MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL

DEPARTMENT OF MATHEMATICS

B.Sc. MATHEMATICS

SYLLABUS TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2021-2022

(CHOICE BASED CREDIT SYSTEM)

Mother Teresa Women's University, Kodaikanal
Department of Mathematics
Choice Based Credit System (CBCS)
(2021-2022 onwards)
B.Sc Mathematics

1. About the Programme

B.Sc. (Bachelor of Science) Mathematics is a three year programme to encourage students in subject area by creates interest and sprit in mathematics to help them potential, to become excellent mathematician and develop knowledge in logical and analytical thinking.

2. Programme Educational Objectives (PEOs)

The B.Sc. Mathematics program describe accomplishments that graduates are expected to attain within five to seven years after graduation

PEO1	Acquire knowledge in functional areas of Mathematics and apply in all the fields of learning.
PEO2	Recognize the need for lifelong learning and demonstrate the ability to explore some mathematical content independently.
PEO3	The graduates will become successful professionals through logical and analytical thinking abilities.
PEO4	Employ mathematical ideas encompassing logical reasoning, analytical, numerical ability, theoretical skills to model real-world problems and solve them.
PEO5	Develop critical thinking, creative thinking, self confidence for eventual success in career.
PEO6	Analyze , interpret solutions and to enhance their Entrepreneurial skills, Managerial skill and leadership
PEO7	To prepare the students to communicate mathematical ideas effectively and develop their ability to collaborate both intellectually and creatively in diverse contexts.
PEO8	Rewarding careers in Education, Industry, Banks, and pursue higher studies.
PEO9	The graduates will work and communicate effectively in inter-disciplinary environment, either independently or in a team, and demonstrate leadership qualities.

3. Eligibility : + 2 pass with General Mathematics

4. General Guidelines for PG Programme

i. **Duration:** The programme shall extend through a period of 6 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.
ii. **Medium of Instruction:** English
iii. **Evaluation:** Evaluation of the candidates shall be through Internal Assessment and External Examination.

- **Evaluation Pattern**

Evaluation Pattern	Theory		Practical	
	Min	Max	Min	Max
Internal	10	25	10	25
External	30	75	30	75

- **Internal (Theory): Test (15) + Assignment (5) + Seminar/Quiz(5) = 25**
- **External Theory: 75**

- **Question Paper Pattern for External examination for all course papers.**

Max. Marks: 75 **Time: 3 Hrs.**

S.No.	Part	Type	Marks
1	**A**	**10*1 Marks=10** Multiple Choice Questions(MCQs): 2 questions from each Unit	**10**
2	**B**	**5*4=20** Two questions from each Unit with Internal Choice (either / or)	**20**
3	**C**	**3*15=45** Open Choice: Any three questions out of 5 : one question from each unit	**45**
Total Marks			**75**

*** Minimum credits required to pass: 156**

- **Project Report**

A student should select a topic for the Project Work at the end of the third semester itself and submit the Project Report at the end of the fourth semester. The Project Report shall not exceed 75 typed pages in Times New Roman font with 1.5 line space.

- **Project Evaluation**

There is a Viva Voce Examination for Project Work. The Guide and an External Examiner shall evaluate and conduct the Viva Voce Examination. The Project Work carries 100 marks (Internal: 25 Marks; External (Viva): 75 Marks).

5. Conversion of Marks to Grade Points and Letter Grade (Performance in a Course/ Paper)

Range of Marks	Grade Points	Letter Grade	Description
90 – 100	9.0 – 10.0	O	Outstanding
80-89	8.0 – 8.9	D+	Excellent
75-79	7.5 – 7.9	D	Distinction
70-74	7.0 – 7.4	A+	Very Good
60-69	6.0 – 6.9	A	Good
50-59	5.0 – 5.9	B	Average
40-49	4.0 – 4.9	C	Satisfactory
00-39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

6. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students with 71% to 74% of attendance must apply for condonation in the Prescribed Form with prescribed fee. Students with 65% to 70% of attendance must apply for condonation in the Prescribed Form with the prescribed fee along with the Medical Certificate. Students with attendance lesser than 65% are not eligible to appear for the examination and they shall re-do the course with the prior permission of the Head of the Department, Principal and the Registrar of the University.

7. Maternity Leave

The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and the Registrar.

8. Any Other Information

In addition to the above mentioned regulations, any other common regulations pertaining to the UG Programmes are also applicable for this Programme.

B.SC. MATHEMATICS CURRICULUM

S. No.	Course Code	Title of Course	Credits	Hours		Maximum Marks		
				T	P	CIA	ESE	Total
Semester I								
1.	U21LTA11	Part-I Tamil I	3	6	-	25	75	100
2.	U21LEN11	Part-II English I	3	6	-	25	75	100
3.	U21MTT11	Core – I Calculus	4	5	-	25	75	100
4.	U21MTT12	Core – II Classical Algebra	4	6	-	25	75	100
5.	U21PHA11	Allied I Ancillary Physics	4	5	-	25	75	100
6.	U21EVS11	Environmental Studies	2	2	-	25	75	100
7.	U21PEPS11	Professional English –I	4	6	-	25	75	100
		Total	**24**	**36**				**700**
Semester II								
8.	U21LTA22	Part-I Tamil II	3	6	-	25	75	100
9.	U21LEN22	Part- II English II	3	6	-	25	75	100
10.	U21MTT21	Core-III Analytical Geometry 3D	4	5	-	25	75	100
11.	U21MTT22	Core- IV Differential Equations & Laplace Transforms	4	5	-	25	75	100
12.	U21PHA22	Allied –II Physics Practical	4	-	5	25	75	100
13.	U21VAE21	Value Education	3	3	-	25	75	100
14.	U21PEPS22	Professional English – II	4	6	-	25	75	100
		Total	**25**	**36**				**700**
Semester III								
15.	U21LTA33	Part I Tamil-III	3	6	-	25	75	100
16.	U21LEN33	Part II English- III	3	6	-	25	75	100
17.	U21MTT31	Core - V Vector Calculus, Fourier Series & Fourier Transforms	4	5	-	25	75	100
18.	U21MTA33	Allied III Ancillary Mathematical Statistics –I	4	5	-	25	75	100
19.	U21MTE311 / U21MTE312 / U21MTE313	Elective I Numerical Methods/ Stochastic Process/ Principles of Experimental Design	3	4	-	25	75	100
20.	U21MSS31	SBE I-Managerial skills	2	2	-	25	75	100

21.	U21MTN31	Non Major Elective –I	2	2	-	25	75	100
22.	U21PEPS33	Professional English III	4	6	-	25	75	100
Total			**25**	**36**				**800**
Semester IV								
23.	U21LTA44	Part I Tamil IV	3	6	-	25	75	100
24.	U21LEN44	Part II English IV	3	6	-	25	75	100
25.	U21MTT41	Core-VI Statics	4	4	-	25	75	100
26.	U21MTT42	Core-VII Sequence & Series	4	4	-	25	75	100
27.	U21MTA44	Allied- IV Ancillary Mathematical Statistics – II	4	4	-	25	75	100
28.	U21MTE421/ U21MTE422/ U21MTE423	Elective- II Programming in C & C++/ Automata Theory/ Knowledge for Industry	3	3	-	25	75	100
29.	U21CSS42	SBE II-Computer Skills for Office Management	2	2	-	25	75	100
30.	U21MTN42	Non Major Elective –II	2	2	-	25	75	100
31.	U21PEPS44	Professional English IV	4	6	-	25	75	100
Total			**29**	**37**				**800**
Semester V								
32.	U21MTT51	Core-VIII Dynamics	4	5	-	25	75	100
33.	U21MTT52	Core-IX Abstract Algebra	4	5	-	25	75	100
34.	U21MTT53	Core-X Real Analysis	4	5	-	25	75	100
35.	U21MTT54	Core- XI Operations Research –I	4	5	-	25	75	100
36.	U21MTT55	Core- XII Theory Of Numbers	4	5	-	25	75	100
37.	U21MTE531/ U21MTE532/ U21MTE533	Elective III Fuzzy Sets and Fuzzy Numbers / Mathematical Modeling / Data Structures and Algorithms	3	3	-	25	75	100
38.	U21MTS53	SBE:III Mathematical Aptitude	2	2	-	25	75	100
Total			**25**	**30**				**800**
Semester VI								
39.	U21MTT61	Core- XIII -Linear Algebra	4	5	-	25	75	100
40.	U21MTT62	Core- XIV Complex	4	5	-	25	75	100

		Analysis						
41.	U21MTT63	Core- XV Operation Research – II	4	5	-	25	75	100
42.	U21MTT64	Core- XVI Graph Theory	4	5	-	25	75	100
43.	U21MTT65	Core -XVII Discrete Mathematics	4	5		25	75	100
44.	U21MTE641/ U21MTE642	Elective-IV Astronomy / Mathematical Cryptography	3	3	-	25	75	100
45.	U21MTS64	SBE- IV- Operations Research Lab	2	2	-	25	75	100
46.	U21EAS61	Extension Activities(NSS/NCC/RRC/ YRC/ PYE)	3	-	-	25	75	100
Total			**28**	**30**		**200**	**600**	**800**
Total Credits			**156**	**205**		**Total Marks**		**4600**

Non Major Elective

The candidates, who have joined the UG Programme, can also undergo Non Major Elective offered by other Departments

Non Major Elective- For Other Department

Semester –III

NME	Course code	Course Name
I	U21MTN31	Resource Management Techniques

Semester –IV

NME	Course code	Course Name
II	U21MTN42	Numerical Methods

Additional Credit Courses (Two Credit courses)

U21MA031: Online Course – III Semester-2 Credits
U21MAI41: Internship – IV Semester-2 Credits

Value added course – V Semester: 2 Credits

S.No	Course code	Course Name
1	U21MAV51	Numerical Methods Lab Using C++

B.Sc. Physics / Chemistry: Ancillary Mathematics I & II

Semester I
Course code: U21MAA11 Ancillary Mathematics I 5 Hours/ 4 credits

Semester - II
Course code: U21MAA22 Ancillary Mathematics II 5 Hours /4 Credits

Programme Outcomes:

PO.No.	Upon completion of this course the students will be able to
PO 1	think critically, evaluate analytically and apply the acquired knowledge of their discipline in related scenario.
PO 2	formulate hypothesis, design experiments, use appropriate tools and interpret the results.
PO 3	demonstrate the precise understanding of the principles and theories of their discipline through experiments.
PO 4	enhance the communicative skills and gain confidence to disseminate knowledge through oral/verbal communications effectively at various situations.
PO 5	identify the different roles in an organizational structure of the work place and carry out multiple roles in social responsibilities.

Programme Specific Outcomes:

PSO. No	upon completion of this course the students will be able to	PO MAPPED
PSO-1	perceive the relevance of the subject in various fields such as science, technology, business and industries.	PO-3
PSO-2	interpret the graphical and numerical data and apply the analytical, theoretical and computational skills to solve problems.	PO-1 PO-2 PO-3
PSO-3	acquaint with the knowledge on the effects of changing conditions in real life systems to construct mathematical models and excel in various decision making tasks	PO-2 PO-3
PSO-4	understand mathematical ideas and foundations of mathematics to develop proficiency in Mathematics	PO-4
PSO-5	engage in activities directly benefiting the broader community and acquire job oriented knowledge	PO-3 PO-5

SEMESTER – I

COURSE CODE	U21MTT11	CALCULUS	L	T	P	C
CORE -I			5	-	-	4

Objectives:

- To learn the different concepts of differential and integral calculus.
- To learn will acquire basic knowledge of integration
- To learn will become proficient in multiple integrals and its applications
- The learner will gain concepts of change of variables

Unit-I: Successive differentiation:
Introduction- the nth derivative-standard results- examples-Trigonometrically transformation – formation of equation involving derivatives-Expansion of function - Leibnitz Theorem and its application Maxima and Minima of Function of two variables.

Unit-II: Curvature:
Introduction of Curvature-circle- Radius of Curvature and Center of Curvature in Cartesian formula for the radius of Curvature-coordinates of the center of curvature - evolute and involute – radius of curvature when the curve is given in polar coordinates- Form and Polar Form p - r equation; Pedal Equation of a Curve – Chord of a Curvature.

Unit-III: Double Integral:
Definition of the Double Integral –Evaluation of double integral – solved problem- exercise - Double integral in polar Co- ordinates- solved problem - exercise.

Unit-IV: Triple Integral:
Definition – Examples- Applications of multiple integrals – finding the area between two coordinates- coordinate of the center of gravity-moment of inertia of an area- properties - Change of variables in the case two variables - Change of variables in the case three variables.

Unit-V: Beta and Gamma Functions:
Definitions of Beta and Gamma Functions – Convergence of Γ(n) – Recurrence formula of Gamma functions – Properties of Beta functions – Relation between Beta and Gamma functions – Solved problems - Applications of Gamma functions to multiple Integrals.

Text Book:

1. **S.Narayanan and T.K.Manickachagam Pillai,** "Calculus-Volume I & II", Viswanathan Printers and Publishers - 2011.
   Unit I – Calculus – Volume I: Chapter 3 and Chapter 8-Sec 4,
   Unit II - Calculus – Volume I: Chapter 10.2.1 to 3.1
   Unit III - Calculus – Volume I: Chapter 5- Sec. 1 to 3.1
   Unit IV – Calculus - Volume II: Chapter 5- Sec. 4 to 5.4 and Chapter 6

Unit V - Calculus - Volume II: Chapter 7 – Sec. 2.1 to 6

Reference books:

1. **P.Kandasamy and K.Thilagavathi,**"Mathematics for Branch I: Vol I and Vol II"- S.Chand and Company Ltd., - New Delhi - 2004.
2. **Arumugam Issac –** "Calculus" – New Gamma Publishing House – Jan 2011.

Course Outcome:

On the successful course completion, students will be able to:		Cognitive Level
CO1	identify areas in Mathematics and study of functions expansion	K1
CO2	understand the concepts of Radius of Curvature, Cartesian Form, p - r equations	K2
CO3	apply the concept of change of variables in double and triple integrals.	K3
CO4	apply double, triple integral to find the area and volume respectively.	K3
CO5	apply the Beta and gamma function to solve the multiple integrals.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT12	CLASSICAL ALGEBRA	L	T	P	C
CORE -II			6	-	-	4

Objectives:

- To impart skills in the various applications of algebraic methods.
- The learner will become proficient in expansion and summation of function.
- Understanding relation between roots and coefficients of equations, sign changes, reciprocals.
- To understand terms of series, summation and its changes

Unit-I: Binomial theorem:

Introduction of Binomial theorem – Greatest term in the expansion of $(1 + x)^n$ - sum of the coefficients - Multinomial theorem - Binomial theorem for rational index – Particular cases –Summation of binomial series - Approximate values- solved problems.

Unit-II: Exponential Limits:

Introduction of Exponential limit – Exponential theorem – Summation – Logarithmic series – Modification of Logarithmic Series – Euler's constant – Series summed by Logarithmic series – Application of exponential and logarithmic series to limits and approximation - Logarithms of Complex Numbers.

Unit-III: Summation:

Summation of series – Definition and Examples - Application of partial fraction- Summation by difference series – Recurring series – To find r^{th} order of a Recurrence series when 2r terms are given - Generating function.

Unit-IV: Theory of Equations:

Remainder Theorem – Relation between roots and coefficients of equations Symmetric Function of Roots – Newton's Theorem on the sum of the powers of the roots. Transformations of Equations: Roots with signs changes - Reciprocal roots.

Unit-V: Reciprocal Equation:

Introduction-Standard form of reciprocal equation – Examples – To increase/ decrease the roots of the equation by given quantity – Removal of terms – Transformation – Discard's rule of signs - Solutions of Numerical Equations: Solutions of Numerical Equations – Newton's methods of divisors – Horner's method.

Text book:

1. **T.K.Manickachagam Pillai and others**, "Algebra Volume I", - S. Viswanathan Printers & Publisher Pvt, Ltd., - 2010.
   Unit – I - Algebra Volume I – Chapter 3
   Unit – II - Algebra Volume I – Chapter 4

Unit – III - Algebra Volume I – Chapter 5
Unit – IV - Algebra Volume I – Chapter 6 – Section 1 to 15.2
Unit – V - Algebra Volume I – Chapter 6 – Section 15.3 to 30

Reference book:

1. **P. Kandasamy and K.Thilagavathy**, "Mathematics, Volume I", S.Chand and Company Ltd., New Delhi – 2004.

Course Outcome:

On the successful course completion, students will be able to:		Cognitive Level
CO1	knowledge in Binomial, Exponential, Logarithmic series and summation of series	K1
CO2	knowledge in methods to find an approximate roots of the equations	K2
CO3	apply the all tests to find the convergence or divergence of an infinite series.	K3
CO4	find the number of positive and negative roots of polynomial equation	K3
CO5	analyze the relation between roots and coefficients of the polynomial equations	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	S	S	S	S	M	S
CO2	S	M	M	S	S	S	S	S	M	M
CO3	S	M	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21PHA11	ANCILLARY PHYSICS	L	T	P	C
ALLIED I			5	-	-	4

Objective:

- To impart preliminary knowledge on basic concepts of physics to chemistry and mathematic students to make them understand the fundamentals of core physics.

Unit- I: Mechanics:

Centre of Gravity – Centre of Gravity of a solid hemisphere – Hollow hemisphere – Centre of Gravity of a solid cone – Centre of Gravity of a solid tetrahedron. States of Equilibrium: Equilibrium of a rigid body – Stable, unstable and neutral equilibrium – Example. Stability of Floating bodies – Meta center – Determination of Metacentric height of a ship.

Unit II: Properties of Matter:

Stress – Strain – Young's modulus – Behavior of wire under progressive tension –Bending of beams – Expression for the bending moment – Measurement of Young's modulus by bending of a beam – Non uniform bending and Uniform bending. Viscosity: Streamline flow and Turbulent flow – critical velocity - Poiseuille's formula – Determination of coefficient of viscosity of a liquid (Variable pressure head). Surface Tension: Drop weight method of determining the surface tension of a Liquid – Experiment to determine the interfacial tension.

Unit-III: Electronics:

Intrinsic and extrinsic semiconductor – PN Junction diode – Biasing of PN junction – V-I characteristics of junction diode – Rectifiers – Half wave – Full wave and bridge rectifiers – Zener diode – Characteristics of Zener diode – Voltage regulator – Transistor – Characteristics of transistor – CB, CE mode – Transistors as an amplifier. **Digital:** Decimal – Binary – Octal and Hexa Decimal number systems and their Mutual Conversions – 1's and 2's complement of a Binary number and Binary arithmetic (Addition, Subtraction, Multiplication and Division) – Binary Subtraction by 1's and 2's complement method – Basic logic gates – AND, OR, NOT, NAND, NOR and EXOR gates – NAND and NOR as universal building gates – Boolean Algebra – Laws of Boolean Algebra – De Morgan's Theorems – Their verifications using truth tables.

Unit -IV: Optics :

Geometrical Optics: Spherical aberration of a thin lens – Methods of reducing spherical aberration – Coma – Aplanatic surface – Astigmatism – Curvature of the field – Distortion. Interference: Introduction – Air wedge – Newton's rings – Colors of thin films. Diffraction: Plane diffraction Grating – Theory of plane transmission Grating

Unit-V: Modern Physics

Atomic Physics Atom Models: Sommerfield's and Vector atom Models – Pauli's exclusion Principle – Various quantum numbers and quantization of orbits. X-rays: Continuous and Characteristic X-rays – Mosley's Law and importance – Bragg's law – Miller indices.

Nuclear Physics Introduction – Nucleus – Classification of Nuclei – Nuclear Size – Charge – Mass and Spin -Nuclear Radiations and their properties, Laws of Radioactivity-Decay Constant-Half life and mean life- age of the earth- carbon Dating.

Text Books:

1. R. Murugeshan, Properties of Matter, S. Chand & Co. Pvt. Ltd., Revised edition, 2012.
2. Narayanamoorthy and N. Nagarathinam, Mechanics – Part II, The National Publishing Company, Chennai, 2005.
3. N. Subramaniyam, Brijlal and M.N.Avathanulu, Optics, S. Chand &Co. Pvt.Ltd.—25 th revised edition, New Delhi, 2012.
4. V. Vijayendran, S.Viswanathan, Digital Fundamentals, Printers & Publishers Private Ltd, Chennai, 2004.
5. Mehta V.K., Principles of Electronics, S.Chand and company Ltd, 2014.
6. Albert Paul Malvino, Digital Principles and Applications, McGraw-Hill International Editions, New York, 2002.
7. Puri V.K., Digital Electronics Circuits and Systems, TATA McGraw Hill Publications, New Delhi, 2011.
8. R. Murugeshan, Kiruthiga Sivaprasath, Modern Physics, S. Chand & Co, New Delhi, First edition, 1984.
9. R. S. Sedha, A Text Book of Digital Electronics, S. Chand & Co, New Delhi, First edition,2004

Books for Reference:

1. D.S Mathur. Revised by: Dr. P.S. Hemne, Mechanics –S. Chand and Co. New Delhi. First edition 1981, Reprint 2015.
2. Brij Lal and Subramanyam, Properties of Matter –Eurasia publishing house (Pvt.) LTD. New Delhi. Sixth Edition 1991
3. B. L. Theraja, Basic Electronics (Solid State), S. Chand and Co. New Delhi 2006
4. R. Murugesan,Optics and Spectroscopy- S. Chand Publishing, 1997.
5. J. B. Rajam, Atomic Physics., S. Chand & Company Limited, New Delhi, First edition, 1990.
6. B. N. Srivastava, Basic Nuclear Physic, Pragati Prakashan, Meerut, 2005.

Course Outcomes (CO):

CO	Learning outcome	Remarks
CO1	Analyze center of gravity	K4
CO2	Learn about modulus, viscosity and surface tension of materials	K2
CO3	Study the characteristics of diode and transistor	K1
CO4	Understand about aberration and different properties of lenses	K2
CO5	Gain knowledge about atomic model and basic nuclear properties	K2

K1- Remember K2- Understand K3- Apply K4- Analyze K5-Evaluate

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	M	S	S	S
CO3	S	M	S	M	M	S	S	S	S	S
CO4	S	M	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER – II

COURSE CODE	U21MTT21	ANALYTICAL GEOMETRY 3D	L	T	P	C
CORE III			5	-	-	4

Objectives:

- This is used to model geometric objects - *points*, (straight) *lines*, and *circles* being the most basic of these.
- To acquire knowledge of planes and its properties as a 3 dimensional objects.
- To understand the concepts skew lines and spheres.
- Solving problems related to geometry of three dimensions.

Unit-I: Rectangular Cartesian Coordinates:

Direction cosines of the line – Coordinates-Distance between points–Angle between the lines – Projections – Direction cosines-Relation between the direction cosines of a straight lines-Direction ratios- The. Projection of the line on any other line with direction cosines-Conditions for perpendicularity and parallelism.

Unit-II: The Plane:

The General equation of the first degree in x,y,z, represents a plane-The equation of the plane making intercepts a,b,c on the axes OX,OY,OZ respectively-The equation of the plane passing through the three given points – Angle between planes – Equation of plane through the intersection of two given planes –Length of the perpendicular.

Unit-III: Straight line:

A straight line in the intersection of two planes – Symmetric form of the equations of a line-Equation of a straight line passing through two given points – Equation of Plane and straight line- The condition for the line perpendicular to the plane – Shortest distance between two given lines.-Coplanar lines.

Unit-IV: Sphere:

Definition-The equation of a sphere when the centre and radius are given– Length of the tangent – Plane section of a sphere – Equation of circle on sphere- Equation of a sphere passing through a given circle – Intersection of two spheres in a circle– Equation of the tangent plane to the sphere and examples.

Unit-V: Cone:

Equation of a Cone with its vertex at the origin - equation of a quadratic cone with given vertex and given guiding curve - necessary condition for general equation of second degree to represent a cone - circular cone - equation of circular cone with given vertex - axis and semi vertical angle – Cylinder – Equation – Enveloping cylinder.

Text book:

1. **T.K.Manickavachagom Pillay and T.Natarajan**,"A Text Book of Analytical Geometry – part II - Three dimensions", Viswanathan Printers and Publishers, 2011.

   Unit I - Chapter 1
   Unit II - Chapter 2
   Unit III - Chapter 3
   Unit IV - Chapter 4
   Unit V - Chapter 5 – Sec. 1 to 8

Reference books:

1. **H.K.Dasse, H.C.Saxena and M.D.Raisinghania,** "Simplified Course in Solid Geometry (3D)", S.Chand and Company, 2009
2. **P.Duraipandian**, "Analytical Geometry – 3 Dimensional", Emerald publishers – 1998

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	familiarize the concept of direction cosines and projections	K1
CO2	identify different forms of equations of plane.	K1
CO3	analyze the symmetric form of equations of a line and the angle between a line and a plane.	K3
CO4	acquire the knowledge of coplanar lines, skew lines and its properties.	K3,K4
CO5	apply concept of a sphere and circle to determine their equations.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	M	S	S	S
CO3	S	M	S	M	M	S	S	S	S	S
CO4	S	M	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT22	DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS	L	T	P	C
CORE IV			5	-	-	4

Objectives:

- To introduce the basic concepts of differential equations and Laplace Transforms.
- Understand the basic concepts of first order differential equation and it applications.
- Determine solutions to second order linear homogeneous, non-homogeneous differential equations with constant coefficients.
- Find solutions by applying Laplace transform methods.
- Understand the elementary theory of partial differential equations, and solve it using various techniques.

Unit-I: Differential Equations of The First Order And First Degree:

Introduction-Variable separable Homogeneous, non – homogeneous, Linear equation, Bernoulli's equations, Exact differential equations. Equation of the first order and higher degree: Equations Solvable for dy/dx – equations solvable for y – equations solvable for x – Clairaut's form.

Unit-II: Linear Equations With Constant Co – Efficient:

Definition – complementary function of a Linear equation with constant Co – efficient – particular Integral – General method of finding P.I – special methods for finding P.I of the functions of the type e^{ax} , cos ax or sin ax , e^{ax} V where V is any function of x , x^m – Linear equations with Variable Co – efficient, Equations reducible to the linear equations.

Unit-III: Simultaneous Differential Equations:

Introduction of Simultaneous equations of the first order and first degree – Simultaneous linear differential equations: Linear equations of the second order : Complete solution given a known integral – Reduction to the normal form – Change of Independent Variables – Variation of Parameters – Methods of operations factors.

Unit-IV: Partial Differential Equations:

Formation of Partial Differential Equation of the first order-Classification of integrals-Singular Integral- General Integral- Derivation of partial differential equation– Lagrange method of solving linear PDE – Solution of PDE of type F(p, q)=0, F(z, p, q)=0, F(x, p) = G(y, q), Clairaut's form and Charpit's method.

Unit-V: Laplace Transforms:

Definition of Laplace Transforms – Piecewise Continuity- Sufficient condition for the existence of the Laplace transform-methods-Examples - Laplace transform of periodic functions – Properties- examples– Some general theorems- Examples – The inverse Transform's-Properties.- Examples

Text Book:

1. **S. Narayanan and T.K. Manickavachagam pillai**, "Differential equations and its applications", S. Viswanathan Printers and Publishers Pvt. Ltd., Madras 2014.
   Unit I - Chapter 2 and 4.
   Unit II - Chapter 5 – Sec. 1 to 6.
   Unit III- Chapter 6 and 8.
   Unit IV –Chapter 12 Sec. 1 to 5.
   Unit V- Chapter 9 – Sec. 1to 7.

Reference Books:

1. **Arumugam and Isaac,**" Differential equations and applications", New gamma publishing house – 1999.
2. **P.Kandasamy and K. Thilagavathi,** "Mathematics for Branch I: Volume III" ,S. Chand and Company Ltd., New Delhi - 2004.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	solve linear equations with variable coefficients.	K2
CO2	understand the fundamental properties of the Laplace transforms	K1&K2
CO3	apply the Laplace inverse transforms to solve simultaneous equations	K3
CO4	solve partial differential equations using Lagrange's method and Charpit's method	K3&K4
CO5	create real life problems into ordinary differential equations.	K4 &K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO4	PO3	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	M	S	M	M	S	S
CO2	S	M	S	S	S	S	M	M	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21PHA22	PHYSICS PRACTICAL	L	T	P	C
ALLIED II			-	-	5	4

Objective:

It is aimed at exposing the non-physics under graduate students to the technique of handling simple measuring instruments and also make them measure certain mechanical, electrical and optical properties of matter

Any Twelve experiments

1. Estimation of Error
2. Compound Pendulum – g and unknown mass determination
3. Young's Modulus – Uniform bending – pin and microscope method
4. Young'sModulus–Cantilever–Pin&Microscope
5. Young's Modulus – Uniform bending – Optic lever method
6. Young's Modulus – Non-Uniform bending – pin and microscope method
7. Viscosity –Stoke's Method
8. Viscosity – Poiseuille's method
9. Sonometer – frequency of a lining fork
10. Calibration of Voltmeter – potentiometer
11. Comparison of capacitances – B.G
12. Dispersive power of prism – Spectrometer
13. Logic Gates – AND, OR, NOT using discrete components
14. Logic Gates – NAND, NOR – using IC's
15. Diode Characteristics
16. Zener diode Characteristics
17. Newton's rings of a liquid
18. Spectrometer – Prism-i-d curve to find μ
19. NANDasUniversalgate: IC
20. NORasUniversalgate:IC
21. SurfaceTension– CapillaryRise
22. Newton's Law of cooling

Text Books

1. C.C Ouseph, G.Rangarajan- A Text Book of Practical Physics, - S. Viswanathan Publisher-Part I (1990).
2. C.C Ouseph, Rangarajan, R. Balakrishnan, A Text Book of Practical Physics, S.Viswanathan Publisher-Part II (1996).
3. S. L Gupta and V.Kumar - Practical Physics, Pragati Prakashan – 25th, Edition (2002).
4. A. P. Malvino, Electronics, Cybergear, 2010.
5. John Morris, Analog Electronics, Import, 1999.
6. S.K. Bhattacharya, Electrical Machines (TTTI Chandigarh) - TMH 1998.

Course Outcomes (CO):

CO	Learning outcome	Remarks
CO1	Able to Estimate Errors	K3
CO2	Analyze dimensional change of bar	K4
CO3	Determine viscosity of liquid	K4
CO4	Study the characteristics of diode and ICs	K3
CO5	Determine surface tension of liquis	K4

K1- Remember K2- Understand K3- Apply K4- Analyze K5-Evaluate

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	S	S	S	S	S	S
CO2	S	M	S	S	S	S	M	S	S	S
CO3	S	M	S	M	M	S	S	S	S	S
CO4	S	M	S	S	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER - III

COURSE CODE	U21MTT31	VECTOR CALCULUS, FOURIER SERIES AND FOURIER TRANSFORM	L	T	P	C
CORE - V			5	-	-	4

Objectives:

- To enhance basic skills in the areas of vector calculus , Fourier series and Fourier transforms
- Vectors and its product
- Multiple vector integration
- To study about Fourier series and their applications.

Unit-I: Differentiation of Vector:

Introduction - Vector Algebra- Differentiation of Vector – Vector operator del - Grad, Div and Curl – geometrical interpretation –Directional derivative - Solenoid, Irrotational vector – formulas involving del operator – Angle between the surfaces.

Unit-II: Double and Triple Integral:

Introduction- Vector Integration – Line Integrals Surface Integrals and volume integrals- (Theorems of Green, Gauss and Stokes) Gauss divergence, Green's and Stoke's theorems – Verification of theses theorems.

Unit-III: Fourier Series:

Definition- Dirchlet's conditions- Fourier series of periodicity 2π – Problems in Fourier series of periodicity 2π - Fourier series of periodicity 2l-Problems in Fourier series of periodicity 2l - Odd and even functions –Root mean square value of a function - Parseval's theorem.

Unit-IV: Half range series:

Introduction about Half range series definition - Half range series formula –Cosin series- Sin series – Problems using Cosin series - Problems using Sin series- Parseval's theorem - Harmonic analysis- Complex form of Fourier series introduction- Definition and . Problems using Complex form of Fourier series.

Unit-V: Fourier Transform:

Introduction of Fourier Transform – Definition of Fourier Transform – Fourier Transform Properties – Fourier integral theorem – convolution theorem – problems solving using Fourier Transform.

Text Books:

1. **Arumugam and Issac**, "Analytical Geomentry 3D and Vector Calculus", Sci. Tech Publishers – 2011.
   Unit I –Chapter 5.

Unit II – Chapter 6 – Sec 6.1, 6.2.

2. **P. Kandasamy and K.Thilagavathy**, "Mathematics, Vol IV", S.Chand and Company Ltd.,- 2004.
   Unit III – Chapter I
   Unit IV – Chapter I
   Unit V - Chapter IV

Reference Book:

1. **T.K.Manickavasagam pillay and Narayanan , "**Vector Algebra and Analysis" Viswanathan printers and publishers Pvt Ltd
2. **Murray R. Spiegel**, "Outline of Theory and Problems of Vector Analysis and an Introduction to Tensor Analysis" , Schaum's, 1959.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	demonstrate the operator of vector	K1
CO2	apply double and triple integration	K2
CO3	demonstrate the Fourier Transforms	K3
CO4	analysis half range series	K3
CO5	integral equations of Fourier Transforms	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	S	S	M	M	S	S
CO2	S	S	S	S	M	S	S	M	M	S
CO3	M	S	S	S	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	M	M	S	S	M

COURSE CODE	U21MTA33	ANCILLARY MATHEMATICAL STATISTICS-I	L	T	P	C
CORE - V			5	-	-	4

Objectives:

- To impart skills in various applications of statistical methods.
- Analyze the given data by using statistical methods.
- Understand the basic concepts of probability and related results.
- Use different probabilistic methods to solve problems arise in different situations.

Unit-I: Measures Of Dispersion:

Dispersion – range, quartile deviation – mean deviation – standard deviation – root mean square deviation – Relation between standard deviation and root mean square deviation – effect of change of origin and scale on moments – Karl pearson's beta and gamma co-coefficient – measures of Skewness – Kurtosis.

Unit-II: Theory Of Probability:

Introduction-Short history- Definition of various terms Mathematical or classical or 'priori' probability-Statistical or Empirical Probability-Problems – Law of addition of probabilities for two events – statement of general law of addition of probabilities – Bayes Theorem.

Unit-III: Random Variables:

Distribution Function-Properties of distribution function-Discrete Random Variable- Probability Mass function-Continuous Random Variables: Probability density function – various measures of central tendency, dispersion, Skewness and Kurtosis for continuous probability distribution and Problems.

Unit-IV: Mathematical Expectation:

Addition and Multiplication Theorem – covariance – Expectation and variance of a linear combination of random variables – Expectation of continuous random variable – Moment generating function and its properties – uniqueness Theorem on Characteristic function-Chebyshev's inequality – weak law and bernoulie's law of large numbers.

Unit-V: Theoretical Discrete Distribution:

Bernoulli Distribution and its moments – Binomial Distribution – moments, mean deviation about mean, mode, M.G.F and Characteristic function – recurrence relation for the moments – additive property of independent Poission variants – recurrence formula for the probability of the Binomial Distribution and Poission Distribution.

Text Book:

1. **S.C Gupta and V.K. Kapoor** , "Elements of Mathematical Statistics",Sultan Chand Publishers, New Delhi. 2009.
   Unit I - Chapter 3
   Unit II - Chapter 4

Unit III- Chapter 5
Unit IV- Chapter 6
Unit V – Chapter 7

Reference Book:

1. **P.R.Vittal**, "Mathematical Statistics", Margham Publications -2002- Reprint 2012.
2. **S.C.Gupta and V.K.Kapoor**,"Funtamentals of Mathematical Statistics", 10th edition,Sulton Chand Publications, 2002.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	calculate mean, median and mode.	K1
CO2	be familiar with elementary statistical methods of analysis of data and interpret them.	K1,K2
CO3	understand the concept of correlation and regression.	K3
CO4	relate Binomial, Poisson and Normal distributions.	K3
CO5	develop problem solving skill on applying statistical methods to real problems.	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M	M	S	S	M	M
CO2	S	S	S	M	M	M	M	S	M	M
CO3	S	S	S	M	M	M	M	S	S	S
CO4	M	M	S	M	M	M	S	M	M	M
CO5	M	S	S	S	M	M	M	S	S	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE311	CHOICE I	L	T	P	C
ELECTIVE I		NUMERICAL METHODS	4	-	-	3

Objectives:

- To develop efficient algorithms for solving problems in Science, Engineering and Technology.
- The leaner will analyze the different aspects of numerical solution of algebraic and transcendental equations.
- Students will be able to identify the basic concept of numerical differentiation and integration, principle of least squares.
- The learner will become knowledgeable in solving solution to simultaneous linear equations.

Unit-I: Introduction:

Solution of Algebraic and Transcendental Equations: Bisection Method definition – Algorithm for Bisection Method - problem solving using Bisection Method -Iteration Method introduction – Condition for Convergence – Order of Convergence of an iterative process.

Unit-II: Solution of Algebraic and Transcendental Equations:

Regular Falsi Method – Geometrical interpolation - Newton's Raphson Method – Geometrical meaning of Newton's method – Criterion for the convergence in Newton Raphson method – Order of convergence of Newton's method.

Unit -III: Solutions of Simultaneous Linear Algebraic Equations:

Simultaneous Linear Algebraic Equations- Solutions of Simultaneous Linear Algebraic Equations introduction - Direct method – Introduction - Gauss Elimination Method for Simultaneous Linear Algebraic Equations – Gauss Jordan Elimination Method Simultaneous Linear Algebraic Equations – Method of triangularization – Iterative methods.

Unit -IV: Solutions of Simultaneous Equations cont.:

Gauss Jacobi method for Solutions of Simultaneous Linear Algebraic Equations Introduction- Algorithm for Gauss Jacobi method for Solutions of Simultaneous Linear Algebraic Equations – Gauss Seidel Method of iteration for Solutions of Simultaneous Linear Algebraic Equations Introduction- . Algorithm and problems in both methods .

Unit -V: Finite Differences:

Introduction about First and Higher Order Differences – Express any value of y in term of y_n and the backward difference of y_n – Difference of a factorial polynomial - Forward and Backward Differences. problems in Forward and Backward Differences.

Text Book:

1. **P.Kandasamy, K.Thilagavathi and K. Gunavathi**, "Numerical Methods", S.Chand and Company Ltd , New Delhi 2013.
   Unit I – Chapter 3 -3.1 to 3.2
   Unit II – Chapter 3 -3.3 to 3.4
   Unit III – Chapter 4 -4.1- 4.2
   Unit IV – Chapter 4 - 4.8 - 4.9
   Unit V – Chapter 5 – 5.1 – 5.2

Reference Books:

1. **Arumuga, Issac, Somasundaram**,"Numerical Analysis", New Gamma Publishing House, Palayam Kottai 2003
2. **G. Balaji**, "Numerical Methods", G.Balaji Publishers, Chennai 2007.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand the equations using different methods under differ conditions and numerical solutions of system algebraic equation	K1
CO2	apply various interpolation methods and finite different concepts	K3
CO3	analyse differentiation and integration whenever and where ever routine methods are not applicable	K4
CO4	evaluate the ordinary differential equations using different methods through the theory of finite differences.	K5
CO5	evaluate the partial differential equations using different methods through the theory of finite differences.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	S	M	M	S	M	S
CO2	S	S	S	M	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	M	S
CO5	S	M	S	S	M	S	M	S	S	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE312	CHOICE II	L	T	P	C
ELECTIVE I		STOCHASTIC PROCESS	4	-	-	3

Objectives:

- To give a depth knowledge about Markov chain and Process.
- To understanding the stochastic models for much real life probabilistic situations and expected results.
- To learn the well known models like birth – death and queueing to reorient the knowledge of stochastic analysis.
- The learner understands in depth knowledge about ergording, renewal theory and its application in discrete and continuous process.

Unit-I: Basic Definitions:

Stochastic Processes: An Introduction-Specification of Stochastic process - Markov Chains: Definition and Examples- Higher Transition Probabilities - Generalization of Independent Beronoulli Trials : Sequence of Chain – Dependent Trails

Unit-II: Morkov Chains:

Definition and examples-:Transition matrix(or Matrix of Transition Probabilities) – order of a Markov Chains – Markov chain in graphs – Higher Transition Probabilities - Classification of States and Chains: Communication relationships – Class properties- Classification of Chains – Classification of States – Determination of Higher Transition Probabilities - Stability of A Markov System – Graph Theoretic Approach.

Unit-III: Markov Process with Discrete State Space:

Poisson Process and its extension: Introduction- Postulates for Poisson Process and its Extension: Poisson Process: Introduction- Poisson Process and Related Distributions – Interval Time-Properties of Poisson process- Generalisation of Poisson process: Poisson process in Higher Dimensions- Poisson Cluster Process – Pure Birth Process: Yule-Furry Process- Birth-Immigration Process- Time dependent Poisson process- Random Variation of the Parameter λ-Renewal process.

Unit-IV: Classification of States:

Introduction about Classification of States -Brownian Motion – Wiener Process – Differential Equations for a Wiener Process -Kolmogorov Equation – First Passage Time Distribution for wiener Process. Problem solving using wiener Process.

Unit-V: Birth and Death Distribution Process:

Introduction about Birth and Death Distribution Process- Renewal Process - Renewal Processes in Continuous Time with problems – Renewal Equation - Stopping Time: Wald's Equation - Renewal Theorems with Applications.

Text Book:

1. **J.Medhi**, "Stochastic process", Second edition- New Age International Publishers.
   Unit I: Chapter 1: 1.5;
   Unit II: Chapter 2: 2.1 to 2.7
   Unit III: Chapter 3: 3.1 to 3.3
   Unit IV: Chapter 4: 4.1 to 4.5
   Unit V: Chapter 6: 6.1 to 6.5

Reference Books:

1. Samuel Karlin and Howard M. Taylor, "A First Course in stochastic process", second edition, academic Press. 1975
2. Samuel Karlin and Howard M. Taylor, "A Second course in stochastic process", Academic Press, 1981
3. Narayan Bhat, U, "Elements of Applied Stochastic Processes", Second Edition John Wiley & Sons, New York
4. Feller, "An Introduction to Probability theory and its applications", Volume 1. Third edition, John Wiley & Sons, New York

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	remember random variables with Probabilistic condition	K1
CO2	understand Markov chains , Markov process and alternate approach	K2
CO3	apply the concepts in Birth and Death Distribution Process	K3
CO4	identify the type of the Differential Equations for A Wiener Process -Kolmogorov Equation	K3
CO5	prove the sampling distribution theory	K3, K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	S	S	S	M	M	M
CO2	M	S	M	M	M	M	S	S	S	M
CO3	S	S	S	S	S	M	M	M	S	S
CO4	M	S	S	S	S	S	S	S	M	S
CO5	M	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE313	CHOICE III	L	T	P	C
ELECTIVE I		PRINCIPLES OF EXPERIMENTAL DESIGN	4	-	-	3

Objectives:

- To learn analysis skill with models
- To know comparing ideas
- To find errors

Unit-I: Basic Principles For Designing Statistical Experiments:
Randomization, Replication and local control techniques - Determination of experimental units and notion of experimental error - Analysis of variance with one–way and two–way classifications - Models and Methods of analysis.

Unit-II: Completely Randomized Design (CRD) and Randomized Block Design (RBD):
Models and estimates of parameters and their standard error - Analysis of data arising from such designs, Analysis when one or two observations are missing.

Unit-III: Latin Square Design (LSD):
Latin Square Design introduction -Model – Estimation of parameters – Method of analysis – Missing Plot technique in Latin Square Design

Unit-IV: Multiple Comparison Tests:
Multiple Comparison Tests introduction -Least Significant Difference- Student-Newman–Keuls test-Duncan's Multiple Range test- Tukey's test

Unit-V: Factorial Experiments:
Factorial Experiments 2^2, 2^3 and 3^2 designs; estimation of main effects and interactions and their standard errors and error estimations..

Text Books:

1. **Das, M.N. and Giri.N.C.** ",Design and Analysis of Experiments", Wiley eastern, 1986
2. **Montgomery, C.D ",**Design of Experiments", 8/e, John Wiley and Sons, 2012

Reference Books:

1. **Goon.A.M, Gupta and Dasgupta.B**. , "An Outline of statistical theory, vol. II ", 6/e World Press Calcutta. 2001
2. **Gupta .S.C. and Kapoor.V.K.,** "Fundamentals of Applied Statistics ", Sultan Chand. 2000.
3. **Parimal Mukhopadhyay**, "Applied Statistics ", 2/e, Books and Allied (P) Ltd, Kolkata,2

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	acquire skills in statistical analysis.	K1
CO2	calculate values through designs.	K2
CO3	apply the concepts through models.	K3
CO4	comparing results in Latin square design.	K3, K4
CO5	calculating standard errors.	K3, K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	M	M	M	S	M	M
CO2	M	M	S	M	M	S	M	M	S	M
CO3	M	S	S	S	M	M	M	S	S	S
CO4	M	M	M	M	M	M	M	M	M	S
CO5	M	M	M	M	M	M	M	M	S	M

*S-Strong; M-Medium; L-Low

SEMESTER – IV

COURSE CODE	U21MTT41	STATICS	L	T	P	C
CORE VI			4	-	-	4

Objectives:

- To learn the application of geometric properties in equilibrium and motion of particles.
- To learn know to apply geometrical concepts in parallel forces, moments and couples
- Proficient in static equilibrium's three forces acting on a rigid body and friction.
- The learner to understand real time application.

Unit–I: Forces Acting At A Point:

Resultant and Components- Parallelogram of Forces- Analytical expression for the Resultant of two forces acting at a point – Triangle of Forces – Perpendicular Triangle of Forces – Converse of the Triangle of Forces- The Polygon of Forces – Lami's Theorem – An extended form of the parallelogram law of Forces- Resolution of a Force – Components of a Force along two given directions –Theorem on Resolved parts.

Unit–II: Resultant Of Any Number Of Coplanar Forces Acting At A Point:

Analytical Method - Conditions of Equilibrium of any Number of forces Acting upon a Particle – Geometrical or Graphical Conditions - Analytical Conditions. Parallel Forces and Moments: To find the Resultant of Two like parallel forces acting on a rigid body- To find the Resultant of Two unlike and unequal parallel forces acting on a rigid body – Resultant of a Number of Parallel Forces Acting on a rigid Body – conditions of Equilibrium of Three Coplanar Parallel Forces – Centre of two Parallel Forces – Moment of a Force – Physical Significance of the Moment of a Force – Geometrical Representation of a Moment – Sign of a Moment.

Unit–III: Unit of Moment:

Varigon's theorem of moments – Generalised Theorem of Moments (Principle of Moments)- Moment of a Force a about an axis. Couples: Definition – Equilibrium of two couples – Equivalence of two Couples- Couples in Parallel Planes – Resultant of Coplanar Couples - Resultant of a Couple and a Force.

Unit–IV: Equilibrium Of Three Forces Acting On A Rigid Body:

Rigid Body subjected to any Three Forces – Three Coplanar Forces – Conditions of Equilibrium- Procedure to be followed in solving any Statical Problem – Two Trigonometrical Theorems – Coplanar Forces: Introduction - Reduction of any number of Coplanar forces – analytical Proof of theorem – Conditions for a system of forces to Reduce to a single force or to a Couple.

Unit–V: Friction:

Introduction – Experimental Results – Statical, Dynamical and Limiting Friction – Law of Friction – Friction-a Passive force – coefficients of Friction – Angle of Friction – Cone of Friction – Numerical Analysis – Equilibrium of a particular on a rough inclined plane -

Equilibrium of a body on a rough inclined plane under a force parallel to the plane - Equilibrium of a body on a rough inclined plane under any force.

Text Book:

1. **M.K.Venkatraman**, "Statics", 12th edition, Agasthiar Publications, Trichy, 2010.
   Unit I - Chapter 2 – Sec. 1 to 13.
   Unit II - Chapter 2 – Sec 15, 16 and Chapter 3 – Sec 1 to 10.
   Unit III- Chapter 3 – Sec. 11 to 14 and Chapter 4.
   Unit IV – Chapter 5 and Chapter 6 – Sec. 1 to 5.
   Unit V – Chapter 7.

Reference Books:

1. **A.V.Dharmapadam**, "Statics", S Viswanathan Printers and Publishing Pvt.,Ltd. 1993
2. **P.Duraipandian and Lakshmi Duraipandian**, "Mechanics", S.Chand and Company Ltd,New Delhi - 1985.
3. **Dr.P.P.Gupta**, "Statics", Kedal Nath Ram Nath, Meerut,1983-1984.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand the action of forces on rigid bodies.	K1
CO2	analyze the concept of parallel forces and moments.	K2
CO3	compute equation of central orbit.	K3
CO4	understand the concept of friction.	K2
CO5	compute equation of equilibrium of strings.	K3

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO4	PO3	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	S	S	M	M	S	S
CO2	S	M	S	S	M	M	M	M	M	S
CO3	S	M	S	S	M	M	S	S	S	S
CO4	S	M	S	S	S	S	M	S	S	S
CO5	S	S	S	S	S	M	S	S	S	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT42	SEQUENCE AND SERIES	L	T	P	C
CORE VII			4	-	-	4

Objectives:

- To enhance basic skills in the areas of sequences and series.
- Types of sets, inequalities and sequences
- Behavior of sequences and its subsequences
- Infinite series and various tests for finding rearrangements its convergence

Unit–I: Sequences:

Definition of Sequences – Bounded sequences – Monotonic sequences – Convergent sequences – Divergent and Oscillating sequences – Solved problems – The Algebra of limits- Behaviour of monotonic sequences- solved problem.

Unit–II: Limit points:

Limit points definition -Some theorems on Limits – Cauchy's first limit theorem- subsequences – Limit points – Cauchy sequences – Cauchy's general principle of convergence- the upper and Lower limits of a sequence – solved problems.

Unit–III: Series of Positive Terms:

Infinite series- Definition – Cauchy's general Principle of convergence – comparison test – Kummer's Test – D' Alembert's ratio test- Solved problems in D' Alembert's ratio test – Raabe's Test – Solved problems in Raabe's Test- De Morgan and Bertrand's test , Gauss's test- solved problems.

Unit–IV: Root test and condensation test:

Cauchy's root test – Cauchy's Condensation test – Cauchy's Integral test – Series of arbitrary terms: Alternating series – Leibnitz's test – Absolute Convergence – Test for Convergence of Series of Arbitrary terms – Dirichlet's test – Abel's test – solved problems.

Unit–V: Rearrangement of Series:

Rearrangement(Derangement) of Series Definition – Riemann's theorem –Insertion of brackets – multiplication of series : Definition – Abel's theorem – Merten's theorem – Power series.

Text Book:

1. **Arumugam and Issac,** "Sequences and series", New Gamma publishing House, December 2015 and reprint 2017.
   Unit I – Chapter 3 – 3.1 to 3.7.
   Unit II – Chapter 3 – 3.8 to 3.12.
   Unit III – Chapter 4 – 4.1 to 4.3.
   Unit IV –Chapter 4 – 4.4 and 4.5, Chapter 5 – 5.1 to 5.3.
   Unit V – Chapter 5 – 5.4 to 5.6.

Reference Book:

1. **S.C.Malik ,Savita Arora., "**Mathematical Analysis**",** New Age International Private Limited.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand the fundamental principles of Analysis	K2
CO2	identify convergence and divergence of series	K2
CO3	apply various tests to find the limit of a series	K3
CO4	distinguish between absolute convergence and ordinary convergence of a Series.	K4
CO5	compute the radius of convergence of the power series.	K4, K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M	M	M	S	S	M
CO2	S	S	S	M	M	M	M	S	S	M
CO3	S	S	M	S	M	M	M	S	M	M
CO4	M	M	M	M	M	S	M	S	S	M
CO5	S	S	M	M	M	M	S	M	M	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTA44	ANCILLARY MATHEMATICAL STATISTICS - II	L	T	P	C
ALLIED IV			4	-	-	4

Objectives:

- To impart skills in various applications of statistical methods.
- Analyze the given data by using statistical methods.
- Construct and evaluate hypothesis tests.
- Apply sampling techniques to real life situations.

Unit–I: Distributions:

Theoretical Continuous Distributions – Rectangular Distribution – Normal Distribution as Limiting form of Binomial Distribution – Chief Characteristic of Normal Distribution and Normal Probability curve – Mode, Median, M.G.F, Moments, Mean Deviation from the Mean of Normal Distribution – A linear combinations of Independent Normal variants – Points of Inflexion of Normal Curve – Area property- Fitting of Normal distribution.

Unit–II: Curve fitting:

Fitting of a straight Line, Second degree Parabola Polynomial of k^{th} degree change of Origin – fitting of power curve $y=ax^b$ fitting of Exponential curves $y=ab^x$, $y=ae^{bx}$ - Theory of attributes – Notations – Dichotomy Classes and Class frequencies – order – relation between class frequencies – class symbols as operators – Condition, for consistency of data – Independence of Attributes and its criterion – association of Attributes – Yule's – Co-efficient of association.

Unit–III: Correlation and regression:

Bivariate Distribution – Correlation – Scatter diagram- Karl Pearson Co-efficient for correlation and Limits – calculation of Correlation Co-efficient for a bivariate frequency Distribution- Rank Correlation- Repeated Ranks – Regression – Line of Regression – Regression Co-efficient and Its Properties – Angles between two lines of regression.

Unit–IV: Sampling and Large sample test:

Introduction- Types of sampling – parameters and Statistics – Test of Significance – Null – Hypotheses – test of Significance for single mean, Difference of Means – Difference of standard Deviation, Exact Sampling Distribution – Chi-square variant – Derivation- M.G.F.Mode, Skewness of Chi square Distribution – additive property of Chi-square variants – Application Chi-square Distribution – Chi-square test for population Variance and Goodness of Fit – Independence of Attributes.

Unit–V: Distribution:

Exact Sampling distribution – t,f and z distribution, definitions and Applications to t,f and z distribution – test for single mean, differences of mean, Observed Correlation Co-efficient – f test for quality of population on variance .

Text Book:

1. **S.C.Gupta&V.K.Kapoor** ,"Elements of Mathematical Staistics", course of Madras: Madurai University, Sultan Chand Publishers, New Delhi 2009.

Unit I - Chapter 8 -8.1 to 8.2.11,8.2.14.
Unit II -Chapter 9- 9.1 to 9.3 and chapter 11
Unit III -Chapter 10
Unit IV - Chapter 12
Unit V -Chapter 13 and 14

Reference Books:

1. **Arumugam and Thangpandi "**Probability and Statistics", New Gamma Publishing House, 2006.
2. **P.R. Vittal**, "Mathematical Statistics", Margham Publications, 2012.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand Theoretical Continuous Distributions	K2
CO2	estimate the parameters of population on the basis of given information, Correlation and regression.	K3
CO3	make decision using t- test and F- test, z - test.	K4
CO4	analyze the association between two or more groups and populations.	K4
CO5	evaluate sample distributions	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M	M	M	S	M	M
CO2	M	M	M	M	S	M	M	S	S	M
CO3	M	S	S	S	M	M	M	M	M	M
CO4	S	S	S	M	M	M	S	M	M	M
CO5	S	S	S	M	M	M	S	S	M	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE421	CHOICE I	L	T	P	C
ELECTIVE -II		PROGRAMMING IN C & C++	3	-	-	3

Objectives:

- To develop programming skills in C and its object oriented concepts.
- The learner will become proficient in object oriented programming concept and proficient in C tokens
- Proficient in C operators , class declaration and definition and its objects
- Proficient in conditional statements and loop concept

Unit–I: Overview of C:

Importance of C - Sample C Programs - Basic structure of C program- Programming style - Executing a C Programe .Constants, Variables and Data types : – Character set – C tokens – Keywords and Identifiers – Constants – Variables – Data types – Declaration of Variables – Assigning Values to Variables – Defining Symbolic Constants.

Unit–II: Operators and Expression:

Arithmetic of Operators – Relational Operators – Logical Operators – Assignment Operators- Increment and decrement Operators – Conditional Operator – Bitwise Operators- Special Operators – Arithmetic Expressions – Evaluation of Expressions – Precedence of Arithmetic Operators – Some Computational Problems – Type Conversions in Expressions – Operator Precedence and Associativity – Mathematical Functions.

Unit–III: Principles of Object- Oriented Programming:

Software crisis – Software evolution – A look at procedure-oriented programming – Object oriented programming paradigm – Basic concept of Object -oriented programming – Benefits of OOP – Object Oriented Languages – Applications of OOP.

Unit–IV: Tokens, Expressions and Control Structures:

Introduction – Tokens – Keywords – Identifiers and constants – Basic data types – User Defined data types – Derived data types – Symbolic constants – Type compatibility – Declaration of variables – Dynamic initialization of variables – Reference variables – Operators in C++ - Scope resolution operator – Member Dereferencing operators - Memory management operators – Manipulators – Type cast operator – Expressions and their Types – Special assignment expressions – Implicit conversions – Operator overloading – Operator precedence – Control structures.

Unit–V: Functions in C++:

Introduction – The main function – Function prototyping – Call by reference – Return by reference- Inline functions – Default arguments – Constant arguments – Function overloading – Friend and Virtual Functions – Math Library functions. Managing Console I/O operations Introduction – C++ streams – C++ stream classes – Unformatted I/O operations – Formatted Console I/O operations – Managing Output with Manipulators

Text Books:

1. **E.Balagurusamy**, "Programming in ANSI C‖" , 4th Edition , Tata McGraw- Hill Publishing Company Ltd., New Delhi, Ninth Reprint 2009.
   Unit I – Chapter 1&2
   Unit II – Chapter 3
2. **E.Balaguruswamy,** "Object – Oriented Programming with C++ ", Tata McGraw Hill Education Private Limited, New Delhi, Tenth Reprint 2010.
   Unit I – Chapter 1 & 2
   Unit II – Chapter 3
   Unit III –Chapter 4 & 10

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand the concepts and Programming	K2
CO2	discuss the representation and appropriate use of primitive data types	K1
CO3	describe the object-oriented programming approach in connection with **C**++	K2
CO4	apply the concepts of object-oriented programming	K3
CO5	evaluate the process of data file manipulations using **C**++	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	S	S	M	M	M	M	S
CO2	S	S	S	S	S	M	M	S	M	S
CO3	S	M	M	M	S	S	M	S	S	S
CO4	S	S	S	S	S	S	M	S	S	M
CO5	S	S	S	S	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE422	CHOICE II	L	T	P	C
ELECTIVE -II		AUTOMATA THEORY	3	-	-	3

Objectives:

- To make the students to understand the nuances of Automata and Grammar.
- To explain various types of automata and grammar.
- Introduce the fundamental concepts of formal languages, grammars and automata theory.
- Identify different formal language classes and their relationships
- To make them to understand the applications of these techniques in computer science.

Unit–I: Finite Automata-An Informal picture of Finite Automata:
The Ground Rules – The Protocol- Enabling the Automata to Ignore Actions – The Entire System as an Automation – Using the Product to Validate the Protocol- Deterministic Finite Automata: Definition of a Deterministic Finite Automation – How a DFA Process strings- Extending the Transition Function to Strings – The Language of a DFA- Exercise

Unit–II: Nondeterministic Finite Automata:
An Informal View of Nondeterministic Finite Automato – Definition of Nondeterministic Finite Automata – The Extended Transition Function- The Language of an NFA- Equivalence of Deterministic and Nondeterministic Finite Automata- A Bad Case for the subset Construction – An Application: Text Search: Finding Strings in Text – Nondeterministic Finite Automata for Text Search – A DFA to Recognize a Set of Keywords – Exercise.

Unit–III: Finite Automata with Epsilon-Transitions:
Use of $\in$ - Transitions – The Formal Notation for an $\in$- NFA- Epsilon–Closures –Extended Transitions and Languages for $\in$-NFA's – eliminating $\in$-Transitions – exercises.

Unit–IV: Regular Expressions and Languages:
Regular Expressions: The operators of Regular Expressions- Building Regular Expressions – Precedence of Regular –Expression operators – Exercises – Finite Automata and Regular Expressions: From DFA's to Regular Expressions – Converting DFA's to Regular Expressions by eliminating states – Converting Regular Expressions to Automata – Exercise.

Unit–V: Algebraic Laws for Regular Expressions:
Associativity and Commutativity – Identities and Annihilators – Distributive Laws – The Idempotent Law – Laws Involving Closures – Discovering laws for Regular Expressions. Properties of Regular Languages: Closure Properties of Regular Languages: Closure of Regular Languages under Boolean Operations –Homomorphisms – Inverse Homomorphisms –Decision properties of Regular Languages: Converting Among Representations – Testing Emptiness of Regular Languages – Equivalence and Minimization of automata:Testing Equivalence of States.

Text Book:

1. **John E. Hopcroft and Rajeev Motwani and Jeffrey D. Ullman**, "Introduction to Automata theory, Languages and Computations", 3rd edition, Pearson Addison Wesley,NewYork,2006 Chennai, 2000.
   Unit I: Chapter 2: Sections 2.1-2.2
   Unit II Chapter 2 Section 2.3.-2.4
   Unit III: Chapter 2, Section 2.5,
   Unit IV: Chapter 3, Sections 3.1-3.2,
   Unit V: Chapter 3, Sections 3.4 and Chapter 4: 4.2-4.4

References Books:

1. **Harry R. Lewis and Christos H. Papadimitriou**, " Elements of the Theory of Computation" Second Edition, Prentice Hall, 1997.
2. **A.V. Aho, Monica S. Lam, R. Sethi, J.D. Ullman**, "Compilers: Principles, Techniques and Tools ", Second Edition, Addison-Wesley, 2007.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand basic concepts in Lattices , formal language and automata theory	K2
CO2	demonstrate abstract models of computing, including deterministic (DFA), non-deterministic (NFA), Push Down Automata(PDA)	K3
CO3	apply theoretical knowledge relate practical problems to languages and automata	K4
CO4	analyze the logic and methods behind grammars and recognizers for different formal languages	K5
CO5	formalize the structure of a given formal language using regular expressions and context free grammars and implementation of a lexical analyzer.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	M	S	S	S	S	M	M	M	S
CO3	M	M	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE423	CHOICE III	L	T	P	C
ELECTIVE -II		KNOWLEDGE FOR INDUSTRY	3	-	-	3

Objectives:

- ❖ To knowledge for Industry, need for digital transformation and the following Industry tools:

1. Artificial Intelligence 2. Big Data and Data Analytics 3. Internet of Things

Unit–I: Industry 4.0:

Need – Reason for Adopting Industry 4.0 - Definition – Goals and Design Principles - Technologies of Industry 4.0 – Big Data – Artificial Intelligence (AI) – Industrial Internet of Things - Cyber Security – Cloud – Augmented Reality.

Unit–II: Artificial Intelligence:

Artificial Intelligence (AI) – What & Why? - History of AI - Foundations of AI -The AI - environment - Societal Influences of AI - Application Domains and Tools - Associated Technologies of AI - Future Prospects of AI - Challenges of AI.

Unit–III: Big Data And IOT:

Evolution - Data Evolution - Data : Terminologies - Big Data Definitions - Essential of Big Data in Industry 4.0 - Big Data Merits and Advantages - Big Data Components : Big Data Characteristics - Big Data Processing Frameworks - Big Data Applications - Big Data Tools - Big Data Domain Stack : Big Data in Data Science - Big Data in IoT - Big Data in Machine Learning - Big Data in Databases - Big Data Use cases Big Data in Social Causes - Big Data for Industry - Big Data Roles and Skills -Big Data Roles - Learning Platforms; Internet of Things (IoT) : Introduction to IoT - Architecture of IoT - Technologies for IoT - Developing IoT Applications - Applications of IoT - Security in IoT

Unit–IV: Applications And Tools Of Industry 4.0:

Applications of IoT – Manufacturing – Healthcare – Education – Aerospace and Defense – Agriculture – Transportation and Logistics – Impact of Industry 4.0 on Society: Impact on Business, Government, People: Tools for Artificial Intelligence, Big Data and Data Analytics, Virtual Reality, Augmented Reality, IoT, Robotics

Unit–V: Jobs 2030+:

Industry 4.0 – Education 4.0 – Curriculum 4.0 – Faculty 4.0 – Skills required for Future - Tools for Education – Artificial Intelligence Jobs in 2030 – Jobs 2030 - Framework for aligning Education with Industry 4.0

Text Book:

1. **P.Kaliraj& T. Devi**, "Higher Education for Industry 4.0 and Transformation to Education 5.0", 2020

Reference Book:

https://nptel.ac.in/courses/106/105/106105195/

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	know the reason for adopting Industry knowledge 4.0 and Artificial Intelligence	K1
CO2	understand the need for digital transformation	K2
CO3	apply the industry 4.0 tools	K3
CO4	analyze the applications of Big Data	K4
CO5	examine the applications and security of IoT Applications	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	S	S	S	S	M	S	S
CO2	S	M	M	S	S	S	M	M	M	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	M	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER - V

COURSE CODE	U21MTT51	DYNAMICS	L	T	P	C
CORE - VIII			5	-	-	4

Objectives:

- Proficient in Newton's laws of motion and projectiles
- Proficient in collision of elastic bodies
- Proficient in motion under action of central forces
- To defines the path of orbiting body around central body relative to, without specifying position as a function of time.

Unit-I: Newton Laws of Motion and Applications:
Introduction- Momentum- Newton's law of motion-Explanation and illustration of the first law-Explanation of the second law of motion-Composition of Forces- Parallelogram law of forces-Absolute Units of forces-Weight- gravitational units of force

Unit-II: Projectiles:
Definition- Two fundamental Principles-Path of the projectile is a parabola- Characteristics of the motion of a projectile– Equation of path range etc. –Range of a particle projected on an inclined plan etc. – Motion on the surfaces of a smooth inclined planes- Enveloping Parabola.

Unit-III: Impulsive Forces-Impulses:
Impulsive force-Impact of two bodies-Loss of kinetic energy in impact-Motion of shot and guns-Impact of water on a surface- worked examples – Impact in a fixed plane – Direct and Oblique impact – Solved Problems.

Unit-IV: Simple harmonic motion:
Introduction-Simple harmonic motion in a straight line- Definition-General solution of the Simple harmonic motion—Geometrical representation of a Simple Harmonic Motion – Equation of motion – composition of two simple harmonic motions – simple pendulum.

Unit-V: P-R Equation:
Introduction - Velocity and acceleration in polar coordinates – Equation of motion in Polar coordinates – Motion under a central force – Differential equation of central Orbits – Perpendicular from the pole on the tangent formulae in polar coordinates – Pedal equation of central orbit – Pedal equation of some well-known curves – Velocities in central orbit – Two fold problems in central orbits – Apses and apsidal distances – Law of the inverse square – Law of the inverse cube.

Text Book:

1. **M.K.Venkatraman**, "Dynamics", 9th edn, Agasthiar Publications, Trichy,1997.
   Unit I – Chapter 4 – Sec. 4.1 to 4.37
   Unit II – Chapter 6 – Sec. 6.1 to 6.17.
   Unit III – Chapter 8 – Sec. 8.1 to 8.10.
   Unit IV – Chapter 10 – Sec. 10.1 to 10.16.
   Unit V – Chapter 11 – Sec. 11.1 to 11.15.

Reference Books:

1. **A.V.Dharmapadam**, "Dynamics", S.Viswanathan Printers and Publisher Pvt.,Ltd.,Chennai 1993.
2. **K.Viswanntham Naik and M.S.Kasi**, "Dynamics", Emerald Publishers, 1999
3. **Narayanamurthy and N.Nagarathnam** , "Dynamics", National Publishers, New Delhi,1991.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	determine the path and range of a projectile in any direction.	K1
CO2	understand the concept of enveloping parabola.	K2
CO3	knowledge about collision of elastic bodies.	K2
CO4	compute equation of simple harmonic equation.	K3
CO5	understand the motion under the central forces.	K2, K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M	M	M	S	S	M
CO2	M	M	S	M	M	M	M	M	S	M
CO3	S	S	S	S	M	M	M	S	S	M
CO4	S	S	S	M	M	M	M	S	S	M
CO5	M	M	M	M	M	S	M	M	S	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT52	ABSTRACT ALGEBRA	L	T	P	C
CORE - IX			5	-	-	4

Objectives:

- ❖ To provide some knowledge about various algebraic structures.
- ❖ Recognize the basic properties of groups and subgroups.
- ❖ Understand the types of homomorphism and use them to classify groups.
- ❖ Apply the theorems to study the structure of groups.
- ❖ Recognize the basic properties of rings, fields and integral domains.
- ❖ Using the algebraic methods for solving problems**.**

Unit-I: Groups:

Definition and Examples – Elementary Properties of a Group – Additive group of integers – Group of residue classes – The Generalised Associative Law - Power and Index law - Quaternion group - Groups of symmetries - Order of an Element – Alternative definitions of a group.

Unit-II: Complexes and Subgroups:

Union and intersection of Subgroups – Properties of Subgroup – Homomorphism – Elementary propertied of Homomorphism – Types of Homomorphism – Some results on isomorphism – Structure of isomorphic groups – Non-isomorphic groups - Cayley's Theorem - Group of Permutation - Cyclic Groups - Automorphism.

Unit-III: Coset's and Lagrange's Theorem:

Properties of Cosets – Index of a subgroup – Consequences of Lagrange's theorem - Normal Subgroups and Quotient Groups – Examples - Quotient Structure – Quotient Group - A Counting Principle - Fundamental theorem of homomorphism.

Unit-IV: Rings:

Definitions and Examples - Elementary properties of rings – division rings and fields – Integral Domains – Zero Divisor - Ordered integral domain – Characteristic of a ring - sub ring and sub field – Properties of sub ring and subfield - prime fields.

Unit-V: Homomorphism of Rings and their types:

Elementary properties of homomorphism – Types of homomorphism - Ideals ring – Quotient structure and Isomorphism theorems - Maximal and Prime Ideals - Field of quotient of an integral domain.

Text Book:

1.T.K.Manickavasagampillai and Narayanan, "Modern Algebra volume I & II" Viswanathan printers and publishers Pvt Ltd., Edition 1982

Unit I- Chapter 6 – 6.1 to 6.2
Units II- Chapter 6 – 6.3 to 6.7
Unit III- Chapter 6 – 6.8 to 6.10
Units IV- Chapter 7 – 7.1 to 7.4

Unit V- Chapter 7 – 7.5 to 7.9

Reference Books:

1. **Arumugam S and Thangapandi Issac**, "Modern Algebra", SCITECH Publications, Chennai, Edition 2003.
2. **A.R.Vasishtha,** "Modern Algebra", Krishna Prakashan Mandir, Meerut, 1994 – 95.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	Knowledge of elementary concepts in Abstract Algebra	K1
CO2	Use appropriate techniques and reasoning to prove the properties of groups	K2
CO3	Understanding the concept of homomorphism and isomorphism in groups	K1,K2
CO4	Extend the results of groups to rings	K3
CO5	Extend the results of rings to fields	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	S	M	M	S	M
CO2	S	S	S	S	M	M	M	S	S	M
CO3	M	M	M	M	S	S	S	M	S	S
CO4	S	S	S	M	M	S	S	M	S	S
CO5	M	M	M	M	M	S	M	M	S	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT53	REAL ANALYSIS	L	T	P	C
CORE - X			5	-	-	4

Objectives:

- Understand the basic concepts of sets
- To provide knowledge about Metric Spaces
- The learner will acquire knowledge of open/closed sets and its properties
- The learner will acquire knowledge of Continuity, Connectedness, and Compactness and apply theorem

Unit-I: Metric Spaces:
Preliminaries- sets and functions - Countable sets- Uncountable sets- Inequalities of Holder and Minkowski- Metric spaces: Definition and Examples-Bounded set in a metric spaces- Open balls in a metric spaces- open sets-subspaces- Interier of a set.

Unit-II: Metric Spaces and Complete metric space:
Closed sets – Definition – Closure of a set- Limit point in set- Dense sets- summary questions - Metric Spaces –definition –examples -Complete metric space: Introduction- Completeness- Baire's Category theorem- summary questions.

Unit-III: Continuity:
Introduction- Continuity-Solved problems -Homeomorphism-Uniform continuity – examples – Uniformly continuous –solved problems - Discontinuous function on R- right limit – left limit – point of discontinuity-discontinuity of the second kind- oscillation.

Unit-IV: Connectedness:
Introduction- Definition and Examples –connected and continuous – solved problems- component - Connected subset of R –solved problems- connectedness and continuity- intermediate value theorem.

Unit-V: Compactness:
Introduction - compact metric spaces – (0,1) with usual metric is not compact- $(0, \infty)$ with usual metric is not compact- discrete metric not compact - compact subsets of R-equivalent characterization for compactness – Compactness and continuity - solved problems.

Text Book:

1. **Arumugam S and Thangapandi Issac ,"** Modern Analysis", New gamma Publishing house , Edition 2013.
   Unit I – Chapter 1& 2 – 1.2 to 2.6 Unit II – Chapter 2 & 3 – 2.7 to 3.2
   Unit III – Chapter 4 – 4.1 to 4.4 Unit IV –Chapter 5
   Unit V – Chapter 6

Reference Books:

1. **Walter Rudin**, "Principles of Mathematical Analysis", McGraw-Hill International. Editions (3^{rd}) – 1976.
2. **V.Karunakaran**, "Real Analysis", Pearson Publications, Edition-2012.
3. **Appostol**, "Mathematical Analysis", Narosa Publishing House-Second Edition-2002.

Course Outcome:

On the successful course completion, students will be able to:		Cognitive Level
CO1	Understand the fundamental properties of real numbers to the formal development of real analysis	K2
CO2	Extended real number system in the complex field developing the theory of real analysis	K3
CO3	Demonstrate an understanding limit and how they are use being sequences and series.	K3
CO4	Analysis various mathematical proofs of basic results in connectedness.	K4
CO5	Evaluate various mathematical proofs of basic results in continuity.	K4,K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	S	S	S	M	S	S
CO2	M	M	M	M	M	S	S	M	S	S
CO3	S	S	S	M	S	S	M	S	S	M
CO4	S	M	M	S	S	S	M	S	S	S
CO5	M	M	S	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT54	OPERATIONS RESEARCH I	L	T	P	C
CORE - XI			-	5	-	4

Objectives:

- To impart the basic concepts and applications of linear programming.
- The leaner will formulate a linear programming problem and solve them graphically and simplex method
- The leaner will be able to understand the concepts of duality programming
- The leaner will analyze the different aspects of transportation problems and also assignment problems
- Students will be able to identify the basic analysis of various inventory models.
- The leaner will develop, organize, evaluate short, long term processes and solve problems

Unit-I: Linear Programming:

Introduction- Mathematical formulation of linear programming problem-Graphical solution-solved problems- Unbounded solution- Infeasible solution –Canonical form –Standard form - Introduction - Simplex method - Use of Artificial Variables: – Big M Method -problems– Two Phase Simplex method- problems.

Unit-II: Degeneracy in Linear Programming:

Introduction- Degeneracy in Linear Programming – Introduction about Duality - Duality Theorem – Finding solution for Linear Programming problem using Duality and Simplex Method – Dual Simplex Method for Linear Programming problem . Finding solution for Linear Programming problem using Dual Simplex Method.

Unit-III: Transportation Problem:

Introduction of Transportation Problem – Definition of Transportation Problem- Mathematical formulation of the problem - Finding Initial Basic Feasible Solution using North - West Corner Rule - Row Minima method- Column Minima method-Matrix Minima Method - Vogel's Approximation Method - Optimum solution – MODI method .

Unit-IV: Assignment Problem:

Introduction – Definition of Assignment problem -Mathematical formulation of Assignment Problem-Assignment Algorithm-problems solving using assignment algorithm- Minimizations case Routing problem- problems using Routing problem- Application of Assignment problem-Traveling salesman problem .

Unit-V: Inventory Control:

Introduction- Definition – Need for inventory Various Cost in : Inventory Control -Types of Inventories – The inventory decisions -Economic order quantity – Deterministic Inventory Problems: EOQ Problem with no shortages – EOQ Problem with price break – EOQ Problem with two price break – EOQ Problem with n price break.

Text Book:

1. **Kantiswarup, P.K.Gupta, Manmohan** "Operations Research", Sultan chand and sons , Edition 2000.
   Unit I- Chapter 2.3 and 4 - 4.1 to 4.5
   Unit II- Chapter 5 -5.1 to 5.7
   Unit III- Chapter 10
   Unit IV- Chapter 11
   Unit V- Chapter 19 – 19.1 to 19.10, 19.12

Reference Books:

1. **J.K.Sharma**, "Operations Research",Macmillan India Ltd. 1997.
2. **Prem Kumar Gupta, D.S. Hijra**, "Operations Research", S. Chand & Company Ltd,2002.
3. **P.R.Vittal**, "Operations Research", Margham Publications, 2002.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand the application of OR and frame a LP Problem with solution – graphic and through solver add in excel	K1
CO2	analyze and interpret results of transportation and problem using appropriate method	K2
CO3	evaluate simple model of L.P.P.	K3
CO4	solutions of assignment and problem using appropriate method	K3
CO5	evaluate the dynamics of inventory managements principles, concepts of customer demand, distribution and product transformation process	K4, K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	M	M	M	M	S	S
CO2	S	S	S	M	M	M	M	S	M	M
CO3	M	M	S	M	M	M	S	M	M	M
CO4	S	S	S	S	M	M	M	S	S	M
CO5	M	S	S	S	M	M	M	S	M	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT55	THEORY OF NUMBERS	L	T	P	C
CORE - XII			5	-	-	4

Objectives:

- The learner will acquire knowledge of basic concepts of number theory
- The learner will become proficient in various types of functions
- The learner will be know the primitive roots
- Apply the theorems to study the numbers.

Unit-I: Principle of Finite Induction:

Well – Ordering Principle(WOP)- Principle of Finite Induction- The Division Algorithm – Basis Representation Theorem- Binomial Coefficients- Divisibility Theory : Greatest Common Divisor-Least common Multiple- Linear Diophantine Equations- Fundamental Theorem of Arithmetic - Some Question Regarding Primes.

Unit-II: Congruencies:

– Residue System – Test of Divisibility – Linear congruence's - Solving Polynomial congruence's – An Application of Congruence's to Diophantine Equations - Fermat's Little theorem –Euler's Generalization of FLT_1 .

Unit-III: Functions and Theorem:

Wilson's Theorem- Euler's Φ-Function- Arithmetic Functions:-The Function τ and σ – The Möbius Function- Multiplicative Arithmetic Functions- Inversion Formula- Greatest Integer Function.

Unit-IV: Primitive Roots:

Exponents – Primitive roots Modulo a Prime – Determination of Integers having Primitive roots – Indices – Euler's Criterion – Legendre Symbol and its Properties – Gauss Lemma.

Unit-V: Quadratic Reciprocity Law and its applications:

Jacobi Symbol – Perfect Numbers – Mersenne Primes-Fermat Numbers - Phythagorean Triples-Fermat's Last Theorem.

Text Book:

1. **S.B.Malik ,** "Basic Number Theory",Second Revised Edition, Vikas Publishing House PVT LTD, 2009

   Unit I – Chapter: 1&2
   Unit II – Chapter: 3, Chapter: 4 – 4.1, 4.2
   Unit III – Chapter: 4 – 4.3, 4.4 & Chapter: 5
   Unit IV – Chapter: 6, 7- 7.1 to 7.3
   Unit V – Chapter: 7- 7.4 to 7.6, Chapter : 8

Reference Books:

1. **Ivan Niven and Herbert S Zuckerman**, "An Introduction to the theory of Numbers", 3rd Edition, Wiley Eastern Ltd., New Delhi, 2000.
2. **David M.Burton**,"Elementary Number Theory", W.M.C.Brown Publishers, Dubuque, Lawa, 1989.

Course Outcome:

On the successful course completion, students will be able to:		Cognitive Level
CO1	Understand factual knowledge including the mathematical notation and terminology of number theory.	K2
CO2	Construct mathematical proofs of statement and find counter examples to false statements in Number Theory.	K2
CO3	Apply theoretical knowledge to problem of computer security	K3
CO4	Analyze the logic and methods behind the major proofs in number theory	K4
CO5	Determine multiplicative inverses , modulo n and use to solve linear congruences	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	M	M	M	S	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	M	M	M	M	M	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE531	CHOICE -I	L	T	P	C
ELECTIVE III		FUZZY SETS AND FUZZY NUMBERS	3	-	-	3

Objectives:

- Recognize the concept of fuzzy sets and its properties.
- Distinguish fuzzy sets from crisp sets.
- Perform various types on fuzzy sets.
- Understand the fuzzy numbers and fuzzy Lattice relations.

Unit-I: From classical (crisp) sets to Fuzzy sets:

A Grand Paradigm Shift : – Introduction – Crisp sets: An overview – Fuzzy sets: Basic types - Fuzzy sets: Basic concepts Characteristics and significance of the Paradigm Shift.

Unit-II: Fuzzy Sets versus Crisp Sets:

Additional properties of alpha(α)-cuts – Representations of fuzzy sets- Extension Principle for fuzzy sets- Notes and Exercise.

Unit-III: Operations On Fuzzy Sets:

Types of operations – Fuzzy complements- Fuzzy intersections: t – Norms- Fuzzy unions : t – Conorms - Combinations of operations- Aggregation Operations- Notes and Exercises.

Unit-IV: Aggregation operations and Fuzzy Arithmetic:

Aggregation operations - Fuzzy Numbers – Linguistic Variables-Arithmetic Operations on Intervals - Arithmetic Operations on Fuzzy numbers- Lattice of Fuzzy numbers - Fuzzy equations.

Unit-V: Fuzzy Relations:

Crisp versus Fuzzy Relations – Projections and Cylindric Extensions – binary Fuzzy Relations – Binary Relations on a Single Set- Fuzzy Equivalence Relations.

Text Book:

1. **George J. Klir / Bo Yuan, "**Fuzzy sets and Fuzzy Logic, Theory and Applications **"**, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
   - Unit – I: Chapter 1: Sections 1.1 – 1.5
   - Unit – II: Chapter 2: Sections 2.1 - 2.3
   - Unit – III: Chapter 3: Sections 3.1 - 3.6
   - Unit – IV: Chapter 3: Sections 3.6 and Chapter 4: Sections 4.1 -4.6
   - Unit – V: Chapter 5: Sections 5.1 – 5.5

Reference Books:

1.**George J. Klir & Tina A. Folger** "Fuzzy Sets, Uncertainty & Information" PHI Learning Private Limited, 2012.

2.**D. Driankov, Hellendoorn & M. Reinfrank** "An Introduction to Fuzzy Control" Narosa Publishing House, Reprint 2001.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand concepts between classical sets and fuzzy sets.	K1
CO2	understand the membership functions.	K1
CO3	understand and Apply of basic operations on fuzzy sets.	K1,K3
CO4	analyze the properties and principles of fuzzy sets.	K4
CO5	evaluate arithmetical ability on fuzzy numbers.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	M	S	S	S	S	M
CO2	M	S	M	S	M	S	S	M	M	M
CO3	M	M	M	S	S	M	M	M	M	M
CO4	S	M	S	M	M	M	S	S	M	M
CO5	S	M	M	M	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE532	CHOICE -II	L	T	P	C
ELECTIVE III		MATHEMATICAL MODELLING	3	-	-	3

Objectives:

- To study the mathematical models through ode and difference equations
- To train the students to develop mathematical models in real life problems

Unit-I: First Order Differential Equations in Mathematical Modelling:

Through Ordinary Differential Equations Of First Order- Linear Growth and Decay Models – Non-Linear Growth and Decay Models – Compartment Models.

Unit-II: Geometrical Problems:

Mathematical Modelling Through Systems Of Ordinary Differential Equations Of First Order: Dynamic problems – Geometrical problems- Population Dynamics – Epidemics – Compartment Models.

Unit-III: Applications:

Mathematical Modeling through Systems of Ordinary Differential Equations of First Order in Economics – Medicine, Arms Race, Battles and International Trade – Dynamics.

Unit-IV: Mathematical Modeling Through Difference Equations:

Simple Models – Basic Theory of Linear Difference Equations with Constant Coefficients – Economics and Finance – Population Dynamics and Genetics.

Unit-V: Mathematical Modelling:

Mathematical Modelling Through Graphs: Solutions that can be Modeled Through Graphs – Mathematical Modelling in Terms of Directed Graphs, Signed Graphs, Weighted Digraphs and Unoriented Graphs.

Text Book:

1. **J.N. Kapur**, "Mathematical Modelling ", Wiley Eastern Limited, New Delhi, 1988.
   Unit 1: Chap 2, Sec 2.1 – 2.4
   Unit 2: Chap 2, Sec 2.5 – 2.6 Chap3, Sec 3.1 – 3.3
   Unit 3: Chap 3, Sec 3.4 – 3.6
   Unit 4: Chap 5, Sec 5.1 – 5.5
   Unit 5: Chap 7, Sec 7.1 – 7.5

Reference Book:

1. **J.N. Kapur**, "Mathematical Models in biology and Medicine ", EWP, New Delhi, 1985.
2. Michael Alder," An Introduction to Mathematical Modelling, Heaven For Books.com , 2001.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand basic definitions from Mathematical Modelling through Ordinary Differential Equations of First order	K2
CO2	understand Mathematical Modelling through Ordinary Differential Equations of First order problems	K2,K3
CO3	apply Mathematical Modelling through Ordinary Differential Equations of First order to applications	K2,K3
CO4	understand simple models through Difference Equations	K2
CO5	evaluate models through Graphs	K2,K3,K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	M	M	S	M	S	M
CO2	S	M	S	S	M	S	S	M	M	S
CO3	S	M	S	S	M	S	S	M	M	S
CO4	S	S	M	M	M	S	M	S	M	M
CO5	M	S	S	M	M	M	M	M	M	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE533	CHOICE -III	L	T	P	C
ELECTIVE III		DATA STRUCTURES AND ALGORITHMS	3	-	-	3

Objectives:

- Impart the basic concepts of data structure, array and its operations.
- Introduce the concept of linked list and its operations.
- Understand the concept of Stack & Queue, its representation and operations.
- Understand the concept of Tree & Graph, its representation and operations.
- Study the basic concepts of algorithms and step by step approach in writing algorithms with help of fundamental data structures

Unit-I: Data Structures:

Definition of a Data structure – Data structure operations- primitive and composite Data Types, Arrays-Linear Arrays-Representation of Linear Array in Memory-Traversing Linear Array-Inserting and Deleting in Linear Arrays.

Unit-II: Linked list:

Representation of Linked lists in Memory-Insertion into a linked list-Deletion from a linked list.

Unit-III: Stack in Array:

Array Representation of stack- Array representation of stack-Linked representation of Stack-difference between Array representation and Linked representation of stack

Unit-IV: Trees:

Definition - Binary trees-Representing Binary tree in Memory-Traversing Binary trees. Graph - Graph terminology- Sequential representation of graph: Adjacency matrix, Linked representation-Traversing a graph (Breadth First Search & Depth First Search).

Unit-V: Algorithms:

Definitions-examples, Complexity of Algorithms- Bubble sort – linear Search- worst case- average case- rate of growth: Big O notation- Other Asymptotic Notations for Complexity of Algorithms.

Text Book:

1. **Seymour Lipschutz**, " Data Structures", TataMcGraw-hill Publications, 2006.
   Unit I: Chapter 1: 1.3-1.4 & Chapter 4: 4.1-4.5
   Unit II: Chapter 5: 5.1-5.3, 5.7-5.8
   Unit III: Chapter 6: 6.1-6.4
   Unit IV: Chapter 7: 7.1-7.4 Chapter8: 8.1-8.5
   Unit V: Chapter 1: 1.5 Chapter 2: 2.5 Chapter 4: 4.6-4.7

Reference Books:

1**. L. MathuKrithigaVenkatesh, "** Data Structures and Algorithms ", , Margham Publications.2005
2. **R. Kruse C.L. Tondo and B. Leung**, "Data Structures and Program design in C", PHI. 1997,
3. **Cangsam,Auguenstein, Tenenbaum**, "Data Structures using C & C++",PHI
4.**D.Samantha**, "Classic Data Structures ", PHI,New Delhi, 2005
5.**A.Puntambekar**, "Data Structures And Algorithms ", Technical Publications, Pune,2005

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	identify the data and apply the suitable concepts of data structure in programming.	K2
CO2	demonstrate linked list and its operations for programming.	K2
CO3	explain and utilize the concepts of stack and queue for programming.	K2,K3
CO4	compare the data in the required format using search and sort techniques.	K3
CO5	ability to analyze and check the algorithms.	K3,K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	S	M	S	M	S	M
CO2	M	S	S	S	M	S	S	M	M	S
CO3	M	S	S	S	M	S	S	M	M	S
CO4	M	S	S	S	M	S	M	S	M	M
CO5	M	S	S	S	M	M	M	M	M	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTS53	MATHEMATICAL APTITUDE	L	T	P	C
SKILL BASED ELECTIVE III			2	-	-	2

Objectives:

- To impart skills in numerical and quantitative techniques.
- Able to critically evaluate various real life situations by resorting to Analysis of key issues and factors.
- Able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.

Unit- I : Numbers system:
HCF – LCM – Problems on numbers. (Chapters 1, 2 & 7)

Unit- II : simplification:
Decimal Fractions and Simplification. (Chapter 3 & 4)

Unit- III : Profit and Loss :
Surds and Indices – Percentage – Profit and Loss. (Chapters 9, 10 & 11)

Unit- IV: Ratio:
Ratio and Proportion – Partnership – Allegation or Mixture. (Chapters 12, 13 & 20)

Unit -V : Average :
Average – Problems on Age. (Chapters 6 &8)

Text Book:

R.S.Aggarwal, "Scope and treatment as in "Quantitative Aptitude" , S.Chand & Company Ltd., Ram Nagar, New Delhi -2007.

Reference Book:

Dr.J.Jayaprakash, "Quantitative Aptitude", 2nd edition, Dr.JP Publication, 2017.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand the basic concepts of Quantitative Ability	K2
CO2	understand the basic concepts of Logical Reasoning Skills.	K2
CO3	acquire satisfactory competency in use of Verbal Reasoning	K2
CO4	solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability	K3,K4
CO5	compete in Various competitive exams	K3, K4

K1- Remember: K2- Understand: K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	S	S	S	S	M	M
CO2	S	M	S	M	M	M	M	S	S	M
CO3	S	S	S	S	S	S	M	S	S	S
CO4	M	M	S	M	S	S	S	M	S	S
CO5	M	S	S	S	S	M	S	S	S	M

*S-Strong; M-Medium; L-Low

SEMESTER - VI

COURSE CODE	U21MTT61	LINEAR ALGEBRA	L	T	P	C
CORE XIII			5	-	-	4

Objectives:

- To introduce the vector space
- Recognize the basic properties of vector spaces
- Understand the concepts of linear algebra in geometric point of view
- Visualize linear transformations as a matrix form
- Formulate the importance and applications of linear algebra in many branches of Mathematics

Unit-I: Vector Spaces:

Definition and examples – General properties of vector space – Subspace – Direct sum – Definition and theorems - Linear combination –linear span – – Subspace spanned or generated - Definition – Finite dimension - linear dependence and independence.

Unit-II: Basis and Dimension:

Maximally linearly independent definition – Minimal generating function - Quotient space – Isomorphism of vector spaces – Direct sums Direct sums : Internal direct sum and External direct sum – Dual space - Anihilator.

Unit-III: Matrix of a linear transformation:

Rank and nullity of a Linear transformation – Singular and non singular definition – Regular transformation - characteristic equation of a matrix- Matrix Polynomial – Elementary matrix and transformations – Cayley Hamilton Theorem.

Unit-IV: Rank of a matrix:

Row rank, column rank and rank of a matrix – Echelon matrix - Row space and column space – Determinant of a matrix - linear equation –consistency of equation – non homogeneous linear system – Consistency of equation – Invariant under T.

Unit-V: Inner product spaces:

Definition and examples of Similar and Congregant matrices - Inner product spaces- Orthogonality – Norm of v – Orthonormal - Orthogonalization – Gram Schmidt Orthogonalization process - Orthogonal complement.

Text Book:

1. **T.K.Manickavasagampillai and Narayanan, "**Modern Algebra" volume II Viswanathan printers and publishers Pvt Ltd., Edition 1982.
   Unit I- Chapter 8 -8.1 to 8.5

Unit II- Chapter 8 -8.6 to 8.10
Unit III- Chapter 8 -8.14 to 8.18
Unit IV- Chapter 8 -8.20, 8.21
Unit V-Chapter 8 -8.22 to 8.24

Reference Books:

1. **Arumugam S and Thangapandi Issac** ," Modern Algebra", SCITECH Publications, Chennai, Edition 2003.
2. **A.R.Vasishtha, "**Modern Algebra**",** Krishna Prakashan Mandir, Meerut, 1994 – 95

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand Vector Space, Quotient space Direct sum, linear span and linear independence, basis and inner product.	K1,K2
CO2	apply the linear transformations, rank, nullity.	K3
CO3	find the characteristic equation, eigen values and eigen vectors of a matrix.	K3
CO4	prove Cayley- Hamilton theorem, Schwartz inequality, Gramschmidt orthogonalisation process.	K3
CO5	evaluate the system of simultaneous linear equations.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	M	S	S	S	S	M
CO2	S	S	S	M	M	S	S	S	M	M
CO3	S	S	S	M	M	S	S	S	M	M
CO4	S	S	S	M	S	S	S	M	M	S
CO5	S	S	S	M	S	S	S	M	M	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT62	COMPLEX ANALYSIS	L	T	P	C
CORE XIV			5	-	-	4

Objectives:

- To introduce the concepts of complex numbers and analytic functions.
- The learner will acquire basic concepts of analytic function and its properties
- The learner will acquire basic knowledge about conformal and bilinear transformation
- The learner will gain knowledge of integration of complex valued function
- The learner will become proficient in series of analytic function
- The learner will acquire skills of finding integral values of complex function using residues

Unit-I: Analytic functions:

Cauchy-Riemann equations – Definition of Analytic functions- Sufficient conditions – Harmonic functions – Cauchy- Riemann equations in polar co-ordinates – Theorems and exercise in this method- Milne Thomson's method. - Conformal Mapping- Bilinear Transformation.

Unit-II: Complex integration:

Introduction of Complex integration Cauchy's integral theorem – Cauchy's integral formula – Derivatives of analytic functions – Morera's theorem – Cauchy's inequality – Liouville's theorem – Fundamental theorem of algebra.

Unit-III: Taylor's theorem:

Expansion of functions in power series –Introduction about Taylor's theorem – Taylor's theorem- Taylor's series – Maclarins' series – Laurent's Theorem - Laurent's series.

Unit-IV: Singularity:

Zeros of an analytic function - Singularity definition- singular points – removable singularity - essential singularity – poles - study of the function for the infinite value of Z - Argument Principle – Rouche's theorem - Fundamental theorem of algebra.

Unit-V: Calculus of Residues:

Introduction about Calculus of Residues - Residues - Cauchy's Residue Theorem – Application of Cauchy's Residue Theorem -Argument theorem – Rouche's theorem – Fundamental theorem of algebra - evaluation of definite integrals.

Text Book:

1. **Arumugam S and Thangapandi Issac** ," Complex Analysis", Scitech Publication pvt Ltd, Edition 2014.
   Unit I – Chapter 2 & 3
   Unit II – Chapter 6
   Unit III – Chapter 7 -7.0 to 7.2
   Unit IV – Chapter 7 -7.3, 7.4

Unit V – Chapter 8

Reference Books:

1. **Santhinarayan**, "Theory of functions of Complex Variable ", S.Chand and Company, Meerut, 1995
2. **T.K.M.Pillay, Dr.S.P.Rajagopalan & Dr.R.S. Sattanathan**, "Complex Analusis", S. Viswanathan (Printers & Publisers),Pvt.Ltd. Revised Edition 2007 Reprint 2013
3. **Lars V Ahlfors** "Complex Analysis" , McGraw – Hill Kogakusha, Ltd. 3rd Edition, 1999.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	remember sums, products, quotients, conjugate, modulus, and argument of complex numbers and exponentials and integral powers of complex numbers	K1
CO2	understand the significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations.	K2
CO3	find residues and evaluate complex integrals, real integrals using the residue theorem.	K3
CO4	apply Cauchy's residue functions and problem.	K3,K4
CO5	determine whether a given function is analytic.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	M	S	M	M	M	M
CO2	S	M	S	S	M	S	S	S	M	S
CO3	S	S	S	S	M	S	S	S	M	S
CO4	S	S	S	S	M	S	S	S	M	S
CO5	S	M	M	S	M	M	S	S	M	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT63	OPERATION RESEARCH II	L	T	P	C
CORE XV			5	-	-	4

Objectives:

- To impart mathematical modeling skills through operations research techniques.
- The learner will become proficient in sequence modeling and processes in mathematics and engineering.
- The leaner will acquire the knowledge of Simulation
- The leaner will acquire the knowledge of basics in game theory and replacement problems
- The learner will become to understand the role and application of PERT/CPM for project scheduling.

Unit-I: Sequencing Models and Related Problems:

Sequencing Problems- assumption in Sequencing Problems – processing n jobs through one machine - processing n jobs through two machines - processing n jobs through three machines - processing 2 jobs through m machines - processing n jobs through m machines – solution of complicated Sequencing Problems- problems related to sequencing(routing problem in networks) – minimal path problem(shortest acyclic route models).

Unit-II: Simulation:

Introduction-when to use Simulation- what is Simulation?- advantage of the Simulation technique- limitation of the Simulation- application of Simulation- Monte Carlo Simulation – generation of random numbers – Simulation languages- Examples and applications in simulation method.

Unit-III: Theory of Games:

Introduction- Definition of Game -Two person zero sum game- examples-The maxmini and minimax principle-Example and exercise problems in maxmini and minimax principle- Games without saddle points- Example and exercise problems in Games without saddle points -Mixed strategies-Dominance property-solution of 2×2 rectangle game- Graphical Method.

Unit-IV: Replacement Problem:

Replacement problem introduction - System Reliability – Various Types of replacement - Replacement of Equipment that Deteriorates Gradually- Algorithm – Problems in Replacement of Equipment that Deteriorates Gradually -Replacement of Equipment the Fails Suddenly-. Problems in Replacement of Equipment the Fails Suddenly

Unit-V: Network Scheduling By PERT/CPM:

Introduction network and Network Scheduling -Basic Components- Rules of Construction – Critical Path Analysis –problems in critical path method-Definition for various times in Program me Evaluation and Review Techniques - Definition of Probability Considerations in PERT – Distinction between PERT and CPM.

Text Book:

1. **Kantiswarup, Gupta, P.K.Manmohan**, "Operations Research", Sultan chand and sons Edition 2002 ,Reprint 2017.
   Unit I – Chapter 12
   Unit II – Chapter 22
   Unit III – Chapter 17
   Unit IV – Chapter 18
   Unit V – Chapter 25

Reference Books:

1. **P.K.Gupta and D.Shira,"** Operations Research" (S. Chand and Company Ltd New Delhi-.1992, Reprint 1994.
2. **Taha H.A., "**Operations Research An introduction" Prence Hall of India Private Ltd 1st Edition New Delhi (2008) .

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	remember the nature and feature of Operations Research	K1
CO2	find the replacement period of equipment that fails suddenly/gradually	K2
CO3	find EOQ problems with price breaks	K2,K3
CO4	find inventory decisions costs using deterministic inventory problems with no shortages /with shortages	K3
CO5	understand and evaluate of CPM and PERT Define basic components of Network and find critical path	K1, K3,K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;
K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	S	S	M	M	M	M
CO2	S	S	M	S	M	S	S	S	S	S
CO3	S	S	S	S	M	S	S	M	S	M
CO4	S	S	S	S	S	S	S	M	S	M
CO5	S	S	S	S	S	S	S	M	S	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT64	GRAPH THEORY	L	T	P	C
CORE XVI			5	-	-	4

Objectives:

- To acquire knowledge of different types of graphs
- To understand different Models of a graph
- To understand how to solve different real life problems
- To understand many techniques to solve a particular problem
- To understand directed graphs.

Unit-I: Graphs:

Definition of Graph – Examples for Graph- various definitions in Graph - Pictorial representation - sub graphs definition –examples- Isomorphism between Graphs – degree of Graph - Walks and connected graphs - cycles in graphs – cut vertices and cut edges definition and examples ..

Unit-II: Eulerian and Hamiltonian Graphs:

Introduction of Eulerian graphs - definition and examples of Eulerian graphs -Fleury's Algorithm for Graph – introduction of Hamiltonian Graphs – Definition and example of Hamiltonian Graphs -Weighted graphs definition and examples ,

Unit-III: Bipartite Graphs:

Introduction and definition of Bipartite graphs-Marriage problem -Trees.- Definition –Example-Incident matrix in Graph algorithm and examples -adjacent matrix in Graph algorithm and examples - path matrix in Graph algorithm and examples and circuit matrix in Graph algorithm and examples

Unit-IV: Planar Graphs:

Defining of Planer graphs – Examples for Planer graphs -Euler's Formula for: Planar Graph – Platonic solids-Dual of a plane graphs- definition and examples of dual of a plane graphs Characterization of planer graphs.

Unit-V: Directed Graphs:

Introduction and definition of directed graphs - Examples of directed graphs- Connectivity in digraphs – examples- Strong orientation of graphs –Eulerian digraphs- examples for Eulerian digraphs - Tournaments.

Text Book:

1. **S.A.Choudum**, "A first Course in Graph Theory", Macmillan india limited,1999.
   Unit I: Chapter 1
   Unit II: Chapter 2
   Unit III: Chapter 3 -3.1 to 3.3 &4-4.1

Unit IV: Chapter 5
Unit V: Chapter 7

Reference Books:

1. **Arumugam S and Thangapandi Issac** ," Graph theory", Sci tech Publication pvt ltd, Edition 2014.
2. **S.A.Choudum**, "A first Course in Graph Theory", Macmillan India limited, 2007.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	remember and understand the theoretical knowledge of graph theory to solve problems.	K1,K2
CO2	understand theories and concepts to test and validate intuition and independent mathematical thinking in problem solving.	K2
CO3	apply networks using the main concepts of graph theory.	K3
CO4	use definitions in graph theory to Analyze examples and to distinguish examples from non-example.	K4
CO5	evaluate graph theory in a coherent and technically accurate manner.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	M	M	S	S	M	M	M
CO2	S	S	M	M	M	S	M	S	S	M
CO3	S	M	S	M	M	M	M	M	S	S
CO4	S	M	M	S	M	S	S	M	S	S
CO5	S	S	M	M	M	M	S	M	S	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTT65	DISCRETE MATHEMATICS	L	T	P	C
CORE XVII			5	-	-	4

Objectives:

- To study and, or and not logics by truth tables.
- To study of normal forms.
- Analysis Free and Bound variable formulas.
- Understand Types of Grammar, function of Pushdown automata.

Unit-I: Mathematical Logic Statement and Notation:

Connection – Negation Conjunction – Disjunction – Statement Formulas and Truth Tables – Logical Capabilities of Programming Languages – Conditional and Bi Conditional – Well Formed Formula – Tautologies –Equivalence of Formula – Duality Law Tautological Implication.

Unit-II: Normal Forms:

Normal Forms-decision problem- Examples- Disjunctive Normal Forms – Examples- Conjunctive Normal Forms -examples– Principal Disjunctive Normal Forms priniciple disjunction normal form- sum–of-products canonical form – Principal Conjunctive Norms.

Unit-III: Theory of Inference:

Theory of Inference introduction -Truth Table Technique – Rules of Inference – Definition and examples - Inconsistent Premises – Indirect Method of Proof – Predicate calculus- Free and Bound Variables – Valid Formulas and Equivalences – Inference Theory of Predicate Calculus- examples and exercise problems .

Unit-IV: Grammar:

Definition –Alphabets- string- length of the sting- Concatenation of string- Grammar-Types of Grammar – Definition and examples - Phrase Structure Grammar definition- Examples for Phrase Structure Grammar -Context Sensitive Grammar definition- Examples for Context Sensitive Grammar – Context Free Grammar definition- Examples for Context Free Grammar – Regular Grammar definition- Examples for Regular Grammar – Languages Generated by these Grammars.

Unit-V: Automata:

Definition – Deterministic Automation – Non-Deterministic Automates – Conversion of Non-Deterministic Automates to Deterministic Automation - Algorithm for Conversion of Non-Deterministic Automates to Deterministic Automation- Pushdown automata – Algorithm for Pushdown automata

Text Books:

1. **J.P.Tremblay**, **R. Manohar –** "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw – Hill Edition 1997.
   Unit I- Chapter: 1- 1-1, 1-2:1-2.1 to 1-2.11.
   Unit II-Chapter: 1-3.1 to 1-3.4
   Unit III- Chapter: 1-4.1to 1- 4.3 .1-5 to1-5.4,1-6:1-6.1 -1-6.4
2. **Dr.Rani Siromoney, "**Formal Languages and Automata", The Chiristian Literature Society**,** Revised Edition 1979.
   Unit IV-Chapter2: 2.1 to 2.6
   Unit V-Chapter 5: 5.1 and Chapter 6

Reference Books:

1. B.S.Vatssa, "Discrete Mathematics",WISHWA PRAKASHAN,1993.
2. V.Sundaresan,K.S.Ganapathy Subramanian, K.Ganesan, "Discrete Mathematics", A.Rd.Publications, 1998.
3.**T.Veerarajan**, "Discrete Mathematics", McGraw Hill Education (India)Pvt.Ltd,NewDelhi, 2014.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understanding of some Logic truth tables	K2
CO2	prove / define basic normal forms	K3
CO3	to analyses the concepts of free and bound variable formulas	K4
CO4	understanding the concepts of Grammars	K4
CO5	basic concepts of Languages and basic definitions of Automata	K6

K1- Remember: K2- Understand: K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	S	S	S	S	M	M
CO2	M	M	S	M	S	M	S	M	M	S
CO3	S	S	S	M	S	S	M	S	M	M
CO4	S	M	M	S	S	M	S	S	M	M
CO5	M	S	S	M	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE641	CHOICE -I	L	T	P	C
ELECTIVE -IV		ASTRONOMY	3	-	-	3

Objectives:

- The learner understands basic knowledge about natural science.
- The leaner will acquire the knowledge of the celestial objects and origin of those objects and phenomena and their evolution
- The learner will acquire basic knowledge about morning , evening stars , circumpolar stars
- Knowledge of equation of Time, seasons from earth rotation
- Calculation to prepare calendar and conservation of Time.
- It applies mathematics, physics, and chemistry.

Unit-I: Spherical Trigonometry:

Sphere - Great circles and small circles- Axis and poles of circle – distance between two points on a sphere-angle between two circles-secondary's-angular radius or spherical radius – spherical figures –spherical triangles –polar triangle –theorems - Relation between spherical triangles and its polar triangle- Some properties of Spherical triangles- principal of duality-colunar and anti podal triangles –Relation between sides and angles of a spherical triangle- Cosine formulas-cotangent formula-supplemental cosine formula.

Unit-II: Functions of half an angel:

Functions of half a side – Delambre's analogies –Napier's analogies- right angled spherical triangle –Napier's rules- Spherical Coordinates – relation between the Spherical and rectangular coordinates – general proof of the cosine formula – formula in plane trigonometry –Important note.

Unit-III: Sideral time:

West hour angle of a body expressed in time units – theorem- latitude of a place – theorem- to determine – tee R.A. and Declination of a body- to find the hour angle of a body at rising or setting – to find the duration of day time –to trace the changes in the azimuth of a star in the course of a day. (With worked examples)- Morning and evening stars –circumpolar stars – to find the condition that a star is circumpolar. (With worked examples)

Unit-IV: Equation of Time:

Introduction- Dynamical mean sun- equation of time – analytical expression for the equation of time –effect of equation of time on the lengths of morning and evening-to prove that the equation of time vanishes four times a year –seasons –causes of seasons.

Unit-V: Calendar:

Different kinds of year –civil year, Julian calendar – Gregorian calendar – Julian date –Besselian year -Conversion of Time: Relation between sidereal and mean times –to convert mean solar time into sidereal time - to convert sidereal time into mean solar time – to find the sidereal time at a given instant of mean solar time on a given date at Greenwich – to find the mean time

corresponding to a given instant of sidereal time at Greenwich – the difference between local times – to find the sidereal time from local mean time for a given place- to find the mean time from the sidereal time for a given place- given the right ascensions of a star and the mean sun, to find the mean time of transit of the star.

Text Book:

1. **S.Kumaravelu and Susheela Kumaravelu**, "Astronomy for degree classes", Rainbow Printers, Nagarcoil, Reprint 2000.(Copies can be had of S.Kumaravelu, Muruga Bhavanam, Chidambaranager, Nagercoil)

   Unit I – Chapter I: Subsection 1- 24
   Unit II – Chapter I: Subsection 25 -38
   Unit III – Chapter II: Sub sections 70-86
   Unit IV - Chapter VII: Subsection 166- 170 and 172-174
   Unit V – Chapter VII: Subsection 175- 184 and 186- 189.

Reference Book:

1.Prophet Muhammad, "Astronomy: Supplemental Guide", Core Knowledge Foundation, 2013

2.**Jeff Becan, "Astronomy: for Beginners", Illustrted by Sarah Began,**

3. Aldnonymous ,"**General Astronom**", y, en.wikibooks.org, 2015

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understanding about natural science	K2
CO2	knowledge about the celestial objects	K3
CO3	to analyses the equation of time and seasons	K4
CO4	categorize various means in solving Time	K4
CO5	basic concepts of calendar and conservation Time	K6

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	S	S	S	S	M	M
CO2	M	M	S	M	S	M	S	M	M	S
CO3	S	S	S	M	S	S	M	S	M	M
CO4	S	M	M	S	S	M	S	S	M	M
CO5	M	S	S	M	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTE642	CHOICE -II	L	T	P	C
ELECTIVE -IV		MATHEMATICAL CRYPTOGRAPHY	3	-	-	3

Objectives:

- To offer number theoretic preliminaries for widely used public-key cryptosystems.
- To teach public-key cryptographic primitives and their role in communication.

Unit-I: Introduction to Cryptography:

Cryptanalysis of Simple substitution ciphers-Divisibility and Greatest Common Divisors (without proofs) – Modular arithmetic: Modular arithmetic and Shift Ciphers- Prime numbers :Prime numbers, unique factorization and finite fields-Powers and primitive roots in finite fields.

Unit-II: Discrete Logarithms and Diffie–Hellman Key Exchange:

The birth of public key cryptography- Discrete Logarithm Problem-Diffie-Hellman key exchange- Elgamal public key cryptosystem-The Chinese remainder theorem- The Chinese remainder theorem describes the solutions to a system of simultaneous linear congruences.

Unit-III: Integer Factorization and RSA:

Euler's formula and roots modulo pq – The RSA public key cryptosystem-Implementations and security issues- Primality testing-The Distribution of the set of Primes- Pollard's p-1 factorization algorithm - Quadratic residues and Quadratic reciprocity Probabilistic encryption.

Unit-IV: Elliptic Curves and Cryptography:

Elliptic Curves (Theorems without proofs)- Elliptic Curves over finite fields-Elliptic Curve Discrete Logarithm Problem: The double –and-Add Algorithm- Elliptic Curve Cryptography and Lenstra's Elliptic Curve Factorization Algorithm.

Unit-V: Digital Signatures:

Digital Signatures – An Over View and Definitions-RSA Digital Signatures Key Creation-signing exponent and is her verification exponent- RSA Signing- RSA Verification.

Text Book:

1. **Jeffrey Hoffstein, Jill Pipher and Joseph H. Silverman**, "An Introduction to Mathematical Cryptography ", ISBN : 978-1-4419-2674-6, Springer, 2010.
   Chapters: 1.1-1.5, 2.1-2.4, 2.8, 3.1-3.5 (excluding 3.4.1 & 3.4.2), 3.9-3.10, 5.1-5.4,5.6, 7.1-7.2.

Reference Books:

1. **Neal Koblitz, "**A Course in Number Theory and Cryptography ", Springer, 1994.
2. **Jonathan Katz and Yehuda Lindell**, "Introduction to Modern Cryptography ", Second edition, CRC Press, 2015.
3. **Douglas R.Stinson**, " Cryptography Theory and Practice ", CRC Press, Third edition, 2005

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	appreciate the role of mathematics in cryptography.	K1
CO2	understand how secure communications happen over insecure channels.	K2
CO3	appreciate how computational complexities form the basis of public-key cryptography.	K3
CO4	understand the importance of data secrecy, data integrity, and data authentication and the ways to achieve them.	K2,K3
CO5	understand key-agreement, public-key encryption and digital signatures.	K2,K4

K1- Remember: K2- Understand: K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	M	S	S	S	S	M	M
CO2	M	M	S	M	S	M	S	M	M	S
CO3	S	S	S	M	M	S	M	S	M	M
CO4	S	M	M	S	S	M	S	S	M	M
CO5	M	S	S	M	S	M	S	M	M	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTS64	OPERATIONS RESEARCH LAB	L	T	P	C
SKILL BASED ELECTIVE -IV			2	-	-	2

Objectives:

To familiarize students with the basic concepts, models and techniques for effective decision making, model formulation and applications.

Prerequisites: Operations Research – I

Use of Operations Research Software such as LINDO, LINGO, TORA etc., to solve

- Linear programming Problems
- Sensitivity analysis in LPP problems
- Integer Programming Problems
- Transportation Problems
- Assignment problems
- Problems on CPM/PERT
- Non Linear Programming problems
- Queuing problems

Reference Books :

1. **Hamdy A. Taha, "** Operations Research – An Introduction", Eight Edition – Pearson Education – Prentice Hall.
2. LINDO User's Manual – LINDO Systems, Inc.
3. Optimization Modeling with LINGO - 5 th edition – LINDO Systems, Inc.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand the basic concepts and application of operations research in various fields	K1
CO2	know principles of construction of mathematical models of conflicting situations.	K2
CO3	analyze the relationship between a linear program and its dual	K3
CO4	techniques constructively to make effective decisions in business and solve problems in industry	K4
CO5	build and solve all problems by using software.	K4

K1- Remember: K2- Understand : K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	S	S	S	S	M	M
CO2	M	M	S	M	S	M	S	M	M	S
CO3	S	S	S	M	S	S	M	S	M	M
CO4	S	M	M	S	S	M	S	S	M	M
CO5	M	S	S	M	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

NON MAJOR ELECTIVE- FOR OTHER DEPARTMENT

COURSE CODE	U21MTN31	RESOURCE MANAGEMENT TECHNIQUES	L	T	P	C
SEMESTER - III			2	-	-	2

Objectives:

- To impart the basic concepts and applications of linear programming.
- The leaner will analyze the different aspects of transportation problems, assignment problems and also sequencing problem.
- The leaner will develop, organize, evaluate short, long term processes and solve problems
- The leaner will acquire the knowledge of basics in game theory

Unit–I: Linear Programming Problem:

Definition-Mathematical formation of the Linear Programming Problem— Basic Solution-Degenerate Solution- Basic Feasible Solution of the Linear Programming Problem.

Unit–II: Transportation Problem:

Introduction and Definition-Mathematical form of L.P.P-Table-Find Intial Basic Feasible Solution – North West Corner Rule -Row Minima-Colum Minima- Least Cost Method- Vogel's Approximations Method(VAM) - Un balanced Transportation problem- Only upto Initial Basic Feasible Solution.

Unit–III: Assignment Problem:

Introduction and Definition of Assignment Problem -Mathematical formulation of the problem– Hungarian Algorithm – Simple Problem.

Unit–IV: Sequencing Problem:

Introduction and Definition of Sequencing Problem -Problem of Sequencing- Basic Terms Used in Sequencing- Processing n jobs & Two machine- Processing n jobs Through two Machines.

Unit–V: Game Theory:

Definition- Two-Person Zero-Sum Games- Some basic terms- The Maximin-Minimax Principle-Game without Saddle point- Mixed Strategies - Graphic Solution of 2 × n and m × 2 games.

Text Book:

Kanti Swarup, P.K .Gupta,Man Mohan"Operations Research", Sultanchand and sons , Edition - 2017.

Unit I – Chapter 2 and 4
Unit II – Chapter 10
Unit III – Chapter 11
Unit IV - Chapter 12
Unit V – Chapter 17

Reference Book :

1.**P.R.Vittal and V.Malini,** "Operations Research" Margham Publishers – 2002.
2.**Taha**, "Operation Research", Printice Hall, New Delhi,2011
3. **Kalavathy** , "Operations Research", Vikas Publishing House Pvt .Ltd. 2003
4. **Gupta P.K &Hira D.S** ,"Problems in Operations Research", S.Chand& Co, Delhi , 2006
5.**V.Sundaresan, K.S. Ganapathy Subramanian, &K.Ganesan**, "Resource Management Techniques" (Operations Research), A.R. Publications, Nagapattinum District

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	formulate the real life problems as Linear programming problem.	K1
CO2	use to solve Linear programming problems	K2
CO3	identify degeneracy in transportation problem	K3
CO4	calculate the optimal solution from the feasible solution using MODI method	K3
CO5	obtain the optimal solution for Assignment problems, Sequencing problem , Game Theory .	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S	S	S	S	S	M
CO2	S	S	S	S	S	M	M	S	M	S
CO3	S	S	S	M	S	S	M	S	S	S
CO4	M	S	S	S	S	M	S	M	S	S
CO5	M	S	S	S	M	S	M	S	S	M

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MTN42	NUMERICAL METHODS	L	T	P	C
SEMESTER - IV			2	-	-	2

Objectives:

- The learner will analyze the different aspects of numerical solution of algebraic and transcendental equations.
- The learner will understand the several methods to solve the simultaneous equations.
- The leaner will derive numerical methods for various mathematical operations and tasks on interpolation.

Unit-I: Solution of Algebraic and Transcendental Equations:
Introduction and advantages of solution of algebraic and Transcendental Equations- Bisection Method – Iteration Method – Condition for Convergence.

Unit-II: Solution of Algebraic and Transcendental Equations:
Deviation and advantage of Solution of Algebraic and Transcendental Equations-Regular Folsi Method -Newton's Raphson Method.

Unit-III: Solutions of Simultaneous Linear Algebraic Equations:
Method of elimination in Simultaneous Linear Algebraic Equations- Gauss Elimination Method for Solutions of Simultaneous Linear Algebraic Equations – Gauss Jordan Method Solutions of Simultaneous Linear Algebraic Equations.

Unit-IV: Solutions of Simultaneous Equations:
Introduction of Jacobi methods of Simultaneous Equations - Algorithm - Gauss Jacobi – Gauss Seidel Method.

Unit-V: Finite Differences:
Introduction of forward and backward Difference of Finite difference: First and Higher Order Differences –Forward and Backward Differences.

Text Book:

1. **P.Kandasamy, K.Thilagavathi and K. Gunavathi**, "Numerical Methods", S.Chand and Company Ltd , New Delhi 2013.

Unit I – Chapter 3 -3.1 to 3.2
Unit II – Chapter 3 -3.3 to 3.4
Unit III – Chapter 4 -4.1- 4.2
Unit IV – Chapter 4 - 4.8 - 4.9
Unit V – Chapter 5 – 5.1 – 5.2

Reference Books:

1. **Arumugam , Issac, Somasundaram**,"Numerical Analysis", New Gamma Publishing House, Palayam Kottai 2003.
2. **G. Balaji**, "Numerical Methods", G.Balaji Publishers, Chennai 2007.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand the fundamentals in finding the roots of the equation using bisection method and iteration method.	K2
CO2	approximate solutions of algebraic and transcendental equations.	K3
CO3	analyze and evaluate the accuracy of numerical methods	K4
CO4	evaluate numerical solution to a system of linear equation by Gauss-Seidal method.	K5
CO5	evaluate the problems in interpolation.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	M	S	S	M	S	M
CO2	M	S	M	S	S	M	S	M	M	M
CO3	M	S	M	M	M	M	M	S	M	S
CO4	S	M	S	M	S	M	S	M	S	M
CO5	S	S	M	S	M	S	M	S	M	M

*S-Strong; M-Medium; L-Low

VALUE ADDED PROGRAMME

COURSE CODE	U21MAV51	NUMERICAL METHODS LAB USING C++	L	T	P	C
SEMESTER - V			-	-	-	2

Objectives:

- To develop programming skills in C and its object oriented concepts.
- The learner will become proficient in object oriented programming concept and proficient in C tokens
- Proficient in C operators , class declaration and definition and its objects
- Proficient in conditional statements and loop concept

1. Write a Program to find the smallest positive / Largest negative root using simple iteration method
2. Write a Program to find the smallest positive / Negative root using Regula Falsi method.
3. Write a Program to find the Smallest positive / Negative root using Newton-Raphson‘s i method.
4. Write a Program to find the solution of system of equation using Gauss Jacobi method..
5. Write a Program to find the Matrix inversion using Gauss Jordan method
6. Write a Program to interpolate y for given x from the given sets of values of x and y by Newton‘s forward method.
7. Write a Program to find interpolate y for given x from the given sets of values of x and y by Newton‘s backward method.
8. Write a Program to find interpolate y using the Lagrange‘s method
9. Write a Program to derivative at initial point by Newton‘s forward method
10. Write a Program to integration using Trapezoidal & simpson’s method

Text Book:

1. **T.Veerarajan and T.Ramachandran**, “Theory and Problems in Numerical Methods with Programs in C and C++”, Tata McGraw Hill Publishing Company Ltd, 2004.

COURSE CODE	U21MAA11	SEMESTER -I	L	T	P	C
B.Sc. Physics / Chemistry		ANCILLARY MATHEMATICS I	5	-	-	4

Objectives:

- The learner will become proficient in expansion and summation of function
- The learner will acquire knowledge of solving problems in matrices
- The learner will capable of solving the interpolation problems.
- The learner will gain knowledge of trigonometric functions and related problems
- The learner will become proficient in various types of hyperbolic functions

Unit-I: Partial Fractions:

Introduction of Partial Fractions- Binomial Theorem: The General Term – Expansion of Rational Fractions – Summation of Series. Exponential Theorem: Summation of Series, The Logarithmic Series- Problems.

Unit-II: Theory of Equations:

Introduction of the general Equations- Fundamental Theorem of Algebra – Symmetric Function of Roots – Relation between Roots and Coefficient of Equation – Formation of Equation – Diminish the Roots of the Equation – Reciprocal Equation. Newton - Raphson Method problems.

Unit-III: Matrices:

Fundamental Concepts of Special Types of Matrices –Addition and Subtraction of Matrices – Matrix Multiplication – Associated Matrices. Rank of a Matrix: Elementary Operations or Transformation. Linear Equations: Homogeneous linear Equation – Non-Homogeneous Equation Characteristic Roots and Vectors: Eigen Value and Eigen Vectors – Properties of the Eigen Vectors – Cayley - Hamilton theorem.

Unit-IV: Interpolations:

Introduction about Interpolations: Newton's Forward Method - Newton's Backward Method- Lagrange's Interpolation Formula: Different form of Lagrange's Interpolation Formula- problems.

Unit-V: Trigonometry:

Basic ideas in Trigonometry: Expansions: $\cos^n\theta$, $\sin^n\theta$ – $\cos n\theta$ and $\sin n\theta$ –Expansion of $\sin\theta$,$\cos\theta$ and $\tan\theta$ in powers of θ.Hyperbolic Function: Relation between Hyperbolic Functions and Circular Functions – Periods of Hyperbolic Functions – Inverse Hyperbolic Functions. Logarithm of Complex Quantities

Text Book:

1. **P.Kandasamy, K.Thilagavathy**,"Allied Mathematics Paper I", 1st Semester, S. Chand Publishing . A Division of S. Chand & Company Pvt. Ltd, Edition 2013

Reference Books:

1.**G.C.Sharma and Madhu Jain**, Algebra and Trigonometry, 1st Edition, Galgotia Publications Pvt.Ltd.2003

2.**Dr.S.Arumugam, A.Thangapandi Isaac and A.Somasundaram**, Numerical Methods, 2nd reprint, Scitech Publication India Pvt, Ltd., 2004.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	remember numbers, sequences, series, basic summaries from partial fraction, equations, matrices	K1
CO2	understand trigonometric values and Interpolations	K2
CO3	solve problems by using theorems.	K3
CO4	analyze homogeneous and non-homogeneous linear equations.	K4
CO5	analyze and Evaluate inverse functions.	K4, K5

K1- Remember; K2- Understand; K3-Apply; K4- Analyse; K5- Evaluate; K6- Create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	S	S	M	S	S	S	M	M
CO2	M	M	S	M	S	M	S	M	M	S
CO3	S	S	M	M	S	S	M	S	M	M
CO4	S	M	M	S	M	M	S	S	M	M
CO5	M	S	S	M	S	M	S	M	M	S

*S-Strong; M-Medium; L-Low

COURSE CODE	U21MAA22	SEMESTER -II	L	T	P	C
B.Sc. Physics / Chemistry		ANCILLARY MATHEMATICS II	5	-	-	4

Objectives:

- To learn methods of integration and properties and its solving related problems.
- Understand the basic concepts of first order differential equation and it applications.
- Find solutions by applying Laplace transform methods.
- Vectors and its product and its integrations.

Unit-I: Vector Calculus:

Introduction about Vector Calculus – Gradient, Divergence and curl (problems only). Integration of vectors: Integration of vector functions, Line integrals – Surface integrals – Green's theorem in the plane (statement only) – Gauss Divergence theorem (statement only) – Problems – Stoke's theorem (statement only) – Problems

Unit-II: Partial differential equation

Introduction of Partial differential equation from differential equations - Formation of Partial differential equations by eliminating arbitrary constants and arbitrary functions* – Solutions of standard types of first order equations- f (p, q) = 0, f(x, p, q)=0, f(y, p, q)=0, f(z, p, q)=0, $f_1(x, p)= f_2(y, q)$, z = px+qy+f (p, q) , Clairaut's form– Lagrange method of solving linear partial differential equations P p + Q q = R. (problems only)

Unit-III: Total differential equations:

Introduction of total differential equations - Bessel's equations : Bessel's equations – Solutions of Bessel's general differential equations (derivations not included) – General solution of Bessel's equations - Recurrence formulae (derivations not included) – Simple problems using Recurrence relation.

Unit-IV: Laplace Transforms:

Introduction of Laplace Transforms- Definition – Laplace Transform of e^{at}, cos at, sin at, cosh at, sinh at, t^n, n, a positive integer – e^{at} f (t) , $t^n f(t)$, f (t), f:(t) – Inverse Laplace Transform of standard functions – Solving differential equations of Second order with constant coefficients using Laplace Transform.

Unit-V: Fourier Series:

Introduction of Fourier Series: Definition- Dirchlet's conditions- Fourier series of periodicity 2π and 2l - Odd and even functions –Root mean square value of a function Half range series: Introduction- Half range series –Cosin series- sin series – Parseval's theorem - Harmonic analysis

Text Book:

1. **P.Kandasamy and K.Thilagavathy**. "Mathematics for B. Sc., Br. -I, Volume-II and Volume-III", S. Chand & Company Ltd, First edition, 2004.(UNIT I and III)
2. **S.Narayanan and T.K. Manickavasagam Pillai**," Calculus Vol. III ", S.Viswanathan (Printers and Publishers, (P)Ltd, Chennai, 2010. (UNIT II and V)
3. **S. Narayanan and T. K. Manickavasagam Pillai**, "Calculus Vol. III " S.Viswanathan (Printers and Publishers, (P)Ltd, Chennai, 1997. (UNIT IV)

References Book

1.**P. Kandasamy and K.Thilagavathy**, "Mathematics, Vol Iv", S.Chand And Company Ltd.,- 2004
2.**Shanti Narayan**, "Differential Calculus", Shyamlal Charitable Trust, New Delhi, 2004.
3.**P.N.Chatterji**,"Vector Calculus ", 1st Edition, Rajhans Prakahan Publishers, Chennai, 1998.

Course Outcome:

On the successful course completion, students will be able to		Cognitive Level
CO1	understand the I and II integrals	K2
CO2	understand properties of integrals, Laplace transform.	K2
CO3	understand first order differential equations.	K2
CO4	analysis Theorems and proves.	K3,K4
CO5	evaluate the importance of shifting properties.	K3, K4

K1- Remember: K2- Understand: K3-Apply, K4- Analyse, K5- Evaluate; K6- create

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	M	S	S	S	M	M
CO2	M	M	S	M	M	M	S	M	M	S
CO3	S	M	S	M	S	S	M	S	S	M
CO4	S	M	M	S	M	M	S	S	M	M
CO5	M	S	S	M	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

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