IV:

Binomial distribution- Poisson distribution – Geometric distribution

(Chapter 8: Section 8.4(Except 8.4.3, 8.4.10-8.4.12), 8.5 and 8.7)

Unit-V:

Normal distribution - Gamma distribution – Beta distributions of first and second kind - Exponential distribution

(Chapter 9: Section 9.2 (Except 9.2.11-9.2.15), 9.5 -9.8)

Textbook:

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons, 1982.

References:

1. P.R. Vittal, Mathematical Statistics, Margham Publications, Chennai, 2004.
2. J.N. Kapur and H.C. Saxena. Mathematical Statistics 20th Edition, S. Chand & Co Ltd. New Delhi, 2010.

TECHNIQUES IN REASONING
(Course Code: 21 USB 32)

Semester - III	SBE - 5	Hours - 2	Credits -2

Course Outcomes: By the end of the course the student will be able to

CO 1. explain the concept of coding and decoding (K2)
CO 2. use the analytical thinking in various situations (K3)
CO 3. analyze the given series of data (K4)
CO 4. select the figures to complete given pattern (K5)
CO 5. develop the mental ability and power of reasoning (K6)
CO 6. develop the competency to face competitive examinations (K6)

Eligibility: Mathematics major students only.

VERBAL REASONING

UNIT- I:

Series completion – analogy - coding-de coding.

(Part I: Section I: Chapters 1, 2 and 4)

UNIT- II:

Blood relations - alphabet test - inserting the missing character.

(Part I: Section I: Chapters 5, 10 and 16)

UNIT- III:

Direction sense test – alpha numeric sequence - mathematical operations.

(Part I: Section I: Chapters 8,11 and 13)

NON-VERBAL REASONING

UNIT- IV:

Series completion - mirror images - water images - spotting out the embedded figures.

(Part II: Chapters 1, 5, 6 and 7)

UNIT- V:

Completion of incomplete pattern - figure matrix - cubes and dice - dot situation.

(Part II: Chapters 8, 9, 14 and 15)

Text book:

R.S. Aggarwal, A modern approach to verbal and non-verbal reasoning, S. Chand and Company Ltd, Ram Nagar, New Delhi.

Reference book:

J. K Chopra, Reasoning and Aptitude test, Unique Publishers, 2012.

BIO-STATISTICS
(Course Code: 21 USB 32)

Semester - III	SBE - 5	Hours - 2	Credits -2

Course Outcomes: By the end of the course the student will be able to

CO 1. discuss the concept of estimation (K2)
CO 2. discuss the role of statistics in clinical medicine (K2)
CO 3. classify the various diseases (K4)
CO 4. assess the health condition of the people (K5)
CO 5. develop the knowledge of preventive medicine(K6)
CO 6. design the methods of statistics in medicine (K6)

Eligibility: Mathematics major students only.

UNIT- I:

Introduction - problem of estimation - tests of hypothesis - experimental setting.

(**Chapter I)**

UNIT- II:

Introduction - some examples of earlier uses of statistics - areas of application of statistics.

(**Chapter II)**

UNIT- III:

Introduction - some early examples - areas of application.

(**Chapter III)**

UNIT- IV:

Health Statistics - Introduction - utilization of the basic data - sources of health statistics.

(**Chapter XIX: Section 19.1 - 19.4)**

UNIT- V:

Measurement of sickness - hospital statistics - international classification of diseases.

(**Chapter XIX: Section 19.5 – 19.7)**

Text book:

P.S.S. Sundar Rao and J. Richard, An Introduction to Bio-Statistics, Third edition.

Reference book:

Dr. S. Arumugam and A. Thangapandi Issac, Statistics, New Gamma Publishing house, July 2011.

C and C++
(Course Code: 21 UMT 41)

Semester - IV	Core - 4 T	Hours - 4	Credits - 4

Course Outcomes: By the end of the course the student will be able to

CO 1. recall key features of the object-oriented programming language (K1)
CO 2. discuss the data types, variables, and operators in C program (K2)
CO 3. apply string functions to perform string manipulations in C program (K3)
CO 4. illustrate constructors and destructors using C++ program (K4)
CO 5. compare Friend and Virtual Functions using C++ program (K5)
CO 6. develop C and C++ programs for the given task.(K6)

UNIT I

Overview of C: History of C - Importance of C - Basic Structure of C Programs - Programming Style - Executing a 'C' Program.

Constants, Variables and Data types: Character Set - C Tokens - Keywords and Identifiers - Constants - Variables - Data Types - Declaration of Variables - Declaration of Storage Class – Assigning values to variables - Defining Symbolic Constants – Declaring a variable as constants.

Operators and Expressions: Introduction – 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.

(Text Book 1: Chapters 1 (1.1.-1.10.), 2 (2.2. – 2.12.) and 3 (3.1. – 3.12.))

UNIT II

Managing Input and Output Operations: Introduction - Reading a Character - Writing a Character -Formatted Input - Formatted Output.

Decision Making and Branching: Introduction – Decision making with If Statement – Simple If statement - The If.....Else Statement - Nesting of If....Else Statements - The Else If Ladder - The Switch Statement - The ?: Operator - The Goto Statement.

Decision making and Looping: Introduction - The While Statement - The Do Statement - The For Statement - Jumps in Loops.

(Text Book 1: Chapters 4, 5 and 6 (6.1.-6.5.))

UNIT III

Arrays: One-Dimensional Arrays - Declaration of One-Dimensional Arrays - Initialization of One-Dimensional Arrays - Two-Dimensional Arrays - Initializing Two-Dimensional Arrays - Multi-Dimensional Arrays - Dynamic Arrays.

Character arrays and strings: Introduction - Declaring and Initializing String Variables - Reading Strings from Terminal - Writing Strings to Screen - Arithmetic Operations on Characters - Putting Strings Together - Comparison of Two Strings - String-Handling Functions.

(Text Book 1: Chapters 7 (7.1.-7.8.) and 8 (8.1 – 8.8.))

UNIT IV

Principles of Object Oriented Programming: Object-Oriented programming Paradigm - Basic Concepts of Object Oriented Programming – Benefits of OOPs - Object-Oriented Languages.

Beginning with C++ :- Structure of C++ program.

Functions in C++: - Introduction - The Main Function - Function Prototyping - Call by Reference - Return by Reference - Inline Functions - Default Arguments - const

Arguments – Recursion - Function Overloading - Friend and Virtual Functions - Math Library Functions.

(Text Book 2- Chapters 1 (1.4. – 1.7.), 2 (2.6.) and 4 (4.1. – 4.12.))

UNIT V

Classes and Objects: - Defining Member Functions - C++ Program with Class - Making an Outside Function Inline - Nesting of Member Functions.

Constructors and Destructors: - Introduction – Constructors - Parameterized Constructors – Multiple Constructors in a Class - Constructors with Default Arguments - Copy Constructors – Destructors.

(Text Book 2- Chapters 5 (5.4. – 5.7.) and 6 (6.1. – 6.5, 6.7 and 6.11))

Text Books:

1. Programming in ANSI C, E. Balagurusamy, sixth Edition, Tata McGraw-Hill Education, 2012.
2. Object Oriented Programming with C++, E. Balagurusamy, seventh Edition, Tata McGraw-Hill Education, 2018.

C and C++ Practical
(Course Code: 21 UMT 42)

Semester - IV	Core - 4 P	Hours - 2	Credit -1

Course outcomes: By the end of the course the student will be able to

CO 1. identify error in the given C program. (K1)
CO 2. use decision making and looping statements in writing a C program. (K2)
CO 3. choose the appropriate tools for constructing a C program. (K3)
CO 4. apply arrays for writing a C program. (K4)
CO 5. break down a C++ program in to different functions. (K5)
CO 6. develop a C or C++ program for the given real-life problem. (K6)

List of Practicals

C Programming

1. Programs to demonstrate input/output operations
2. Programs using Decision Making statements
3. Programs using Looping statements
4. Programs using one and two dimensional arrays
5. Programs using String-Handling Functions
6. Programs using Friend and Virtual Function

C++ Programming

7. Programs to demonstrate input/output operations
8. Programs using classes and objects
9. Programs using Functions
10. Programs using Constructor and Destructor

STATISTICS - II
(Course Code: 21 UMTA 41)

Semester - IV	Allied - 4	Hours - 5	Credits - 5

Course Outcomes: By the end of the course the student will be able to

CO 1. interpret the concept of correlation coefficients (K2)
CO 2. discuss the various types of sampling (K2)
CO 3. explain the procedure for testing of hypothesis (K2)
CO 4. describe the applications of t and F distributions (K2)
CO 5. demonstrate the use of the chi-square distribution (K3)
CO 6. analyze the types of estimators (K4)

Unit-I:

Introduction – Meaning of Correlation – Scatter diagram – Karl Pearson's Coefficient of Correlation – Rank Correlation.

(Chapter 10: Section: 10.1 - 10.4, 10.7)

Unit-II:

Introduction - Types of Sampling - Parameter and Statistic - Tests of significance - Procedure for testing of hypothesis - Test of significance for large samples - Sampling of attributes – Sampling of variables.

(Chapter 14)

Unit-III:

Introduction – Derivation of the chi-square distribution – MGF of chi-square distribution - Applications of chi-square distribution.

(Chapter 15: Section 15.1- 15.3, 15.6 (Except 15.6.4-15.6.7))

Unit-IV:

Introduction – Student's t- distribution - Applications of t-distribution – Distribution of sample correlation coefficient when population correlation coefficient is zero- F-distribution - Applications of F-distribution.

(Chapter 16: Section 16.1-16.6)

Unit-V:

Introduction - Characteristics of estimators – Unbiasedness - Consistency - Efficient and Most Efficient Estimators – Methods of Estimation - MLE (statement of properties and direct simple problems, no theorems).

(Chapter 17: Section 17.1-17.2 (Except MVU Estimators and 17.2.4), 17.6 (Except 17.6.2 - 17.6.4))

Textbook:

S.C.Gupta and V.K.Kapoor, Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons, 1982.

References:

1. P. R. Vittal, Mathematical Statistics, Margham Publications, Chennai, 2004.
2. J.N. Kapur and H.C. Saxena. Mathematical Statistics 20th Edition, S. Chand & Co Ltd. New Delhi, 2010.

ANALYTICAL GEOMETRY AND VECTOR CALCULUS
(Course Code: 21 UMTE 41)

Semester - IV	Elective - 1	Hours - 5	Credits - 4

Course Outcomes: By the end of the course the student will be able to

CO 1. recollect the properties of circle, sphere, and straight line (K1)
CO 2. describe the concept of dot product and cross product in vectors (K2)
CO 3. demonstrate the 3D structures of sphere, cone and cylinder (K3)
CO 4. apply the concepts of gradient, divergence and curl to solve the vector differentiation problems (K3)
CO 5. associate line and surface integrals using Green's and Stokes' theorems (K3)
CO 6. test Gauss divergence theorem (K5).

Unit - I:

Coordinates - distance between points - the centroid of a triangle - direction cosines - condition for perpendicularity and parallelism - the of the general equation of a plane - intercept form - normal form equation of a plane through three points - angle between two planes - length of perpendicular - bisecting angle between two planes - symmetrical form of the equation of a straight line - equation of a straight line through two points - the plane and the straight line.

(Text Book 1- Chapter I, II, Chapter III: Sections 1 - 6)

Unit - II:

Coplanar lines - shortest distance between two lines - skew lines - equation of a sphere with centre and radius - standard form of the equation of a sphere - length of tangent from a point to the sphere.

(**Text Book 1- Chapter III: Sections 7 and 8;**
Chapter IV: Sections 1 - 4)

Unit - III:

Section of a sphere by a plane - equation of a sphere through a circle – the equation of the tangent plane to the sphere at a point - the equation of a cone with index at the origin - right circular cone - the equation of a cylinder - the equation of a right circular cylinder.

(**Text Book 1- Chapter IV: Sections 5 - 8**
Chapter V: Sections 2 and 8)

Unit - IV:

Vector algebra - differentiation of vectors - gradient - divergence and curl.

(**Text Book 2 - Chapter 5: Sections 5.1 - 5.4)**

Unit - V:

Line integrals - surface integrals - theorems of Green, Gauss and Stokes.

(**Book 2 - Chapter 7: Sections 7.1 - 7.3)**

Text books:

1. T. K. Manicavasagam Pillay and T. Natarajan, Analytical Geometry-Part-II, S. Viswanathan (Printers and Publishers) Pvt. Ltd Revised edition, 2000.
2. S. Arumugam and Thangapandi Isaac, Analytical Geometry 3D and Vector Calculus, New Gamma Publishing House, 2011.

Reference book:

K. C Mathew, S. Veeraraghavan and T. Raghavan, A Text book of co-ordinate geometry of two and three dimensions, S. Chand and Company (Pvt) LTD, 1988.

NUMBER THEORY
(Course Code: 21 UMTE 41)

Semester - IV	Elective - 1	Hours - 5	Credits - 4

Course Outcomes: By the end of the course the student will be able to

CO 1. describe the well-ordering principle and the Archimedean property (K1)
CO 2. discuss division algorithm, Euclidean algorithm and their application (K2)
CO 3. demonstrate fundamental theorem of arithmetic (K3)
CO 4. analyze the basic properties of congruence (K4)
CO 5. argue the divisibility tests and the linear congruence (K5)
CO 6. test the primality of numbers by using Wilson's theorem (K5)

Unit- I:

Well-ordering principle – Archimedean property – principle of finite induction – the binomial theorem.

. **(Chapter 1)**

Unit- II:

The division algorithm – greatest common divisor – the Euclidean algorithm

(Chapter 2)

Unit- III:

The fundamental theorem of arithmetic – the Sieve of Eratosthenes – the Goldbach conjecture

. **(Chapter 3)**

Unit- IV:

Basic properties of congruence – special divisibility tests – linear congruences

(Chapter 4)

Unit- V:

Fermat's factorization theorem – the Little theorem –Wilson's theorem.

(Chapter 5)

Text book:

David M. Burton, Elementary Number Theory, 4th edition, The McGraw-Hill Companies Inc., 1998.

Reference book:

S.B. Malik, Basic Number Theory, Vikas Publishing House PVT LTD, Reprint 2006.

MATHEMATICS FOR COMPETITIVE EXAMS
(Course Code: 21 USB 41)

Semester - IV	SBE - 6	Hours - 2	Credits - 2

Course Outcomes: By the end of the course the student will be able to

CO 1. explain the concept of coding and decoding (K2)
CO 2. use the analytical thinking in various situations (K3)
CO 3. analyze the given series of data (K4)
CO 4. select the figures to complete given pattern (K5)
CO 5. develop the mental ability and power of reasoning (K6)
CO 6. develop the competency to face competitive examinations (K6)

Eligibility: All UG students except from the Department of Mathematics

UNIT- I:

Series completion – Analogy – Coding and decoding.

(Text book – 1: Part I & Section I: Chapters 1, 2 and 4)

UNIT- II:

Blood relations - Alphabet test - Inserting the missing character.

(Text book – 1: Part I & Section I: Chapters 5, 10 and 16)

UNIT- III:

Direction sense test – Alpha numeric sequence - Mathematical operations.

(Text book – 1: Part I & Section I: Chapters 8,11 and 13)

UNIT- IV:

Series completion - Mirror images - Water images - Spotting out the embedded figures.

(Text book – 1: Part II: Chapters 1, 5, 6 and 7)

UNIT- V:

Sequence - Series - A.P. - G.P. - H.P. - Some special sequences

(Text book – 2: Chapter 6)

Text books:

1. R.S. Aggarwal, A modern approach to verbal and non-verbal reasoning, S. Chand and Company Ltd, Ram Nagar, New Delhi.
2. Bharat Jhun J. hunwala Quantitative aptitude, S. Chand and Company Ltd.

Reference book:

J. K. Chopra, Reasoning and Aptitude test, Unique Publishers, 2012.

ABSTRACT ALGEBRA
(Course Code: 21 UMT 51)

Semester - V	Core - 5	Hours - 6	Credits - 6

Course Outcomes: By the end of the course the student will be able to

CO 1. describe the concept of Group and its related topics (K1)
CO 2. explain homomorphism and isomorphism (K2)
CO 3. demonstrate subgroup, normal subgroup and quotient group (K3)
CO 4. analyze Integral domain and Euclidean domain. (K4)
CO 5. categorize integral domain using unique Factorization theorem (K4)
CO 6. develop the thirst to familiarize the concept of Rings and Ideals (K6)

Unit - I:

Groups and subgroups - Simple properties - Cyclic groups - Cosets and Lagrange's theorem.

(Chapter 2: Sections 2.1 - 2.6)

Unit - II:

Normal subgroups - Quotient groups – Homomorphism – Isomorphism

(Chapter 2: Sections 2.7 - 2.9)

Unit – III:

Automorphisms - Permutation groups - Definition and properties of rings - Special classes of rings.

(Chapter 2: Sections 2.10 - 2.11, Chapter 3: Sections 3.1 - 3.3)

Unit – IV:

Subrings and subfields - Ideals and Quotient rings – Homomorphisms - Maximal and prime ideals.

(Chapter 3: Sections 3.4 - 3.7)

Unit – V:

The characteristic of an Integral domain - Definition and properties of Euclidean domain - The unique Factorization theorem - Gaussian integers.

(Chapter 3: Section 3.8, Chapter 4: Sections 4.1 - 4.3)

Text Book:

M.L. Santiago, Modern Algebra, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2001.

Reference books:

1. S. Arumugam, A.T. Issac, Modern Algebra, Scitech publishers, 2015.
2. Vijay K. Khanna, S. K. Bhambri, A Course in Abstract Algebra, Fifth edition, Vikas publishing house private limited, 2016.

REAL ANALYSIS
(Course Code: 21 UMT 52)

Semester - V	Core - 6	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the student will be able to

CO 1. recall the knowledge on real number system (K1)
CO 2. discuss the concept of continuity and differentiability (K2)
CO 3. apply the higher order derivatives (K3)
CO 4. analyze the behavior of series (K4)
CO 5. analyze the relation between differentiation and integration (K4)
CO 6. evaluate definite integrals (K5).

Unit – I:

Algebra of the real number system – upper and lower bounds – l.u.b. property and its applications – absolute value and triangle inequality

(Chapter: 1)

Unit – II:

Continuous functions - ε-δ definition of continuity – Intermediate value theorem – Extreme value theorem – monotone Functions.

(Chapter: 3: Sections 3.1-3.5)

Unit – III:

Limits - uniform continuity – differentiability of functions - Mean value theorem – L' Hospital's rule (statement only).

(Chapter: 3: Sections 3.6-3.7, Chapter 4: Sections 4.1- 4.2)

Unit – IV:

Higher order derivatives – Taylor's theorem – Darboux integrability – properties of the integral.

(Chapter 4: Sections 4.4 - 4.5, Chapter 6: Sections 6.1- 6.2)

Unit – V:

Fundamental theorem of Calculus - Mean value theorem for integrals – Riemann's definition – Sum of an infinite series as an integral.

(Chapter 6: Sections 6.3, 6.4, 6.6 and 6.7)

Text Book:

Ajith Kumar and S. Kumaresan, A basic course in Real Analysis, Second Indian Reprint, CRC Press, 2016.

Reference Books:

1. S.C Malik, Principles of Real Analysis, first edition, New Age International Private Limited, 2017
2. Robert G. Bartle, Donald R. Sherbert, Principles of Real Analysis, first edition, New Age International Private Limited, 2014

DIFFERENTIAL EQUATIONS AND FOURIER SERIES
(Course Code: 21 UMT 53)

Semester - V	Core - 7	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the student will be able to

CO 1. identify the types of differential equations (K1)
CO 2. discuss the applications of differential equations in various fields (K2)
CO 3. solve the types of differential equations (K3)
CO 4. classify the differential equations (K4)
CO 5. evaluate the first order partial differential equations (K5)
CO 6. use the sine and cosine series in Fourier series (K6)

Unit - I:

Linear equations with constant coefficients - methods of finding complementary functions - methods of finding particular integrals.

(Text Book 1: Chapter 2: Sections 2.1 - 2.4)

Unit - II

Linear equation with variable coefficients (Type-D method of variation of parameters only) - simultaneous linear differential equations - total differential equation

(Text Book 1: Chapter 2: Sections 2.5 - 2.7)

Unit - III:

Formation of partial differential equations - first order partial differential equations - methods of solving first order p.d.e – some standard forms - Charpit's method

(Text Book 1: Chapter 4: Sections 4.1 - 4.5)

Unit - IV:

Definition - sufficient conditions for the existence of the Laplace transform - Laplace transform of periodic functions - some general theorems - the inverse transforms - solving differential equation by Laplace transform.

(Text Book 2: Chapter 5)

Unit - V:

Definition - even and odd functions - half- range Fourier series - development in cosine series - development in sine series.

(Text Book 2: Chapter 6: Sections 6.1 – 6.5)

Text Books:

1. Dr. S. Arumugam and Thangapandi Issac, Differential Equation and Applications, Publishing House, 2008.
2. S. Narayanan and T.K. Manicka Vachagam Pillay, Calculus (Volume III), S. Viswanthan Publishers Pvt., Ltd., Chennai, 2006.

Reference books:

1. Richard Bronson and Gabriel B. Costa, Differential equations (fourth edition), McGraw Hill education, 2014.
2. N.P. Balli, Differential Equation (Golden Math series), Firewall media, 2015.
3. Joel L. Schiff, The Laplace Transform (Theory and applications), Springer, 1999.

MECHANICS
(Course Code: 21 UMT 54)

Semester - V	Core - 8	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the students will be able to

CO 1. explain simple harmonic motion and seconds pendulum (K2)
CO 2. describe the equilibrium of Strings and its applications (K2)
CO 3. discuss the concepts of statics and dynamics (K2)
CO 4. solve simple problems related to projectiles (K3)
CO 5. demonstrate the laws of forces (K3)
CO 6. apply Newton's laws in real life situations (K3)

Unit-I

Forces acting at a point - resultant and components - parallelogram of forces - triangle law of forces – Lami's theorem – Resolution of a force – Components of a force along to given directions – Theorem on resolved parts – Resultant of any number forces acting at a point.

(Text book 1: Chapter 2: Sections 1-15)

Unit - II

Equilibrium of Strings - the common catenary - approximations to the shape of the catenary – The parabolic catenary – Suspension bridges.

(Text book 1: Chapter 11)

Unit - III

Laws of motion - Newton's laws of motion - motion of a particle on a rough horizontal plane - pressure of a body - Atwood's Machine - tension in an elastic string - work done – energies - applications.

(Text book 2: Chapter 4: Sections 4.1-4.36)

Unit - IV:

Projectiles - the path of a projectile - characteristics of the motion of a Projectile - velocity of the projectile - range on an inclined plane - time of flight - motion on the surface of a smooth inclined plane - applications.

(Text book 2: Chapter 6: Sections 6.1 – 6.16)

Unit - V:

Simple harmonic motion - simple harmonic motion in a straight line - general solution of the S.H.M equation - geometrical representation of a S.H.M - composition of two simple harmonic motion of the same period and in the same straight line - composition of two simple harmonic motion of the same period and in perpendicular directions - forces necessary to produce simple harmonic motion - motion of a particle suspended by a spiral spring - horizontal oscillations of a particle tied to an elastic string - simple pendulum - period of a oscillation of a simple pendulum - equivalent simple pendulum - applications.

(Text book 2: Chapter 10: Sections 10.1 – 10.5)

Text books:

1. M. K. Venkataraman, Statics, Agasthiar Publications, Trichy, 1999.
2. M. K. Venkataraman, Dynamics, Agasthiar Publications, Trichy, 2001.

Reference books:

1. Rajeswari, Mechanics, Saras publication, Nagercoil, 2016.
2. S. L. Kakani, C. Hemrajani and S. Kakani, Mechanics (Second edition), Viva Student edition, 2012.

LINEAR PROGRAMMING AND GAME THEORY
(Course Code: 21 UMTE 51)

Semester - V	Elective - 2	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the student will be able to

CO 1. recall the simplex algorithm (K1)
CO 2. describe graphical solution method to solve LPP (K2)
CO 3. illustrate Big-M method and inverting a matrix (K3)
CO 4. apply Hungarian method to solve assignment problem (K3)
CO 5. outline MODI method to solve transportation problem (K4)
CO 6. design methods to solve $m \times n$ game (K6)

Unit - I:

Introduction - mathematical Formulation of the problem - Introduction - graphical solution method - some exceptional cases - general linear programming problem - canonical and standard forms of L.P.P.

(Chapter: 2, 3 (Sections 3.1 – 3.5))

Unit - II:

Introduction - fundamental properties of solutions (statement of the theorems and problems only) - the computational procedure - the simplex algorithm - use of artificial variables (BIG - M method only) - solutions of simultaneous linear equations – inverting a matrix using simplex method – applications of simplex method.

(Chapter 4)

Unit - III:

Introduction - general transportation - the transportation table - loops in transportation tables - solution of a transportation problem - finding an initial basic feasible solution - test for optimality - degeneracy in transportation problem - transportation algorithm (MODI method).

(Chapter 10: Sections 10.1 – 10.12)

Unit - IV:

Introduction - mathematical formulation of the problem - the Assignment method special cases - the travelling salesman problem.

(Chapter 11: Sections 11.1 – 11.4 and 11.6)

Unit - V:

Introduction - Two person zero - sum games - some basic terms - the maximin - minimax principle - games without saddle point - mixed strategies - graphical solution – dominance.

(Chapter 17: Sections 17.1 – 17.7)

Text book:

Kandi Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand and Sons, New Delhi, 2006.

Reference books:

1. G. V. Shenoy, Linear Programming methods and Applications, second edition, New age international (p) limited, 2007.
2. P. Sankara Iyer, operations Research, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2009

OPERATIONS RESEARCH
(Course Code: 21 UMTE 51)

Semester - V	Elective - 2	Hours - 6	Credits - 5

Course Outcomes: By the end of the course, the student will be able to

CO 1. recall various methods to solve a game (K1)
CO 2. describe dynamic programming to solve LPP (K2)
CO 3. illustrate replacement, recruitment and promotion problem (K3)
CO 4. outline techniques in calculus to solve inventory problem (K4)
CO 5. evaluate the methods of solving real time problems using network models by PERT/CPM (K5)
CO 6. design methods to solve managerial problems. (K6)

Unit - I:

Introduction –the recursive equation approach – characteristics of dynamic programming – dynamic programming algorithm – solution of discrete DPP – some applications - Solution of LPP by dynamic programming.

(Chapter 13)

Unit - II:

Introduction – Two-Person Zero-Sum Games - some basic terms - the maximin and minimax principles - Games without saddle points - mixed strategies - graphic solution of 2 x n and m x 2 games - Dominance property.

(Chapter 17: Sections 17.1 - 17. 7)

Unit - III:

Introduction - replacement of equipment - asset that deteriorates gradually - replacement of equipment that fails suddenly - recruitment and promotion problem.

(Chapter 18: Sections 18.1 - 18. 4)

Unit - IV:

Introduction - the inventory decisions - costs associated with inventories - factors affecting inventory control - economic order quantity - deterministic inventory problems with no shortages - with shortages - EOQ problems with price breaks – multi item deterministic problems (solutions of inventory models are not for examination).

(Chapter 19: Sections 19.1 - 19.9)

Unit - V:

Introduction - network and basic components logical sequencing - rules of network constructions - critical path analysis - probability considerations in PERT - distinction between PERT and CPM.

(Chapter 21)

Text book:

Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Ninth revised edition, Sultan Chand and Sons, New Delhi, 2001.

Reference books:

1. Prem Kumar Gupta and D.S. Hira, Operations Research – An Introduction, S. Chand and Company Ltd., New Delhi, 2015.
2. P. Sankara Iyer, operations Research, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2009

LINEAR ALGEBRA AND LATTICES
(Course Code: 21 UMT 61)

Semester - VI	Core - 9	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the student will be able to

CO 1. define vector space, Linear independency and Homomorphism (K1)
CO 2. describe different kinds of lattices (K1)
CO 3. associate matrices and vector spaces (K2)
CO 4. determine eigen values and eigen vectors (K3)
CO 5. calculate the dimension of the given vector space (K3)
CO 6. outline the vector space and its related concepts (K4)

Unit – I:

Definition and simple properties of a vector space - Subspace and quotient spaces - Sums and direct sums - Linear independence.

(Text Book 1 - Chapter 6: Sections 6.1 - 6.4)

Unit – II:

Basis and dimension – Homomorphism - Dual spaces.

(Text Book 1 - Chapter 6: Sections 6.5 - 6.7)

Unit – III:

Inner product spaces - Eigen values and eigen vectors - Matrix algebra.

(Text Book 1 - Chapter 6: Section 6.8, Chapter 7: Sections 7.2 - 7.3)

Unit – IV:

The rank of a matrix - Linear equation - Hermitian and unitary transformations.

(Text Book 1 - Chapter 7: Sections 7.6, 7.7 and 7.9)

Unit – V:

Partially ordered set – Lattices - Distributive lattices - Modular Lattices - Boolean algebra

(Text Book 2 - Chapter 9: Sections 9.1 - 9.5)

Text books:

1. M. L. Santiago, Modern Algebra, Tata McGraw Hill Publishing Company Ltd. New Delhi, 2001
2. Modern Algebra, Dr. S. Arumugam, A. Thangapandi Issac, SCITECH publications (India) (P) limited, 2003

Reference books:

1. Seymour Lipschutz, 3000 solved problems in linear algebra, Schaum's solved problem series, 1988.
2. Vijay K. Khanna, S. K. Bhambri, A Course in Abstract Algebra, Fifth edition, Vikas publishing house private limited, 2016.

MODERN ANALYSIS
(Course Code: 21 UMT 62)

Semester - VI	Core - 10	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the student will be able to

CO 1. differentiate countable and uncountable sets (K2)
CO 2. discuss the properties related to connected set and compact spaces (K2)
CO 3. associate the concepts learnt in real line and metric space (K2)
CO 4. illustrate the properties of complete set (K4)
CO 5. derive various concepts in topology (K6)
CO 6. develop the related concepts in advanced analysis (K6)

Unit – I:

Countable Sets - uncountable sets - metric space - definition and examples - bounded sets in a metric space - open ball- open sets.

(Chapter 1: Sections 1.2 and 1.3, Chapter 2: Sections 2.1- 2.4)

Unit – II:

Subspaces - interior of a set - closed sets – closure - limit point - dense sets.

(Chapter 2: Sections 2.5-2.10)

Unit – III:

Complete metric space – completeness - Baire's category theorem - continuity – homeomorphism - uniform continuity.

(Chapter 3: Section 3.1 and 3.2, Chapter 4: Sections 4.1 - 4.3)

Unit – IV:

Connectedness - definition and examples - connected subsets of R - connectedness and continuity

(Chapter 5: Sections 5.1 - 5.3)

Unit – V:

Compactness - compact space - compact subsets of R - equivalent characterization for compactness - compactness and continuity

(Chapter 6: Sections 6.1 - 6.4)

Text book:

Dr. S. Arumugam and Mr. A. Thangapandi Issac, Modern Analysis, New Gamma Publishing House, Palayamkottai, 2007.

Reference books:

1. Narayanan Shanti, Mittal P. K., A Course of Mathematical Analysis, S. Chand publishing company, 2005.
2. S. Kumaresan, Topology of metric space, Second edition, Narosa publication, 2011.

COMPLEX ANALYSIS
(Course Code: 21 UMT 63)

Semester - VI	Core - 11	Hours - 6	Credits - 5

Course Outcomes: By the end of the course the student will be able to

CO 1. identify the isolated singularities of a function (K1)
CO 2. explain the concept of mappings and transformations (K2)
CO 3. show the significance of differentiability for complex functions (K3)
CO 4. analyze the functions with reference to Taylor and Laurent series (K4)
CO 5. evaluate the complex integrals using the residue theorem (K5).
CO 6. summarize the concepts of continuity, derivatives and analytic functions in contour integrals (K5)

Unit - I:

Complex numbers - sums and products - vectors and moduli - complex conjugates - exponential forms - products and quotients in exponential form - roots of complex number – examples – regions in complex plane - analytic functions - functions of a complex variable - mappings - mappings by the exponential function – limits - theorems on limits - limits involving the point at infinity – continuity – derivatives - differentiation formulas - Cauchy-Riemann equations - sufficient condition for differentiability.

(Chapter 1: Sections 1, 4 - 10, Chapter 2: Sections 11 - 21)

Unit - II:

Polar coordinates - analytic functions – examples - harmonic functions - mapping by elementary functions - linear transformation - the transformation w =1/z - mapping by 1/z - linear fractional transformations - an implicit form - mappings of the upper half plane

(Chapter 2: Sections 22 - 25, Chapter 8: Sections 83 - 88)

Unit - III:

Integrals - derivatives of function w(t) - Definite Integrals – Contours - Contour Integrals - examples – upper bounds for moduli of contour integrals - Cauchy-Goursat Theorem (without proof) - simply and multiply connected domains (theorems without proof) - Cauchy integral formula - derivatives of analytic functions - Liouville's Theorem and the Fundamental Theorem of Algebra - maximum modulus principle.

(Chapter 4: Sections 36 - 41, 44, 46 - 50)

Unit-IV

Series - convergence of sequences and series (theorems without proof) - Taylor series - examples - Laurent series - examples – residues - Cauchy's Residue Theorem - using a single residue - the three types of isolated singular points.

(Chapter 5: Sections 51 - 56, Chapter 6: Sections 62 - 65)

Unit - V:

Residues at Poles – examples - zeros of analytic functions - zeros and poles - evaluation of improper integrals – example - improper integrals from fourier analysis - Jordan's lemma - definite integrals involving sines and cosines.

(Chapter 6: Sections 66 - 69, Chapter 7: Sections 71 - 74 and 78)

Text book:

James Ward Brown, Ruel V. Churchill, Complex Variables and Applications (Seventh Edition), McGraw Hill Publishers.

Reference books:

1. S. Ponnusamy, Foundations of Complex Analysis, second edition, Alpha science publications, 2011.
2. S. Arumugam, Thangapandi Issac and A. Somasundaram, Complex Analysis, Scitech publication, 2015.

GRAPH THEORY
(Course Code: 21 UMT 64)

Semester - VI	Core - 12	Hours - 6	Credits -5

Course Outcomes: By the end of the course the **s**tudents will be able to

CO 1. recall the various types of graph (K1)
CO 2. discuss bridges, spanning trees, cut vertices and connectivity (K2)
CO 3. illustrate the Euler and the Hamiltonian graphs (K3)
CO 4. illustrate vertex colouring and edge colouring (K4)
CO 5. summarize the various characteristics of graphs (K5)
CO 6. derive the solutions for logistics problems using vertex and edge colourings (K6)

Unit - I:

The definition of a graph - More definitions - vertex degree - sub graphs - paths and cycles – The matrix representation of graphs (Theorems 1.5 and 1.6 are omitted)

(**Chapter 1: Sections 1.1, 1.3 - 1.7)**

Unit - II:

Definitions and simple properties - bridges - spanning trees – cut vertices and connectivity.

(Chapter 2: Sections 2.1 - 2.3 and 2.6)

Unit - III:

Euler Tours - Hamiltonian graphs – matchings and augmenting paths - the marriage problem.

(Chapter 3: Sections 3.1, 3.3, (Omit Fleury's algorithm and Theorem 3.5), Chapter 4: Sections 4.1 and 4.2)

Unit - IV:

Plane and planar graphs - Euler's Formula - the dual of a plane graph.

(Chapter 5: Sections 5.1, 5.2 and 5.6)

Unit - V:

Vertex colouring - critical graphs - edge colouring

(Chapter 6: Sections 6.1, 6.3 and 6.5 (Omit Theorems 6.5 and 6.14))

Text book:

John Clark, Derek Allan Holton, A First Look at Graph Theory, world scientific, 1991.

Reference books:

1. S. Arumugam and S. Ramachandran. Invitation to Graph Theory, 2006.
2. C. Vasudev, Graph Theory with Applications, 2006.

ASTRONOMY
(Course Code: 21 UMTE 61)

Semester - VI	Elective - 3	Hours - 6	Credits - 5

Course outcomes: By the end of the course the student will be able to

CO 1. recall the celestial bodies and celestial coordinates (K1).
CO 2. describe Kepler's laws (K2).
CO 3. associate the solar system, solar and lunar eclipses (K2).
CO 4. apply the laws in Newton deductions (K3).
CO 5. analyze the seasons, calendar and time in various countries (K4).
CO 6. build the knowledge of Astro-Physics (K6).

Unit - I:

Celestial sphere - celestial co-ordinates - sidereal time - latitude of place - hour angle and azimuth at raising - diurnal motion - morning and evening stars - circumpolar stars - time taken by a star to rise - diagram of celestial sphere.

(Chapter II)

Unit - II:

The Earth - zones of the earth - perpetual day - dip of horizon - twilight - duration of twilight - twilight throughout night - shortest twilight.

(Chapter III: Sections 1, 5 and 6)

Unit - III:

Refraction - tangent formula - constant of refraction - refraction on horizontal and vertical arcs - refraction of any arc - Cassini's Formula - horizontal refraction - geocentric parallax - horizontal parallax of moon - Kepler's laws - eccentricity of earth's orbit - Newton's law of gravitation - true and eccentric anomalies - mean anomalies - Kepler's Equation.

(Chapter IV, V and VI)

Unit - IV:

Equation of time – seasons - lengths of seasons - causes of seasons - calendar heliocentric parallax - effects of parallax - the moon - phases of moon - lunar day and time - harvest moon - metonic Cycle - lunar mountains.

(Chapter - VII: Sections 1- 3, Chapter VIII and Chapter XIII)

Unit - V:

Eclipses - lunar eclipse - solar Eclipse - condition for a lunar eclipse - totality of a lunar eclipse - radius of cross-section of shadow cone - diameter of section of shadow cone - length of earth's shadow - condition for solar eclipse - total eclipse - major and minor ecliptic limits - synodic period of nodes of Lunar orbit - maximum and minimum eclipses.

(Chapter - XIII)

Text book:

S. Kumaravelu and Susheela Kumaravelu, Astronomy, Janki Calendar Corporation, Sivakasi, 1993.

Reference books:

1. S.K.Sharma, R.K. Gupta and Dhirendra Kumar, Spherical Astronomy, Krishna Prakashan Media (P) Ltd, Meerut, 2014.
2. W M Smart, A Text Book on Spherical Astronomy, 6th edition, revised by R.M. Green, Cambridge University Press, 1977.

NUMERICAL METHODS
(Course Code: 21 UMTE 61)

Semester - VI	Elective - 3	Hours - 6	Credits - 5

Course Outcomes: By the end of course the student will be able to

CO 1. recall the basics of numerical methods of differentiation and integration (K1)
CO 2. compute the roots of algebraic and transcendental equations using numerical methods (K2)
CO 3. solve the simultaneous equations using iterative methods (K3)
CO 4. calculate the derivatives and integration using numerical methods (K3)
CO 5. analyze the various interpolation of functions (K4)
CO 6. derive the solutions for differential equations (K6)

Unit - I:

Algebraic and Transcendental equations - Introduction - errors in numerical computation - iteration method - bisection method - Regula-Falsi method - Newton-Raphson method.

(Chapter 3: Sections 3.0 - 3.5)

Unit - II:

Introduction - simultaneous equations - back substitution - Gauss Elimination method - Gauss-Jordan elimination method - iterative methods – Gauss-Jacobi iteration method - Gauss-seidel iteration method

(Chapter 4: sections 4.0 - 4.4, 4.7 and 4.8)

Unit - III:

Finite differences - introduction - difference operators - other difference operators – interpolation – introduction - Newton's interpolation formulae - central difference interpolation formulae - Lagrange's interpolation formulae - divided differences - Newton's divided differences formula.

(Chapter 6: Sections 6.0 - 6.2,
Chapter 7: sections 7.0 - 7.5)

Unit - IV:

Numerical Differentiation and Integration - Introduction - derivatives using Newton's forward difference formula and Newton's backward difference formula - derivatives using central difference formulae - numerical integration.

(Chapter 8: Sections: 8.0 - 8.3, 8.5)

Unit - V:

Numerical solutions of Ordinary Differential Equations - Introduction - Taylor's series method - Picard's method - Euler's method - Runge - Kutta methods – Predictor-corrector methods - Milne's method.

(Chapter 10: Sections 10.0 - 10.6)

Text book:

S. Arumugam, A. Thangapandi Issac and A. Somasundaram, Numerical methods, Scitech Publications (India) Pvt Ltd, 2008.

Reference books:

1. Singaravelu. A, MA 1251 Numerical methods, Meenakshi academy, 2008.
2. Babu Ram, Numerical methods, Pearson, 2010.

DISCRETE MATHEMATICS
(Course Code: 21 UMTE 61)

Semester - VI	Elective - 3	Hours - 6	Credits - 5

Course Outcomes: By the end of course the student will be able to

CO 1. identify the applications of Pascal's triangle (K1)
CO 2. summarize the combinatorial tools (K2)
CO 3. discuss the Euclidean Algorithm (K2)
CO 4. use combinatorial concepts in Computer Applications (K3)
CO 5. argue the laws of large and small numbers (K5)
CO 6. compare number theory and combinatorics (K5)

Unit - I:

Combinatorial tools –induction - comparing and estimating numbers - inclusion-exclusion - the twin Paradox and the good old Logarithm.

(Chapter 2: Sections 2.1 – 2.3 and 2.5)

Unit - II:

Binomial Coefficients - the binomial theorem - Pascal's triangle - identities in Pascal's triangle - a bird's eye view of Pascal's triangle.

(Chapter 3: Sections 3.1, 3.5-3.7)

Unit - III:

Fibonacci Numbers – Fibonacci's exercise - lots of Identities - a formula for the Fibonacci numbers - combinatorial probability - the law of large Numbers - the law of small numbers.

(Chapter: 4, Chapter 5: Sections 5.3 and 5.4)

Unit - IV:

Integers - divisors and primes - divisibility of integers – primes - factorization into primes - Fermat's little theorem.

(Chapter 6: Sections 6.1- 6.3 and 6.5)

Unit - V:

The Euclidean Algorithm – congruences - number theory and Combinatorics - testing Prime

(Chapter 6: Sections 6.6, 6.7, 6.9 and 6.10)

Text book:

L. Lovasz, J. Pelikan, K. Vesztergombi, Discrete Mathematics - Elementary and Beyond, Springer-Verlag, New York, 2003.

Reference books:

1. Richard Johnsonbaugh, Discrete Mathematics, sixth edition, Pearson, 2008.
2. Seymour Lipschutz, Marc Laras Lipson, Varsha H. Patil, Discrete Mathematics, Schaum's outline series, 2017.

SET THEORY
(Course Code: 21 UME 11)

Semester - I	ECC (Self Study)	Credits - 4

Course Outcomes: By the end of the course the student will be able to

CO 1. list out the sets and the operations on sets (K1)
CO 2. discuss the equivalence relations (K2)
CO 3. examine the knowledge of functions and binary operations (K3)
CO 4. apply the law of trichotomy and the properties of numbers to solve problems (K3)
CO 5. analyze the number system and well ordering principle (K4)
CO 6. create confidence to face the competitive examination (K6)

Eligibility: All UG students except from the Department of Mathematics

Unit - I:

Sets - operation on sets – union – intersection – difference - complement of a set - symmetric difference.

(Chapter 1: Sections 1.1 - 1.7)

Unit - II:

Cartesian product - relations - equivalence relations - partial order.

(Chapter 1: Section 1.8, Chapter 2: Sections 2.1 - 2.3)

Unit - III:

Functions - Binary operations

(Chapter 2: Sections 2.4 - 2.5)

Unit - IV:

Number systems - Peano's postulates - addition and multiplication in N - Properties- order in N - law of trichotomy - well ordering principle.

(Chapter 3: Sections 3.0-3.1)

Unit - V:

The integers - addition and multiplication properties - order relation in Z- Identification of positive integers with natural numbers - Divisibility in Z.

(Chapter 3: Sections 3.2 - 3.3)

Text Book:

Dr. S. Arumugam and A. Thangapandi Issac, Set theory, Number system and Theory of Equations, New gamma Publishing house.

Reference Books:

1. S. B. Malik, Basic Number Theory, Vikas Publishing House Private Limited, Reprint 2006.
2. Daniel W. Cunningham, Set Theory, A first course.

ANALYTICAL GEOMETRY OF TWO DIMENSION
(Course Code: 21 UME 21)

Semester - II	ECC (Self Study)	Credits - 4

Course Outcomes: By the end of the course the student will be able to

CO 1. recollect the properties of straight lines and circles (K1)
CO 2. discuss the role of transformations and invariants (K2)
CO 3. discuss the concepts of polar system and conic sections (K2)
CO 4. solve problems using tangents and normals (K3)
CO 5. categorize the conics (K4)
CO 6. develop the skill to face competitive examination (K6)

Eligibility: For all major students

Unit - I: METRIC PROPERTIES IN PLANE

Fundamental notions - transformations and invariants - Examples

(Chapter 1: Sections 1.1 - 1.2)

Unit - II: STRAIGHT LINES IN PLANE

Different forms - A point in relation to a straight line - Pair of Straight lines

(Chapter 2: Sections 2.1 - 2.3)

Unit - III: CIRCLES IN PLANE

Different forms - A point in Relation to a Circle - A line in Relation to a circle.

(Chapter 3: Sections 3.1- 3.3)

Unit - IV:

Tangents and normals - Pole and Polar - System of Circles.

(Chapter 3: Sections 3.4 - 3.6)

Unit - V:

Some Fundamental Notions – Parabola – Ellipse – Hyperbola.

(Chapter 4: Sections 4.1- 4.4)

Text Book:

D. Chatterjee, Analytical geometry of Two Dimension, Narosa publishing House, 1999.

Reference Book:

K.C.Mathew, S.Veeraraghavan and T.Raghavan, A Text Book of Co-ordinate Geometry of two and three dimensions, S.Chand and Company (Pvt), LTD, 1988.

PYTHON
(Course Code: 21 UME 31)

Semester - III	ECC (Self Study)	Credits -4

Course Outcomes: By the end of the course the student will be able to

CO 1. identify the errors in the given program (K1)
CO 2. describe the basic operations in python programming (K2)
CO 3. apply the decision making and looping statements (K3)
CO 4. break down a program in to smaller functions (K4)
CO 5. select the tools to write the given program (K4)
CO 6. develop a python program for the given real time problem (K6)

Unit - I:

Data types in python: Comments in python-Docstrings-How python sees variables – Data types in Python – Built-in data types-Bool Data type – Sequences in python-Sets – Literals in python – Determining the data type of a variable – What about characters – User-defined data types – Constants in python – Identifiers and Reserved words – Naming conventions in python.

(**Chapter 3)**

Unit - II:

Operators in Python: Operator - Arithmetic operators – Assignment operators – Unary minus operator – Relational operators – Logical operators – Boolean operators – Bitwise operators – Membership operators – Identity operators – Operator precedence and Associativity – mathematical Functions.

(**Chapter 4)**

Input and Output: Output statements – Input statements.

(**Chapter 5)**

Unit - III:

Control statements: Control statements – The if statement – A word on indentation – The if…else statement – The if…elif…else statement- The while loop – The for loop – Infinite loops – Nested loops – The else suite – The break statement – The continue statement – The pass statement – The assert statement – The return statement

(**Chapter 6)**

Unit - IV:

Strings and Characters: Creating strings – Length of a string – Indexing in strings – Slicing the strings – Repeating the strings – Concatenations of strings – Checking membership – Comparing strings.

Functions: Difference between a function and a method – Defining a function – Calling a function – Returning results from a function – Returning multiple values from a function – Functions are first class objects – Pass by object reference – Formal and actual arguments – Positional arguments – Keyword arguments – Default arguments – Variable length arguments – Local and global variables – The global keyword – Passing a group of elements to a function – Recursive functions .

(**Chapter: 8, 9)**

Unit - V:

Lists and Tuples: List – Creating lists using range() function – Updating the elements of a list – Concatenation of two lists – Repetition of lists – Membership in lists – Aliasing and cloning lists – Methods to process lists – Finding biggest and smallest elements in the list – Sorting the list elements – Number of occurrences of an element in the list – Finding common elements in two lists – Storing different types of data in a list – Tuples – Creating tuples – accessing the tuple elements – Basic operations on tuples – Functions to process tuples.

(**Chapter 10**)

Dictionary: Operations on dictionaries – Dictionary methods – Using for loop with dictionaries.

(**Chapter 11)**

Text book:

Dr. R. Nageswara Rao, Core python programming, Second edition, Dreamtech press, 2018.

Reference books:

1. Joseph Joyner, Python programming for beginners (Python programming language tutorial), Kindle edition.
2. Allen Downey, Jeffrey Elkner, Chris Meyers, Learning with Python, dream tech press, 2015.

R PROGRAMMING
(Course Code: 21 UME 32)

Semester - III	ECC (Self Study)	Credits – 4

Course Outcomes: By the end of the course the student will be able to

CO 1. recall the basics of R programming (K1)
CO 2. explain how to use R for statistical programming, computation, graphics, and modeling (K2)
CO 3. apply functions to Matrix Rows and Columns (K3)
CO 4. outline simulation programming in R (K4)
CO 5. create Data Frames (K6)
CO 6. develop R programs for the given task (K6)

UNIT - I:

Gainting started - Introduction to Functions - Important R Data Structures - Gainting Help - vectors - Declarations - Common Vector Operations - Using all() and any() - Vectorized Operations - NA and NULL Values

UNIT - II:

Filtering - The Selection Function which() - The ifelse() Function - Vector Element Names - Matrices and Arrays - General Matrix Operations - Filtering on Matrices - Applying Functions to Matrix Rows and Columns - Adding and Deleting Matrix Rows and Columns - More on the Vector/Matrix Distinction - Higher-Dimensional Arrays - Lists - Creating Lists - General List Operations - Accessing List Components and Values - Applying Functions to Lists - Recursive Lists.

UNIT - III

Data frames - Creating Data Frames - Other Matrix-Like Operations - Merging Data Frames - Applying Functions to Data Frames - Factors and Tables - Factors and Levels - Common Functions Used with Factors

UNIT - IV

Working with Tables - Other Factor- and Table-Related Functions - R Programming Structures - Control Statements - Arithmetic and Boolean Operators and Values - Default Values for Arguments - Return Values - Functions Are Objects - Environment and Scope Issues - No Pointers in R - Writing Upstairs - Recursion - Replacement Functions - Anonymous Functions

UNIT - V

Doing Math and Simulations in R - Math Functions - Functions for Statistical Distributions - Sorting - Linear Algebra Operations on Vectors and Matrices - Set Operations - Simulation Programming in R.

Practical List:

1. Write a program that prints ‘Hello World’ to the screen.
2. Write a program that asks the user for a number n and prints the sum of the numbers 1 to n
3. Write a program that prints a multiplication table for numbers up to 12.
4. Write a function that returns the largest element in a list.
5. Write a function that computes the running total of a list.
6. Implement the following sorting algorithms: Selection sort, Insertion sort, Bubble Sort
7. Implement matrices addition, subtraction and Multiplication

Text Book

1. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011.

Reference Books

1. Michael J. Crawley, “The R Book”, John Wiley & Sons Ltd, 2007.
2. Jared P. Lander, “R for Everyone”, Pearson Education, Inc., 2014.

CLASSICAL ALGEBRA
(Course Code: 21 UME 33)

Semester - III	ECC (Self Study)	Credits - 4

Course Outcomes: By the end of the course the student will be able to

CO 1. describe exponential theorem and its applications (K1)
CO 2. discuss the binomial and the logarithmic series and their applications (K2)
CO 3. discuss the increase or decrease of the root by a given number (K2)
CO 4. demonstrate Descartes's rule of signs (K3)
CO 5. analyze the relation between roots and coefficients (K4)
CO 6. create efficiency to face competitive examinations (K6)

Eligibility: For all major students except mathematics major students.

Unit - I:

Binomial series: Binomial Theorem – Statement and Proof – Application to summation.

(Chapter 3: Sections 1,2 & 10, 11)

Unit - II:

Exponential Theorem – Statement and Proof – Application to summation.

(Chapter 4: Sections 1 to 4)

Unit - III:

Logarithmic series: Logarithmic series theorem – Statement and Proof – application to summation.

(Chapter 4: Sections 5 to10)

Unit - IV:

Theory of equations: Relation between the roots and coefficients – reciprocal equation**.**

(Chapter 6: Sections 1 to 11 & 16)

Unit - V:

Theory of equations: To increase or decrease the root by a given numbers – Descartes's rule of sign.

(Chapter 6: Sections 17,18 & 24)

Text Book:

T.K. Manicavachagom Pillay, T. Natarajan and K.S. Ganapathy, Algebra Volume I, S. Viswanatham (printers and publishers) Pvt. Ltd., 1999.

Reference Books:

1. S. Arumugam and Isaac, Allied Mathematics paper I, New Gamma Publishing House, 1996.
2. S. Arumugam and Isaac, Allied Mathematics paper IV, New Gamma Publishing House, 1996.

DATA ANALYTICS
(Course Code: 21 UME 41)

Semester - IV	ECC (Self Study)	Credits - 4

Course Outcomes: By the end of the course the student will be able to

CO 1. recall the basics of Statistics and Data Analysis (K1)
CO 2. recall the fundamentals of Python (K1)
CO 3. describe the types of data visualization (K2)
CO 4. apply classification techniques in Data Analytics (K3)
CO 5. outline Challenges for Big Data Analytics (K4)
CO 6. Summarize Data Analytics for Pharmaceutical Discoveries (K5)

UNIT-I:

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources; ***Data Analysis****:* Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

(Textbook – 1, Chapters: 1 - 3 & Textbook – 2, Chapters: 1 - 3)

UNIT- II:

Machine Learning: Introduction and Concepts, Differentiating algorithmic and model-based frameworks; Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbour, Regression & Classification; ***Data Visualization:*** Introduction, Types of Data Visualization, Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

(Textbook – 2, Chapter: 4, Textbook – 3, Chapter: 3, 9)

UNIT - III

Supervised Learning with Regression and Classification Techniques -1: Bias-Variance, Dichotomy Model, Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines. ***Supervised Learning with Regression and Classification techniques -2:*** Ensemble Methods: Random Forest Neural Networks Deep learning.

(Textbook – 4, Chapters: 4 - 5)

UNIT - IV

Unsupervised Learning and Challenges for Big Data Analytics: Clustering, Associative Rule Mining, Challenges for big data analytics. ***Prescriptive Analytics:*** Creating data for analytics through designed experiments, Creating data for analytics through Active Learning, Creating data for analytics through Reinforcement learning. ***Introduction to Python Packages***: Fundamentals of Python, Inserting and Exporting Data, Data Cleansing, Checking and Filling Missing Data, Merging Data, Operations, Joins.

(Textbook – 4, Chapters: 1 - 3)

UNIT - V

Applications of Data Analytics: Technologies for visualization, Bokeh (Python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods used in data analytics. ***Applications and Practical Systems for Healthcare*:** Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer-Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.

(Textbook – 5, Part – 1 and Part – 2)

Text Books:

1. Roger Sapsford and Victor Jupp, "Data collection and analysis", SAGA publisher, 2nd Edition, 2003.
2. Introduction to Data Science, Davy Cielen, Arno D B Meysman and Mohamed Ali, Manning, dreamtech press.
3. E. Alpaydin, "Introduction to Machine Learning", 2nd Edition, MIT Press, 2010.
4. Hefin I. Rhys, "Machine learning with R, the tidyverse, and mlr, e-book, online, MANNING Publisher, 2020.
5. Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement", Wiley, 2016.

References:

1. Hastie, Trevor, et al., "The elements of statistical learning", Vol. 2. No.1, New York: Springer, 2009.
2. Samir Madhavan., "Mastering Python for Data Science", Packt, 2015.
3. Mark Lutz., "Learning Python" O'Reilly, 5th Edition, 2013.
4. Tiffany Bergin, "An Introduction to Data analysis – Quantitative, Qualitative and Mixed Models", SAGA Publisher, 2018
5. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.

STATISTICAL METHODS
(Course Code: 21 UME 42)

Semester - IV	ECC (Self Study)	Credits - 4

Course Outcomes: By the end of the course the student will be able to

CO 1. explain the concept of sampling design and methods (K2)
CO 2. discuss the rules and types of classification (K2)
CO 3. apply various statistical tools for solving real life problems (K3)
CO 4. analyze the primary and secondary data (K4)
CO 5. classify diagrammatic representation and graphic presentation (K4)
CO 6. design questionnaire for collecting data (K6)

Eligibility: For all UG students

Unit - I: Collection of Data

Primary and Secondary Data, Direct Personal Observation, Indirect Oral Interview, Information Through Agencies, Mailed Questionnaires, Schedules sent through Enumerators, Sources of Secondary Data, Precautions in the use of Secondary Data, Framing Questionnaires, Theoretical Questions.

(Chapter 4)

Unit - II: Sampling Design

Finite and infinite population. Hypothetical and Existent Population, Census method, Sample Method, Essentials of Sampling. Methods of sampling, Random Sampling method, Non-Random Sampling, Simple Random Sampling, Restricted Random Sampling, Stratfied Sampling, Systematic Sampling, Cluster Sampling, Judgement Sampling, Quota Sampling, Convenience or churk Sampling, Statistical laws, The Law of Statistical regularity, The Law Inertia of Large Numbers, Statistical Error, Measurement of Errors, Test of Reliability of Samples, Theoretical Questions.

(Chapter 5)

Unit - III: Classification and Tabulation

Introduction, Meaning of Classification, Chief Characteristics of Classification, objects of Classification, Rules of Classification, Types of Classifications, Geographical Classification, Chronological Classification, Qualitative Classification, Quantitative Classification, Statistical Series, Types of Series ,Frequency Distribution, Continous Frequency Distribution, class frequency, Magnitude of class Intervals, Cumulative Frequency Distribution, Two-way Frequency Distribution, Tabulation of data, Meaning, objects, Difference between Classification and Tabulation, Parts of tabulation, Structure of Tabulation, Rules for Tabulation, Types of tables, On the basis of Originality, Illustration, Theoretical Questions, Practical Problems.

(Chapter 6)

Unit - IV: Diagrammatic Representation

Limitations of a diagram, rules for making a diagram, types of diagram, one dimensional diagram, two dimensional diagram (Area of surface diagram), three dimensional diagram, Pictogram, cartogram, choice or selection of a diagram, Theoretical questions, practical problems.

(Chapter 7)

Unit - V: Graphic Presentation

Advantages of Graphic Presentation, Construction of a graph, General Rules, Difference Between Diagram and graph, Graph of Frequency Distribution: Histogram,

Frequency Polygon, Frequency Curve, Ogive or Cumulative Frequency Curves, more than Ogive, Graph of Time Series: Horizontal Line Graph of Histogram, Fale Base lines, Silhouette (Net Balance Graph) Range of Variation Graph, Component or Band Graph, Z Curve, Theoretical Questions.

(Chapter 8)

Text Book:

R. S. N, Pillai and Bagavathi, Statistics, Theory and Practice, S. Chand and Company Ltd, 2013.

Reference Book:

S. C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11th Edition, Sultan Chand and Sons, 1982.

QUANTIATIVE APTITUDE
(Course Code: 21 UME 51)

Semester - V	ECC (Self Study)	Credits - 4

Course Outcomes: By the end of the course the students will be able to

CO 1. explain the concepts of coding, decoding and ranking tests (K2)
CO 2. discuss the problems on digit aptitude (K2)
CO 3. apply the number analogy test to solve problems (K3)
CO 4. solve the problems on date, calendar and clock (K3)
CO 5. Evaluate the problems on permutations and combinations (K5)
CO 6. develop the reasoning ability (K6)

Eligibility: For all UG students

Unit - I:

Coding – Decoding Test - Direction Sense Test.

(Text Book 1: Chapters 2 and 3)

Unit - II:

Ranking Test - Seating Arrangement Test – Date, Calendar and Clock - Mathematical operations – Mathematical problems.

(Text Book 1: Chapters 5, 6, 7, 8 and 9)

Unit - III:

Analogy – Dice – Number Analogy Test – Matrix.

(Text Book 1: Chapters 12, 13, 14 and 15)

Unit - IV:

Puzzle Test – Inequality – Digit Aptitude.

(Text Book 1: Chapters 22, 23 and 24)

UNIT - V;

Permutations and Combinations – Probability – True Discount – Banker's Discount – Heights and Distances – Odd man out & Series.

(Text Book 2: Chapters 30, 31, 32, 33, 34 and 35)

Text Book:

1. Dr. Lal, Mishra & Kumar, Multi-Dimensional Reasoning (Verbal and Non-Verbal), Upkar Prakashan, Agra,
2. Dr. R. S. Aggarwal, Quantitative Aptitude (for competitive examinations), S. Chand and company Limited, 2017

Reference Book:

U. Mohan Rao, Quantitative Aptitude (For Competitive Examinations), Scitech Publications (India) Pvt, Ltd, Chennai, 2012.

DIFFERENTIATION AND INTEGRATION
(Course Code: 21 UME 61)

Semester - VI	ECC (Self Study)	Credits -4

Course Outcomes: By the end of the course the student will be able to

CO 1. recall differentiation of various forms of functions (K1)
CO 2. discuss problems using Leibnitz theorem (K2)
CO 3. explain the concepts of curvature, evolutes and envelopes (K2)
CO 4. apply the method of substitution to evaluate integrals (K3)
CO 5. apply the methods to integrate rational and irrational functions (K3)
CO 6. compute integrals using integration by parts (K3)

Eligibility: All UG students except from the Department of Mathematics

Unit - I:

Derivatives of some standard functions -The chain rule - Differentiation of inverse functions - Differentiation by transformation - Logarithmic differentiation – Parametric differentiation - Differentiation of function with respect to functions - Differentiation of implicit function.

(Part I: Chapter 2: Sections 2.3 - 2.10)

Unit - II:

Higher Derivatives - n^{th} derivatives and Leibnitz theorem.

(Part I: Chapter 2: Sections 2.11 and 2.12)

Unit - III:

Curvature-Evolute- Envelope.

(Part I: Chapter 3: Sections 3.4 - 3.6)

Unit - IV:

Some simple integrals- method of substitution - integration of rational functions - Integration of irrational functions - Integration of trigonometric functions

(Part II: Chapter 2: Sections 2.1 - 2.5)

Unit - V:

Evaluation of definite integrals –Integration by parts - reduction formulae

(Part II: Chapter 2: Sections 2.6 - 2.8)

Text Book:

Dr. S. Arumugam and Mr. A. Thangapandi Issac, Calculus, New Gamma Publishing House, 2014.

Reference Books:

1.Tom M. Apostol, Calculus, Wiley Student Edition, 2011.

2. Howard Anton, Irl Bivens and Stephen Davis, Calculus, 7^{th} edition, Wiley India Pvt. Ltd., 2007.