ETHIRAJ COLLEGE FOR WOMEN

(AUTONOMOUS)

CHENNAI-600 008

COLLEGE WITH POTENTIAL FOR EXCELLENCE

DEPARTMENT OF MATHEMATICS

(Aided & Self Supporting)

SYLLABUS

Choice Based Credit System

Outcome Based Education

(Offered from the academic year 2021-22)

ETHIRAJ COLLEGE FOR WOMEN

(AUTONOMOUS)

CHENNAI-600 008

COLLEGE WITH POTENTIAL FOR EXCELLENCE

B.Sc. Mathematics

Allied Mathematics

B.Com (Business Mathematics) &

M.Com (Statistics)

SYLLABUS

CHOICE BASED CREDIT SYSTEM

OUTCOME BASED EDUCATION

(Offered from the academic year 2021-22)

CONTENTS

RULES AND REGULATIONS FOR THE PROGRAMME

As per the guidelines given by the University Grants Commission and the Tamil Nadu State Council for Higher Education, the B.Sc. Degree programme is designed in such a way to have a foundation in discrete and continuous mathematics; a mathematical attitude towards problem formulation and solving; an analytical skill and desire for correctness; an appreciation of the approaching of mathematical techniques, the programming skill at higher level computer language and research aptitude to mathematics.

Department of Mathematics is revising syllabi with effect from the academic year 2021-22, as specified by the Government of Tamil Nadu. Part IV and Part V components will seek to build the capacity of the students and provide inputs for their social service and social analysis capabilities.

Every academic year is divided into two semester sessions. Each semester will have a minimum of 90 working days and each day will have 5 working hours. Teaching is organized into a modular pattern of credit courses. Credit is normally related to the number of hours a teacher teaches a particular subject. It is also related to the number of hours a student spends learning a subject or carrying out an activity.

1. ELIGIBILITY FOR ADMISSION

Candidates for admission to the first year of the degree of B. Sc. course shall be required to have passed the Higher Secondary Examinations conducted by Government of Tamil Nadu or an Examination accepted as equivalent thereto by the Syndicate of the University of Madras.

2. ELIGIBILITY FOR THE AWARD OF DEGREE

The candidate shall be eligible for the award of degree only if she has under gone the prescribed course of study for a period of not less than three academic years, passed the examinations of all the six semesters prescribed earning 140 credits - 12 credits from Part I, 12 credits from Part II, 95 credits from Part III, 20 credits from Part IV and 1 credit from Part V. The department offers **Self Study** papers in the penultimate semester. Students who have no arrears and who have obtained distinction in all the previous semesters alone are eligible for these papers.

3. DURATION OF THE PROGRAMME: 3 YEARS

Each academic year shall be divided into two semesters. The first academic year shall comprise of the first and second semesters, the second academic year, the third and fourth semesters and the third academic year, fifth and sixth semesters respectively. The odd semesters shall consist of period from June to November of each year and the even semesters from December to April of each year. There shall not be less than 90 working days for each semester.

COURSE OF STUDY

The main subject of study for Bachelor Degree shall consist of the following:

Part – I **:** Tamil/Other Languages

Part – II **:** English

Part – III **:** Core Subjects, Allied Subjects and Project / Electives with three courses.

Part – IV **:** 1.(a) Those who have not studied Tamil up to XII standard and taken a Non- Tamil Language under Part I shall take Tamilcomprising of two Courses (Level will be at 6^{th} Standard).

(b) who have studied Tamil up to XII standard and taken a Non Tamil language under Part I shall take Advanced Tamil comprising of two courses.

(c) Others who do not come under (a) & (b) can choose Non Major elective

2. Soft skill paper (offered by English Department)
3. Environmental Studies
4. Value Education

Part V: Extension Activities.

PASSING MINIMUM

A candidate shall be declared to have passed in each paper / practical of the main subject of study wherever prescribed, if she secured NOT LESS THAN 40% of the marks prescribed for the examination.

1. There shall be no passing minimum for Internal.
2. For External Examination Passing Minimum shall be 40% of the maximum marks prescribed for the paper for each paper / practical and project.
3. In the aggregate (External +Internal) the Passing Minimum shall be of 40%.
4. She shall be declared to have passed the whole examination, if she passes in all the papers and practical where ever prescribed / as per scheme of examinations by earning 140 credits in part I, II, III, IV and V. She shall also fulfill the extension activities prescribed earning a minimum of one credit to qualify for the degree.

CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Part I, II, III & IV

Successful candidates passing the examinations and securing the marks (i) 60 percent and above and (ii) 50 percent and above but below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND class respectively. All other successful candidates shall be declared to have passed the examination in the THIRD class.

Candidates who pass all the examinations (Part I, II, III & IV) prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for ranking.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

On obtaining an Undergraduate degree, the students will be able to:

PEO 1: Apply and advance the knowledge and skills acquired, to become a creative professional in their chosen field.

PEO 2: Engage in self-directed continuous learning, aimed at global competency, whichwill promote professional and personal growth.

PEO 3: Develop management skills and entrepreneurial skills, by harnessing core competencies tempered by values and ethics

PEO 4: Work towards achieving economic and social equity for women through application of relevant knowledge

PEO 5: Contribute to promoting environmental sustainability and social inclusivity.

PROGRAMME OUTCOMES (POs)

On completion of the **Programme,** the learner will be able to:

PO 1- Promote and apply scientific knowledge for finding sustainable solution to solve issues pertaining to the society/Industry.

PO 2- Identify, Analyse and formulate novel ideas to yield, substantial results in the fields of research utilizing the principles of Physical and Biological Science.

PO 3- Relate key concepts and scientific principles to various scientific phenomenon and their applications in day-to-day life.

PO 4- Cultivate unparalleled comprehension of fundamental concepts relevant to basic sciences leading to an individual progress and career advancement at the National and Global levels.

PO 5- To communicate effectively their views and ideas orally/written in English and in other related languages.

PO 6 - Design solutions for complex problems and design system components or processes that meet the specific needs with appropriate consideration for public health and safety, cultural, societal and environmental conditions.

PROGRAMME SPECIFIC OUTCOME (PSOs)

Upon successful completion of the **B.Sc. Mathematics** Programme, the students will be able to:

PSO 1 - Demonstrate basic manipulative and calculative skills in Trigonometry, Geometry and Calculus.

PSO 2 - Solve problems in advanced areas of Mathematics like Algebra and Analysis.

PSO 3 - Read, analyse and judge the validity of Mathematical arguments.

PSO 4 - Students will be able to communicate mathematical ideas both orally and in writing.

PSO 5 - Display mastery of basic computational skills and recognise the appropriate use of technology to enhance those skills.

PSO 6 - Investigate and apply mathematical models in a variety of contexts related to science, technology, business and industry.

ETHIRAJ COLLEGE FOR WOMEN (AUTONOMOUS) CHENNAI -08
CURRICULUM TEMPLATE (2021-22 ONWARDS)
UNDERGRADUATE PROGRAMME PROFILE
DEPARTMENT OF MATHEMATICS
COURSE CODES AND CREDITS

TOTAL MINIMUM CREDITS: 140 **TOTAL TEACHING HOURS: 180**

PART	CORE/ ALLIED/ ELECTIVE	TITLE OF THE PAPER	CODE	L	T	P	H	C	CA	SE	MM
I SEMESTER											
I	Language	Tamil/Hindi/French/ Sanskrit					5	3	40	60	100
II	English	Communicative English					4	3	40	60	100
III	Core 1	Trigonometry and Laplace Transforms	MA21/1C/ TLT	3	2	0	5	4	40	60	100
III	Core 2	Differential Calculus	MA21/1C/DCL	3	2	0	5	4	40	60	100
III	Allied	Calculus of Finite Differences – I (or) Allied General Physics-I	MA21/1A/FD1 (or) PH21/1A/ AP1	4	2	0	6	5	40	60	100
IV	EVS	Environmental Studies		2	0	0	2	2	-	50	50
IV	Soft Skill	English Department- Professional English for Arts/Commerce/Physical Sciences/Life Sciences					2	3	-	50	50
II SEMESTER											
I	Language	Tamil/Hindi/French/ Sanskrit					5	3	40	60	100
II	English	Communicative English					4	3	40	60	100
III	Core 3	Classical Algebra	MA21/2C/CLA	3	2	0	5	4	40	60	100
III	Core 4	Integral Calculus and Fourier Transforms	MA21/2C/ICF	3	2	0	5	4	40	60	100
III	Allied	Calculus of Finite Differences – II (or) Allied General Physics – II	MA21/2A/FD2 (or) PH21/2A/AP2	4	2	0	6	5	40	60	100
IV	Val. Ed	Value Education		2	0	0	2	2	-	50	50
IV	Soft Skill	English Department- Professional English for Arts/Commerce/Physical Sciences/Life Sciences					2	3	-	50	50
III SEMESTER											
I	Language	Tamil/Hindi/French/ Sanskrit					5	3	40	60	100
II	English	Communicative English					4	3	40	60	100
III	Core 5	Differential Equations and its Applications	MA21/3C/DEA	3	2	0	5	4	40	60	100
III	Core 6	Algebraic Structures	MA21/3C/ALS	3	2	0	5	4	40	60	100

PART	CORE/ ALLIED/ ELECTIVE	TITLE OF THE PAPER	CODE	L	T	P	H	C	CA	SE	MM
III	Allied	Mathematical Statistics & R Software – I	MA21/3A/MS1	4	0	2	6	5	40	60	100
IV	NME (1c)	Office Automation (Practicals)	MA21/3N/OAN	1	0	1	2	2	-	50	50
IV	Soft Skill	English Department- Professional English for Arts/Commerce/Physical Sciences/Life Sciences					2	3	-	50	50
IV SEMESTER											
I	Language	Tamil/Hindi/French/ Sanskrit					5	3	40	60	100
II	English	Communicative English					5	3	40	60	100
III	Core 7	Vector Calculus and Analytical Solid Geometry	MA21/4C/VAG	3	2	0	5	4	40	60	100
III	Core 8	Linear Algebra	MA21/4C/LAL	3	2	0	5	4	40	60	100
III	Allied	Mathematical Statistics & R Software – II	MA21/4A/ MS2	4	0	2	6	5	40	60	100
IV	NME (1c)	Statistics using 'R' Software (Practicals)	MA21/4N/SUR	1	0	1	2	2	-	50	50
IV	Soft Skill	English Department- Professional English for Arts/Commerce/Physical Sciences/Life Sciences					2	3	-	50	50
V SEMESTER											
III	Core 9	Real Analysis	MA21/5C/RAN	3	3	0	6	4	40	60	100
III	Core 10	Statics	MA21/5C/STT	2	4	0	6	4	40	60	100
III	Core 11	Operations Research	MA21/5C/OPR	2	4	0	6	4	40	60	100
III	Elective I	Programming Language 'C'(Theory & Practicals)	MA21/5E/PLC	4	0	2	6	5	40	60	100
III	Elective II	Graph Theory (Option -1)	MA21/5E/GRT	3	3	0	6	5	40	60	100
		Mathematical Modelling (Option- 2)	MA21/5E/MAM								
VI SEMESTER											
III	Core 12	Complex Analysis	MA21/6C/CAN	3	3	0	6	4	40	60	100
III	Core 13	Dynamics	MA21/6C/DYN	2	4	0	6	4	40	60	100
III	Core 14	Discrete Mathematics	MA21/6C/DIM	3	3	0	6	4	40	60	100
III	Core 15	Number Theory and Cryptography	MA21/6C/NTC	3	3	0	6	4	40	60	100
III	Elective III	Programming in Python (Theory & Practicals)	MA21/6E/PPY	4	0	2	6	5	40	60	100
V		Extension Activity (Sports/NCC/NSS/CSS/ YRC/RRC/Retract/ Yoga)		-	-	-	Min. 60 hours	1	-	-	-

PART	(OPTIONAL) EXTRA CREDITS										
IV	Self-Study (Semester V) Extra Credits	Astronomy Fundamentals of Fuzzy set Theory	MA21/5SS/ASY MA21/5SS/FST	-	-	-	-	2	-	100	100
		Internship (Summer Vacation after IV Semester)		-	-	-	Min. 14 days	1	-	-	-
		Project (Semester VI)					-	2	-	100	100

L = Lecture Hours

T = Tutorial Hours

P = Practical Hours

H = Hours per week

C = Credits

CA = Continuous Assessment

SE = Semester Examinations

MM = Maximum Marks

EVALUATION PATTERN FOR CONTINUOUS ASSESSMENT-UG

INTERNAL VALUATION BY COURSE TEACHER/S

PART I, II AND III-THEORY PAPERS

S.NO.	COMPONENT	TIME	MAX. MARKS	C.A. MARK
1	TEST I	2 HOURS	50 MARKS (TO BE CONVERTED)	10
2	TEST II	2 HOURS	50 MARKS (TO BE CONVERTED)	10
3	*ASSIGNMENT/QUIZ/SEMINAR /FIELD VISIT			10
4	*PARTICIPATORY LEARNING			10
TOTAL				**40**

*Ten marks each for Assignment and Participatory Learning of **Programming Language 'C' (MA21/5E/PLC), Programming in Python (MA21/6E/PPY)** are evaluated by conducting internal practicals.

* Ten marks for Assignment of **Mathematical Statistics & R Software- I (MA21/3A/MS1), Mathematical Statistics & R Software II (MA21/3A/MS2)** are evaluated by conducting internal practicals.

C.A. QUESTION PAPER PATTERN–UG

Knowledge Level	Section	Word Limit	Marks	Total
K 1	A - 5×2 marks	50	10	50
K 1, K 2	B - 3/5×8marks	200	24	
K 2, K 3	C - 1/2×16 marks	500	16	

RUBRICS FOR C.A. EVALUATION

Assignment	Content / Originality / Presentation / Schematic Representation andDiagram / Bibliography
Seminar	Organization / Subject Knowledge / Visual Aids / Confidencelevel / presentation-Communication and Language
Field Visit	Participation/Preparation/Attitude/Leadership
Participation	Answering Questions/Clearing Doubts/Participating in Group Discussions/ Regular Attendance

END SEMESTER EVALUATION PATTERN-UG

THEORY PAPERS

PART III (Major & Allied)

SEMSTER I/II/III/IV/V/VI

Knowledge Level	Section	Word Limit	Marks	Total
K 1	**A: 10 ×2 marks**	**50**	**20**	**100**
K1, K 2	**B: 5/8× 7marks**	**200**	**35**	
K2, K 3	**C: 3/5× 15 marks**	**500**	**45**	

Section A: Short Answer: 10 questions to be answered without choice, 2 questions from each unit, each carrying 2 marks

Section B: 5 questions to be answered out of 8 questions, each carrying 7 marks – at least one question from each unit.

Section C: 3 questions to be answered out of 5 questions, each carrying 15 marks – one question from each unit.

DOUBLE VALUATION BY COURSE TEACHER AND EXTERNAL EXAMINER

MAXIMUM MARKS: 100 TO BE CONVERTED TO 60

PASSING MARK: 40

PART IV: SINGLE VALUATION ONLY **(ORAL TEST/WRITTEN TEST)**

MAXIMUM MARKS: 50

PASSING MARK: 20

SELF STUDY: The Self Study courses will have only single valuation and question papers will have to be set by the department. There will be no continuous assessment for Self Study courses.

SEMESTER I COURSE PROFILE-PROGRAMME OF STUDY

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/ WEEK	TOTAL HOURS	L-T-P	C.A.	S.E.	TOTAL
Part I	Tamil / Hindi / French / Sanskrit	3	5	75		40	60	100
Part II	English	3	4	60	2-1-1	40	60	100
MA21/1C/ TLT	Trigonometry and Laplace Transforms	4	5	75	3-2-0	40	60	100
MA21/1C/DCL	Differential Calculus	4	5	75	3-2-0	40	60	100
MA21/1A/FD1 (or) PH21/1A/GP1	Calculus of Finite Differences – I (or) Allied General Physics - I	5	6	90	4-2-0	40	60	100
Part IV	Environmental Studies	2	2	30	2-0-0	-	50	50
	Soft Skill (Offered by English department)	3	2	30		-	50	50

SEMESTER – I

CORE 1

TRIGONOMETRY AND LAPLACE TRANSFORMS

TEACHING HOURS: 75 Hours **COURSE CODE: MA21/1C/TLT**
CREDITS: 4 **L T P : 3 2 0**

COURSE OBJECTIVES:

To enable students to

1. Apply Trigonometric formulae to verify identities and simplify expressions.
2. Explore the relationship between hyperbolic and inverse hyperbolic functions.
3. Apply Laplace and Inverse Laplace transforms to solve differential equations.

COURSE OUTLINE:

UNIT I: Expansion of Sin nθ, Cos nθ, tan nθ, Sin ^{n} θ, Cos$^{n}\theta$. Expansion of Sin θ,Cos θ, tan θ in ascending powers of θ.

Book 1 Chapter 3 Section 3.1, 3.2, 3.4, 3.5 (omit examples on formation of equations) **(15 Hours)**

UNIT II: Hyperbolic Functions: definition, relation between hyperbolic functions and Inverse hyperbolic functions.

Book 1 Chapter 4 Section 4.1, 4.2. **(20 Hours)**

UNIT III: Logarithm of complex quantities.

Book 1 Chapter 5 Section 5.1, 5.2. **(10 Hours)**

UNIT IV: Summation of Trigonometric series by using complex quantities: C+iS form, Gregory series (only simple problems in both the cases).

Book 1 Chapter 6 Section 6.3 **(15 Hours)**

UNIT V : Laplace Transform: Laplace Transform- Inverse Laplace Transform, properties. Application of Laplace Transform to solution of the first andsecond order linear differential equations (with constant coefficients).

Book 2 Chapter **(15 Hours)**

BOOKS RECOMMENDED:

1. S. Narayanan and T.K. Manicavachagom Pillay, Trigonometry (2008).
2. S. Narayanan and T.K. Manicavachagom Pillay (2003), Differential Equations & its Applications, S. Viswanathan Printers and Publishers Pvt.Ltd, Chennai.

REFERENCE BOOKS:

1. A. Singaravelu, Algebra and Trigonometry Volume I (2003), MeenakshiAgency, Chennai.
2. P.R. Vittal, Trigonometry, Margham Publications.
3. P.R. Vittal, Calculus, (2004), Margham Publications, Chennai.
4. Dr. M.D. Raisinghania, H.C. Saxena, H.K. Dass Trigonometry (S. Chand).
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers (2002).

PERIODICALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography.

WEBSITES & e-LEARNING SOURCES:

1. **https://www.youtube.com/watch?v=HOk2XLeFPDk**
2. **https://www.youtube.com/watch?v=6Rw-GMEjQ8s**
3. **https://www.onlinemathlearning.com/hyperbolic-function.html**
4. **https://www.youtube.com/watch?v=ve7CmEIEv_U**
5. **https://nptel.ac.in/content/storage2/courses/122104018/node94.html**

COURSE OUTCOMES

Upon successful completion of **Trigonometry and Laplace Transforms**, students will be able to

CO Number	CO STATEMENT
CO1	Expand sines and cosines of θ in terms of functions of multiples of θ.
CO2	Determine the hyperbolic functions and inverse hyperbolic function and study the relation between them.
CO3	Determine the logarithms of complex numbers.
CO4	Compute the Laplace Transforms and Inverse Laplace Transforms of various basic mathematical functions.
CO5	Investigate the Laplace Transform techniques to solve second order differential equations.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	1	3
CO2	3	2	3	3	1	3
CO3	3	2	3	3	1	3
CO4	3	2	3	3	1	3
CO5	3	2	3	3	1	3
AVERAGE	**3**	**2**	**3**	**3**	**1**	**3**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION – 0.

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knwledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**Nil**
K1, K 2	B-5/8 x7 marks	200	35		
K2, K 3	C-3/5 x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – I

CORE 2

DIFFERENTIAL CALCULUS

TEACHING HOURS: 75 Hours **COURSE CODE: MA21/1C/DCL**
CREDITS: 4 **L T P : 3 2 0**

COURSE OBJECTIVES:

To enable students to

1. Find maxima and minima of a given function
2. Apply differentiation to find envelope, curvature and pedal equation of a curve.
3. Develop problem solving skills.

COURSE OUTLINE:

UNIT I: Successive Differentiation- n^{th} derivative, standard results – Leibnitz Theorem (without proof) and its applications.

Book 1 Chapter 3: Section 1.1 -1.6 & Section 2.1 -2.2 (15 Hours)

UNIT II: Jacobians – Maxima and minima of functions of two independent variables. Necessary and Sufficient conditions (without proof) – Lagrange's method of undetermined multipliers (without proof) and its applications.

Book 1 Chapter 8: Section 4, 4.1, 5
Book 2 Chapter 3 (15 Hours)

UNIT III: Polar coordinates – Angle between the radius vector and the tangent – Slope of the tangent in polar coordinates – the angle of intersection of two curves in polar coordinates – Polar sub tangent and polar sub normal - the length of arc in polar coordinates.

Book 1 Chapter 9: Section 4.1- 4.6 (12 Hours)

UNIT IV: Envelopes- Curvature – Circle, Radius and Centre of curvatures, Cartesian formula for the Radius of curvature- Co-ordinates of the Centre of Curvature,Evolutes and Involutes, Radius of curvature in Polar Co-ordinates, p-r equations, Pedal equation of a curve.

Book 1 Chapter 10: Section 1.1- 1.3, 2.1- 2.8 (18 Hours)

UNIT V: Definition – Asymptotes parallel to the axis, oblique asymptotes, $F_n + F_{n-2} = 0$ form, Intersection of a curve with its asymptotes (without proofs)

Book 1 Chapter 11: Section 1 – 4, 6, 7 (15 Hours)

BOOKS RECOMMENDED:

1. S. Narayanan & T.K. Manickavachagom Pillay, Calculus, Volume I (2004), S. Viswanathan Printers & Publishers Pvt Ltd. Chennai.
2. A. Singaravelu and R. Ramaa, Calculus and Co-ordinate Geometry of two-dimension, First edition (2003) Meenakshi Agency, Chennai.

REFERENCE BOOKS:

1. Dr. S. Sudha, Calculus, First edition (1998), Emerald Publishers, Chennai.
2. S.C. Arora & Ramesh Kumar, A Text Book of CALCULUS, First edition (1984), Pitambar Publishing Company-New Delhi.
3. R.K. Ghosh, K.C. Mait, An Introduction to Analysis, Differential Calculus,Part-I, Tenth edition (1999), Books and Allied(P) Ltd-Calcutta.
4. Shanti Narayan, P.K. Mittal, Differential Calculus, Tenth RevisedEdition (2005), S. Chand & Company Pvt Ltd, New Delhi.
5. Apostal.T.M, Calculus-Volume I, Second edition, Wiley Publications, New Delhi.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society, Chennai.
2. Discrete Mathematical Sciences & Cryptography.

E-LEARNING SOURCES:

1. http://www.mathforum.org
2. http://www.opensource.org
3. http://www.khanacademy.org
4. http://in.ixl.com
5. http://www.learningwave.com
6. https://brilliant.org/
7. https://openstax.org/subjects/math
8. https://tutorial.math.lamar.edu/

COURSE OUTCOMES:

Upon successful completion of **Differential Calculus**, students will be able to

CO Number	CO STATEMENT
CO 1	Compute n^{th} derivatives of algebraic & trigonometric functions. Evaluate n^{th} derivative of product of two functions using Leibnitz formula
CO 2	Find maxima and minima of functions of two independent variables. Use Lagrange's multiplier method to solve constrained optimization problem. Apply PDE to find Jacobian of a given multiple variables.
CO 3	Compute the angle of intersection, Sub tangent, Sub Normal, Length of the arc using Polar Coordinates
CO 4	Demonstrate and compute envelopes, radius and centre of curvature, Co-ordinates of centre of curvature, p-r equation and pedal equation of a curve.
CO 5	Explain and evaluate the asymptotes.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	1	2	3	1	-
CO2	3	2	2	2	2	2
CO3	3	1	2	2	2	2
CO4	3	1	2	3	2	2
CO5	3	1	2	2	2	-
AVERAGE	**3**	**1.2**	**2**	**2.4**	**1.8**	**1.2**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED- 1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN - UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10×2 marks	50	20	**100**	**Nil**
K1, K 2	B-5/8 × 7 marks	200	35		
K2, K 3	C-3/5× 15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER–I

ALLIED - 1

CALCULUS OF FINITE DIFFERENCES – I

TEACHING HOURS: 90 Hours **COURSE CODE: MA21/1A/FD1**
CREDITS: 5 **L T P: 4 2 0**

COURSE OBJECTIVES:

To enable students to

1. Apply Numerical Methods to obtain approximate solutions to mathematical problems.
2. Derive Numerical Methods for various mathematical operations and tasks, such as interpolation, differentiation, integration.
3. Analyse the accuracy of common Numerical Methods.

UNIT I: FINITE DIFFERENCES

Forward, Backward, Divided difference and Shift Operators, Relation between operators, representation of polynomials in factorial notations, Successive differences of polynomial – Inverse Operator Δ^{-1}, Differences of zero, Simple problems. (Proof of theorems in finite differences excluded)

Book 1 Chapter 2 Section 2.1 **(20 Hours)**

UNIT II: INTERPOLATION

Newton's forward and backward formulae for interpolation- Central difference formulae- Gauss forward, Gauss backward, Stirling's and Bessel'sformulae. (Derivations not included for all the formulae)

Book 2 Chapter 4 & 6 **(20 Hours)**

UNIT III: INTERPOLATION (contd.)

Lagrange's formula for interpolation – Newton's divided differences formula.Lagrange's inverse formula. (Derivations are not included)

Book 2 Chapter 5 Section 5.1-5.3, 5.6 **(15 Hours)**

UNIT IV: NUMERICAL DIFFERENTIATION

Methods of derivatives using interpolation formulae (only first order), Maxima and minima using Newton's forward formula – simple problems.

Book 2 Chapter 8 **(15 Hours)**

UNIT V : NUMERICAL INTEGRATION

Quadrature formula for equidistant ordinates based on Newton's Forward formula - Trapezoidal rule – Simpson's one third rule – Simpson's three Eighthrule.

Book 2 Chapter 9 Section 9.1-9.3 **(20 Hours)**

BOOKS RECOMMENDED:

1. B. D. Gupta (2001) Numerical Analysis, Konark Publication Ltd., Delhi.
2. S. G. Venkatachalapathy (2012), Calculus of finite differences and Numericalanalysis, Margham publications, Chennai.

REFERENCE BOOKS:

1. H.C. Saxena, Finite Differences and Numerical Analysis(1991) S.Chand & Co. Delhi.
2. S. Arumugham, Numerical Methods, (2003) New Gamma Publishing, Palayamkottai.
3. M. K. Jain, S. R.K. Iyengar, R. K. Jain, Numerical methods for scientific and Engineering Computation (6^{th} Edition), 2003, New age International Publishers.
4. E. Balagurusamy, Numerical Methods, (2017) Tata Mc-Graw Hill, New Delhi.
5. Manicavachagom Pillay, Narayanan, Numerical Analysis (2001),S. Viswanathan Printers & Publishers, Chennai.
6. Dr. M.K. Venkataraman, Numerical Methods in Science & Engineering (Fifth Edition), 2005, The National Publishing Company, Chennai.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society.
2. Discrete Mathematical Sciences & Cryptography.

E-LEARNING RESOURCES:

1. http://www.mathforum.org
2. http://www.opensource.org
3. https://nptel.ac.in/courses/111/107/111107105/
4. http://in.ixl.com
5. http://www.learningwave.com

COURSE OUTCOMES:

Upon successful completion of **Calculus of Finite Differences – I**, students will be ableto

CO Number	CO STATEMENT
CO 1	Compare accuracy, precision and errors.
CO 2	Applying the Methods of interpolation to compute the missing value in real life problems.
CO 3	Utilize various numerical operators to find the generalized term.
CO 4	Compute the missing values for unequal intervals using Divided difference and Lagrange's Method.
CO 5	Evaluate the approximate values of the first derivative, max and min values of the Function using Newton's formula.
CO 6	Compute definite integral for different combinations of integrands using various methods and analyze their accuracy.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	1	2	3	1	3
CO 2	3	2	2	3	1	3
CO 3	3	2	2	3	1	3
CO 4	3	2	2	3	1	3
CO 5	3	2	2	3	1	3
CO 6	3	2	2	3	1	3
Average	**3**	**1.83**	**2**	**3**	**1**	**3**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructionsif any
K 1	A- 10 x 2 marks	50	20	**100**	**Nil**
K1, K 2	B - 5/8 x7 marks	200	35		
K2, K 3	C-3/5 x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2 Understanding

Knowledge Level 3. Application

SEMESTER II COURSE PROFILE

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/ WEEK	TOTAL HOURS	L-T-P	C.A	S.E.	TOTAL
Part –I	Tamil/Hindi/ French / Sanskrit	3	5	75		40	60	100
Part- II	English	3	4	60	2-1-1	40	60	100
MA21/2C/CLA	Classical Algebra	4	5	75	3-2-0	40	60	100
MA21/2C/ICF	Integral Calculus Fourier Series and Transforms	4	5	75	3-2-0	40	60	100
MA21/2A/FD2 (or) PH21/2A/GP2	Calculus of Finite Differences –II (or) Allied General Physics – II	5	6	90	4-2-0	40	60	100
Part- IV	Value Education	2	2	30	2-0-0	-	50	50
	Soft Skill (Offered by English Department)	3	2	30		-	50	50

SEMESTER – II
CORE 3
CLASSICAL ALGEBRA

TEACHING HOURS: **75 Hours** **COURSE CODE: MA21/2C/CLA**

CREDITS: 4 **L T P : 3 2 0**

COURSE OBJECTIVES:

To enable students to

1. Sum the Series using Binomial, Exponential and Logarithmic series.
2. Compute the inverse of the matrix using Cayley Hamilton Theorem
3. Understand the basic concepts of Theory of Numbers.

COURSE OUTLINE:

UNIT I: Summation of series and approximations using Binomial, Exponential and Logarithmic series

Book 1 - Chapter 3 Section 10 & 14
Chapter 4 Section 3, 9 & 12 **(12 Hours)**

UNIT II: Theory of Equations: Polynomial Equations – Relation between roots andCoefficients – Symmetric functions of roots, Formation of equation.

Book 1 - Chapter 6 Section 1 - 12 **(18 Hours)**

UNIT III: Transformation of Equations, Reciprocal equations – Descartes' rule ofsigns, Approximation of roots of cubic equations by Horner's method.

Book 1 - Chapter 6 Section 15 - 17, 24, 30 **(12 Hours)**

UNIT IV: Matrices: Symmetric – Skew- symmetric- Hermitian, Skew-Hermitian, Orthogonal and Unitary matrices, Cayley- Hamilton theorem (without proof),finding the inverse of a matrix using Cayley-Hamilton theorem. Eigen Valuesand Eigenvectors – Similar matrices – Diagonalisation.

Book 2 Chapter 2 Section 1 - 8, 9.1, 16 **(15 Hours)**

UNIT V: Theory of numbers: prime and composite numbers, decomposition intoprime Factors (without proof), Divisors of a positive integer 'n', Euler function $\phi(n)$, Formula for $\phi(n)$ (without proof), the higher power of a prime contained in n!, Congruences, Fermat's and Wilson's theorem –simple problems.

Book 2 Chapter 5 Section 1, 6 - 8, 10 -13, 16, 17. **(18 Hours)**

BOOKS RECOMMENDED:

1. T.K. Manicavachagam Pillay, T. Natarajan, K.S. Ganapathy, Algebra Volume-I(2008) S. Viswanathan Printers & Publishers Pvt. Ltd, Chennai.

2. T.K. Manicavachagam Pillay, T. Natarajan, K.S.Ganapathy, Algebra Volume – II (2008) S.Viswanathan Printers & Publishers Pvt. Ltd, Chennai.

REFERENCE BOOKS:

1. P.R.Vittal and V.Malini, Algebra and Trigonometry (2003), Margam Publishers, Chennai.
2. Dr.A.Singaravelu, Algebra and Trigonometry Vol I &II (2003), Meenakshi Agency, Chennai.
3. Dr.S.Arumugam, Prof. A.Thangapandi Isaac , Classical Algebra (2003), New gamma Publishing House, Palayamakottai.
4. H.K. Dass, H.C.Saxena, M.D.Raisingghania, Matrices (1999), S.Chand & Company Pvt. Ltd , New Delhi.
5. Dr.Sudir K. Pundir, Dr.Rimple Pundir, Theory of numbers , Third Revised edition (2012), Pragati Prakashan , Meerut.
6. A course in Number Theory, Second edition, H. E. Rose, Oxford Science Publications.
7. An Introduction to the theory of Numbers, Ivan M.Niven and Zuckerman, Wiley.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society,Chennai.
2. Discrete Mathematical Sciences & Cryptography

E-LEARNING SOURCES:

1. http://www.mathforum.org
2. http://www.opensource.org
3. http://www.khanacademy.org
4. http://www.in.ixl.com
5. http://www.learningwave.com
6. https://www.youtube.com/watch?v=iKQESPLDnnI
7. https://www.youtube.com/watch?v=kGdezES-bDU

COURSE OUTCOMES

Upon successful completion of **Classical Algebra**, students will be able to

CO Number	CO STATEMENT
CO1	Sum the series using Binomial, Exponential and Logarithmic expansions.
CO2	Analyse the relation between root and coefficients of a polynomial equation. Form the equations using symmetric roots of a given equation
CO3	Find an approximation of roots of cubic equation by Horner's method.
CO4	Compute the inverse of a matrix using Cayley Hamilton Theorem, eigen values and eigen vectors of a matrix.
CO5	Analyse and interpret the concept of numbers, divisibility, Congruence, Euler function, Fermat's and Wilson's theorem.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	1	3
CO2	3	2	3	3	1	3
CO3	3	2	3	3	1	3
CO4	3	2	3	3	1	3
CO5	3	2	3	3	1	3
AVERAGE	**3**	**2**	**3**	**3**	**1**	**3**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructionsif any
K 1	A- 10 x 2 marks	50	20	**100**	**Nil**
K1, K 2	B - 5/8 x7 marks	200	35		
K2, K 3	C-3/5 x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2 Understanding

Knowledge Level 3. Application

SEMESTER- II

CORE 4

INTEGRAL CALCULUS, FOURIER SERIES AND TRANSFORMS

TEACHING HOURS: **75 Hours** **COURSE CODE: MA21/2C/ICF**
CREDITS: 4 **L T P : 3 2 0**

COURSE OBJECTIVES:

To enable students to

1. Be familiar with the concepts of reduction formulae, Fourier Series, Fourier Transforms.
2. Apply double and triple integrals to find the area and volume.
3. Understand the concepts of Beta and Gamma functions and their applications.

COURSE OUTLINE:

UNIT-I: Reduction formulae- $\int x^n e^{ax}\, dx$, $\int sin^m x\, cos^n x dx$, $\int x^m (\log x)^n$ dx, $\int \cos^m x \cos nx$ dx, $\int \cos^m x \sin nx$ dx, (m, n being positiveintegers), Bernoulli's formula

Book 1 Chapter 1: Section 13.1, 13.5, 13.10, 15.1 **(12 Hours)**

UNIT-II: Double Integral (Cartesian and Polar Coordinates) - Change of order of integration.

Book 1 Chapter 5: Section 2.1, 2.2, 3.1, 3.2 **(18 Hours)**

UNIT-III: Triple Integral - Beta and Gamma functions (Simple problems)

Book 1 Chapter 4: Section 4

Book 1 Chapter 7: Section 2.1 - 2.3, 3, 4, 5 **(15 Hours)**

UNIT-IV: Fourier Series:

Fourier series of periodic functions, Fourier series of odd and even functions,Half range Fourier Series – Development in Cosine and Sine series.

Book 2 Chapter 6: Section 1 - 4, 5.1, 5.2 **(14 Hours)**

UNIT-V: Fourier Transforms:

Complex form of Fourier Integral Formula-Fourier Integral Theorem – Properties of Fourier Transform-Fourier Cosine and Sine Transform-SimpleProblems

Book 2 Chapter 6: Section 9, 10, 11.1 & 11.2 **(15 Hours)**

BOOKS RECOMMENDED :

1. S. Narayanan and T.K. Manicavachagom Pillay, Calculus Volume – II (2008), S.Viswanathan Printers & Publishers Pvt. Ltd, Chennai.
2. S. Narayanan and T.K. Manicavachagom Pillay, Calculus Volume – III (2008), S.Viswanathan Printers & Publishers Pvt. Ltd, Chennai.

REFERENCE BOOKS:

1. P.Kandasamy and K. Thilagavathi, Mathematics for B.Sc., Volume II (2004) ,S.Chand & Company Ltd , New Delhi.
2. Apostol, T.M, Calculus Volume II Fourth edition (1991), John Wiley and Sons, Inc., New York.
3. S.C.Arora & Ramesh Kumar, A Text Book of Calculus, First edition (1984), Pitambar Publishing Company, New Delhi.
4. Shanti Narayan, P.K.Mittal, Integral Calculus, Tenth Revised Edition (2005), S.Chand & Company Ltd., New Delhi.
5. R.KGhosh, K.C.Maity , An Introduction to Analysis, Integral Calculus, Part-I,Ninth edition (1999), Books and Allied(P) Ltd-Calcutta.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society,Chennai.
2. Discrete Mathematical Sciences & Cryptography.

E-LEARNING RESOURCES:

1. http://www.mathforum.org
2. http://www.opensource.org
3. http://www.khanacademy.org
4. http://in.ixl.com
5. http://www.learningwave.com
6. https://brilliant.org/
7. https://openstax.org/subjects/math
8. https://tutorial.math.lamar.edu/

COURSE OUTCOMES:

Upon successful completion of **Integral Calculus, Fourier Series and Transforms**, students will be able to

CO Number	CO STATEMENT
CO 1	Derive reduction formula and thereby evaluate some standard integrals.
CO 2	Apply change of variable method to evaluate double integral
CO 3	Utilize double and triple integral to compute area and volume of the solid
CO 4	Explain the properties of Beta and Gamma function and apply it to compute the integral
CO 5	Identify odd and even function. Use that to determine Fourier series expansion of the given function.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	1	3	1	-
CO 2	3	2	2	3	2	2
CO 3	3	2	2	3	2	3
CO 4	3	2	2	3	1	2
CO 5	3	2	1	3	1	2
AVERAGE	**3**	**2**	**1.6**	**3**	**1.4**	**1.8**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10×2 marks	50	20	**100**	**Nil**
K1, K 2	B-5/8 × 7 marks	200	35		
K2, K 3	C-3/5× 15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – II

ALLIED - 2

CALCULUS OF FINITE DIFFERENCES – II

TEACHING HOURS: 90 Hours **COURSE CODE: MA21 / 2A / FD2**
CREDITS: 5 **L T P : 4 2 0**

COURSE OBJECTIVES:

To enable students to

1. To develop the basic understanding of Numerical Algorithms
2. To learn how to interpolate the given set of values
3. To learn numerical solution of differential equations.

COURSE OUTLINE:

UNIT I: Summation of series: Use of forward difference operators – Summation usingEuler – Maclaurin's formula

Book 2 Chapter 9 Section 9.5, 9.6 **(20 Hours)**

UNIT II: Solution of Algebraic and Transcendental Equations: Numerical solutions of Polynomial and Transcendental equations in one variable - Bisection Method - Method of false position (Regular falsi Method) -Newton Raphson Method, Method of iteration**.**

Book 2 Chapter 1 **(20 Hours)**

UNIT III: Solution of a system of Algebraic Equations: Numerical solution of Simultaneous Linear Equations in three variables by Gauss Elimination Method - Gauss Jordan Method - Jacobi Iteration Method - Gauss SeidelMethod**.**

Book 2 Chapter 13 &14 Section 13.1 - 13.4, 14.3 **(20 Hours)**

UNIT IV: Difference equations: Definition, method of solutions - First order linear difference equation with constant - variable coefficients - second order lineardifference equation with constant coefficients- Particular integrals of type $a^x, x^m, x^m a^x$ – Simple problems.

Book 1 Chapter 11 **(15 Hours)**

UNIT V: Numerical solution of ordinary differential equations of first order: Euler's method - Modified Euler Method - Picard's method of successive Approximation Runge- Kutta Method of order four. **(omit predictor corrector Methods)**

Book 1 Chapter 11 Section 11.1 - 11.5 **(15 Hours)**

BOOKS RECOMMENDED:

1. B. D. Gupta (2001) Numerical Analysis, Konark Pub. Ltd., Delhi.
2. S. G. Venkatachalapathy (2012), Calculus of finite differences and Numerical Analysis, Margham publications, Chennai.

REFERENCE BOOKS :

1. H.C. Saxena, Finite Differences and Numerical Analysis (1991) S. Chand & Co. Delhi.
2. S. Arumugham, Numerical Methods, (2003) New Gamma Publishing, Palayamkottai.
3. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical methods for scientific and Engineering Computation (6^{th} Edition), 2003, New age International Publishers.
4. E. Balagurusamy, Numerical Methods, 2017, Tata Mc-Graw Hill, New Delhi.
5. Manicavachagom Pillay, Narayanan, Numerical Analysis (2001),S. Viswanathan Printers & Publishers, Chennai.
6. Dr. M. K. Venkataraman, Numerical Methods in Science & Engineering (Fifth Edition), 2005, National Publishing Company.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography.

E-LEARNING RESOURCES:

1. http://www.mathforum.org
2. http://www.opensource.org
3. http://www.khanacademy.org
4. https://nptel.ac.in/courses/111/107/111107105/
5. http://www.learningwave.com

COURSE OUTCOMES:

Upon successful completion of **Calculus of Finite Differences – II**, students will be able to

CO Number	CO STATEMENT
CO 1	Compute the summation of series by applying Numerical Operators and Euler Maclaurin Formula.
CO 2	Apply Numerical Methods to evaluate numerical solution of algebraic and transcendental equations.
CO 3	Solve Simultaneous linear equation in three variables.
CO 4	Formulate difference equation for the given problem and solve the equation.
CO 5	Evaluate the solution of first order differential equation using Euler, Picard's and Runge - Kutta Methods.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	**3**	**2**	**1**	**3**	**1**	**3**
CO 2	**3**	**2**	**-**	**3**	**1**	**3**
CO 3	**3**	**2**	**-**	**3**	**1**	**3**
CO 4	**3**	**1**	**1**	**3**	**1**	**3**
CO 5	**3**	**1**	**1**	**3**	**1**	**3**
Average	**3**	**1.6**	**0.6**	**3**	**1**	**3**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A- 10 x 2 marks	50	20	100	Nil
K1, K 2	B - 5/8 x7 marks	200	35		
K2, K 3	C - 3/5 x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER III COURSE PROFILE

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/ WEEK	TOTAL HOURS	L-T-P	C.A	S.E	TOTAL
Part I	Tamil/Hindi/ French/ Sanskrit	3	5	75		40	60	100
Part II	English	3	4	60	2-1-1	40	60	100
MA21/3C/DEA	Differential Equations and its Applications	4	5	75	3-2-0	40	60	100
MA21/3C/ALS	Algebraic Structures	4	5	75	3-2-0	40	60	100
MA21/3A/MS1	Mathematical Statistics & R Software – I	5	6	90	4-0-2	40	60	100
Part IV	Lab/NME Office Automation	2	2	30	1-0-1	-	50	50
	Soft Skill (from English department)	3	2	30		-	50	50

SEMESTER III

CORE 5

DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS

TEACHING HOURS: 75 Hours **COURSE CODE: MA21/3C/DEA**
CREDITS: 4 **L T P : 3 2 0**

COURSE OBJECTIVES:

To enable students to

1. Gain logical skills in the formulation of differential equations.
2. Expose students to different techniques of finding solution to these equations.
3. Know the basics for Mathematical Modelling.

COURSE OUTLINE:

UNIT I: Equations of the first order and of first degree equation, Applications of first order equations

Variables separable - Homogeneous equations – Non- homogeneous equationsof the first degree in x and y – Linear equations- Bernouilli's equation – Exact differential equations. Applications of first order equations: Growth, Decay and Chemical Reactions – Flow of water from an orifice -Falling bodies and other rate problems –The Brachistochrone.

Chapter II Sections 1 to 6
Chapter III Sections 1 to 4 **(18 Hours)**

UNIT II: Equations of the first order but of higher degree

Equations of first order but of higher degree: Equations solvable for p – Equations solvable for x and solvable for y – Clairaut's form

Chapter IV Sections 1 to 3 **(12 Hours)**

UNIT III: Linear equation with constant coefficients

Definitions - The operator D - complementary function, - Particular Integral –Linear equations with variable coefficients –Equations reducible to thelinear equations - Application to vibrations in Mechanical systems.

Chapter V Sections 1 – 7 **(15 Hours)**

UNIT IV: Simultaneous differential equations, Linear equations of the second order, Total differential equations.

Simultaneous differential Equations of the first order and first degree – Methods for Solving $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ - Variation of parameters – Criterion of integrability – Rules for integrating $Pdx + Qdy + Rdz = 0$

Chapter VI Sections1 to 4, Chapter VIII Section 4,
Chapter XI Section 1 **(15 Hours)**

UNIT V: Partial Differential Equations of the first order

Classification of integrals - Formation of P.D.E., Lagrange's Method of solving linear equation, Special Methods: The four standard forms – Equations reducible to standard forms.

Chapter XII Sections 1 - 5 **(15 Hours)**

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RECOMMENDED TEXTBOOKS:

S. Narayanan & T.K. Manicavachagam Pillay, Differential Equations and its Applications, Revised Ninth Edition, S.Viswanathan Pvt. (Ltd.), 2007, Chennai.

REFERENCE BOOKS:

1. P.R. Vittal, Differential Equations and Laplace transforms, Margham Publications, 2016.
2. Zafar Ahsan, Differential equations and their applications, 2nd Edition, PHILearning Pvt. Ltd., 2013.
3. Richard Bronson, Differential Equations (Schaum's Outline Series), ThirdEdition, 2017.
4. Dr. M. D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand &Company Pvt., Ltd., 16th Revised edition, 2014, New Delhi.
5. M. K. Venkataraman, Higher Engineering Mathematics ,III-B ,National PublishingCo, 2008, Chennai.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

E-LEARNING RESOURCES:

1. **http://www.khanacademy.org**
2. **http://in.ixl.com**
3. **http://www.learningwave.com**
4. **https://byjus.com**
5. **https://tutorial.math.lamar.edu**
6. **https://ocw.mit.edu**
7. **https://ncert.nic.in**

COURSE OUTCOMES:

Upon successful completion of **Differential Equations and its Applications**, students will be able to

CO Number	CO STATEMENT
CO 1	Analyze and solve the first order differential equation.
CO 2	Compute C.F and P.I for the Linear equation with constant coefficients.
CO 3	Compute C.F and P.I for the Linear equation with variable coefficients. Discuss the method of variation of Parameters.
CO 4	Evaluate the solution of exact equations, Total Differential Equations, Lagrange's Equation.
CO 5	Formulate P.D.E. Complete, particular and singular integrals.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	-	2	3	-	2
CO 2	3	-	1	2	-	1
CO 3	3	-	1	2	-	1
CO 4	3	2	3	2	-	1
CO 5	3	2	3	2	-	1
AVERAGE	**3**	**0.8**	**2**	**2.2**	**-**	**1.2**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2
WEAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A: 10 x 2 marks	50	20	**100**	Nil
K1, K 2	B: (5/8) x7 marks	200	35		
K2, K 3	C: (3/5) x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER III

CORE 6

ALGEBRAIC STRUCTURES

TEACHING HOURS: 75 Hours **COURSE CODE: MA21/3C/ALS**
CREDITS : 4 **L T P : 3 2 0**

COURSE OBJECTIVES:

To enable students to

1. Understand algebraic concepts of groups and rings.
2. Analyze and understand theorems on algebraic concepts.
3. Apply the algebraic concepts in mathematical science.

COURSE OUTLINE:

UNIT I : Groups - Subgroups.
Chapter 2 Sections 2.1 - 2.4 **(15 Hours)**

UNIT II : A Counting Principle - Normal subgroups and Quotient groups.
Chapter 2 Sections 2.5, 2.6 **(15 Hours)**

UNIT III : Homomorphisms–Automorphisms -Cayley's theorem-Permutation groups.
Chapter 2 Sections 2.7 - 2.10

(Excluding applications 1 and 2 of Section 2.7. Examples 2.8.1 & 2.8.2 and applications of Section 2.9) **(15 Hours)**

UNIT IV: Definitions and Examples of Rings -Some Special classes of rings- Homomorphisms.
Chapter 3 Sections 3.1 - 3.3 **(15 Hours)**

UNITV: Ideals and Quotient Rings – More Ideals and Quotient Rings –Euclidean rings – A Particular Euclidean Ring.

Chapter 3 Sections 3.4, 3.5, 3.7, 3.8 **(15 Hours)**

BOOKS RECOMMENDED:

I.N. Herstein (2015) Topics in Algebra, (2nd edition) Wiley India Pvt Ltd. NewDelhi.

REFERENCE BOOKS:

1. Vijay .K Khanna, S. K. Bhambri, A course in Abstract Algebra, 5th Edition, Vikas Publishing House Pvt., Ltd., 2021.
2. K S. Arumugam (2013) Modern algebra, Scitech Publications, Chennai.
3. K. Viswanatha Naik(Reprint 1992), Modern algebra, Emerald Publishers.
4. Joseph Gallian(2009), Contemperory Algebra,9th edition, Narosa Publications, Chennai.
5. Schuam's outlines(2020)- Group theory, Benjamin baumslag, Brucechandler, Tata McGraw-Hill Publishing company Ltd.
6. M. L. Santiago (1999) Modern Algebra Arul Publications, Chenna,1988 1st edition.

PERIODICALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

WEBSITES & E- LEARNING SOURCES:

1. https://nptel.ac.in/courses/111/106/111106113
2. https://nptel.ac.in/courses/111/106/111106131
3. https://ocw.mit.edu/courses/mathematics/18-703-modern-algebra-spring 2013/lecture-notes/MIT18_703S13_pra_l_16.pdf

COURSE OUTCOME:

Upon successful completion of **Algebraic Structures**, students will be able to:

CO Number	CO STATEMENT
CO 1	Analyze the properties implied by the definition of groups and rings.
CO 2	Assess the properties of various canonical types of groups and rings like cyclic groups, normal groups, quotient rings, polynomial rings.
CO 3	Analyze and demonstrate examples of subgroups, normal subgroups, quotient group, ideals and quotient rings
CO 4	Use the concepts of isomorphism and homomorphism for groups and rings
CO 5	Produce rigorous proofs of propositions arising in the context of abstract algebra.

MAPPING: COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO /PCO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	1	2
CO 2	3	3	3	3	1	2
CO 3	2	3	3	3	1	2
CO 4	1	3	3	3	1	3
CO 5	-	3	3	3	1	-
AVERAGE	**3**	**3**	**3**	**3**	**1**	**2**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2
WEAKLYCORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion-Role Modelling
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN - UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**Two questions from each section (Section A & Section B) should test problem solving skills.**
K1, K 2	B-5/8x7 marks	200	35		
K2, K 3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – III
ALLIED 3
MATHEMATICAL STATISTICS & R SOFTWARE – I

TEACHING HOURS: 90 Hours **COURSE CODE: MA21/3A/ MS1**
CREDITS: 5 **L T P : 4 0 2**

COURSE OBJECTIVES:

To enable the students to

1. Distinguish between discrete and continuous distributions.
2. Understand the degree of relationship between two variables and to compute the relationship as linear equations.
3. Be equipped with the knowledge of R – Programming and apply it to compute statistical measures.

COURSE OUTLINE:

THEORY COMPONENT

UNIT I : RANDOM VARIABLES AND MATHEMATICAL EXPECTATION

Definition of a random variable – Distribution function – Discrete Random Variable Continuous Random Variable – Mathematical expectation – Addition theorem of Expectation– Multiplication theorem of Expectation – Co-Variance –Expectation of Linear Combination of Random Variables –Variance of a Linear Combination of Random Variables – Expectationof a Continuous Random Variable.

Book 1 Chapter 5 Sections 5.1 – 5.4.1
Chapter 6 Sections 6.1 – 6.7 **(12 Hours)**

UNIT II : DISCRETE DISTRIBUTIONS

Binomial distribution– Poisson distributions – Definition– Mean – Mode – Recurrence relation for moments – Moment generating function– Characteristic function– Cumulants – Additive – Recurrence formula for the probability of distributions.

Book 1 Chapter 7 **(18 Hours)**

UNIT III : CONTINUOUS DISTRIBUTIONS

Rectangular distribution– Normal distribution – Definition– limiting form of Binomial Distribution (derivation excluded) – Chief characteristics of normal distribution and Normal probability curve– Mean – Mode – Median – Moment generating functions – moments– Cumulants – Area property – Fitting of normal distribution.

Book 1 Chapter 8 Sections 8.1 - 8.2.14 **(20 Hours)**

UNIT IV : CORRELATION AND REGRESSION

Correlation : Bivariate Distribution – Correlation – Karl Pearson Coefficientof Correlation – Rank correlation-Repeated ranks.

Regression : Lines of Regression – Regression Curves – Regression Coefficients – Properties of Regression Coefficients – Angle between two lines of Regression. (Derivation of formulae for correlation and regression lines excluded)

Book 1 Chapter 10 Sections 10.1 - 10.6.1, 10.7 - 10.7.5 (10 Hours)

PRACTICAL COMPONENT

UNIT V: DESCRIPTIVE STATISTICS USING "R" SOFTWARE

Introduction – R as a statistical software and language – R as a Calculator – Methods of data input – Some useful built in functions –Diagrammatic representation of data – subdivided and multiple Bar diagram – pie chart – Graphical representation of frequency data- Rod & Spike graph – frequency polygon – Less than and more than Ogives –Fitting of Binomial and Poisson distributions – Correlation and rank correlation between two variables – Regression lines of X on Y and Yon X.

(Internal Practical only, No questions for the end semester examination)

Book 2 (30 Hours)

BOOKS RECOMMENDED:

1. S.C. Gupta and V.K. Kapoor, Elements of Mathematical Statistics, (ThirdEdition), 2014 Sultan Chand & Son Publications, New Delhi.
2. Sudha G. Prohit, Sharad D.Gore and Shailaja R. Deshmukh, Statisitcs using R , (Second edition), 2012, Narosa Publishing house Pvt Ltd, New Delhi

REFERENCE BOOKS:

1. P.R. Vittal, Mathematical Statistics, (2015), Margham Publications
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics (Third Edition), 2014 Sultan Chand & Sons Publications
3. Hogg R.V. & Craig A.T, Introduction to Mathematical Statistics(1998)
4. Snedecor G.W. & Cochran (2014), Statistical Methods, Oxford
5. S.P. Gupta(2017), Statistical Methods, Sultan Chand & Co.

PERIODICALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

WEBSITES & e-LEARNING SOURCES:

1. https://www.coursera.org/lecture/introductiontoprobability/discrete-random-variables-9b7gS
2. https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression
3. http://www.opensource.org
4. http://www.learnigwave.com
5. https://sites.google.com/a/tamu.edu/dlcarlson/home/r-project-for-statistical-computing/r-resources-on-the-web

COURSEOUTCOMES

Upon successful completion of **Mathematical Statistics & R Software –I** students will be able to

CO Number	CO STATEMENT
CO 1	Differentiate between discrete and continuous random variables and compute mathematical expectation of a random variable. Compute Mathematical Expectation of a random variable.
CO 2	Compute Mean, Median and Mode of Binomial and Poisson distribution and their moments.
CO 3	Analyse rectangular and normal distribution and compute the various parameter of the distribution. Apply Normal distribution properties to solve real life problems.
CO 4	Compute Correlation and Rank Correlation and find the relation between two variables using Regression.
CO 5	Effectively use 'R' software for representation of data, Computation of Correlation and Regression lines.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	3	3
CO2	3	2	3	3	3	3
CO3	3	2	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	2	3	3	3	3
AVERAGE	**3**	**2**	**3**	**3**	**3**	**3**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2
WEAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion-Role Modelling
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**No Questions to be taken from UNIT V**
K1, K 2	B-5/8x7 marks	200	35		
K2, K 3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER IV COURSE PROFILE

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/ WEEK	TOTAL HOURS	L-T-P	C.A	S.E	TOTAL
Part I	Tamil/Hindi/ French/ Sanskrit	3	5	75		40	60	100
Part II	English	3	5	75	2-1-1	40	60	100
MA21/4C/VAG	Vector Calculus and Analytical Solid Geometry	4	5	75	3-2-0	40	60	100
MA21/4C/LAL	Linear Algebra	4	5	75	3-2-0	40	60	100
MA21/4A/MS2	Mathematical Statistics & R Software – II	5	6	90	4-0-2	40	60	100
Part IV	Soft Skill	3	2	30		-	50	50
	Lab/NME - Statistics using R Software	2	2	30	1-0-1	-	50	50

SEMESTER - IV

CORE 7
VECTOR CALCULUS AND ANALYTICAL SOLID GEOMETRY

Teaching Hours: **75 Hours** **Course Code: MA21/4C/VAG**
Credits: 4 **L T P : 3 2 0**

COURSE OBJECTIVES:

To enable students to

1. Understand the fundamental concepts of vector calculus and co-ordinate geometry
2. Apply the knowledge of plane, straight line and sphere, to solve various problems
3. Apply the various techniques of vector integration in solving volume and surfaceintegrals

COURSE OUTLINE:

UNIT I : Vector Differentiation: Directional Derivative, gradient, unit normal to the surface, equation of tangent plane to a surface, equation of normal to a surface, Divergence, Curl, Laplace operators.
Book 1 Chapter 2 Sections 2.1 - 2.13 **(20 Hours)**

UNIT II: Vector Integration: Evaluation of line integral, surface integral and volume integral
Book 1 Chapter 3 Sections 3.1 - 3.6 **(10 Hours)**

UNIT III: Application of Green's theorem, Gauss-Divergence theorem, and Stokes' theorem (proofs of theorems not included), simple problems
Book 1 Chapter 4 Sections 4.1 - 4.5, 4.8 **(10 Hours)**

UNIT IV: Plane
General equation of a plane – Equation of a plane in the normal form – Angle between planes– Plane through three given points – Equation of a plane through the line of intersection, length of the perpendicular to the plane.
Straight Line
Symmetrical form of a straight line –Equation of a straight line passing through two given points –the plane and the straight line, Coplanar lines.
Book 2 Chapter II Sections 1 - 10
Chapter III Sections 1 - 7 **(20 Hours)**

UNIT V : Sphere
Equation of the sphere – Length of the tangent – Tangent plane – Section of a sphere by a plane – Orthogonal spheres – Equation of a sphere through a given circle.
Book 2 Chapter IV **(15 Hours)**

BOOKS RECOMMENDED:

1. Duraipandian. P, Kayalal Pachaiyappa, Vector Analysis I Edition S. Chand & Company Private Ltd, Reprint 2015
2. T.K. Manicavachagam Pillay & Narayanan , Revised edition, Reprint 2001, Analytical Geometry (Part II – Three dimensions), S. Vishwanathan Printersand Publishers pvt.ltd, Chennai

REFERENCE BOOKS:

1. P.R. Vittal & V.Malini, Vector Calculus Fourier Series and Fourier Transforms Margham Publications (2004),
2. S.G. Venkatachalapathy, Analytical Geometry (Two dimensions & Three dimensions) Margham Publications(2016).
3. P.R. Vittal, Vector analysis, Analytical solid geometry and sequences and series, Margham Publications, Third Edition (2003).
4. Murray R Spiegel, Theory and Problems of Vector Analysis (Schaum's Outline Series, (McGraw – Hill Book Company.

PERIODICALS:

1. The Mathematics Intelligencer.
2. Mathematics Newsletters

E-LEARNING RESOURCES:

1. http://www.mathforum.org
2. http://www.opensource.org
3. http://khanacademy.org
4. https://nptel.ac.in/courses/111/105/111105122/
5. http://www.learningwave.com

COURSE OUTCOMES:

Upon successful completion of **Vector Calculus and Analytical Solid Geometry**, students will be able to

CO Number	CO STATEMENT
CO 1	Understand the basic concepts and compute gradient, Scalar Potential, Directional Derivative, Divergence and Curl.
CO 2	Evaluate line integral, surface integral and volume integral.
CO 3	Apply Green's theorem, Gauss-Divergence theorem, Stoke's theorem to evaluate Area and Volume.
CO 4	Understand the concept of the equation of a plane and a straight line
CO 5	Compute equation of a circle on a sphere, tangent plane to the sphere.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFICOUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	1	2
CO2	3	3	3	3	1	2
CO3	3	3	3	3	1	2
CO4	3	2	3	3	1	3
CO5	3	3	3	3	1	1
AVERAGE	**3**	**2.8**	**3**	**3**	**1**	**2**

KEY: STRONGLY CORRELATED - 3 **M**ODERATELY CORRELATED – 2

WEAKLY CORRELATED -1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving- Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A -10 x 2 marks	50	20	**100**	Nil
K1, K2, K3	B - 5/8x7 marks	200	35		
K2, K3	C- 3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – IV
CORE 8
LINEAR ALGEBRA

TEACHING HOURS: 75 Hours **COURSE CODE: MA21/4C/LAL**
CREDITS: 4 **L T P : 3 2 0**

COURSE OBJECTIVES:

To enable students to

1. Understand Linear Algebra.
2. Analyze and understand Theorems on Vector Space and Linear Transformation
3. Apply the Algebraic concepts in Mathematical Science.

COURSE OUTLINE:

UNIT I: VECTOR SPACES

Definition-Examples-Subspaces – Homomorphisms -Internal and External Direct Sum of Vector Spaces - Linear Dependence and Independence of Vectors - Linear Span - Bases - Dimensions of Vector Spaces.

Chapter 4 Sections 4.1, 4.2 **(15 Hours)**

UNIT II: DUAL SPACES

Definition of Hom (V, W) – Dimension of Hom (V, W) –Hom(V, V) – Hom(V, F) - Definition of Annihilator – dim(A(W)).

Chapter 4 Section 4.3 **(15 Hours)**

UNIT III: INNER PRODUCT SPACES

Definition – Examples – Norm of a Vector – Schwarz Inequality – Orthogonal Complement – Gram Schmidt Orthogonalization Process.

Chapter 4 Section 4.4 **(15 Hours)**

UNIT IV: LINEAR TRANFORMATIONS

The Algebra of Linear Transformations – Definition of Algebra – Invertible and Singular Linear Transformation – Rank of Linear Transformation.

Chapter 6 Section 6.1 **(15 Hours)**

UNIT V: CHARACTERISTIC ROOTS:

Definition of Characteristic Roots and Characteristic Vectors – Lemmas and Theorems on Regular and Singular Transformations – Matrices.

Chapter 6 Sections 6.2, 6.3. **(15 Hours)**

BOOKS RECOMMENDED:

I.N. Herstein (2015) Topics in Algebra (2nd edition) Wiley Eastern Ltd. New Delhi.

REFERENCE BOOKS:

1. Vijay K Khanna, S. K. Bhambri, A Course in Abstract Algebra, 5th Edition, Vikas Publishing House Pvt., Ltd., 2021.
2. K. Hoffmann and R. Kunze, Linear Algebra, 2nd Edition, Prentice-Hall of India, 2005.
3. M. Artin, Algebra, Prentice-Hall of India, 2005.
4. S. Axler, Linear Algebra Done Right, 2nd Edition, John-Wiley, 1999.
5. S. Lang, Linear Algebra, Springer UTM, 1997.
6. S. Kumaresan, Linear algebra: A Geometric Approach, Prentice-Hall of India, 2004.

PERIODICALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

WEBSITES & e-LEARNING SOURCES:

1. https://www.khanacademy.org/math/linear-algebra/vectors-and-spaces
2. https://ekamperi.github.io/mathematics/2019/11/17/dual-spaces-and-dual- vectors.html
3. https://onlinemschool.com/math/library/vector/linear-independence/
4. http://linear.ups.edu/html/section-LT.html
5. http://in.ixl.com
6. http://www.learningwave.com
7. https://en.wikipedia.org/wiki/Rank_(linear_algebra)
8. https://en.wikipedia.org/wiki/Eigenvalues_and_eigenvectors
9. https://www.sciencedirect.com/topics/mathematics/invertible-linear-transformation

COURSE OUTCOMES:

Upon successful completion of **Linear Algebra**, students will be able to:

CO Number	CO STATEMENT
CO 1	Assess the properties implied by the definition of Vector Spaces. Analyze the concepts of Linear Span, Basis and Dimension of a Vector Space and apply it to solve problems.
CO 2	Identify the dual space of a Vector Space and to prove some results associated with it.
CO 3	Compute the length of a vector or the angle between two vectors and orthogonality between vectors.
CO 4	Represent a Linear Transformation in the form of a Matrix.
CO 5	Rigorously prove the various propositions arising in the context of Linear Transformations.

MAPPING – COURSE OUTCOMES WITH PROGRAMME SPECIFIC OUTCOMES

CO / PSO	PSO 1	PSO 2	PSO3	PS04	PSO5	PSO6
CO 1	3	3	3	3	1	2
CO 2	3	3	3	3	1	3
CO 3	3	3	3	3	1	2
CO 4	3	3	3	3	1	3
CO 5	1	3	3	3	1	3
Average	**2.6**	**3**	**3**	**3**	**1**	**2.6**

KEY: STRONGLY CORRELATED-3, **M**ODERATELY CORRELATED-2,
WEAKLY CORRELATED-1**N**OCORRELATION-0

TEACHING METHODOLOGY

1. Lecture (Chalk and Talk-OHP-LCD
2. Problem Solving- Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN – UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructionsif any
K 1	A-10x2 marks	50	20	**100**	**Two questions from each section (Section A & Section B) should test problem solving skills.**
K1, K 2	B -5/8x7 marks	200	35		
K2, K 3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – IV
ALLIED 4
MATHEMATICAL STATISTICS & R SOFTWARE – II

TEACHING HOURS: 90 Hours **COURSE CODE: MA21 /4A/ MS2**
CREDITS: 5 **L T P: 4 0 2**

COURSE OBJECTIVES:

To enable the students to

1. Understand the concepts of sampling theory, testing of hypothesis, critical regionand standard error.
2. Be familiarized with applications of various tests of significance.
3. Be equipped with the knowledge of R – Programming and apply it to computestatistical measures.

COURSE OUTLINE:

THEORY COMPONENT

UNIT I: SAMPLING AND LARGE SAMPLE TESTS

Sampling Theory : Introduction –Types of sampling–Parameters and Statistic–Tests of Significance –Null Hypothesis –Errors in Sampling –Critical region and Level of Significance.**Large Samples Test :** Test of significance for large samples– Sampling attributes–Test for Single Proportion of single mean– Test of significance for difference of two proportions – Test of significance of Single Mean–Test of significance for difference of means –Test of Significance for the Difference ofStandard Deviations.

Book 1 Chapter 12 Sections 12.1 – 12.7, 12.8 -12.9.2, 12.13 – 12.15
(15 Hours)

UNIT II: SMALL SAMPLE TESTS

Student's 't' test – Derivation of Students t-distribution – Fisher's 't' test– Testfor single mean– 't' Test for difference of means– F Statistic –Applications of F distribution– F- test for equality of population variance.

Book 1 Chapter 14 Sections 14.1-14.2.7, 14.3 (15 Hours)

UNIT III: THEORY OF ATTRIBUTES AND CHI - SQUARE TEST

Theory of attributes: Independence of Attributes– Association of Attributes.
Chi – Square Test: Chi – Square test - Chi-square test forGoodness of Fit – Test of independence of two attributes.

Book 1 Chapter 11 Sections 11.7 – 11.8
Chapter 13 Sections 13.5.2, 13.5.3 (15 Hours)

UNIT IV: ANALYSIS OF VARIANCE

Introduction– ANOVA – One way classification– Mathematical analysis ofthe model – Two way classification.

Chapter 17 Sections17.1 – 17.3 (15 Hours)

PRACTICAL COMPONENT

UNIT V: STATISTICAL INFERENCE USING "R" SOFTWARE

Measures of central tendency –Mean –Median– Mode – Geometric mean– Harmonic Mean– Quartiles –Deciles–Percentiles –Measures of dispersion – Measures of Skewness and Kurtosis – Chi-Square test of Goodness of fit– Test of Significant– Difference between two means and two proportions– Paired t- test– ANOVA one way classification.

(Internal Practical only, No questions for the end semester examination)

Book 2 (30 Hours)

BOOKS RECOMMENDED:

1. S.C. Gupta and V.K. Kapoor, Elements of Mathematical Statistics, (Third Edition), 2014 Sultan Chand & Sons, New Delhi.
2. Sudha G. Prohit, Sharad D. Gore and Shailaja R. Deshmukh, Statisitcs using R, (Second edition), 2010, Narosa Publishing house Pvt Ltd, New Delhi.

REFERENCE BOOKS:

1. P.R. Vittal, Mathematical Statistics(2015), Margham publications
2. D.C.Sancheti, V.K.Kapoor, Statistics (Theory ,Methods and Application) Sultan Chand & Sons publications
3. Hogg R.V. & Craig A.T Introduction to Mathematical Statistics (1998)
4. Snedecor G.W. & Cochran, Statistical Methods, Oxford
5. S.P. Gupta(2017), Statistical Methods, Sultan Chand & Co.

PERIODICALS:

1. Mathematics Newsletter Published by Ramanujan MathematicalSociety.
2. Discrete Mathematical Sciences & Cryptography.

WEBSITES & e-LEARNING SOURCES:

1. http://www.mathforum.org
2. http://www.opensource.org
3. http://www.khanacademy.org
4. http://www.in.ixl.com
5. https://sites.google.com/a/tamu.edu/dlcarlson/home/r-project-for-statistical-computing/r-resources-on-the-web

COURSE OUTCOMES

Upon successful completion of **Mathematical Statistics & R Software –II** , students will be able to:

CO Number	CO STATEMENT
CO1	Determine the basic concepts of Sampling, Test statistics and Critical region.
CO2	Understand, apply and compute sample tests of hypothetic problems.
CO3	Apply and examine the Chi-square goodness of fit, test for independence and homogeneity.
CO4	Analyse the principles of Designs of experiments to yield valid conclusions.
CO5	Effectively use 'R' software to find averages and derive at statistical inferences from various distributions.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	3	3
CO2	3	2	3	3	3	3
CO3	3	2	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	2	3	3	3	3
AVERAGE	**3**	**2**	**3**	**3**	**3**	**3**

KEY: STRONGLY CORRELATED - 3 **M**ODERATELY CORRELATED - 2
WEAKLY CORRELATED -1 **N**O CORRELATION – 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10x2 Marks	50	20	**100**	**No questions to be taken from UNIT V**
K1. K 2	B-5/8x7 Marks	200	35		
K2, K 3	C-3/5x15 Marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

knowledge Level 3. Application

SEMESTER V COURSE PROFILE

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS/ WEEK	TOTAL HOURS	L-T-P	C.A.	S.E.	TOTAL
MA21/5C/RAN	Real Analysis	4	6	90	3-3-0	40	60	100
MA21/5C/STT	Statics	4	6	90	2-4-0	40	60	100
MA21/5C/OPR	Operations Research	4	6	90	2-4-0	40	60	100
MA21/5E/PLC	Programming Language 'C' (Theory & Practicals)	5	6	90	4-0-2	40	60	100
MA21/5E/GRT	Graph Theory **(Option 1)**	5	6	90	3-3-0	40	60	100
MA21/5E/MAM	Mathematical Modelling **(Option 2)**							

SEMESTER V

CORE 9

REAL ANALYSIS

TEACHING HOURS: 90 Hours **COURSE CODE: MA21 / 5C / RAN**
CREDITS: **4** **L T P : 3 3 0**

COURSE OBJECTIVES:

To enable students to

1. Get acquainted with the concepts of real analysis
2. Demonstrate skills in constructing rigorous mathematical arguments.
3. Write a concise logical proof.

COURSE OUTLINE:

UNIT I: Equivalence, Countability, Real numbers, least upper bounds, Definition of sequence and subsequence, limit of a sequence, convergent sequences, divergent sequences, bounded sequences , Monotone sequences, Operations on convergent sequences, Operations on divergent sequences,Cauchy sequences.

Chapter 1 Sections 1.5 - 1.7
Chapter 2 Sections 2.1 -2.8, 2.10 **(18 Hours)**

UNIT II: Convergence and divergence of series, series with non-negative terms, Alternating Series, conditional and absolute convergence, Tests for absolute convergence.

Chapter 3 Sections 3.1 - 3.4, 3.6 **(18 Hours)**

UNIT III: Limit of a function on the real line, Metric spaces, functions continuous ata point on the real line, Reformulation, functions continuous on a metric space, Open sets, Closed sets.

Chapter 4 Sections 4.1, 4.2
Chapter 5 Sections 5.1 - 5.5 **(18 Hours)**

UNIT IV: Connectedness and Completeness

More about open sets, Connected sets, Bounded sets and totally bounded sets, Complete metric spaces.

Chapter 6 Sections 6.1-6.4 **(18 Hours)**

UNIT V: Compactness

Compact metric spaces, Calculus: Sets of measure zero, Definition of the Riemann integral, Existence of the Riemann integral, Derivatives, Rolle's theorem, The Law of the mean, Pointwise convergence of sequence of functions, Uniform convergence of sequence of functions.

Chapter 6 section 6.5
Chapter 7 sections 7.1 - 7.3, 7.5 - 7.7
Chapter 9 sections 9.1, 9.2 **(18 Hours)**

BOOKS RECOMMENDED:

Richard . R .Goldberg, Methods of Real Analysis (Second Edition), (1976)Oxford & IBH Publishing Co., Pvt . Ltd, New Delhi .

REFERENCE BOOKS:

1. Rudin W. Principles of Mathematical Analysis, 3rd edition, 2017 , Tata Mc Graw Hill Education, New York.
2. Malik. S. C & Savita Arora, Mathematical Analysis , 6th edition, 2021, New Age International Pvt Ltd.,
3. Sanjay Arora & Bansi Lal, Introduction to Real Analysis 2012, Satya Prakashan , New Delhi
4. Gelbaum .B.R & Olmsted, Counter Examples in Analysis, 2003, Holden Day, San Francisco.
5. A. L. Gupta & N. R. Gupta, Principles of Real Analysis ,2003, 2nd edition, Pearson Education(India Print).

PERIODICALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

WEBSITES & e-LEARNING SOURCES:

1. https://en.wikipedia.org/wiki/Uncountable_set
2. https://en.wikipedia.org/wiki/Alternating_series_test
3. http://www-groups.mcs.st-andrews.ac.uk/~john/MT4522/Lectures/L5.html
4. https://en.wikipedia.org/wiki/Complete_metric_space
5. https://en.wikipedia.org/wiki/Rolle%27s_theorem

COURSE OUTCOME:

Upon successful completion of **Real Analysis**, students will be able to:

CO NUMBER	CO STATEMENT
CO 1	Determine the basic topological properties of the subsets of the real numbers.
CO 2	Apply the concept of limit to sequences, series and functions.
CO 3	Analyse the topological properties of connectedness, completeness and compactness of a metric space.
CO 4	Produce rigorous proofs of results that arise in the contexts of real analysis.
CO 5	Determine the continuity, differentiability and integrability of functions defined on subsets of real numbers.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO /PCO	PCO 1	PCO 2	PCO 3	PCO 4	PCO 5	PCO 6
CO 1	1	3	2	3	-	1
CO 2	2	3	3	3	-	1
CO 3	1	3	3	3	-	-
CO 4	-	3	3	3	-	-
CO 5	2	3	3	3	-	-
AVERAGE	1	3	3	3	-	0.4

TEACHING METHODOLOGY

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN – UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10x2 marks	50	20	**100**	**Two questions from each section (Section A & Section B) should test problem solving skills.**
K1, K 2	B-5/8x7 marks	200	35		
K2, K 3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – V
CORE 10
STATICS

TEACHING HOURS: 90 Hours **Course Code : MA21 / 5C / STT**
Credits: 4 **L T P: 2 4 0**

COURSE OBJECTIVES:

To enable students to

1. Understand the development of skills in formation of suitable mathematical models.
2. Understand the problem-solving techniques.
3. Understand the basic concepts of forces, moments, couple, friction and centre of gravity.

COURSE OUTLINE:

UNIT I: Forces: Newton's law of motion **-** Resultant of the forces on a particle**.**
Chapter 2 Sections 2.1, 2.2
Equilibrium of a Particle: Equilibrium of a particle – Limiting equilibrium ofa particle on an inclined plane.
Chapter 3 Sections 3.1, 3.2 **(20 Hours)**

UNIT II: Forces on a Rigid Body: Moment of a force - General Motion of a rigid body Equation of motion of a rigid body (Statement only)-Equivalent Systems offorces-Parallel forces - Forces along the sides of a triangle
Chapter 4 Sections 4.1 - 4.5 **(20 Hours)**

UNIT III: Forces on a Rigid Body: Couples - Resultant of several coplanar forces-Equation of the line of action of the resultant.
Chapter 4 Sections 4.6 - 4.8 **(15 Hours)**

UNIT IV: Centre of Mass: Centre of mass-Finding mass centre – A hanging body in equilibrium.
Chapter 6 Sections 6.1, 6.2 (Omit 6.2.3 and 6.2.4), 6.3 **(20 hours)**

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UNIT V: Hanging strings- Equilibrium of a uniform homogeneous string – Sage – Suspension bridge
Chapter 9 - Sections 9.1, 9.2 **(15 Hours)**

BOOKS RECOMMENDED

Duraipandian, P., Laxmi Duraipandian, Muthamizh Jayapragasam. (2013). Mechanics. (6th Revised Edition), New Delhi: S. Chand and Co.

REFERENCE BOOKS:

1. Dharmapadam, A.V. Statics(2006). Chennai, ,1st edition,S.Viswanathan and Co Printers and Publishers Pvt Ltd.
2. Viswanath Naik, K & M.S. Kasi , Dynamics (2000), Emerald Publishers Chennai,1992, 1st edition. .
3. S.G.Venkatachalapathy , Statics, Margham Publications (2005), Chennai-17
4. Golden Maths Series , Statics, N.P.Bali, Firewall Media , An Imprint of Laxmi Publications Pvt. Ltd,New Delhi .

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

E-LEARNING RESOURCES:

1. https://nptel.ac.in/courses/112/106/112106180/
2. http://www.mathforum.org
3. http://www.opensource.org
4. https://en.wikipedia.org/wiki/Force

COURSE OUTCOMES:

Upon successful completion of **Statics**, students will be able to:

CO Number	CO STATEMENT
CO 1	Discuss the fundamental concepts of forces and friction and to find the resultant of two or more forces acting on a particle. Apply the concepts of Lami's Theorem to determine the equilibrium of a particle under three or more forces. Find the Limiting Equilibrium of a particle on an Inclined Plane.
CO 2	Explain the concepts of Forces on a Rigid Body. Investigate the Resultant of like and unlike parallel forces and Varignon's theorem to find the Moment of a force.
CO 3	Discuss the Basic concepts of Couples , Moment of a Couple, Moment of a Couple as an area and to find equation of the line of action of the resultant .
CO 4	Summarize the concepts of finding mass centre, hanging body in equilibrium.
CO 5	Understand the concepts of equilibrium of uniform homogenous strings and suspension bridge and solve problems.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	-	3	3	2	3
CO2	3	-	3	3	2	3
CO3	3	-	3	3	1	3
CO4	3	-	3	3	2	3
CO5	3	-	3	3	1	3
AVERAGE	**3**	**-**	**3**	**3**	**1.6**	**3**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLYCORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**Nil**
K1, K 2	B-5/8x7 marks	200	35		
K2, K 3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – V

CORE 11
OPERATIONS RESEARCH

TEACHING HOURS: 90 **Course Code : MA21 / 5C / OPR**
Credits: 5 **L T P: 2 4 0**

COURSE OBJECTIVES:

To enable students to

1. Formulate a mathematical model of a real life problem.
2. Find optimum service rate and number of servers using queuing model
3. Determine the transportation plan of a single commodity from number of sources.

COURSE OUTLINE:

UNIT I: LINEAR PROGRAMMING PROBLEM

Introduction- Linear Programming Problem - Mathematical Formulation- Graphical Solution and Extension - Simplex Method – Duality in Linear Programming.

Chapter 2 Section 2.1 – 2.4
Chapter 3 Section 3.1- 3.5
Chapter 4 Section 4.1 – 4.4
Chapter 5 Section 5.1- 5.7 **(23 Hours)**

UNIT II: TRANSPORTATION AND ASSIGNMENT PROBLEM

Transportation Problem: Introduction –Linear Programming - Formulation of the Transportation Problem - North-West corner rule – Least cost Method- Vogel's approximationmethod- Optimality test.

Assignment problem: Introduction – Mathematical Formulation of the Problem – Solution Methods of Assignment Problem - Hungarian method of solving an assignment problem – Special case in Assignment problem - The Travelling Salesman problem.

Chapter 10 Section 10.1 – 10.15 (omit 10.7, 10.11, 10.14)
Chapter 11 Section 11.1 - 11.4, 11.7 **(23 Hours)**

UNIT III: GAMES AND STRATEGIES

Introduction - Two persons zero-sum games - The Maximin - Minimax Principle - Games without saddle points - Mixed strategies – Graphic Solution of 2 x n and m x 2 games - Dominance property.

Chapter 17 Section 17.1 – 17.7 **(18 Hours)**

UNIT IV: QUEUING THEORY

Introduction – Queuing System – Elements of a Queuing System - Probability Distributions in Queuing System - Classification of queuing Models – Transient and Steady States - Poisson Queuing Systems - Models

i. (M / M / 1): (∞/ FIFO)
ii (M / M / 1): (∞/ SIRO)
iii (M / M / 1): (N/ FIFO)

Chapter 21 Section 21.1 – 21.3, 21.6 -21.9 **(13 Hours)**

UNIT V: PERT AND CPM

Introduction- Network: Basic Components – Logical Sequencing – Rules of Network Construction – Concurrent Activities – Critical Path Analysis – Probability Considerations in PERT - Distinction between PERT and CPM.

Chapter 25 Section 25.1 – 25.8 **(13 Hours)**

BOOKS RECOMMENDED:

Kanti Swarup, P.K. Gupta, Man Mohan, Operations Research, 19th edition 2021, Sultan Chand &Sons.

REFERENCE BOOKS:

1. Gupta P.K & Hira D.S Problems in Operations Research, S. Chand & Co, 2007.
2. Hamdy A.Taha, Operations Research, 9th edition, Pearson Education, 2013.
3. S.D. Sharma, Operations Research, 16th edition, Kedhar Nath Ram Nath & co, Meerut (2010).
4. V.Sundaresan, K.S. Ganapathy Subramanian, & K.Ganesan, Resource Management Techniques, A.R. Publications, 2005.

PERIODICALS:

1. The Mathematics intelligencer
2. Mathematics Newsletter
3. Discrete Mathematical Sciences

WEBSITES & E- LEARNING SOURCES:

1. https://nptel.ac.in/courses/111/107/111107128/
2. https://onlinecourses.nptel.ac.in/noc20_ma23/preview
3. https://nptel.ac.in/courses/111/102/111102012/
4. https://nptel.ac.in/courses/111/105/111105039/
5. https://www.britannica.com/science/game-theory

COURSE OUTCOME:

Upon successful completion of **Operations Research**, students will be able to:

CO NUMBER	CO STATEMENT
CO1	Formulate and model the linear programming problem and solve them graphically in two dimensions. Convert the given linear programming problem into standard form and use the Simplex method or Big –M method to solve it.
CO2	Classify the Queuing problem under the models:(M/M/1):(∞/FCFS), (M/M/1):(N/FCFS),(M/M/S):(∞/FCFS)
CO3	Formulate the given Transportation problem into a mathematical model and find the optimum solution using all mentioned method appropriately. Interpret the Assignment problem as a classical linear programming model such as Travelling Salesman Problem using Hungarian method.
CO4	Represent the Network problem through Network diagram and label using Fulkerson's 'I-J' rule and determine the critical path. Using PERT model, find the optimistic time, most likely time, pessimistic time, expected time and variance.
CO5	Analyze the given Game problem and solve it using the appropriate models, two person zero sum games, games without saddle points, pure strategies and mixed strategies. Interpret $2\times n$ and $n\times 2$ games graphically.

MAPPING - COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO /PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	3	3	1	3
CO2	3	2	3	3	1	3
CO3	3	2	3	3	1	3
CO4	3	2	3	3	1	3
CO5	3	2	3	3	1	3
AVERAGE	**3**	**2**	**3**	**3**	**1**	**3**

KEY: STRONGLY CORELATED -3 **M**ODERATELY CORELATED - 2

WEAKLYCORELATED-1**N**OCORELATION-0

TEACHINGMETHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion - Role Modelling
3. Quiz- Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10X2 marks	50	20	**100**	**Nil**
K1, K 2	B-5/8x7 marks	200	35		
K2, K 3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – V

ELECTIVE - 1

PROGRAMMING LANGUAGE 'C'

(Theory & Practicals)

TEACHING HOURS: 90 Hours **COURSE CODE:MA21/5E/PLC**

CREDITS: 5 **L T P : 4 0 2**

COURSE OBJECTIVE:

1. To introduce the concept of C programming to the students.
2. To learn different structures like decision control, loop control, array and structures.
3. To enable the students to develop programming skill in 'C' language.

COURSE OUTLINE:

UNIT I: About C – Introduction –Basic structure of C program- Character set – C tokens- Keywords and Identifiers – Constants – Variables – Data types- declaration of variables –Assigning values to Variables – Operators - Arithmetic Expressions, Evaluation of expressions.

Chapter 1 (Omit Sections Unix Systems, MS-DOS Systems)
Chapter 2 (From Introduction to declaration of variables)
Chapter 3 (From Introduction to evaluation of expressions) **(10 Hours)**

UNIT II: Managing Input and Output Operations. Control statements: Decision making and Branching: Simple *If* statement-The *If… Else* statement- Nesting of *If …Else* Statements- The *Else If* Ladder-The Switch Statement-The ? : Operator – The *goto* Statement.Decision making and Looping: The *While* Statement- The *do* Statement – The *for* Statement- Jumps in Loops

Chapter 4 (Omit Sections Formatted Input and Output)
Chapter 5, 6 **(20 Hours)**

UNIT III: Arrays: One and Two-dimensional arrays – Initialization of one dimensional and two –dimensional arrays– Character arrays and strings – Declaring and initializing string variables –Arithmetic operations on characters– String handling functions.

Chapter 7 (From introduction to initializing two dimensional arrays)
Chapter 8 (Omit Sections Table of Strings, Other Features of Strings)
(20 Hours)

UNIT IV: User- Defined Functions: Elements of User- Defined Functions – Function Declaration- Category of functions – Recursion.

Pointers: Understanding Pointers – Accessing the address of a variable – Chain of Pointers-Pointer Expressions - Pointers and arrays – Pointers and character strings.

Chapter 9 (From Introduction to Recursion)
Chapter 11 (From Introduction to Pointers and Character Strings)

(20 Hours)

UNIT V: Structures: Defining a structure - Declaring structure variables-Accessing structure members – Structure initialization – Arrays of structures – Arrays within structures. - Structures within structures

File Management in C: Introduction – Defining and Opening a File- Closing a File – Input/output operations on Files.

Chapter 10 (From Introduction to Structures within Structures)
Chapter 12 (From Introduction to Input/ Operations on Files)

(20 Hours)

PRACTICAL PROGRAMS

1. Program to find roots of a quadratic equation.
2. Program to generate prime numbers between any two given numbers.
3. Program to sort a given set of numbers in ascending order by interchange sort.
4. Program to find the transpose and trace of a matrix.
5. Program to find multiplication of matrices.
6. Program to accept a line of text and to count the number of vowels, consonants and special characters and the number of words in the text.
7. Program using function, to find the binomial co-efficient for a given n and r.
8. Program to exchange two strings using pointers.
9. Program using pointers to compute the sum and average of all numbers stored in an array.
10. Program to read a name, grade and ten test scores into a structure and print them with high, low and average score.
11. Program to read the data from the keyboard, write it to a file, called ”INPUT”, read the same data from the same file and to display it on the screen.
12. Program to create a file called DATA containing a series of integer numbers,to read these numbers and then to write all odd numbers to a file to be called ODD and all even numbers to a file to be called EVEN, read the Data stored in ODD and EVEN files and to display them on the screen.

RECOMMENDED TEXT:

Programming in ANSI C, Seventh Edition, E. Balagurusamy McGraw Hill Education (India) Pvt. Ltd, New Delhi.2017

REFERENCE BOOKS:

1. Programming with 'C', Schaum series, Bryon.S .Gottfried, Second edition, TataMc- Graw Hill publishing Pvt Ltd. , New Delhi.2008.
2. Let us C, Yashavant P.Kanetkar,15th Edition BPB Publications. 2016
3. C How to Program, Paul Deitel, Harvey Deitel,7thEdition, Pearson Publication.2013.
4. Computer Fundamentals and Programming in C, Anita Goel, Ajay Mittal, Pearson Education India 2016.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. International journal of computer science

E-LEARNING RESOURCES

1. https: // nptel.ac.in/courses/ 106/104/ 106104128/
2. https://www.programiz.com/c-programming
3. https://www.tutorialspoint.com/cprogramming/index.htm4.
4. http://khanacademy.org

COURSE OUTCOME:

Upon successful completion of **Programming Language 'C' (Theory &Practicals)** students will be able to:

CO Number	CO STATEMENT
CO1	Demonstrate the fundamental structures of C programming.
CO2	Choose the right data representation formats based on the requirement of the problem.
CO3	Discuss conditional and iterative statements to develop C programs.
CO4	Develop C programs using arrays, functions, pointers, structures, and files.
CO5	Assess and Debug errors at the time of execution.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFICOUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	-	3	3	2	3
CO2	1	-	3	3	3	3
CO3	1	-	3	3	2	3
CO4	1	-	2	3	2	3
CO5	1	-	3	3	3	3
Average	**1.4**	**-**	**2.8**	**3**	**2.4**	**3**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2
WEAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K1	A-10 x 2 marks	50	20	**100**	**Nil**
K1, K2	B-5/8 x 7 marks	200	35		
K2, K3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1.Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

EVALUATION PATTERN FOR CONTINUOUS ASSESSMENT

INTERNAL VALUATION BY COURSE TEACHERS

S.NO.	COMPONENT	TIME	MAX. MARKS	C.A. MARK
1	TEST I	2 HOURS	50 MARKS (TO BE CONVERTED)	10
2	TEST II	2 HOURS	50 MARKS (TO BE CONVERTED)	10
3	PRACTICAL EXAM	2 HOURS	50 MARKS (TO BE CONVERTED)	20
	TOTAL			**40**

C.A QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K1	**A-5** x **2 marks**	**50**	**10**	**50**
K1, K2	**B-3/5x8marks**	**200**	**24**	
K2, K3	**C-1/2x16marks**	**500**	**16**	

ASSESSMENT OF COMPUTER PRACTICAL EXAMINATION

Two questions will be asked for the Practical examination.

For each question

Programming skill (writing) - 10 marks

Technical Skill (Keying) - 10 marks

SEMESTER – V
ELECTIVE II
GRAPH THEORY
(OPTION 1)

TEACHING HOURS: 90 Hours **COURSE CODE: MA21/5E/GRT**
CREDITS :5 **L T P: 3 3 0**

COURSE OBJECTIVES:

To enable students

1. To introduce basic concepts of graph theory.
2. To translate situations to diagrammatic representations.
3. To apply graph theory based tools in solving practical problems.

UNIT I: GRAPHS, SUBGRAPHS

Definition and Examples – Degrees – Subgraphs – Isomorphism-Matrices – Operation on Graphs – Degree Sequences – Graphic sequences.

Chapter 2. Sections 2.0 - 2.4, 2.8 - 2.9
Chapter 3 Sections 3.1, 3.2 **(15 Hours)**

UNIT II: CONNECTEDNESS

Walks, trails and paths – connectedness and components – Blocks – Connectivity

Chapter 4 Section 4.1 - 4.4 **(20 Hours)**

UNIT III: EULERIAN AND HAMILTONIAN GRAPHS

Introduction - Eulerian Graphs - Hamiltonian Graphs.

Chapter 5 Sections 5.1, 5. 2 **(20 Hours)**

UNIT IV: TREES AND PLANARITY

Introduction – Characterization of trees – Centre of a Tree -Definition and Properties – Characterization of Planar Graphs

Chapter 6 Sections 6.0 – 6.2
Chapter 8 Sections 8.1, 8.2 **(20 Hours)**

UNIT V: TREES AND APPLICATIONS OF GRAPH THEORY

Colourability-Chromatic Number and Chromatic Index – Five Colour Theorem – Four Colour Problem- – Connector Problem – Shortest Path Problem

Chapter 9 Sections 9.1 - 9.3
Chapter 11 Sections 11.0 – 11.2 **(15 Hours)**

BOOKS RECOMMENDED

S. Arumugam, S. Ramachandran: Invitation to graph theory, Scitech Publications (India)Pvt. Ltd., Chennai -17, (2013).

REFERENCE BOOKS:

1. Balakrishnan R, Ranganathan K, Textbook of Graph Theory, 2nd edition, Springer, 2012.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, 1st edition, Courier Dover Publications Inc., 2016.
3. J. A. Bondy & U. S. R. Murty, Graph Theory with Applications, Elsevier Science Publishing Co.,Inc,1982.
4. Parthasarathy K. R., Basic Graph Theory, Tata McGraw Hill, (1994).
5. Doughlas B. West, Introduction to Graph Theory –Second edition, Prentice Hall, (1996).

JOURNALS:

1. Discrete Mathematics- Elsevier publications.
2. Journal of Graph Theory.
3. Electronic journal of Graph Theory and Applications.

WEBSITES AND e-LEARNING SOURCES

1. https://nptel.ac.in/courses/111/106/111106102/
2. https://nptel.ac.in/courses/111/106/111106050/
3. https://nptel.ac.in/courses/128/106/128106001/

COURSE OUTCOMES:

Upon completion of **Graph Theory**, the students will be able to

CO Number	CO Statement
CO 1	Interpret the basic concepts of graphs and explain isomorphism and operations on graphs.
CO 2	Identify walks, trails, paths, blocks and connectivity.
CO 3	Explain basic results related with Eulerian and Hamiltonian graphs
CO 4	Understand the concept of plane graph and colouring and solve problems involving planarity and colourability.
CO 5	List basic properties of trees and also prove Kruskal's Algorithm

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	-	-	3	3	2	3
CO2	-	-	2	3	2	3
CO3	-	-	3	3	2	3
CO4	-	-	1	2	3	3
CO5	-	-	1	2	3	3
AVERAGE	**-**	**-**	**2.0**	**2.6**	**2.4**	**3.0**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2
WEAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Group Discussion
3. Quiz-Seminar
4. Peer Learning

Question Paper Pattern – End Semester Examination

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**Nil**
K1,K 2	B-5/8 x 7 marks	200	35		
K2, K 3	C-3/5 x15marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER V
ELECTIVE II
MATHEMATICAL MODELLING
(OPTION 2)

TEACHING HOURS: 90 Hours **Course Code: MA21/5E /MAM**

Credits : 5 **L T P: 3 3 0**

COURSE OBJECTIVES:

To enable students

1. To study the Mathematical models through ode and difference equations.
2. To train the students to develop Mathematical models in real life problems.

COURSE OUTLINE:

UNIT I : Mathematical Modelling through Ordinary Differential Equations of First order - Linear Growth and Decay Models - Non-Linear Growth and Decay Models - Compartment Models -Dynamic problems - Geometrical problems.

Book 1 Chapter 2 Sections 2.1 - 2.6 (18 Hours)

UNIT II: Mathematical Modelling through Systems of Ordinary Differential Equationsof First Order Population Dynamics - Epidemics - Compartment Models – Economics – Medicine, Arms Race, Battles and International Trade – Dynamics.

Book 1 Chapter 3 Sections 3.1 - 3.6 (18 Hours)

UNIT III: Mathematical Modelling through Ordinary Differential Equations of Second Order - Planetary Motions - Circular Motion and Motion of Satellites – Mathematical Modelling through Linear Differential Equations of Second Order Miscellaneous Mathematical Models.

Book 1 Chapter 4 Sections 4.1- 4.4 (18 Hours)

UNIT IV: Mathematical Modelling through Difference Equations - Simple Models - Basic Theory of Linear Difference Equations with Constant Coefficients - Economics and Finance - Population Dynamics and Genetics – Probability Theory.

Book 1 Chapter 5 Sections 5.1 - 5.5 (18 Hours)

UNIT V: Mathematical Modelling through Graphs - Solutions that can be Modelled Through Graphs - Directed Graphs - Signed Graphs – Weighted Digraphs and Unoriented Graphs.

Book 1 Chapter 7 Sections 7.1 - 7.5 (18 Hours)

BOOKS RECOMMENDED:

1. J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, New Delhi,1988.
2. J.N. Kapur, Mathematical Model in Biology and Medicine, EWP, New Delhi,1985.

REFERENCE BOOKS:

1. Singh mathematical modelling, international book house – 2013.
2. Frank R Giordano, Maurice D. weir and William P fox, - A first course in Mathematical modelling, Thomson learning, London and New York, 2003.
3. Kapur J.N – Mathematical modelling – New age international publishers, 2004.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society, Chennai.
2. Mathematics – NOC: Mathematical Modelling ……. NPTEL

E-LEARNING RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_bt13/preview
2. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ma18/
3. https://www.furb.br/modelling/

COURSE OUTCOMES:

Upon successful completion of **Mathematical Modelling,** students will be able to

CO Number	CO STATEMENT
CO 1	Acquire knowledge of growth and decay models through first order differential equations
CO 2	To know the applications of Mathematical Modelling in various fields like Medicine, Arms Race and International Trade.
CO 3	Construct different motions of satellites through second order differential equations.
CO 4	Analyze Mathematical Modelling through difference equations.
CO 5	Illustrate Mathematical Modelling through different types of graphs.

MAPPING – COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	1	-	2	3	2	2
CO2	1	1	2	3	1	1
CO3	1	1	1	3	2	2
CO4	1	1	1	1	2	2
CO5	1	1	1	1	2	2
AVERAGE	**1**	**0.8**	**1.4**	**2.2**	**1.8**	**1.8**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2
WEAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**Nil**
K1, K 2	B-5/8 x 7 marks	200	35		
K2, K 3	C-3/5 x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER VI COURSE PROFILE

COURSE CODE	TITLE OF THE PAPER	CREDITS	HOURS /WEEK	TOTAL HOURS	L-T-P	C.A	S.E	TOTAL
MA21/6C/CAN	Complex Analysis	4	6	90	3-3-0	40	60	100
MA21/6C/DYN	Dynamics	4	6	90	2-4-0	40	60	100
MA21/6C/DIM	Discrete Mathematics	4	6	90	3-3-0	40	60	100
MA21/6C/NTC	Number Theory and Cryptography	4	6	90	3-3-0	40	60	100
MA21/6E/PPY	Programming in Python (Theory & Practicals)	5	6	90	4-0-2	40	60	100

SEMESTER – VI

CORE 12

COMPLEX ANALYSIS

TEACHING HOURS: 90 Hours **Course Code: MA21 / 6C /CAN**
Credits: 4 **L T P: 3 3 0**

COURSE OBJECTIVES:

To enable students to

1. Represent complex numbers algebraically and geometrically.
2. Understand the concepts and techniques of Complex functions.
3. Solve problems involving Complex functions.

COURSE OUTLINE:

UNIT I: Analytic functions:

Functions of a complex variables– Limits - Continuity – Derivatives - DifferentiationFormulas- Cauchy- Riemann equations- Sufficient conditions for differentiability- Polar coordinates- Analytic Functions - Harmonic Functions.

Chapter 2 Sections 12 – 26. (15 Hours)

UNIT II: Mapping by Elementary Functions and Conformal Mapping:

Linear Transformations- w = 1/z - Linear Fractional Transformations- An Implicit Form- Preservation of Angles.

Chapter 8 Sections 90 – 94, Chapter 9 Section 101. (20 Hours)

UNIT III: Complex Integration:

Contours – Contour integrals – Cauchy – Goursat theorem (statement only) – Cauchy theorem for simply connected domain and multiply connected domain- Cauchy Integral formula - Cauchy's integral formula for higher derivatives (without proof) - Morera's Theorem- Liouville's Theorem andFundamental Theorem of Algebra- Maximum Modulus Principle (simple problems)

Chapter 4 Sections 39 – 41, 46, 48 – 54. (20 Hours)

UNIT IV: Series and Singularities:

Convergence of sequences - Convergence of series - Taylor and Laurent Series (statement only) – Examples – Isolated Singular Points – Residues - Cauchy's Residue Theorem – Residue at infinity - The Three types of Isolated Singular Points – Residues at Poles – Examples – Zeros of Analytic Functions – Zeros and Poles – Meromorphic Function - Argument principle – Rouche's Theorem (simple problems)

Chapter 5 Sections 55 - 62 (omit 58 & 61)
Chapter 6 Sections 68 – 76
Chapter 7 Sections 86 – 87. (20 Hours)

UNIT V: Applications of Residues:

Evaluation of improper integrals

(i) $\int f(\cos\theta, \sin\theta)\, d\theta$

(ii) $\int f(x)\, dx$, where f(x) is a rational polynomial having no poles on the Real Axis

(iii) $\int f(x) \sin mx\, dx$

(iv) $\int f(x) \cos mx\, dx$, where $m > 0$ and f(x) is a rational function having no poles on the Real Axis.

Jordon's Lemma (statement only)

Chapter 7 Sections 78 – 81, 85. **(15 Hours)**

BOOKS RECOMMENDED:

R.V. Churchill and J.W Brown (2014), Complex variables and Applications (8th edition) McGraw Hill Education (India) Private Limited.

REFERENCE BOOKS:

1. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House Pvt., Ltd., 2nd Edition,2012.
2. B.S.Tyagi (2018), Functions of a Complex Variable, Kedar Nath and Ram Nath Publishers, Meerut.
3. S. Arumugam, A. Thangapandi Isaac & A. Somasundaram, Complex Analysis, SciTech publications (India) Pvt., Ltd., 2016.
4. P. Duraipandian and Laxmi Duraipandian (1976), Complex Analysis, Emarald Publishers, Chennai.

PERIODICALS:

1.The Mathematics Intelligencer

2.Mathematics Newsletter Published by Ramanujan Mathematical Society

3.Discrete Mathematical Sciences & Cryptography

WEBSITES AND e-LEARNING SOURCES:

1. https://byjus.com/maths/limits-and-continuity/
2. https://www.khanacademy.org/math/linear-algebra/matrix-transformations/linear-
3. transformations/v/linear-transformations
4. https://sites.oxy.edu/ron/math/312/14/ws/24.pdf
5. http://people.math.harvard.edu/~knill/teaching/residues_1996/residue.pdf
6. http://in.ixl.com
7. http://www.learningwave.com

COURSE OUTCOMES:

Upon Completion of **Complex Analysis**, students will be able to

CO Number	CO STATEMENT
CO 1	Represent complex numbers algebraically and geometrically,define and analyze the concept of analyticity and apply it to derive Cauchy Riemann Equations.
CO 2	Define Conformal mapping and find the mapping that maps threedistinct points on the Z – plane to three distinct points on the W – plane by applying Bilinear transformation.
CO 3	Evaluate Complex integrals directly by using Cauchy- Gaursat Theorem and study the various applications of Cauchy's Integral Formula.
CO 4	Represent Functions as Taylor and Laurent Series, classify singularities and Poles, find residues and evaluate complex integrals using Residue Theorem.
CO 5	Evaluate complex contour integrals by applying Cauchy Integral Formula and its various versions.

MAPPING – COURSE OUTCOMES WITH PROGRAMME SPECIFIC OUTCOMES

CO / PSO	PSO 1	PSO 2	PSO3	PS04	PSO5	PSO6
CO 1	3	3	3	3	1	2
CO 2	3	3	3	3	1	3
CO 3	3	3	3	3	1	2
CO 4	3	3	3	3	1	3
CO 5	3	3	3	3	1	2
Average	**3**	**3**	**3**	**3**	**1**	**2.4**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2
WEAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer learning

QUESTION PAPER PATTERN – UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructionsif any
K 1	A-10 x 2 marks	50	20	**100**	**Two questions from each section(Section A & Section B) shouldtest problem solving skills**
K1, K 2	B-5/8x7 marks	200	35		
K2, K 3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – VI
CORE 13
DYNAMICS

TEACHING HOURS: 90 Hours **Course Code: MA21 /6C/DYN**
Credits: 4 **L T P : 2 4 0**

COURSE OBJECTIVES:

To enable students to:

1. Understand some real-life problems in motion.
2. Understand the motion of projectiles, impact of spheres and central orbits.
3. Interpret and logically deduct physics aspects of the problems.

COURSE OUTLINE:

Unit-I: Kinematics: Velocity- Velocity of a particle describing a circle - Acceleration-Coplanar motion.
Chapter 1 Sections 1.1, 1.2, 1.3, 1.4. **(18 hours)**

Unit-II: Work, Energy and Power: Work- Conservative field of force – Power.
Rectilinear motion under varying force: Simple harmonic motion.
Chapter 11 & 12 - Sections 11.1 - 11.3, 12.1 **(12 hours)**

Unit-III: Projectiles: Forces on a projectile - Projectiles projected on an inclined plane
Impact: Impulsive force-Impact of sphere- Impact of two smooth spheres
Chapter 13 Sections 13.1, 13.2
Chapter 14 Sections 14.1 - 14.3 **(22 hours)**

Unit-IV: Circular Motion: Circular motion – Conical pendulum – Simple pendulum.
Central Orbits: General Orbits – Central orbit – Conic as a centred orbit.
Chapter 15 - Section 15.1 - 15.6 (omit 15.3, 15.4, 15.5)
Chapter 16 Sections 16.1 - 16.3 **(23 hours)**

Unit-V: Moment of Inertia: Moment of Inertia.
Chapter 17 Section 17.1 **(15 hours)**

BOOKS RECOMMENDED:

Duraipandian, P., Laxmi Duraipandian, MuthamizhJayapragasam. (2005). Mechanics. (6^{th} Revised Edition), New Delhi: S. Chand and Co.

REFERENCE BOOKS:

1. Dharmapadam, A.V. Mechanics. (1991), Viswanathan, S., Printers & Publishers Pvt. Ltd.
2. Viswanath Naik, K & M.S. Kasi, Dynamics, First edition (1992), Emerald Publishers.Chennai.
3. Golden ,Maths Series,Dynamics,Laxmi Publications.
4. Dr .S.G.Venkatachalapathy, Dynamics (2005), Margham Publications.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

E-LEARNING RESOURCES:

1. https://nptel.ac.in/courses/112/106/112106180/
2. https://en.wikipedia.org/wiki/Moment_of_inertia

COURSE OUTCOMES:

Upon successful completion of **Dynamics,** students will be able to

CO Number	CO STATEMENT
CO 1	Acquire knowledge about the basic concepts of Kinematics anddetermine Speed and Shortest distance between the particles.
CO 2	Apply the fundamental concepts of Work, Energy and Power to Calculate Work done, frictional resistance and Kinetic energy. Discuss Simple Harmonic Motion to find period and Amplitude.
CO 3	Analyze the motion of Projectiles and their results. Discuss theDirect Impact and Oblique impact of two Spheres.
CO 4	Critique the Concepts of Central Orbits, Differential equation ofcentral Orbit and Kepler's law of planetary motion. Understand circular motion on a vertical plane, relative rest in revolving cone and simple pendulum.
CO 5	Determine Moment of Inertia for various geometrical shapes byusing Parallel and Perpendicular axis theorem.

MAPPING - COURSE OUTCOME WITH PROGRAMME SPECIFICOUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	-	3	3	2	3
CO 2	3	-	3	3	3	3
CO 3	3	-	3	3	2	3
CO 4	3	-	3	3	3	3
CO 5	3	-	3	3	1	3
AVERAGE	**3**	**-**	**3**	**3**	**2.2**	**3**

KEY:STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**Nil**
K1, K 2	B-5/8 x 7 marks	200	35		
K2, K 3	C-3/5 x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – VI
CORE 14
DISCRETE MATHEMATICS

TEACHING HOURS:90 Hours **Course Code:MA21/6C/DIM**
Credits: 4 **L T P: 3 3 0**

COURSE OBJECTIVES:

To enable students to

1. Develop construction and verification of mathematical Statements.
2. Gain fundamental knowledge about lattices and Boolean Algebra.
3. Compute in programming for matching strings and extracting text.

COURSE OUTLINE:

UNIT I: RECURRENCE RELATION AND GENERATING FUNCTIONS

Recurrence –Introduction – Recursion and Induction – Recurrence Relations – Solutions of finite order homogeneous Relations – Generating Functions – Steps involved in determining the generating functions for a given recurrence relation.

Book1 Chapter 5 Sections 1–6 **(20 Hours)**

UNIT II: MATHEMATICAL LOGIC

Connectives – Conjunction – Disjunction - Tautology and contradiction - Equivalence of formulae - Equivalent formulae – duality law– Tautological implications – Functionally complete set of connectives – other connectives - Normal forms –Disjunctive normal forms - Conjunctive normal forms.

Book 2 Chapter 4 **(15 Hours)**

UNIT III: RELATIONS AND LATTICES

Introduction – Binary Relations – Properties of Binary relations – Equivalence relations – Partial ordering Relations –partial ordered set – Hasse diagram. Lattices –Introduction- Principle of duality- Properties of Lattice –sub Lattice –Distributive Lattice- Modular lattice– Bounded lattice- Complemented lattice.

Book2 Chapter 5,6 and 7 **(15 Hours)**

UNIT IV: BOOLEAN ALGEBRA

Introduction –Basic laws of Boolean Algebra – Principle of duality – Boolean expression–Boolean function–Literal–Minterm and Maxterm-Normal forms and Canonical forms –Simplification of Boolean functions by Karnaugh Map method.

Book2 Chapter 8, 9 and10 **(20 Hours)**

UNIT V: AUTOMATA, LANGUAGES AND COMPUTATIONS

Introduction – Finite Automata-Definition of Finite Automaton–Representation – Acceptability of a String by a Finite Automaton- Languages accepted by a Finite Automaton– –Acceptability of a string by a Non-Deterministic Finite Automata – Equivalence of Finite Automata and Non-Deterministic Finite Automata .

Book1 Chapter 12 Sections 1– 7 **(20 Hours)**

BOOKS RECOMMENDED:

1. Discrete Mathematics by Dr. M.K. Venkataraman, Dr. N. Sridharan and Dr. N. Chandrasekaran, The National Publishing Company (2007).

2. Discrete Mathematics by Dr. S.P. Rajagopalan and Dr. R. Sattanathan, Margham Publications (2007).

REFERENCE BOOKS:

1. Discrete Mathematics and its Applications by Kenneth H. Rosen (2011).
2. Discrete Mathematical Structures with Applications to Computer Science by Tremblay J.P and Manohar. R, Tata McGraw-Hill Publications Co., limited, New Delhi (2003).
3. Discrete Mathematics by Prof. V. Sundaresan, K. S. Ganapathy Subramanian, K. Ganesan, A.R. Publications, Tamil Nadu (2005).

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society, Chennai.
2. Discrete Mathematical Sciences.

E-LEARNING RESOURCES:

1.https://nptel.ac.in/courses/111/107/111107058/
2.https://nptel.ac.in/courses/111/106/111106050/
3.https://nptel.ac.in/content/storage2/courses/111106086/lecture4.pdf
4. https://en.wikipedia.org/wiki/Disjumctive_normal_form
5. https://calcworkshop.com/relations/lattices/

COURSE OUTCOMES:

Upon successful completion of **Discrete Mathematics**, students will be able to

CO Number	CO STATEMENT
CO 1	Acquire knowledge of Recurrence relations and generating functions of polynomials.
CO 2	Construct truth table for the given proposition. Interpret tautology and contradictions. Demonstrate logical operator.
CO 3	Define and illustrate poset and lattices. Discuss the properties and types of lattices. Demonstrate Hasse diagram.
CO 4	Analyze Boolean functions. Recognize the use of Karnaugh map method to construct the canonical form of Boolean expression.
CO 5	Compute in programming for matching strings and extracting text using Non-Deterministic Finite Automata.

MAPPING – COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	1	-	2	3	2	2
CO2	1	1	2	3	1	1
CO3	1	1	1	3	2	2
CO4	1	1	1	1	2	2
CO5	1	1	1	1	2	2
AVERAGE	**1**	**0.8**	**1.4**	**2.2**	**1.8**	**1.8**

KEY: STRONGLY CORRELATED- 3 **M**ODERATELY CORRELATED - 2
WEAKLY CORRELATED -1 **N**O CORRELATION - 0

TEACHING METHODOLOGY

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**Two questions from each section (Section A & Section B) should test problem solving skills**
K1, K 2	B-5/8 x7 marks	200	35		
K2, K 3	C-3/5 x15 marks	500	45		

All question papers can be framed in the following cognitive levels.

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER VI

CORE 15

NUMBER THEORY AND CRYPTOGRAPHY

TEACHING HOURS: 90 Hours **COURSE CODE : MA21/6C/NTC**
CREDITS: 4 **L T P : 3 3 0**

COURSE OBJECTIVES:

To enable students to

1. Have conceptual understanding of the fundamentals of Number theory.
2. Know the connections of number theory with other branches.
3. Gain competence in solving problems.

UNIT I: Divisibility Theory: Greatest common Divisor- Relatively Prime integers – Algorithm to find G.C.D : Investigation of the set of Integers {bx+cy}- Least Common Multiple.

Book 1: Chapter 2 Sections 2.3 - 2.5 and 2.7. (17 Hours)

UNIT II: Linear Diophantine Equations: Linear Diophantine Equations- The Equation ax+by=c – Diophantine Equation in three or more Unknowns- Diophantine Equation of the Second Degree (Statements of theorems and problems only)

Book 1: Chapter 3 Sections 3.2 - 3.5 (17 Hours)

UNIT III: Primes and their Distributions: Introduction - Prime Number- The Sieve of Eratosthenes-Positive divisors of a positive integer-The Goldbach Conjecture. **Congruences:** Congruence-Properties of Congruences -Special Divisibility Tests- Linear Congruence.

. **Book 1: Chapter 4 Sections 4.1-4.5**
Chapter 5 Sections 5.2, 5.3, 5.6, 5.7 (22 Hours)

UNIT IV: Quadratic Residues, Cryptography: Introduction, quadratic residues, Elementary Properties, An Introduction to Cryptography, Substitution Ciphers.

Book 1: Chapter 9 Sections 9.1- 9.3
Book 2: Chapter 9 Sections 9.3, 9.4 (17 Hours)

UNIT V: Cryptography(continued): Modern Cryptography, Other Cryptographic Ideas, Attacks on the RSA System.

Book 2: Chapter 9 Sections 9.5- 9.7 (17 Hours)

BOOKS RECOMMENDED:

1. Theory of Numbers –Pundir & Pundir – Pragati Prakashan – Third revised edition 2012.

2. A Beginner's Guide to Discrete Mathematics, Second Edition - W.D. Wallis, Springer Science + Business Media, LLC 2012.

REFERENCE BOOKS:

1. An Introduction to the theory of numbers, Ivan M. Niven , Zuckerman and Hugh L Montgomery, 1991, John Wiley & Sons
2. Elementary theory of numbers, cy. Hsiung, 1992, World Scientific Publishing Co Pvt Ltd.
3. Elementary Number Theory, David. M.Burton, McGrawHill Education,7th edition, 2017.
4. A course in Number Theory, Second Edition, H.E. Rose, Oxford Science Publications,1995.
5. Introduction to Analytic Number Theory, Tom. M. Apostol, Narosa Publishing House, New Delhi, 1998.

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

E-LEARNING RESOURCES:

1. https://en.wikipedia.org/wiki/Coprime_integers
2. https://brilliant.org/wiki/linear-diophantine-equations-one-equation/
3. https://mathstats.uncg.edu/sites/pauli/112/HTML/seceratosthenes.html
4. https://crypto.stanford.edu/pbc/notes/numbertheory/qr.html
5. https://www.geeksforgeeks.org/substitution-cipher/

COURSE OUTCOMES:

Upon successful completion of **Number theory and Cryptography,** students willbe able to

CO Number	CO STATEMENT
CO 1	Analyse the concept of divisibility, congruence, GCD & LCM. Evaluate GCD by Euclid Algorithm.
CO 2	Solve Diophantine equations of two or three variables. Acquire knowledge of Cryptography and data encryption.
CO 3	To understand and appreciate the significance of prime numbers and their properties and also to apply divisibility test in congruences.
CO 4	Apply the law of quadratic reciprocity and their methods to classify numbers as primitive roots, quadratic residues and non-residues.
CO 5	Solve Diophantine equations of two or three variables. Acquire knowledge of Cryptography and data encryption

MAPPING – COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	-	1	3	3	-	-
CO2	-	1	1	3	1	1
CO3	-	1	1	3	3	1
CO4	1	1	-	2	1	-
CO5	1	1	-	2	1	1
AVERAGE	**0.4**	**1**	**1**	**2.6**	**1.2**	**0.6**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**Two questions from each section (section A & Section B) should test problem solving skills.**
K1, K 2	B-5/8 x 7 marks	200	35		
K2, K 3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER VI

ELECTIVE - III
PROGRAMMING IN PYTHON
(Theory & Practicals)

TEACHING HOURS: 90 Hours **COURSE CODE:MA21/6E/PPY**
CREDITS: 5 **L T P : 4 0 2**

COURSE OBJECTIVES:

1. To introduce the Python programming language to the students.
2. To define Python functions and call them.
3. To use Python data structures - lists, tuples and dictionaries.
4. To read and write simple Python programs.

COURSE OUTLINE:

UNIT I : Basics of Python Programming

Features of Python-Literal constants- Variables and identifiers-Data Types- Input Operation- Comments – Reserved words- Indentation- Operators and expressions – Expressions in Python.

Chapter 3: 3.1,3.5 - 3.13 **(15 Hours)**

UNIT II : Decision Control Statements

Introduction to decision control statements- Conditional branching Statements- Basic Loop structures- Nested Loops – The *break* statement- The *continue* statement- The *pass* Statement - The *else* Statement used with loops.

Chapter 4: 4.1 -4.8 **(15 Hours)**

UNIT III: **Functions and Strings**

Function- Introduction- Function Definition-Function call- Variable scope and lifetime- The *return* Statement- More on Defining Functions- Lambda Functions - Recursive Functions.

Strings -Introduction- Concatenating, Appending and Multiplying Strings- Strings are immutable -String formatting operator- Built- in – String methods and functions. Slice operation- *in* and *not in* operators- Comparing strings.

Chapter 5: 5.1 -5.7, 5.10
Chapter 6: 6.1 – 6.5, 6.7, 6.8 **(20 Hours)**

UNIT IV: Data structures.

Lists: access values in lists - Updating values in lists- Nested lists – Cloning lists- Basic List Operations- List Methods.

Tuple: Creating tuple- Utility of tuples- Accessing values in a tuple-

Updating tuple- Deleting elements in tuple- Basic tuple operations – Tuple assignment- Tuples for returning multiple values - Nested tuples- Checking the Index. – counting the elements - Advantage of tuple over list

Chapter 8: 8.2: 8.2.1—8.2.6

Chapter 8: 8.4 :8.4.1 - 8.4.11 ,8.4.16 (20 Hours)

UNIT V: **Dictionaries and File Handling**

Creating a dictionary- accessing values- adding and modifying an item in a dictionary- Modifying an Entry- Deleting items- sorting items in a dictionary- Looping over a dictionary- Nested Dictionaries.

File Handling-Introduction- Filepath- Types of files- Opening and closing files- Reading and writing Files-File positions-Renaming and deleting files.

Chapter 8: 8.6 :8.6.1 - 8.6.7

Chapter 7: 7.1-7.7 (20 Hours)

PRACTICAL PROGRAMS

1. Program to calculate the distance between 2 points.
2. Program to find whether the given number is an Armstrong number.
3. Program to find GCD of 2 numbers.
4. Program to generate calendar of a month given the start day and the number of days in that month.
5. Program to sort the numbers using bubble sort.
6. Program to sum the series $\frac{1}{1!}+\frac{4}{2!}+\frac{27}{3!}+...$
7. Program to find the Fibonacci series using recursion.
8. Program to reverse a string.
9. Program to accepts a string from a user and redisplays the same string after removing vowels from it.
10. Program to convert a list of temperatures in Celsius into Fahrenheit.
11. Program to add two matrices using nested list.
12. Program that accepts different number of arguments and return sum of only the positive value passed to it.
13. Program to create a dictionary of radius of a circle and its circumference.
14. Program to display the content of a text file.
15. Program to accept filename as an input from the user and to open the file and count the number of times a character appears in the file.

RECOMMENDED TEXT:

Reema Thareja, ``Python programming using problem solving approach'',10^{th} impression 2021, Oxford University press 2017.

REFERENCE BOOKS:

1. Allen B.Downey, Think Python,2nd Edition, O'Reilly Media,2015.
2. P.Subha, P.Ashok, R.Shobana Lakshmi Python Problem solving and programming ,CBA Publisher,2020.
3. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013.
4. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python 3, Second edition, Pragmatic Programmers, LLC,2013.

PERIODICALS:

International Journal of Computer science

WEBSITES AND e-LEARNING SOURCES

1. https://nptel.ac.in/courses/106/106/106106212/
2. www.udemy.com/Python/Online-Course3.
3. http://greenteapress.com/wp/think- python
4. https://docs.python.org/3/tutorial/

COURSE OUTCOME:

Upon successful completion of **PROGRAMMING IN PYTHON (Theory &Practicals)** students will be able to:

CO Number	CO statement
CO1	Set up Python environment for execution of Python programs.
CO2	Explain basic principles of Python programming language
CO3	Identify different Decision - Making statements, Functions, Conditionals and recursion statement
CO4	Perform operations on List, tuples and dictionary in Python
CO5	Develop programs and simple application using python

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	-	3	3	2	3
CO2	1	-	3	3	3	3
CO3	1	-	3	3	2	3
CO4	1	-	2	3	2	3
CO5	1	-	3	3	3	3
Average	**1.4**	**-**	**2.8**	**3**	**2.4**	**3**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2

WEAKLY CORRELATED-1 **N**OCORRELATION-

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10 x 2 marks	50	20	**100**	**Nil**
K1,K 2	B-5/8x7 marks	200	35		
K2, K 3	C-3/5x15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

EVALUATION PATTERN FOR CONTINUOUS ASSESSMENT

INTERNAL VALUATION BY COURSE TEACHER/S

S.NO.	COMPONENT	TIME	MAX. MARKS	C.A. MARK
1	TEST I	2 HOURS	50 MARKS (TO BE CONVERTED)	10
2	TEST II	2 HOURS	50 MARKS (TO BE CONVERTED)	10
3	PRACTICAL EXAM	2 HOURS	50 MARKS (TO BE CONVERTED)	20
	TOTAL			**40**

CA QUESTION PAPER PATTERN

Knowledge Level	Section	Word Limit	Marks	Total
K1	**A-5** x **2 marks**	**50**	**10**	**50**
K1, K2	**B-3/5x8marks**	**200**	**24**	
K2, K3	**C-1/2x16marks**	**500**	**16**	

ASSESSMENT OF COMPUTER PRACTICAL EXAMINATION.

Two questions will be asked for the practical examination.For each question

Programming skill (writing) - 10 marks

Technical Skill (Keying) - 10 marks

UG & PG - Allied Course Profile

Semester (I & II)

(Offered to Other Departments)

SEMESTER – I

(for I Year Physics & Chemistry)

ALLIED 1

ALLIED MATHEMATICS – I

TEACHING HOURS: 90 Hours **COURSE CODE: MA21 / 1A / AM1**
CREDITS:5 **L T P: 3 3 0**

COURSE OBJECTIVES:

To enable students to

1. Equipped with the knowledge of matrices and its applications.
2. Understand the concept of reduction formula and integral calculus.
3. Know the principle & concepts of Trigonometry

COURSE OUTLINE:

UNIT I: Matrices: Eigen values and Eigen vectors, Cayley Hamilton Theorem (No proof) verification of Cayley Hamilton theorem, Inverse of a Matrix using Cayley Hamilton Theorem. **(17 Hours)**

UNIT II: Theory of equations: Roots of polynomial Equations, Symmetric functions of roots in Terms of coefficients, Transformation of equations, Formation of equations, Reciprocal Equations. **(20 Hours)**

UNIT III: Trigonometry: Expansions of Cos nθ, Sin nθ, Expressions of Cos θ, sin θ, tan θ in powers of θ, Hyperbolic functions and Inverse Hyperbolic functions. Real and imaginary parts of sin (α+iβ) , cos (α+iβ), tan (α+iβ), $\tan^{-1}(\alpha + i\beta)$. **(18 Hours)**

UNIT IV: Integral calculus: Bernoulli's formula, Reduction formulae $\int e^{ax}\cos bx\, dx$, $\int e^{ax}\sin bx\, dx$, $\int \sin^m x \cos^n x\, dx$ (m, n being positive integers), $\int x^m (\log x)^n\, dx$, $\int \cos^m x \cos nx\, dx$, $\int \cos^m x \sin nx\, dx$. **(20 Hours)**

UNIT V: Fourier Series: Definition- Finding Fourier coefficients for a given periodic functions with period 2π- odd and even function Half range series**.** **(15 Hours)**

BOOKS RECOMMENDED:

1. Narayanan and Manicavachagom Pillay, Ancillary Mathematics Book I (2000), II (2002), and III (1998) **,** S**.**Viswanathan Printers and publishers Private limited, Chennai.
2. Dr. A. Singaravelu, Allied Mathematics, 3rd Revised edition (2011), MeenakshiAgency, Chennai.

REFERENCE BOOKS:

1. P.R. Vittal, Allied Mathematics, 4th edition (2009), Margham Publications,Chennai.
2. P. Duraipandian and S. Udayabaskaran, Allied Mathematics, Volume I & II,Second edition (2000), Muhil Publishers, Chennai.
3. A.Singaravelu & R.Ramaa , Algebra and Trigonometry ,Volume- I, First edition(2003), Meenakshi Agency, Chennai.
4. P. Kandasamy and K. Thilagavathi, Mathematics for B.Sc, Volume II, Firstedition (2004) , S.Chand & Co., New Delhi.
5. T.KManicavachagam Pillay, T. Natarajan, K.S. Ganapathy, Algebra vol-I (2003), S. Viswanathan Pvt. Ltd,

JOURNALS

1. Mathematics Newsletter Published by Ramanujan Mathematical Society, Chennai.
2. Discrete Mathematical Sciences & Cryptography

E- LEARNING RESOURCES:

1. http://www.mathforum.org
2. http://www.opensource.org
3. http://khanacademy.org
4. http://in.ixl.com
5. http://www.learningwave.com

COURSE OUTCOME:

Upon successful completion of **Allied Mathematics-I**, students will be able to:

CO NUMBER	CO STATEMENT
CO 1	Compute Eigen values and Eigen vector of a square matrixand find inverse of matrix using Cayley -Hamilton theorem.
CO 2	Evaluate the roots of the polynomial equation solving the transformation of equation and Reciprocal equation.
CO 3	Evaluate $\cos n\theta, \sin n\theta, \cos\theta, \sin\theta, \tan\theta$ in power of θ. Compute hyperbolic and inverse hyperbolic function.
CO 4	Derive reduction formula and thereby evaluate standard integral.
CO 5	Find Fourier series expansion for the given function and evaluate Fourier series for odd and even function.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO /PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	2	1	3
CO 2	3	2	3	2	1	3
CO 3	3	2	3	2	1	3
CO 4	3	2	3	2	1	3
CO 5	3	2	3	2	1	3
AVERAGE	**3**	**2**	**3**	**2**	**1**	**3**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED -2 **W**EAKLY CORRELATED -1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Group Discussion
3. Peer Learning

QUESTION PAPER PATTERN – UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10×2 marks	50	20	**100**	**Nil**
K1, K 2	B-5/8 × 7 marks	200	35		
K2, K 3	C-3/5× 15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – II

(for I Year Physics & Chemistry)

ALLIED 2

ALLIED MATHEMATICS- II

TEACHING HOURS: 90 Hours **COURSE CODE:MA21 / 2A /AM2**

CREDITS: 5 **L T P: 3 3 0**

COURSE OBJECTIVES:

To enable students to

1. Solve the different types of linear differential equations.
2. Apply Laplace Transform to solve differential equation.
3. Interpolate a value from a given set of data.

COURSE OUTLINE:

UNIT I : Ordinary Differential Equations: Linear differential equations with constant co-efficients, Particular integral of polynomial and Ve^{mx}, where V is a polynomial or sin x or cos x. **(20 Hours)**

UNIT II : Partial Differential Equations : Formation, Complete Integral, Four standard types, Lagrange's equation, simple problems. **(20 Hours)**

UNIT III: Laplace Transforms: Laplace Transforms of Standard functions, Simple theorems. (no proof) Inverse Laplace Transforms, solving first order differential equations with constant coefficients using Laplace transforms. **(20 Hours)**

UNIT IV: Vector Analysis: Introduction, operator∇, Gradient, Directional derivative, unit Normal to surface. Divergence and curl of vectors, solenoidal and irrotational vectors, the operator ∇^2 ,harmonic functions. **(15 Hours)**

UNIT V: Interpolation – Newton's forward and backward formulae for interpolation (no proof) Lagrange's formula for interpolation (No Proof) – Simple problems**.** **(15 Hours)**

BOOKS RECOMMENDED:

1. Narayanan and Manicavachagom Pillay, Ancillary Mathematics Book I (2000), II (2002), and III (1998) **,** S.Viswanathan Printers and publishers Private limited, Chennai.
2. Dr.A.Singaravelu, Allied Mathematics, 3rd Revised edition (2011), Meenakshi Agency, Chennai.

REFERENCE BOOKS:

1. P.R. Vittal, Allied Mathematics, 4th edition (2009), Margham Publications, Chennai.
2. P. Duraipandian and S. Udayabaskaran, Allied Mathematics, Volume I & II , Second edition (2000), Muhil Publishers, Chennai.
3. A.Singaravelu & R.Ramaa , Algebra and Trigonometry ,Volume- I, First edition (2003), Meenakshi Agency, Chennai.
4. S. Arumugham, Numeical methods,2nd edition (2003). New Gamma publishing, Palayamkottai.
5. P.R. Vittal, Differential equation and Laplace Transformations, First edition (2004), Margham Publications, Chennai.

JOURNALS

1. Mathematics Newsletter Published by Ramanujan Mathematical Society, Chennai.
2. Discrete Mathematical Sciences & Cryptography

E- LEARNING RESOURCES:

1. http://www.mathforum.org
2. http://www.opensource.org
3. http://khanacademy.org
4. http://in.ixl.com
5. http://www.learningwave.com

COURSE OUTCOME:

Upon successful completion of **Allied Mathematics-II**, students will be able to:

CO Number	CO STATEMENT
CO 1	Solve linear differential equation with constant co-efficient.
CO 2	Recognize the major classification of PDE'S and solve four standard type of PDE.
CO 3	Solve first order differential equation using Laplace and inverse Laplace transform.
CO 4	Determine gradient, divergence and curl of vectors.
CO 5	Analyse and use Newton's forward, backward and Lagrange's formula for interpolation and apply it in real life problems.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO /PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	3	2	1	3
CO 2	3	2	3	2	1	3
CO 3	3	2	3	2	1	3
CO 4	3	2	3	2	1	3
CO 5	3	2	3	2	1	3
AVERAGE	**3**	**2**	**3**	**2**	**1**	**3**

KEY: STRONGLY CORRELATED - 3 **M**ODERATELY CORRELATED -2
WEAKLY CORRELATED - 1 **N**OCORRELATION - 0

TEACHING METHODOLOGY

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN - UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A-10×2 marks	50	20	**100**	**Nil**
K1, K 2	B-5/8 × 7 marks	200	35		
K2, K 3	C-3/5× 15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – I
ALLIED 1- (FOR B.COM)
BUSINESS MATHEMATICS – I

Teaching Hours: 90 Hours **Course Code: MA21 /1A / BM1**
Credits: 5 **L T P : 3 3 0**

COURSE OBJECTIVES

To enable students

1. To acquire the knowledge of matrices and its applications.
2. To apply the various rules of differentiation and integration to problems in Business and Commerce.
3. To understand the basic concepts of linear programming which can be applied in real life situations.

COURSE OUTLINE:

UNIT I : DIFFERENTIAL AND INTEGRAL CALCULUS

Differentiation-First and Second order derivative of a function of one variable-Differentiation by the method of Substitution – Differentiation of Implicit functions - Successive Differentiation-Points of Inflexion-Maxima and Minima – Partial Differentiation – Total Differentiation.

Indefinite Integral-Rules of Integration-Some Standard Integrals- Integration by Substitution-Integrals reducible to some standard form-Integration by Parts and Partial Fractions-Definite Integrals (Trigonometric functions excluded).

Book 1 Chapter 17 Sections 17.1 – 17.21 (omit 17.14, 17.16, 17.17)
Chapter 18 Sections 18.1 – 18.10 (20 Hours)

UNIT II: **MATRIX ALGEBRA**

Introduction - Types of matrices - Inverse of a matrix -Simultaneous equations - Gauss Elimination Method – Rank of Matrix.

Book 1 Chapter 20 Sections 20.1 - 20.25 (15 Hours)

UNIT III: LINEAR PROGRAMMING

General linear programming problem - Mathematical formulation of a LPP - Graphical Method and Simplex Method - Simplex Algorithm

Book 2 Chapter 2 Sections 2.1 – 2.5,
Chapter 3 Sections 3.1.1 – 3.1.4 (15 Hours)

UNIT IV: SEQUENCING PROBLEMS

Introduction – Assumptions for solving sequencing problems – Procedure for determining the optimal sequence for n-Jobs on two machines – Processing of n-Jobs on three machines.

Book 2 Chapter 14 Sections 14.1 – 14.5 (15 Hours)

UNIT V: GAME THEORY

Introduction - Two persons zero-sum games - The maximin – minimax principle - saddle point and value of the games - Games without saddle points - mixed strategies – Arithmetic method forn xn games - Dominance property.

Book 2 Chapter 16 Sections 16.1 – 16.6 (20 Hours)

BOOKS RECOMMENDED:

1. D.C. Sancheti and V.K. Kapoor, Business mathematics, (2017) Sultan Chand &Co.
2. V. Sundaresan, K.S. Ganapathy Subramanian, & K. Ganesan, Resource Management Techniques, A.R. Publications, 2002.

REFERENCE BOOKS:

1. Mathematical Statistics by P.R. Vittal. (2015), Margham Publications.
2. Manicavachagam Pillay, Natarajan, S. Ganapathy, (2018), Algebra vol. II.
3. P.R. Vittal, Business Mathematics, (2007), Margham Publications

PERIODICALS:

1. The Mathematics Intelligencer.
2. Mathematics Newsletters.

WEBSITES & e-LEARNING SOURCES:

1. https://nptel.ac.in/content/storage2/courses/122104018/node28.html
2. https://www.youtube.com/watch?v=J21WwbSbN4M
3. https://nptel.ac.in/courses/111/105/111105041/
4. https://www.youtube.com/watch?v=8B31SAk1nD8
5. https://www.youtube.com/watch?v=KKg88oSUv0o

COURSE OUTCOMES:

Upon successful completion of **Business Mathematics - I**, students will be able to:

CO Number	CO STATEMENT
CO1	Apply the derivatives of elementary functions to solve Business and Commerce problems. Analyse the integration problems using basic techniques of integration.
CO2	Find the inverse of the matrix and study the various types of matrix.
CO3	Determine the optimum sequence and solving problems for n jobs on two machine and three machines.
CO4	Formulate a mathematical model of a real life problem and solve it by using Linear Programming Techniques.
CO5	Determine the key concepts and strategies in game theory and apply in certain real life problems.

MAPPING - COURSE OUTCOME WITH PROGRAMME SPECIFICOUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	-	1	3	-	3
CO 2	3	-	1	3	-	3
CO 3	3	-	1	3	-	3
CO 4	3	-	1	3	-	3
CO 5	3	-	1	3	-	3
AVERAGE	**3**	**-**	**1**	**3**	**-**	**3**

KEY: STRONGLY CORRELATED - 3 **M**ODERATELY CORRELATED - 2 **W**EAKLY CORRELATED – 1 **N**O CORRELATION - 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion-Role Modelling
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN - UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instruction s if any
K1	A-10 x 2 marks	50	20	**100**	**Nil**
K1. K 2	B-5/8 x 7 marks	200	35		
K2, K 3	C-3/5 x 15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – II
ALLIED - 2
(for I B.Com)
BUSINESS MATHEMATICS – II

Teaching Hours: 90 Hours **Course Code: MA21/2A/BM2**
Credits: 5 **L T P: 3 3 0**

COURSE OBJECTIVES
To enable students to

1. Acquire the knowledge of solving problems financially.
2. Solve the problems of finding optimum allocation for a number of jobs to equal number of facilities.
3. Construct the network diagram.

COURSE OUTLINE:

UNIT I: COMBINATORICS

Permutations and Combinations: Fundamental rule of counting – Permutations Permutation of different things – Circular Permutations – Permutations of things not all different – Restricted Permutations – Combinations – RestrictedCombinations – Combination of things not all different – Arithmetic Progression – Sum of Series in AP – Arithmetic Mean – Geometric Progression – Sum of Series in GP – Geometric Mean.

Book 1 Chapter 13 Section 13.1 – 13.6.1
Book 1 Chapter 12 Section 12.1 – 12.4.4 **(20 Hours)**

UNIT II: FINANCIAL MATHEMATICS

Mathematics of Finance – Simple and Compound interest – annuity – Sinking fund – Present value of an annuity – Present value concept in capital expenditure – leasing and bonds.

Book 1: Chapter 7 Section 7.1 – 7.14 **(20 Hours)**

UNIT III: TRANSPORTATION PROBLEM

Introduction – Mathematical formulation of Transportation problem – Methods for finding initial feasible solution - North-West corner Rule -Least cost method – Vogels method – optimality test (only problems) degeneracy excluded – Unbalanced Transportation Problems – Maximization case in Transportation Problems.

Book 2 Chapter 7 Section 7.1 – 7.5 (omit 7.3) **(20 Hours)**

UNIT IV: ASSIGNMENT PROBLEM

Introduction-Mathematical formulation of an assignment problem- difference between transportation and assignment problems- Unbalanced assignment problems-Travelling salesman problems.

Book 2 Chapter 8 Section 8.1 – 8. 9 (omit 8.8) **(15 Hours)**

UNIT V: PERT AND CPM

Introduction-Basic Terminologies - Rules for constructing a Project network - Network computation- Floats – Programme Evaluation ReviewTechnique – Differences between PERT and CPM .

Book 2 : Chapter 15 Section 15.1 – 15.7 (15 Hours)

BOOKS RECOMMENDED:

1. Business Mathematics by A.P. Verma, (2007), Asian Books Pvt., Ltd.
2. V. Sundaresan, K.S. Ganapathy Subramanian, & K. Ganesan, Resource Management Techniques, A.R. Publications, 2002

REFERENCE BOOKS:

1. D.C. Sancheti and V.K. Kapoor, (2017), Business Mathematics, Sultan Chand &Co
2. Gupta P.K. & Hira D.S., Problems in Operations Research, S. Chand & Co., Delhi, 2000.
3. P.R. Vittal, Business Mathematics, (2007), Margham Publications.

PERIODICALS:

1. The Mathematics Intelligencer.
2. Mathematics News letter.

WEBSITES & e-LEARNING SOURCES:

1. **https://youtu.be/0NAASclUm4k**
2. **https://youtu.be/JgenG0tgQAo**
3. **https://youtu.be/f3wC8fjMV9g**
4. **https://youtu.be/6WOhzmQsnac**
5. **https://youtu.be/KarLMGILAjc**

COURSE OUTCOMES

Upon successful completion of **Business Mathematics - II**, students will be able to:

CO Number	CO STATEMENT
CO1	Apply the mathematical skill to solve permutation and combination problems.
CO2	Apply the mathematical skill to solve financial oriented problems.
CO3	Evaluate the logistic operations of various resources from one place to another by transportation problems and to apply to Marketing problems.
CO4	Apply the techniques of finding optimal assignment using Hungarian method and apply to real life problems.
CO5	Determine the project network and evaluating latest and earliest completion time.

MAPPING - COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	-	1	3	-	3
CO2	3	-	1	3	-	3
CO3	3	-	1	3	-	3
CO4	3	-	1	3	-	3
CO5	3	-	1	3	-	3
AVERAGE	**3**	**-**	**1**	**3**	**-**	**3**

KEY: STRONGLY CORRELATED - 3 **M**ODERATELY CORRELATED - 2

WEAKLY CORRELATED – 1 **N**O CORRELATION - 0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN - UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A -10 X 2 marks	50	20	**100**	**Nil**
K1, K 2	B - 5/8 X 7 marks	200	35		
K2, K 3	C-3/5 X 15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER – I

CORE – I

(for I B.Com. Hons)

BUSINESS MATHEMATICS

TEACHING HOURS: 75 Hours **COURSE CODE:MA21/1C/BMM**
CREDITS: 4 **L T P: 3 2 0**

COURSE OBJECTIVES:

1. To apply the concepts of differentiation and integration to real world problems.
2. Apply mathematical methods of counting principles and matrices to solve problems.
3. To calculate and interpret the probability of events.

UNIT – I : DIFFERENTIAL CALCULUS

Introduction – Differentiation – Derivative of a function of one variable – Derivative of a power function –Derivative of a constant with any function – Derivative of the sum of functions – Derivative of the product and quotient of two functions – Derivative of a function of function – Derivative of Logarithmicfunctions –Differentiation by the method of substitution – Logarithmic differentiation – Successive differentiation – Applications of maxima and minima.

Book 1, Chapter 17 – Section 17.0 – 17.20
(omit sections 17.9, 17.13, 17.14,17.17, 17.18). (15 Hours)

UNIT – II : COMBINATORICS

Permutation and combination - Arithmetic Progression – Geometric Progression.

Book 1, Chapter 9 Section 9.0 - 9.11
Book 1, Chapter 12 Section 12.0 - 12.6 (15 Hours)

UNIT – III: INTEGRAL CALCULUS

Integration – Indefinite Integral – Rules of Integration – Standard Results- Integration by Substitution – Standard Integrals – Integrals Reducible to standard form – Integration by parts – Integration by Partial Fractions – Definite Integrals. (Integration of Trigonometric functions excluded).

Book 1, Chapter 18 Section 18.1 - 18.11 (15 Hours)

UNIT –IV: MATRICES

Introduction –Definition – Types of Matrices – Operations on Matrices – Transpose of a Matrix – Cramer's Rule – Properties of Determinants – Minorsof a Matrix – Adjoint of a Square Matrix – Inverse of a Matrix - Solutions of simultaneous equations by Gauss Elimination Method – Rank of a Matrix.

Book 1, Chapter 20 Section 20.1 - 20.25 (Omit 2.16) (15 Hours)

UNIT – V: PROBABILITY

Concept of probability- Independent and mutually exclusive events- Addition rule for two or more mutually exclusive events –Conditional probability - Multiplication law of probability – Bayes' Rule (Proof excluded) – Discrete random variable – Continuous random variable – Cumulative distribution – Properties of distribution function – Function of a random variable.

Book 2, Chapter 1 – Sec 20.1, - 20.15, 20.17 – 20.25. (15 Hours)

RECOMMENDED TEXT:

1. D.C. Sancheti and V.K. Kapoor, Business Mathematics, Sultan Chand & Sons, 2019.
2. P.R. Vittal, Mathematical Statistics, Margham Publications, 2015.

REFERENCE BOOKS:

1. B.M. Agarwal, Business Mathematics &Statistics, Ane Books Pvt Ltd., 2001.
2. R.S.Soni, Business Mathematics, Ane Books Pvt Ltd, 2013.

PERIODICALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

WEBSITES & e-LEARNING SOURCES:

1. https://nptel.ac.in/content/storage2/courses/122104018/node28.html
2. https://www.youtube.com/watch?v=J2IWwbSbN4M
3. https://nptel.ac.in/courses/111/105/111105041/
4. https://www.youtube.com/watch?v=8B31SAk1nD8
5. https://www.youtube.com/watch?v=KKg88oSUv0o

COURSE OUTCOMES

Upon successful completion of **Business Mathematics**, students will be able to:

CO Number	CO STATEMENT
CO 1	Recognize that mathematics permeates the world around us.
CO 2	Formulate and compute general term, sum of sequence and series.
CO 3	Learn to solve problems related to integration.
CO 4	Prepare to improve computation skills.
CO 5	Use appropriate mathematical concepts and skills to solve problems including those in real life contexts.

MAPPING- COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO /PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	1	2	2	2
CO2	1	3	1	2	2	1
CO3	2	3	1	2	1	2
CO4	1	3	2	1	1	1
CO5	1	1	2	1	1	3
Average	**1.6**	**2.4**	**1.4**	**1.6**	**1.4**	**1.8**

KEY:STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN-UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A -10 X 2 marks	50	20	**100**	**Nil**
K1, K 2	B - 5/8 X 7 marks	200	35		
K2, K 3	C-3/5 X 15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER –II

CORE - II
(for I B.Com. Hons)

OPTIMIZATION TECHNIQUES

TEACHING HOURS: 75 Hours **COURSE CODE:MA21/2C/OPT**
CREDITS: 4 **L T P: 3 2 0**

COURSE OBJECTIVES:

1. To formulate a simplified description of suitable real world problems as a Linear programming model.
2. To interpret the Mathematical tools that are needed to solve the optimization problem.
3. To apply PERT and CPM techniques to plan, schedule and control project activities.

UNIT – I : LINEAR PROGRAMMING

General linear programming problem – Mathematical formulation of a LPP – Graphical procedure and Simplex procedure.

Chapter 2 Sections 2.1, 2.2, 2.3, 2.4, 2.5
Chapter 3 Sections 3.1.1, 3.1.2, 3.1.3 (15 Hours)

UNIT – II : GAME THEORY

Two persons zero sum games -the Maximin – Minimax Principle – Saddle point and Value of the games - Games without saddle points, Mixed Strategies -Dominance property.

Chapter 16 Sections 16.1, 16.2, 16.3, 16.4, 16.6 (15 Hours)

UNIT – III : TRANSPORTATION PROBLEM

Introduction – Mathematical Formulation of a Transportation problem – Initial feasible solution, North-West Corner Rule – Least Cost Method – Vogel's Approximation Method – Optimality Test (Degeneracy excluded).

Chapter 7 Sections 7.1, 7.2 (15 Hours)

UNIT –IV: ASSIGNMENT PROBLEM

Introduction – Mathematical Formulation of an Assignment problem Hungarian Method.

Chapter 8 Sections 8.1, 8.2, 8.5 (15 Hours)

UNIT – V: PERT AND CPM

Drawing network diagram - Critical Path Method - Concept of slack and floats on network - Algorithm for PERT and CPM.

Chapter 15 Sections 15.1 – 15.7 (15 Hours)

RECOMMENDED TEXT:

Prof. V. Sundaresan, K.S. Ganapathy Subramanian, K. Ganesan, Resource Management Techniques, A.R. Publications, Chennai (2008).

REFERENCE BOOKS:

1. D. C. Sancheti and V.K. Kapoor, Business Mathematics (1993), Sultan Chand& Co.
2. R. K. Gupta, Operations Research (2003), Krishna Prakashan Mandir.
3. J.K. Sharma, Operations Research Theory and Applications, (2008), Macmillan India Ltd.
4. Man Mohan, Kanti Swarup, P. K. Gupta, Introduction to ManagementScience Operations Research (2021), Sultan Chand & Co.

PERIODICALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. Discrete Mathematical Sciences & Cryptography

WEBSITES & e-LEARNING SOURCES:

1. https://nptel.ac.in/courses/111/105/111105039/
2. https://nptel.ac.in/courses/112/106/112106134/
3. https://nptel.ac.in/courses/111/107/111107128/

COURSE OUTCOMES

Upon successful completion of **Optimization Techniques**, students will be able to:

CO Number	COSTATEMENT
CO1	Formulate and solve industry oriented problems.
CO2	Analyse the decision making process of interdependent subject.
CO3	Identify and solve the cases of unequal supply and demand to maximize a transportation problem.
CO4	Plan to allocate various resources to various activities on one to one basis.
CO5	Define basic components of Network and find critical path.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	2	2	3	3
CO2	1	1	3	1	2	3
CO3	1	1	2	1	2	3
CO4	1	1	2	1	2	3
CO5	1	1	2	1	2	2
Average	**1**	**1**	**2.2**	**1.2**	**2.2**	**2.8**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2
WEAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar
4. Peer Learning

QUESTION PAPER PATTERN - UG

Knowledge Level	Section	Word Limit	Marks	Total	Special Instructions if any
K 1	A -10 X 2 marks	50	20	**100**	**Nil**
K1. K 2	B - 5/8 X 7 marks	200	35		
K2, K 3	C-3/5 X 15 marks	500	45		

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER I

CORE – I (for I M.Com)

STATISTICAL TOOLS FOR BUSINESS MANAGEMENT – I

TEACHING HOURS: 90 Hours **COURSE CODE: 7P21/1C/ST1**
CREDITS:5 **L T P : 3 3 0**

COURSE OBJECTIVES:

1. To classify the random variable as discrete and apply the relevant distribution in problems.
2. To classify the random variable as continuous and apply the relevant distribution in problems.
3. To calculate the degree of relationship between 2 variables.
4. To employ the technique of decision making in the problems.
5. To understand the patterns in time-based data and forecast the patterns for thefuture.

COURSE OUTLINE:

Prerequisites-Sample space-Events-Definition of Probability - Basic Probability Rules

UNIT I : Theoretical discrete distributions – Binomial and Poisson (simple problemsonly) Fitting of Binomial and Poisson distributions. **(15 Hours)**

UNIT II : Theoretical Continuous distributions – Rectangular and Normal distributions. Fitting of Normal Distribution (simple problems only) **(15 Hours)**

UNIT III: Partial and multiple correlations- Rank correlation - Regression lines of *x* on *y* and *y* on x (problems only) **(15 Hours)**

UNIT IV: Statistical decision theory – Decision Environment – Decision making under Certainty and Uncertainty- Expected Monetary Value, Expected Monetary Loss and Marginal Analysis. Expected Value of Perfect Information. Decisiontree analysis. **(25 Hours)**

UNIT V: Analysis of Time Series : Introduction-components of Time Series- Methods of finding trend-Measurement of seasonal variation. **(20 Hours)**

RECOMMENDED TEXTBOOKS:

1. Statistical Methods – S.P. Gupta, Sultan Chand & Sons (2012)
2. Statistics (Theory, Methods & Application) – D.C. Sancheti, V.K. Kapoor

REFERENCE BOOKS:

1. S.C. Gupta and V.K. Kapoor, Elements of Mathematical Statistics(Third Edition), 2014, Sultan Chand & Sons Publications
2. P.R. Vittal, Mathematical Statistics, (2015), Margham Publications.
3. Fundamentals of Mathematical Statistics, S C Gupta and V K Kapoor, Sultan Chand and Sons (2014).
4. Basic Statistics, B L Agarwal, New Age International Private Limited; 6th Edition (1 January 2013).
5. Schaum's Outlines Statistics, Murray R Spiegel and Larry J Stephens, McGraw Hill Education; 4 edition (1 July 2017)

JOURNALS:

1. The Mathematics Intelligencer.
2. Mathematics News Letter
3. Journal of Mathematics and Statistics, Science Publications.
4. International Journal of Mathematics and Statistics™

E-LEARNING RESOURCES:

1. https://www.analyticsvidhya.com/blog/2017/09/6-probability-distributions-data-science/
2. http://www.real-statistics.com/correlation/multiple-correlation/
3. https://en.wikipedia.org/wiki/Partial_correlation
4. https://en.wikipedia.org/wiki/Time_series
5. https://www.researchgate.net/publication/272493896_Decision_making_under_risk_and_uncertainty_and_its

COURSE OUTCOMES:

Upon successful completion of **Statistical Tools for Business Management - I**,students will be able to:

CO Number	CO STATEMENT
CO 1	To fit a mathematical model or a function of the form y = p(x) to the observed data.
CO 2	To apply the concepts of the appropriate distributions to solve business related problems.
CO 3	To measure the intensity of relationship between two variables and to compute the relationship in the form of linear equations.
CO 4	To apply decision making technique in relevant situations in business and commerce.
CO 5	To compare the changes in the values of different phenomenon at different times.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	2	2	1	2
CO2	3	2	2	1	2
CO3	3	2	2	2	3
CO4	3	3	3	1	2
CO5	2	2	2	3	2
AVERAGE	**2.6**	**2.2**	**2.2**	**1.6**	**2.2**

KEY: STRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2 **W**EAKLY CORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

1. Lecture (Chalk and Talk-OHP-LCD)
2. Problem Solving-Group Discussion
3. Quiz-Seminar

QUESTION PAPER PATTERN

Template – End Semester Examination

Knowledge level	Section	Nature of the question	Maximum Marks	
K_4, K_5	A	Analysis, Evaluation, Description/Problems - At least one question from every Unit	5 (out of 8) x 8	40
K_4, K_5	B	Application/ Analysis/ Synthesis/ Evaluation – One question from every Unit	3 (out of 5) x 20	60
			Total	100

Template –Continuous Assessment

Knowledge level	Section	Nature of the question	Maximum Marks	
K_4, K_5	A	Analysis, Evaluation, Description/Problems- At least two question from every Unit	5 (out of 8) x 6	30
K_4, K_5	B	Application/ Analysis/ Synthesis/ Evaluation – At least one question from every Unit	2 (out of 3) x 10	20
Total				50

SEMESTER II

CORE – 2 (for I M.Com)

STATISTICAL TOOLS FOR BUSINESS MANAGEMENT – II

TEACHING HOURS: 75 Hours **COURSE CODE: 7P21/2C/ST2**
CREDITS:5 **L T P : 4 1 0**

COURSE OBJECTIVES:

1. To learn the concept of sampling applied in the problems.
2. To apply the concept of tests of significance in large samples.
3. To apply the concept of tests of significance in small samples
4. To explore on the various methods for finding the association between attributes.
5. To draw valid inferences about the data by carefully analyzing its variance.

COURSE OUTLINE:

UNIT I: Sampling Distribution –Standard errors, errors in sampling, Level of significance, One tailed and Two- tailed test **(15 Hours)**

UNIT II: Large sample Tests – single proportion, single mean, difference between two means, standard deviations and proportions, Confidence limits**.** **(15 Hours)**

UNIT III: Small sample tests – *t* test for single mean, difference between two means, paired *t* tests for difference of means, F test. **(15 Hours)**

UNIT IV: Chi square tests – Test of goodness of fit, Test of independence of attributes, Association of two attributes – proportion method, Yule's coefficient of Association**.** **(15 Hours)**

UNIT V: Analysis of variance – One way and two way classification, Latin Square Design, Non Parametric tests - Sign test, Mann-Whitney U test, Kruskal-Wallis test. **(15 Hours)**

RECOMMENDED TEXTBOOKS:

1. Statistical Methods – S.P. Gupta, Sultan Chand & Sons (2012)
2. Statistics (Theory, Methods & Application) – D.C. Sancheti & V.K. Kapoor

REFERENCE BOOKS:

1. S.C. Gupta and V.K. Kapoor, Elements of Mathematical Statistics (Third Edition), 2014, Sultan Chand & Son Publications
2. P.R. Vittal, Mathematical Statistics, (2015), Margham Publications.
3. Fundamentals of Mathematical Statistics, S C Gupta and V K Kapoor, SultanChand and Sons(2014).
4. Basic Statistics, B L Agarwal, New Age International Private Limited; 6th Edition (1 January 2013).
5. Schaum's Outlines Statistics, Murray R Spiegel and Larry J Stephens, McGrawHill Education; 4 edition (1 July 2017)

JOURNALS:

1. The Mathematics Intelligencer.
2. Mathematics News Letter
3. Journal of Mathematics and Statistics, Science Publications.
4. International Journal of Mathematics and Statistics™

E-LEARNING RESOURCES:

1. https://en.wikipedia.org/wiki/Mann%E2%80%93Whitney_U_test
2. http://onlinestatbook.com/2/sampling_distributions/samplingdist_diff_means.html
3. https://www.coursera.org/lecture/six-sigma-define-measure-advanced/t- distribution-distribution-MdOjL
4. https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square- one/8-chi-squared-tests
5. https://www.analyticsvidhya.com/blog/2018/01/anova-analysis-of-variance

COURSE OUTCOMES:

Upon successful completion of **Statistical Tools for Business Management - II**,students will be able to:

CO Number	CO STATEMENT
CO 1	To analyze the sample for determining the population characteristics.
CO 2	To apply the tests of significance for the samples whose size is large.
CO 3	To apply the tests of significance for the samples whose size is small.
CO 4	To apply suitable methods for finding the association between the variable and to test the goodness of the distribution fitted to the given data.
CO 5	To apply the techniques of ANOVA to test the difference of means of three or more samples and to apply suitable methods for nonparametric tests.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	2	1	2
CO2	3	2	3	1	2
CO3	3	2	3	2	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2
AVERAGE	3	2	2.8	2	2

KEY: **S**TRONGLY CORRELATED-3 **M**ODERATELY CORRELATED-2
WEAKLYCORRELATED-1 **N**O CORRELATION-0

TEACHING METHODOLOGY:

Lecture (Chalk and Talk-OHP-LCD)
Problem Solving-Group Discussion
Quiz-Seminar

QUESTION PAPER PATTERN

Template – End Semester Examination

Knowledge level	Section	Nature of the question	Maximum Marks	
K_4, K_5	A	Analysis, Evaluation, Description/Problems- At least one question from every Unit	5 (out of 8) x 8	40
K_4, K_5	B	Application/ Analysis/ Synthesis/ Evaluation – One question from every Unit	3 (out of 5) x 20	60
			Total	**100**

Template –Continuous Assessment

Knowledge level	Section	Nature of the question	Maximum Marks	
K_4, K_5	A	Analysis, Evaluation, Description/Problems- At least two question from every Unit	5 (out of 8) x 6	30
K_4, K_5	B	Application/ Analysis/ Synthesis/ Evaluation – At least one question from every Unit	2 (out of 3) x 10	20
Total				**50**

UG - Non Major Elective - Course Profile

Semester III & IV

(Offered to Other Departments)

SEMESTER III

NON-MAJOR ELECTIVE

OFFICE AUTOMATION

TEACHING HOURS: 30 Hours **COURSE CODE: MA21 / 3N / OAN**
CREDITS: 2 **L T P: 1 0 1**

COURSE OBJECTIVES:

To enable students to

1. Understand the basic concepts like creating and formatting a word document.
2. Represent the data – diagrammatically and graphically and to use basic functionsand formula in excel sheet.
3. Prepare the Power point presentation.

COURSE OUTLINE:

UNIT I: MS WORD 2010

Introduction – Creating a New Document – Opening a Document – Save a new Document – Save a document as a different file type – Closing a Document – Inserting Symbols and Special Characters – Insert an equation – Formatting Characters – Formatting Paragraphs – Creating bulleted and numbered lists – Adding borders and shading – Applying styles – Inserting Tables – Selecting table parts – Adding borders and shading – Aligning table text - Inserting rows and columns – resizing rows and columns – Merging and splitting cells – Sorting table data – Deleting rows and columns – Deleting tables – Mail merge/ creating customized merge documents.

(10 Hours)

UNIT II: MS EXCEL 2010

Introduction – Starting Excel 2010 – Creating Excel worksheet – Entering and Editing Cell entries – Working with numbers – Inserting and deleting of cells , rows and columns – Moving, Copying, Inserting and Deleting Worksheet – Formatting a Worksheet – Working and entering a formula – Creating Charts.

(10 Hours)

UNIT III: MS POWERPOINT 2010

Creating Powerpoint presentation – Building presentation – Modifying Visual elements – Adding Objects – Applying Transitions – Animation effects.

(10 Hours)

BOOKS RECOMMENDED:

Dr. P. Rizwan Ahmed. "*Office Automation 2010*", Margham Publication 2016.

REFERENCE BOOKS:

1. Stephen, L. Nelson, "Office 2000 Complete Reference", Tata McGraw Hill Publishing Company Ltd.
2. Sumner Mary – "Enterprise Resource Planning", Pearson Education, inc. Edition2012.

E-LEARNING RESOURCES:

1. https://wwwlivewireindia.com/microsoftoffice_automation_software_training.php
2. **https://www.udemy.com**

COURSE OUTCOME:

Upon successful completion of NME- Office Automation, students will be able to:

CO NUMBER	CO STATEMENT
CO 1	To open a word document, formatting a document and creating a table.
CO 2	To open an Excel worksheet, input data and manipulate data in Excel and represent data using bar diagrams and pie diagram in excel spreadsheet.
CO 3	Be equipped with the knowledge of creating a PowerPoint Presentation with transition, sound effects and also with a animation pictures.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFIC OUTCOME

CO /PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	-	-	-	-	3	2
CO 2	-	-	-	-	3	2
CO 3	-	-	-	-	3	2
AVERAGE	**-**	**-**	**-**	**-**	**3**	**2**

TEACHING METHODOLOGY:

1. LCD - OHP
2. Problem Solving - Group Discussion
3. Peer Learning

QUESTION PAPER PATTERN: UG

5/6 questions carrying 10 marks each (Practical)

SEMESTER IV

NON-MAJOR ELECTIVE

STATISTICS USING 'R' SOFTWARE

TEACHING HOURS: 30 Hours **COURSE CODE: MA21/4N/SUR**

CREDITS: 2 **L T P: 1 0 1**

COURSE OBJECTIVES:

To enable students to

1. Be equipped with the knowledge of R- Programming.
2. Represent the data – diagrammatically and graphically by using R – Programming.
3. Apply the R coding to compute statistical measures.

COURSE OUTLINE:

UNIT I: INTRODUCTION TO 'R'

R as a Calculator – R Preliminaries – Methods of Data Input– Data Accessing – Some useful Built-in functions – Graphics with R. **(10 Hours)**

UNIT II: DIAGRAMMATIC REPRESENTATION

Diagrammatic representation of data - Bar Diagram – subdivided and multiple Bar diagram– Pie chart– Graphical representation of data – Stem and Leaf plot – Graphical Representation of frequency Distribution – Rod or Spike graph– Histogram – frequency polygon– Less than and more than Ogives.

(10 Hours)

UNIT III: MEASURES OF CENTRAL TENDENCY

Mean – Median – Mode – Standard Deviation – Variance (Raw , Discrete and Continuous data) – Quartile – Percentiles **(10 Hours)**

BOOKS RECOMMENDED:

Sudha G. Purohit, Sharad D. Gore and Shailaja R. Deshmukh, Statistics using R Second edition (2015) ,Narosa Publishing House,New Delhi.

REFERENCE BOOKS:

1. P.R. Vittal, Mathematical Statistics, Margham Publications
2. S.P. Gupta Statistical methods, Sultan Chand & Sons publications.
3. Narasimhan, Veeraraghavan, Ramachandran, Ramana, K. C. S Desikan and Co., Business Mathematics and Business Statistics.

JOURNALS:

1. Journal of Statistical Software.
2. The R Journal.

E-LEARNING RESOURCES:

1. https://nptel.ac.in/courses/111/104/111104120/
2. https://onlinecourses.nptel.ac.in/noc21_ma37/preview
3. https://www.coursera.org/learn/r-programming
4. https://www.mooc-list.com/tags/r-software
5. https://sites.google.com/a/tamu.edu/dlcarlson/home/r-project-for-statistical-computing/r-resources-on-the-web

COURSE OUTCOME:

Upon successful completion of NME- Statistics Using R Software, students will be able :

CO NUMBER	CO STATEMENT
CO 1	To get the basic knowledge of R Software
CO 2	To know the diagrammatic and graphic representation of data using R software.
CO 3	To compute the mean, median, mode and standard deviation and variance of data using R Software.

MAPPING-COURSE OUTCOME WITH PROGRAMME SPECIFICOUTCOME

CO /PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	-	-	-	-	3	2
CO 2	-	-	-	-	3	2
CO 3	-	-	-	-	3	2
AVERAGE	**-**	**-**	**-**	**-**	**3**	**2**

TEACHING METHODOLOGY:

1. LCD- OHP
2. Problem Solving - Group Discussion
3. Peer Learning

QUESTION PAPER PATTERN: UG

5/6 questions carrying 10 marks each (Practical)

Self Study Papers

Semester V

SEMESTER V

SELF STUDY PAPER

ASTRONOMY

CREDITS: 2 **COURSE CODE : MA21/5SS/ASY**

COURSE OBJECTIVE:

1. To introduce the students to Space science.
2. To familiarize the student with the important features of the planets, sun, moon and stellar universe.

COURSE OUTLINE:

UNIT I: Celestial sphere-Celestial co-ordinates, sidereal times – Simple Problems.
Chapter:II Section: 39- 78.

UNIT 2: The Earth-The Zones of earth-Terrestrial Latitudes and Longitudes-Radius of earth-Rotation of Earth - Simple problems.
Chapter:III Section : 87-101, 103-105.

UNIT 3: Kepler's laws –equation of time – seasons – calendar – conversion of time.
Chapter:VI Section 146-157
Chapter:VII Section 166-170, 173-184.

UNIT 4: Moon - Eclipses
Chapter:XII Section 229-245, 250-255
Chapter:XIII Section 256-266.

UNIT 5: The Solar system .
Chapter:XVII Section 327- 339.

RECOMMENDED TEXT*:*

S. Kumaravelu and Susheela Kumaravelu. Astronomy. SKV Publishers,Nagarkoil,2004

REFERENCE BOOKS:

1. Astronomy,A Beginner's Guide to the Universe, Eric Chaisson Steve Mcmillan , Pearson Education , Seventh Edition 2017.
2. Astronomy, Andrew Fraknoi, David Morrison, Sidney C.Wolff, Rice University,2017

JOURNALS:

1. Mathematics Newsletter Published by Ramanujan Mathematical Society
2. International journal on research in Astronomy and Astrophysics.

E-LEARNING RESOURCES:

1. http://www.sciencedaily.com/news/space_time/astronomy/
2. http://www.universetoday.com/
3. http://www.livescience.com/space/

Question Paper Pattern – End Semester Examination

Knowledge Level	Component	Nature of the question	Maximum marks
K1 **K2** **K3**	Section –A	Understanding Description/Problems Minimum Two Questions from every Unit	**10 (out of 12) x 5 = 50**

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application

SEMESTER V

FUNDAMENTALS OF FUZZY SET THEORY

SELF STUDY PAPER

CREDITS: 2 **COURSE CODE : MA21/5SS/FST**

COURSE OBJECTIVES:

The student will be able to

1. Understand the fundamentals of fuzzy sets.
2. Explore the application of uncertainty through fuzzy mathematics.
3. Apply fuzzy concept to physical and social science problems.
4. Get knowledge about fuzzy numbers.
5. Know how to implement arithmetic operations on intervals.

COURSE OUTLINE:

UNIT I: Introduction

Crisp sets, Basic types of fuzzy sets.
Chapter 1: Sections 1.1, 1.2, 1.3

UNIT II: Fuzzy Sets

Basic Concepts of fuzzy sets.
Chapter 1: Section 1.4

UNIT III: Fuzzy sets verses Crisp sets

Additional Properties of α- cuts, Representations of fuzzy sets.
Chapter 2: Sections 2.1, 2.2

UNIT IV: Fuzzy Arithmetic

Fuzzy Numbers, Linguistic Variables
Chapter 4 : Sections 4.1 , 4.2

UNIT V: Fuzzy Arithmetic (Continuation)

Arithmetic Operations on Intervals, Arithmetic Operations on Fuzzy Numbers
Chapter 4 : Sections 4.3 , 4.4

BOOKS RECOMMENDED:

George J.Klir and Bo Yuan, Fuzzy sets and Fuzzy logic , Theory and Applications, Pearson India Education services Pvt., Ltd., 2016.

REFERENCE BOOKS:

1. Introduction to Fuzzy arithmetic theory and Applications by Arnold Kaufmann and Madan M.Gupta,1985.

2. Fuzzy Set Theory – and its Applications, 4th edition, by H.J. Zimmermann, 2006.
3. Introduction to Fuzzy Logic by Rajjan Shinghal, PHI Publisher, 2013.
4. Fuzzy Sets and Fuzzy Logic with Engineering Applications, 4th edition by Timothy J. Ross, Wiley India Pvt. Ltd., 2011.
5. Fuzzy Set Theory, Fuzzy Logic and their Applications by Dr. A.K. Bhargava, S.Chand Publishing, 2013.

JOURNALS:

1. International Journal of Fuzzy Logic Systems (IJFLS) – Wireilla.
2. Journal of Intelligent & Fuzzy Systems - IOS Press.
3. The Mathematics Intelligencer.
4. Mathematics News letter.

WEBSITES AND e-LEARNING SOURCES:

1. http://mathforum.org,
2. https://cours.etsmtl.ca/sys843/REFS/Books/ZimmermannFuzzySetTheory2001.pdf
3. http://OCW.mit.edu/ocwweb/Mathematics
4. http://www.iaeng.org/IJCS/issues_v39/issue_1/IJCS_39_1_07.pdf
5. https://sci2s.ugr.es/fss

Question Paper Pattern – End Semester Examination

Knowledge level	Component	Nature of the question	Maximum marks
K1 **K2** **K3**	Section –A	Understanding Description/Problems Minimum Two questions from every Unit	**10(out of 12) x 5 = 50**

All question papers can be framed in the following cognitive levels

Knowledge Level 1. Recall

Knowledge Level 2. Understanding

Knowledge Level 3. Application