Syllabus (Regulations 2020)

Master of Science in

MATHEMATICS

For students admitted from academic year 2021-22 onwards

Under Choice Based Credit System

BOARD OF STUDIES - NOVEMBER 2021

SRR & CVR GOVT. DEGREE COLLEGE (A)

(NAAC Accredited B^{+} Grade (III cycle with CGPA 2.60) Institution & District Identified College)

Vijayawada- 520 004, Andhra Pradesh, INDIA

SRR & CVR Government Degree College (A)

An Autonomous & ISO 9001: 2015 Certified Institution:: Ranked by NIRF in 101-150 band at NIRF-2020 & 151-200 band in NIRF 2019
NAAC accredited Institution with grade B+ with C.G.P.A 2.6 during March, 2017

Machavaram, Vijayawada, Krishna District, AP-520 004

Department of Mathematics

(Academic Year: 2021-22)

Report on 2nd Board of Studies Meeting for M. Sc. Mathematics Program

The **2nd** Board of Studies Meeting of M. Sc. Mathematics Program (**Code:1603**) Was held on **30 - 11 – 2021** at 03.00 p.m. at Department of Mathematics, SRR & CVR Govt. Degree College (Autonomous), Vijayawada, through online mode for the academic year 2021 – 2022.The composition of the BoS of M. Sc. Mathematics as per UGC Guidelines is as given below.

Name of the person	Designation in BoS	Remarks
Dr. Mohammad Mastan	Chairman	Nominated with the Proceedings from the Principal vide Rc. No. PG - A/4/BoS/2020-21 Dated:25/12/2020
Dr. K. Jayalakshmi	University Nominee	Nominated with the Proceedings of the Vice Chancellor, Krishna University, MTM. vide KRU/Affil/SRR & CVR GDC (A), VJA / BoS / 2020- 2012 Dated: 08 / 01 / 2021
Dr. B. Satyanarayana	Subject Expert	Nominated with the Proceedings from the Principal vide RC. No: .
Prof. K. Moses	Subject Expert	Nominated with the Proceedings from the Principal vide RC. No: .
Smt. K.V. Nagalakshmi	Member	As per UGC guidelines
Sri. M. Lakshmanadasu	Member	As per UGC guidelines
Dr. G. Lalitha	Member	As per UGC guidelines
Dr. K. Rajinikanth	Member	As per UGC guidelines
Dr. Shaik Sajana	Member	As per UGC guidelines
Smt. Shaik Parveen	Member	As per UGC guidelines
Ms. MVL. Sirisha	Member	As per UGC guidelines
Dr.K.V.Rama Rao	Alumni	Nominated with the Proceedings from the Principal vide RC. No:

Counter signed by:

30.11.2021

Principal.

PRINCIPAL
SRR & CVR GOVT. DEGREE COLLEGE
(Autonomus)
Machavaram, VIJAYAWADA - 520 004

The Autonomous status of M.Sc. Mathematics has been approved by Krishna University, Machilipatnam. The proceedings are mentioned below.

1. Krishna University, Machilipatnam - Affiliation No. KRU/SRR & CVR Govt. Degree College (A), VJA / Affiliation order 2020-21, dated. 08/01/2021.
2. Nomination of Chairman for BOS for P.G. Courses for the Academic Year 2020-21. R.C.No.PG-A/4/BOS/2020-21 dated 25-12-2020.
3. Nomination of University representatives to BOS for a period of 3 years Order No: KRU / Affil / SRR & CVR Govt. Degree College (A), VJA / BOS / 2020-21 dated 08-01-2021.

AGENDA

1. To consider and approve the program structure of M.Sc. Mathematics (Course Code: 1603) for the admitted batch 2021 – 2022.
2. To consider and approve the course syllabus for the papers introduced in **I , II, III & IV – Semesters** of M.Sc. Mathematics under CBCS with **L**earning **O**utcomes based **C**urriculum **F**ramework (**LOCF**) for the academic year 2021 onwards.
3. To consider and approve Student Evaluation Policy & Procedure and split up of **CIA** & **SEE.**
4. Preparing model question papers for **I, II, III & IV – Semesters.**
5. Identifying the question paper setters and examiners.
6. To approve other academic activities of the department.
7. To consider and approve Executive Development Programs offered by the department.
8. To consider and approve the student-centered Pedagogy Policy to enrich the curriculum.
9. To give permission to the Chairman for any small changes.

The Chairperson & faculty of the department welcomed the members and had discussion on the Agenda. He apprised members of Krishna University and Acharya Nagarjuna University regarding framing of Curriculum, Syllabus and proposed evaluation ratio for Internal and External Examinations. The following members were present.

Members attended the BoS Meeting

Name & Designation	Designation in BoS	Signature
Dr. Mohammad Mastan Lecturer in Mathematics	Chairman	
Dr. K. Jaya Lakshmi Associate Professor, Head, Dept. of Mathematics Krishna University, Machilipatnam.	University Nominee	
Dr. B. Satyanarayana Associate Professor, Chairman PG BoS & Head Department of Mathematics, Acharya Nagarjuna University	Subject Expert	
Prof. K. Moses Associate Principal, Department of Mathematics, Andhra Christian College, Guntur.	Subject Expert	
Smt. K.V. Nagalakshmi, In-Charge, Department of Mathematics	Member	
Sri. M. Lakshmanadasu Lecturer in Mathematics	Member	
Dr. G. Lalitha Lecturer in Mathematics (Addnl. Controller of Examinations)	Member	
Dr. K. Rajinikanth Lecturer in Mathematics	Member	
Dr. Shaik Sajana Lecturer in Mathematics	Member	
Smt. Shaik Parveen Lecturer in Mathematics	Member	
Ms. M.V.L. Sirisha Lecturer in Mathematics	Member	M.V.L. Sirisha.
Dr.K.V.Rama Rao	Alumni	K. V. Rama Rao

Resolutions:

In BOS meeting, the committee has unanimously resolved and approved the following items.

1. To implement the program structure of M. Sc. Mathematics (Program Code: 1603) with effect from the academic year 2021 – 2022.

2. To implement M. Sc. Mathematics Syllabus (Program Code : 1603) for the courses of **Semesters - I, II for 2021-2023 batch & Semesters - III & IV for 2020-2022 batch** under **C**BCS with **L**earning **O**utcomes based **C**urriculum **F**ramework **(LOCF)**.

3. To approve the Student Evaluation Policy and Procedure and split-up (40:60) of **CIA** & **SEE.**

4. To implement **Internal - 40 Marks** and **External - 60 Marks** out of **100 Marks** for each Theory Paper and for each Practical Paper. To pass the examination, candidate has to obtain **40 % in Internal Exam**, and **40 % in External Exam** in each paper and overall **aggregate 50% marks**.

5. To adopt the Students Centered Pedagogy Policy to enrich the curriculum.

6. To approve the list of Question paper setters and Examiners.

7. To approve the Departmental Activities Calendar.

8. To implement the pattern of model question paper enclosed here with.

9. To follow the recommended syllabus and evaluation procedure for the next **Two years.**

10. Committee approved the panel of External Examiners in Theory and Practicals for the **I, II, III & IV** - Semesters (list enclosed).

11. The Chairman has empowered to do any small changes.

12. The Controller of Examinations is empowered to do any changes in selecting paper setter, in case of non- availability of examiners in the approved list.

1. 2. 3. 6

The committee recommended the following subject papers with titles for theory and practicals in M.Sc. Mathematics with effect from 2021-2022 admitted batches.

Semester – I

S. No.	Paper No.	Title of the paper
1.	Paper-I	Real Analysis-I
2.	Paper-II	Ordinary Differential Equations
3.	Paper-III	C- Programming
4.	Paper-IV	Algebra
5.	Paper-V	Problems Solving Lab
6.	Paper-VI	C-Programming Lab

Semester – II

S. No.	Paper No.	Title of the paper
1.	Paper-I	Complex Analysis
2.	Paper-II	Numerical Methods – I
3.	Paper-III	Partial Differential Equations
4.	Paper-IV	Lattice Theory
5.	Paper-V	Graph Theory
6	Paper – VI	Real Aanlysis – II
7.	Paper-VII	Open Elective- I
8.	Paper-VIII	Numerical Methods Lab

Semester – III

S. No.	Paper No.	Title of the paper
1.	Paper-I	Topology
2.	Paper-II	Probability and Statistics
3.	Paper-III	Galois Theory
4.	Paper-IV	Mathematical Methods
5.	Paper-V	Analytical Number Theory
6.	Paper –VI	Open Elective- II
7.	Paper –VII	Python Interpreter Practice Lab

1.

Semester – IV

S. No.	Paper No.	Title of the paper
1.	Paper - I	MOOCS
2.	Paper - II	Elective – I
3.	Paper - III	Elective – II
4.	Paper - IV	Functional Analysis
5.	Paper - V	Measure and Integration
6.	Paper - VI	Seminar

Elective – I	Elective – II
20 ET MAT 402A: Mathematical Modelling	20 ET MAT 403A: Algebraic Coding Theory
20 ET MAT 402 B: **Integral Transforms**	20 ET MAT 403 B:**Linear Programming**
20 ET MAT 402C: Lebesgue Theory	20 ET MAT 403C: Discrete Mathematical Structures
20 ET MAT 402E: Any other relevant subject approved by BOS	20 ET MAT 403E: Any other relevant subject approved by BOS

SEMINAR

The student will be given seminar topics at the beginning of the IV semester by faculty In-charge and the student has to present the topics, submit the hard copy of seminar topic report at the end of the IV semester. Out of a total of **100** marks, for the Seminar Evaluation, **50** marks shall be for Seminar report/record and **50** marks for the End Semester Examination (Viva - Voce). The Viva - Voce shall be conducted by a committee consisting of HOD, faculty in charge and a senior faculty member/external examiner nominated by the university.

Open Elective - I & II:

Open Elective - I & II are offered by other departments. The student (Min. 50% Students) may opt from the list of Open Electives approved by the University.

Open Elective - I offered by the Department:

Course Code	Name of the course
20 OE MAT206	MATRIX THEORY

Open Elective - II offered by the Department:

Course Code	Name of the course
20 OE MAT306	NUMERICAL METHODS – II

1.

Program Structure of M. Sc. Mathematics: 1603

1	**Title of the course**	M. Sc. (Mathematics)
2	**Duration of the course**	2 years (Four Semesters)
3	**Eligibility criteria for admission**	Any candidate who passed B.Sc. or B.A. with Mathematics as one of the Three equal subjects or as main or ancillary subject.
4	**Level of the course**	Post – Graduation
5	**Mode of admission**	The mode of admission is through **AP PG CET** conducted by Krishna University.
6	**Objectives of the course**	The Objective of M.Sc. Mathematics course is to impart knowledge and skill - oriented training in the recent advancements in Mathematics with an aim to develop research and innovations.
7	**Course requirement**	The course shall include Theory papers, Labs, Assignments, Tests, Seminars and Project Work.
8	**Number of working days**	In each semester at least ninety working days must be dedicated for theory classes, practical classes and seminars.

PROGRAM STRUCTURE:: SEMESTER – I

Course code	Name of the Subject	Hours		Credits	
		Lecture	Practical	Theory	Practical
20 MAT 101	Real Analysis - I	4	-	4	-
20 MAT 102	Ordinary Differential Equations	4	-	4	-
20 MAT 103	C-Programming	4	-	4	-
20 MAT 104	Algebra	4	-	4	-
20 L MAT 105	Problems Solving Lab	--	6	-	3
20 L MAT 106	C – Programming – Lab	--	6	-	3
	Sub Total	16	12	16	6
	Total	28 Hours per week		22 Credits per semester	

PROGRAM STRUCTURE :: SEMESTER - II

Course code	Name of the Subject	Hours		Credits	
		Lecture	Practical	Theory	Practical
20 MAT 201	Complex Analysis	4	-	4	-
20 MAT 202	Numerical Methods	4	-	4	-
20 MAT 203	Partial Differential Equations	4	-	4	-
20 MAT 204	Lattice Theory	4	-	4	-
20 MAT 205	Graph Theory	4	-	4	-
20MAT 206	Real Analysis II	4	-	4	
20 OE MAT 207	Open Elective-I	4	-	4	-
20 L MAT 208	Numerical Methods LAB	-	6	-	3
	Sub Total	28	6	28	3
	Total	34 Hours per week		31 Credits per semester	

PROGRAM STRUCTURE:: SEMESTER – III

Course code	Name of the Subject	Hours		Credits	
		Lecture	Practical	Theory	Practical
20 MAT 301	Topology	4	-	4	-
20 MAT 302	Probability and Statistics	4	-	4	-
20 MAT 303	Galois Theory	4	-	4	-
20 MAT 304	Mathematical Methods	4	-	4	-
20 MAT 305	Analytical Number Theory	4	-	4	-
20 OE MAT 306	Open Elective – II	4	-	4	0
20 L MAT 307	Python Interpreter Practice Lab	-	3	-	0
	Sub Total	24	03	24	00
	Total	27 Hours per week		24 Credits per semester	

PROGRAM STRUCTURE:: SEMESTER – IV

Course code	Name of the Subject	Hours		Credits	
		Lecture	Practical	Theory	Practical
20 MO MAT 401	MOOCS	4	-	4	-
20 ET MAT 402	Elective – I	4	-	4	-
20 ET MAT 403	Elective – II	4	-	4	-
20 MAT 404	Functional Analysis	4	-	4	-
20 MAT 405	Measure and Integration	4	-	4	-
20 SM MAT 406	Seminar	6	-	3	-
	Sub Total	26	-	23	-
	Total	26 Hours per week		23 Credits per semester	

Electives, Open Electives & MOOCS offered by the Department

Course Code	Name of the course	Semester	Hours	Credits
20 OE MAT 207	**Open Elective – I**	**II**	**4**	**4**
20 OE MAT 306	**Open Elective –II**	**III**	**4**	**4**
20 MO MAT 401	**MOOCS**	**IV**	**4**	**4**
20 ET MAT 402 B	**Elective – I**	**IV**	**4**	**4**
20 ET MAT 403 B	**Elective – II**	**IV**	**4**	**4**
20 SM MAT 406	**SEMINAR**	**IV**	**6**	**3**

Theory Internal Assessment:

(i)	Internal Exams (Two)	-	10 Marks
(ii)	Assignments (Two)	-	10 Marks
(iii)	Project	-	10 Marks
(iv)	Attendance	-	05 Marks
(v)	Seminar	-	05 Marks
	Total	**=**	**40 Marks**

Theory External Assessment:

Syllabus divided into **5** Units, equal weightage to all Units. Theory Paper consists of Two Sections namely Section – **A** & Section – **B.**

Section – A: Candidate has to answer **Any 5 Questions out of 10 Questions.**
5Q x 2Marks = 10 Marks

Section – B: Candidate has to answer **All 5 Questions out of 5 Questions**, each Question having Internal Choice.
5Q x 10Marks = 50 Marks

Practical:

Continuous assessment / Day to day work	Semester end exam	Total
40 marks	**60 Marks**	**100 Marks**

Internal Practical Assessment:

(i)	Internal Exams (Two)	-	20 Marks
(ii)	Assignments (Two)	-	10 Marks
(iii)	Seminar	-	05 Marks
(iv)	Attendance	-	05 Marks
	Total	=	**40 Marks**

External Practical Assessment:

(i) Record : **10** Marks

(ii) Student has to answer **4** Questions out of **8** Questions, (Two Questions will be given from each theory paper). Question Paper will be set from the **16** Practical problems done by the student in the Record.

4Q x 10 M = **40** Marks

(iii) Viva-Voce Examination: **10** Marks

Total Marks = **60** Marks.

S. No.	SEMESTER – I	MARKS
1.	**Four Theory Papers (**4 x 100M)	**400**
2.	**Problem Solving Lab**	**100**
3.	**C – Programing Lab**	**100**
	Total	**600**

S. No.	SEMESTER – II	MARKS
1.	**Five Theory Papers (**6 x 100M)	**600**
2.	**Numerical Methods Lab**	**100**
	Total	**700**

S. No.	SEMESTER – III	MARKS
1.	**Five Theory Papers (**5 x 100M)	**500**
2.	**PYTHON LAB**	**100**
	Total	**600**

S. No.	SEMESTER – IV	MARKS
1.	**Five Theory Papers (**5 x 100M)	**500**
2.	**SEMINAR**	**100**
	Total	**600**

Summary of Program Structure:

Semester – I

S. No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper-I	Real Analysis – I	20 MAT 101	40	60	100
2.	Paper-II	Ordinary Differential Equations	20 MAT 102	40	60	100
3.	Paper-III	Algebra	20 MAT 103	40	60	100
4.	Paper-IV	C-Programming	20 MAT 104	40	60	100
5.	Paper-V	Problems Solving Lab	20 MAT 105	40	60	100
6.	Paper-VI	C-Programming-Lab	20 MAT 106	40	60	100

Semester – II

S. No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper-I	Complex Analysis	20 MAT 201	40	60	100
2.	Paper-II	Numerical Methods	20 MAT 202	40	60	100
3.	Paper-III	Partial Differential Equations	20 MAT 203	40	60	100
4.	Paper-IV	Lattice Theory	20 MAT 204	40	60	100
5.	Paper-V	Graph Theory	20 MAT 205	40	60	100
6	Paper- VI	Real Analysis II	20 MAT 206	40	60	100
7.	Paper-VII	Open Elective –I	20 OE MAT 207	40	60	100
8	PaperVIII	Numerical Methods Lab	20 L MAT 208	40	60	100

Semester – III

S. No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper-I	Topology	20 MAT 301	40	60	100
2.	Paper-II	Probability and Statistics	20 MAT 302	40	60	100
3.	Paper-III	Galois Theory	20 MAT 303	40	60	100
4.	Paper-IV	Mathematical Methods	20 MAT 304	40	60	100
5.	Paper-V	Analytical Number Theory	20 MAT 305	40	60	100
6.	Paper - VI	Open Elective-II	20 OE MAT 306	40	60	100
7.	Paper -VII	Python Interpreter Practice Lab	20 L MAT 307	40	60	100

Semester – IV

S. No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper - I	MOOCS	20 MO MAT 401	40	60	100
2.	Paper - II	Elective – I	20 ET MAT 402 B	40	60	100
3.	Paper - III	Elective – II	20 ET MAT 403 B	40	60	100
4.	Paper - IV	Functional Analysis	20 MAT 404	40	60	100
5.	Paper - V	Measure and Integration	20 MAT 405	40	60	100
6.	Paper - VI	Seminar	20 SM MAT 406	50	50	100

Total Number of Hours, Credits and Marks at the end of the Program:

S. No.	Semester	HOURS	CREDITS	MARKS
1.	**I**	**28**	**22**	**600**
2.	**I I**	**34**	**31**	**700**
3.	**I I I**	**27**	**24**	**600**
4.	**IV**	**26**	**23**	**600**
TOTAL		**115**	**100**	**2500**

SRR & CVR Govt. Degree College (A), Vijayawada
Department of Mathematics
M.Sc. Mathematics

Program Outcomes:

On successful completion of M.Sc. Mathematics Program, students will be able:

PO–1. To interpret the concepts of Analyticity, Cauchy-Riemann relations by solving problems and also discuss about zeros of a complex function and represent complex function in Mobius transformation and power series.

PO-2. To know the usage of theory of Partial Differential Equations, used in formulating many fundamental laws of Physics and Chemistry.

PO-3. To demonstrate knowledge and understanding of numerical methods to solve Systems of linear equations, to compute quadrature and to solve Ordinary and Partial Differential Equations.

PO-4. To solve Mathematical Problems that arise in Science and Engineering, by using Numerical Methods and learn how to apply Numerical Methods for various Mathematical Operations such as Interpolation, Differentiation, and Integration, Solutions of Differential equations, analyzing and evaluating the accuracy of common Numerical Methods.

PO-5. To learn to implement the Algorithms and draw flow charts for solving Mathematical Problems. Also to obtain the complete knowledge of Development User Friendly Software / MATLAB/ Python Lab.

PO-6. To learn the fundamental concept of Algebra and their role in Mathematics and Applied Sciences.

PO-7. Evaluate Complex Integrals and expanding Complex function in PowerSeries.

PO-8. Know the advantages of Residues and the application of Linear Transformation.

Program Specific Outcomes:

On successful completion of M.Sc. Mathematics Program, students will be able:

PSO – 1. To provide systematic understanding of the concepts and theories of Mathematics and their application in the real world - to an advanced level, and enhance career prospects in a huge array of fields.

PSO – 2. Apply knowledge of Mathematics, in all the fields of learning including higher research and its extensions.

PSO –3. Solve complex problems by critical understanding, analysis and synthesis.

PSO –4. Communicate effectively by oral, written, computing and graphical means.

PSO –5. Critically interpret data, write reports and apply the basis of rules of evidence.

PSO –6. Develop proficiency in the analysis of complex Physical problems and the use of Mathematical or other appropriate techniques to solve them.

PSO –7. Demonstrate engagement with reports and apply the basics of rules of evidence.

PSO –8. Innovate, invent and solve complex Mathematical problems using the knowledge of pure and applied Mathematics.

PSO –9. Explain the knowledge of contemporary issues in the field of Mathematics and applied sciences.

PSO–10. Crack Lectureship and fellowship exams approved by UGC like CSIR – NET and SET.

BOS APPROVED THE FOLLOWING LIST OF PAPER SETTERS/EXAMINERS

S. No.	Name	Designation	College/ University
1.	Prof. Shobha Latha	Professor	Sri Krishna Devaraya University, Ananthapur.
2.	Prof. Anuradha Kameswari	Professor	Andhra University, Visakhapatnam.
3.	Prof. K. K. M. Sharma	Professor	Andhra University, Visakhapatnam.
4.	Prof. G. V. R. Babu	Professor	Andhra University, Visakhapatnam.
5.	Dr. Venkata Lakshmi	Associate Professor	Sri Padmavathi Mahila University, Tirupathi.
6.	Dr. J. L. Rama Prasad	Associate Professor	P.B. Siddhartha College of Arts & Science, Vijayawada
7.	Dr. L. Madhavi,	Associate Professor	Yogi Vemana University, Kadapa.
8.	Dr. Nanaji Rao	Associate Professor	Andhra University, Visakhapatnam.
9.	Dr. C. Jayasubba Reddy	Associate Professor	S.V. University, Tirupathi.
10.	Prof. Siva Parvathi	Associate Professor	Sri Padmavathi Mahila University, Tirupathi.
11.	Dr. Ch. Srinivasulu	Lecturer in Mathematics	GDC, Rajamundry.
12.	Dr. U. Bindu Madhavi	Assistant Professor	Dr. MRAR College of PG Studies, Nuzvid.
13	Dr. Bharathi	Professor	S V University, Tirupathi.

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Machavaram, Vijayawada, Krishna District, AP-520 004

Department of Mathematics

Departmental Activities Calendar

Details	Date
Commencement of Class Works for I Semester	27/01/2021
I Internal Examinations	15/03/2021 to 17/03/2021
II Internal Examinations	15/04/2021 to 17/04/2021
Closure of Instruction	15/05/2021
Practical Examinations	17/05/2021 to 22/05/2021
End Semester –I Examinations	26/05/2021 to 05/06/2021
Semester Break	**07/06/2021 to 12/06/2021**
Commencement of Class Works for II Semester	14/06/2021
I Internal Examinations	19/07/2021 to 22/07/2021
II Internal Examinations	26/08/2021 to 28/08/2021
Closure of Instruction	25/09/2021
Practical Examinations	27/09/2021 to 30/09/2021
End Semester –II Examinations	04/10/2021 to 09/10/2021
Semester Break	10/10/2021 to 19/10/2021
Commencement of Class Works for III Semester	20/10/2021
I Internal Examinations	26/11/2021 to 30/11/2021
II Internal Examinations	05/01/2022 to 07/1/2022
Closure of Instruction	25/02/2022
Practical Examinations	28/02/2022 to 04/03/2022
End Semester –III Examinations	07/03/2022 to 11/03/2022
Semester Break	12/03/2022 to 20/03/2022
Commencement of Class Works for IV Semester	21/03/2022
I Internal Examinations	04/05/2022 to 06/05/2022

II Internal Examinations	16/06/2022 to 18/06/2022
Closure of Instruction	23/07/2022
Practical Examinations	26/07/2022 to 30/07/2022
End Semester –IV Examinations	04/08/2022 to 10/18/2022

SRR & CVR GOVT.DEGREE COLLEGE (A), NAAC B^{+}

Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER-I PAPER-I

REAL ANALYSIS-I 20 MAT 101

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40 M & External: 60 M)

Course Learning Objectives:
This Course is intended to expose the ideas of Real Analysis by Learning Continuity, Differentiation, Riemann Integral, Improper Integral of functions.

UNIT-I

Continuity & Differentiation: Limits of functions, continuous functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Derivative of a Real Function, Mean value theorems, The Continuity of Derivatives, L' Hospital's rule, Derivatives of higher Order, Taylor's theorem.
[4.1 to 4.34 of chapter4 & 5.1 to 5.19 of chapter5 of Text Book1]

UNIT-II

The Riemann - Stieltjes Integral: Definition and Existence of Integral-Properties of the integral -Integration and Differentiation –Integration of vector-valued function - Rectifiable Curves.[Chapter-6 of Text Book-1]

UNIT-III

Sequences and series of functions: Discussion of main problem - Uniform convergence – Uniform convergence and continuity – Uniform Convergence and Integration – Uniform Convergence and Differentiation – Equicontinuous Families of functions – The Stone - Weierstrass Theorem. [7.1 to 7.26 of Text Book 1]

UNIT-IV

Improper Integrals: Introduction – Integration of unbounded Functions with Finite limits of Integrations – Comparison Tests for Convergence at "**a**" of Infinite Range of $\int_a^b f \, dx$ Integration – Integrand as a Product of Functions.
[Chapter-11 of Text Book-2]

UNIT-V

Functions of several variables: Explicit and Implicit Functions - Continuity - Partial Derivatives – Differentiability – Partial Derivatives of Higher Order - Functions of Functions – Change of variables – Taylor's Theorem – Extreme Values - Maxima and Minima – Functions of Several Variables. [Chapter-15 of Text Book-2]

Course Learning Outcome(s):

This Course able to helps the student how to apply the concepts of Real Analysis and understand the Improper Integrals concept and to construct the Mathematical proofs of basic Results in Real Analysis.

Prescribed Text books:

1. **Principles of Mathematical Analysis**, Walter Rudin, Student Edition 1976 Mc Graw - Hill International.
2. **Mathematical Analysis** by S.C. Malik and Savita Aurora, Fourth edition, New Age International Publishers.

Reference Book:

1. **Mathematical Analysis** by Tom. M. Apostol, second Edition, Addison Wesley Publishing Company.

S.R.R & C.V.R GOVT DEGREE COLLEGE (A), VJA

M.Sc. MATHEMATICS

SEMESTER – I PAPER - I

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

REAL ANALYSIS-I 20 MAT 101

Time: 3 Hours Max. Marks: 60 M

I. Answer any 5 questions out of 10 short answer questions **5X4 =20M**

1. Define $f(x) = \text{Sin}\left(\frac{1}{x}\right)$, $x \neq 0$

$= \quad 0 \quad , \; x = 0$

Discuss the continuity of this function on **R**.

2.Let **f** be a differentiable function on **(a, b)** Then prove that '**f** ' is continuous on **(a, b).**

3.If '**f** is continuous on **[a, b]** then show that **f** ∈ **R(*α*)** on **[a, b].**

4.State Fundamental theorem of Calculus.

5.Define Uniform convergence.

6.Discuss the uniform convergence of the series $\sum_{n=1}^{\infty} \frac{1}{1+n^2 x}$.

7.Define Beta function.

8. Examine the convergence of $\int_0^1 \frac{dx}{\sqrt{1-x}}$.

9. Define Explicit and Implicit functions.

10. Define Maxima and Minima value of extreme values.

II. Answer any 5 questions out of the 10 internal choice essay questions **5X8=40M**

UNIT-I

11. If **f** is a continuous mapping of a compact metric space **X** into a metric space **Y**, then show that **f** is uniformly continuous on **X.**

(OR)

12. State and Prove Taylor's theorem.

UNIT-II

13. If f is monotonic on **[a, b]** and if **α** is continuous on **[a, b]** then show that **f** ∈ **R(*α*)** (Assume that **α** is monotonic).

(OR)

14. If $\boldsymbol{\gamma^1}$ is continuous on **[a, b]** then show that $\boldsymbol{'\gamma'}$ is rectifiable and $\wedge(\gamma) = \int_a^b \left|\gamma^1(t)\right| dt$

UNIT-III

15. If **$\{f_n\}$** is sequence of continuous functions on **E** and if **f_n -> f** uniformly on **E**, then show that **f** is continuous on **E**

(OR)

16. State and prove Stone – Weierstrass theorem.

UNIT – IV

17. State and prove Abel's test.

(OR)

18. Show that $\int_0^\infty \frac{sinx}{x}\ dx$ is convergent but not absolutely.

UNIT – V

19. State and prove Taylor's theorem.

(OR)

20. Show that **$f(x,y,z)= (x + y + z)^3 - 3(x + y + z) - 24xyz+a^3$** has a Minima at (1,1,1) and Has a Maxima at (-1, -1, -1)

SRR & CVR GOVT.DEGREE COLLEGE (A), NAAC B^{+}

Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER-I PAPER-II

ORDINARY DIFFERENTIAL EQUATIONS-20 MAT 102

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40 M & External: 60 M)

Course Learning Objectives:

The goal of this course is to provide the students with an understanding of the solutions of first order and second order linear ordinary differential equations and applications of ordinary differential equations.

UNIT-I:

Linear Equation of the first order: Linear equations of the first order, The equation **y' + ay = 0**, The equation **y' + ay = b(x)**, The general equations of the first order. Linear Equations with constant coefficients: The homogeneous equation of order **n**, Initial value problems for **nth** order equations.

[Chapter 1 of Text Book(1) and Section 7, 8 of Chapter 2 of Text book.(1)]

UNIT-II:

Linear Equations with Constant Coefficients: The non - homogeneous equation of order **n**, A special method for solving the non-homogeneous equation. Linear equations with variable coefficients: Initial value problems for the homogeneous equations, Solution of the homogeneous equations, The Wronskian and linear independence.

[Sections 10, 11 of Chapter 2 and Sections 1,2,3,4 of Chapter 3 of Text book (1)]

UNIT-III:

Solutions of Differential Equations in Power series: Preliminaries – Second order Linear Equations with Ordinary points – Legendre equations with Legendre Polynomials – Second Order equations with regular singular points – Properties of Bessel functions.

[Topics from Chapter 3 of Text Book (2)]

UNIT-IV:

Systems of Linear Differential Equations: Preliminaries - Systems of first order equations - Model of arms competitions between two nations - Existence and uniqueness theorem - Fundamental Matrix - Non homogeneous linear systems - Linear systems with constant coefficients. [Topics from Chapter 4 of Text Book (2)]

UNIT-V:

Existence and Uniqueness of solutions: Preliminaries – Successive approximations – Picard's theorem

[Chapter 5.1 to 5.4 of Text Book (2)]

Course Learning Outcome(s):

From this course students will be able to learn the study of differential focuses on the existence and uniqueness of solutions and the theory of differential equations is widely used in formulating many fundamental laws of physics and chemistry.

Text Book:

1. An introduction to Ordinary Differential Equations by E.A. Codington
2. S.G. Deo, V. Lakshmi kantham and V. Raghavendra: Text Book of Ordinary Differential Equations, second edition, Tata McGraw – Hill Publishing company Limited, New Delhi, 1997.

Reference Books:

1. Differential Equations with applications and Historical notes by George F. Simmons.
2. Theory of Ordinary Differential Equations by Samsundaram – Narosa Publications.

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M.Sc. MATHEMATICS

SEMESTER – I PAPER - II

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

ORDINARY DIFFERENTIAL EQUATIONS - 20 MAT 102

Time: 3 Hours Max Marks: 60M

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I. Answer any 5 questions out of 10 short answer questions 5X4=20M

1. Solve $y' - 2y = 1$
2. Solve $y' + e^x y = 3e^x$
3. Write Characteristic polynomials of e^{ax}, $\sin ax$, $x^k \cos ax$, $x^k e^{ax}$.
4. Define homogeneous and non-homogeneous equations with example.
5. Express $f(t) = 1 + t + t^2$ in terms of Legendre series.
6. Show that $P_n(1) = 1$ and $P_n(-1) = (-1)^n$.
7. Define fundamental matrix of the system of Linear Differential Equations.
8. State Existence of Uniqueness theorem.
9. Define Contraction Principle.
10. Compute first two successive approximations of the equation $x' = e^x$.

II. Answer any 5 questions out of 10 internal choice essay questions 5X8=40M

UNIT-I

11. State and prove Existence theorem.

(OR)

12. Consider the equation $y''' - 4y' = 0$. Compute three Linearly Independent solutions and Wronskian of the solutions, find Φ satisfying $\Phi(0) = 0, \Phi'(0) = 1, \Phi''(0) = 0$.

UNIT-II

13. Compute the solution of non-homogeneous equation $y''' + y'' + y' + y = 1$, Satisfying $\psi(0) = 0, \psi'(0) = 1, \psi''(0) = 0$.

(OR)

14. Find two linearly independent solutions for $x>0$, and prove that they are linearly Independent of the equation $y'' + \frac{1}{x}y' - \frac{1}{x^2}y = 0$.

UNIT-III

15. Show that the legendry polynomials are given by $P_n(t) = \frac{1}{2^n n!}\frac{d^n}{dt^n}(n^2 - 1)^n$

(OR)

16. Show that $\frac{d}{dt}[t^p J_p(t)] = t^p J_{p-1}(t)$ *and* $\frac{d}{dt}[t^{-p} J_p(t)] = -t^{-p} J_{p+1}(t)$

UNIT-IV

17. Find the fundamental matrix for **X' = AX** where A = $\begin{bmatrix} 3 & -2 \\ -2 & 3 \end{bmatrix}$

(OR)

18. Determine exponential e^{At} for the system X' = AX where A = $\begin{bmatrix} 1 & 1 & 1 \\ 0 & -2 & 3 \\ 0 & 1 & 0 \end{bmatrix}$

UNIT-V

19. State and prove Picard's theorem.

(OR)

20. State and Prove Fixed point theorem.

SRR & CVR GOVT.DEGREE COLLEGE (A), NAAC B^{+}

Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER-I PAPER-III

C - PROGRAMMING – 20 MAT 103

No. of Hours: 04 Total credits: 04

Total Marks: 100 (Internal: 40 M & External: 60 M)

Course Learning Objectives:

This course is designed to provide complete knowledge of C-language and able to develop the logics which will help them to create programs, applications in C.

UNIT-I

Over view of C - Constants - variables - Data types - operators and expressions.

[Chapters 2, 3&4 of the Text Book]

UNIT-II

Managing Input and output operations - Decision making – branching - decision making and looping.

[Chapters 5, 6& 7 of the Text Book]

UNIT-III

Arrays–one dimensional, two dimensional and multi-dimensional- Handling of character strings.

[Chapters 8 & 9 of the Text Book]

UNIT-IV

Functions- user defined functions-. Pointers-Pointers and arrays –Pointers and functions

[Chapters 10&11 of the Text Book]

UNIT-V

Structures and Unions-file management in C [Chapter 12 and 13 of the Text Book]

Course Learning Outcome(s):

From this course students will be learn to implement the algorithms and draw flow charts for solving mathematical problems and understanding the concepts of computer programming language.

Prescribed Text Book:

1. **C Programming and Data Structures** – E. Balaguruswamy, Second Edition, Tata McGraw- Hill Publishing Company (We should verify 4th edition).

Reference Books:

1. **Fundamental of C Programming** by E. Balaguruswamy
2. **Programming in C** by D. Ravichandran, 1998, New Age International.
3. **C and Data Structures** by Ashok N. Karthane, Pearson Education.

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M.Sc. MATHEMATICS

SEMESTER – I PAPER - III

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

C PROGRAMMING 20 MAT 103

Time: 3 Hours Max.Marks:60M

I. Answer any 5 questions out of the 10 short answer questions 5X4=20M

1. Explain history of **C** programming language.
2. Write the Advantages of **C** programming languages.
3. Explain increment and decrement operators with examples.
4. What is algorithm and explain key features of algorithm.
5. What is array explain types of arrays with syntax.
6. What is string? Explain any two string functions with examples.
7. What is function? Uses of functions.
8. What is pointer? Uses of pointer.
9. Write a program to print **1** to **n** numbers using for loop.
10. Explain data types.

II. Answer any 5 questions out of 10 internal choice essay questions 5X8=40M

UNIT-I

11. Briefly explain structure of C program with example.

(OR)

12. Explain C Tokens.

UNIT-II

13. Write a program for calculator operations using switch case.

(OR)

14. Explain simple if, if-else, nested if, if else ladder with example programs.

UNIT-III

15. Write a program addition of two matrices using arrays.

(OR)

16. Explain the following with example programs

i.Strupr ii. Strlen iii. Strlwr

UNIT-IV

17. Explain types of functions and its features?

(OR)

18. Explain call by reference.

UNIT-V

19. Difference between structure and union.

(OR)

20. What is file and write file operations.

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Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER-I PAPER-IV

ALGEBRA – 20 MAT 104

No. of Hours: 04 Total credits: 04

Total Marks: 100 (Internal: 40 M & External: 60 M)

Course Learning Objectives:

The objective of the course is to introduce the basic structures of algebra like groups, rings, fields, and vector spaces which are the main pillars of modern mathematics.

UNIT-I

Group Theory: Definition of a Group, Some Examples of Groups, Some Preliminary Lemmas, Subgroups, A counting Principles, Normal Subgroups and Quotient groups, Homomorphism, Automorphism.

(2.1 to 2.8 of the prescribed book [1]).

UNIT-II

Group Theory Continued: Cayley's theorem, Permutation groups. Another counting principle.

(2.9 to 2.11 of the prescribed book [1]).

UNIT-III

Group Theory Continued: Sylow's theorem, Direct products, Finite Abelian groups.

(2.12 to 2.14 of the prescribed book [1]).

UNIT-IV

Ring Theory: Definition and Examples of Rings, Some special classes of Rings, Homomorphisms, Ideals and quotient Rings, More Ideals and quotient Rings, The field of quotients of an Integral domain.

(3.1 to 3.6 of the prescribed book [1]).

UNIT-V

Ring Theory Continued: Euclidean rings, A Particular Euclidean ring, Polynomial Rings, Polynomials over the rational field, Polynomial Rings over Commutative Rings.

(3.7 to 3.11 of the Prescribed books [1]).

Course Learning Outcome(s):

From this course students will be able to learn the fundamental concept of algebra and their role in mathematics and applied contexts.

PRESCRIBED TEXT BOOK:

1. **Topics in Algebra** by I. N. HERSTEIN, Second Edition 1988, Wiley Eastern Limited. New Delhi.

REFERENCE BOOK:

1. **Basic Abstract Algebra** by BHATTACHARYA P. B., JAIN S. K., NAGPAUL S.R. Cambridge Press, Second Edition.
2. **Abstract Algebra** by David S Dummit and Richard M Foote , Wiley Publication, Third Edition.
3. **Introduction to rings and modules**, by C Musili, Narosa Publications.

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M.Sc. MATHEMATICS

SEMESTER –I PAPER - IV

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

ALGEBRA 20 MAT 104

Time: 3 Hours **Max Marks: 60M**

I. Answer any 5 questions out of 10 short answer questions **5X4=20M**

1. If G is a finite group and a ϵ G then $\mathbf{a^{O(G)} = e}$.
2. If $\emptyset$ is a homomorphism from $\mathbf{G \rightarrow G'}$, then $\emptyset (x^{-1}) = [\emptyset (x)]^{-1}$
3. State Sylow's theorem.
4. Define direct product of groups.
5. Define an ideal and maximal ideal of ring **R**.
6. Define integral domain with an example.
7. Define Euclidean Ring.
8. Define irreducible polynomial over a field **F**.
9. Write a short note about vector space.
10. Define finite dimensional vector space.

II. Answer Five Questions choosing One question from each unit **5X8=40M**

UNIT-I

11. If **H** and **K** are finite subgroups of **G** of orders **O(H)** and **O(K)** respectively then $O(HK) = \frac{O(H).O(K)}{O(H \cap K)}$

12. Prove that if G is a group then A(G), the set of automorphisms of a group G is also a group;.

UNIT-II

13. State and Prove Cauchy's Theorem.

(OR)

14. State and Prove fundamental theorem on finitely generated Abelian groups.

UNIT-III

15. If **R** is a commutative ring with unity and **M** is an ideal of **R**, then prove that **M** is maximal if $f = \frac{R}{M}$ is a field

(OR)

16. Prove that every integral domain can be embedded in a field.

UNIT-IV

17. Prove that **J[i],** the ring of Gaussian integers is a Euclidean ring.

(OR)

18. State and prove Gauss Lemma.

UNIT-V

19. Prove that **L(S)**, the linear span of **S**, is a subspace of the vector space **V**.

(OR)

20. If **V** is a finite dimensional vector space and **W** is a subspace of **V**, then prove that **W** is a finite dimensional, $\boldsymbol{dim\, W \leq dim\, V}$ *and* $\boldsymbol{dim \frac{V}{W} = dim\, V - dim\, W}$

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Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER-I PAPER-V

Problems Solving Lab - 20 L MAT 105

No. of Hours: 06 Total credits: 03

Total Marks: 100 (Internal: 40M & External: 60M)

LIST OF PROBLEMS:

1. **Concepts on Continuity and Differentiation.**
2. **Problems on Improper Integrals.**
3. **Concepts on functions of several variables.**
4. **Concepts on uniform convergence.**
5. **Solve Linear Equation of First Order.**
6. **Solve Homogeneous and Non-homogeneous differential equations.**
7. **Solving differential equations in power series.**
8. **Finding Fundamental matrix of Non-homogeneous linear systems.**
9. **Concepts of Normal subgroups and coefficient groups.**
10. **Concepts on Permutation groups.**
11. **Sylow's theorem concept.**
12. **Concepts of Ring Theory.**

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SEMESTER-I PAPER-VI

C- PROGRAMMING LAB - 20 L MAT106

No. of Hours: 06 Total credits: 03
Total Marks: 100 (Internal: 40M & External: 60M)

LIST OF C – PROGRAMES:

1. Factorial of a number
2. Reverse of a number
3. GCD of two numbers using EUCLIDIAN algorithm
4. Fibonacci numbers up to "N"
5. Perfect numbers up to "N"
6. Prime numbers up to "N"
7. Sum of digits of a number
8. Number palindrome
9. Find the squares of first ten natural numbers using function
10. Find biggest of three numbers using function
11. Find biggest element in an array
12. Find Transpose of a Matrix
13. Sum of the matrices
14. Product of the matrices
15. To find String length using user defined function

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M.Sc (MATHEMATICS) SYLLABUS
SEMESTER-II PAPER-I
COMPLEX ANALYSIS – 20 MAT 201

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40M & External: 60 M)

Course Learning Objectives:
This course helps to describe basic properties of complex integration and having the ability to compute integrals and decide the analytic function and able to expand complex function in power series, finding complex integrals, using residues and having the ability of using Linear transformations.

UNIT-I
Analytic Functions: Limits- Continuity- Derivatives- Differentiation Formulas-Cauchy-Riemann Equations-Sufficient conditions for Differentiability-Polar Coordinates- Analytic Functions-Harmonic Functions
[Sec 18 to 26 of Chapter 2 of the Text Book]

UNIT-II
Integrals: Contours- Contour Integrals- Cauchy-Goursat Theorem- Proof of the theorem-Simply Connected Domains- Multiply Connected Domains- Cauchy Integral Formula- An extension of Integral Formula- Some Consequences of the extension-Liouville's Theorem and the Fundamental Theorem of Algebra
[Sec 37 to sec 41 and sec 46 to sec 53 of chapter 4 of the Text Book]

UNIT-III
Series: Taylor's series – Proof of Taylor's theorem- Examples- Laurent's series – Proof of Laurent"s Series- Examples.
[Sec 57 to 62 of Chapter-5 of the Text Book]

UNIT-IV
Residues and Poles: Isolated singular points- Residues – Cauchy's residue theorem-Residue at Infinity- the three types of isolated singular points - Residues at poles, Zeroes of analytic function- Zeroes and Poles- Evaluation of improper integrals- Indented paths, An Indentation around a Branch point.
[Sec 68 to 76 of chapter 6 and sec 78, 79, 82, 83 of chapter 7 of the Text Book]

UNIT-V
Argument principle- Rouche's theorem- Linear Transformations: The transformation w=1/z - mappings by w=1/z - Linear fractional transformations - The transformation w=sins, Mapping by Z^2 .
[86 & 87 of chapter7, sec90 to 93, 96 & 97 of chapter 8 of the Text Book]

Course Learning Outcomes:

This Course helps the student to evaluate complex integrals and expanding complex function in power series, advantage of residues and the application of linear transformation.

Text Book:

1.Complex Variables and Applications by James Ward Brown, Ruel V. Churchill, McGraw- Hill International Editions-Eighth Edition.

Reference Books:

1. Complex analysis for Mathematics and Engineering by John H. Mathews and Russel. W, Howell, Narosa Publishing house.
2. Complex Variables by H. S. Kasana, Prentice Hall of India.

S.R.R & C.V.R GOVT DEGREE COLLEGE

M.Sc., Mathematics

SEMESTER –II PAPER - I

[W.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

COMPLEX ANALYSIS 20 MAT 201

Time: 3 Hours Max Marks: 60M

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I. Answer any 5 questions out of the 10 short answer questions 5X4 =20 M

1. Check the differentiability of $f(z) = \bar{z}$

2. Determine the singular points of $f(z) = z^2 + 1/ (z^2 + 2z + 2)$.

3. Write the polar form of C-R equations.

4. Expand the function in a series, $f(z) = 1 / z^2 (1 + z)$.

5. State Liouville's theorem and fundamental theorem of algebra.

6. Find the value of the integral of g (z) around the circle $| z – i | = 2$, if $g(z) = 1 / (z^2 + 4)$

7. Find the residue of the function $f(z) = 2z / (z + 4) (z – 1)^2$ at z = 1.

8. Define three types of Isolated singular points.

9. Define Argument principle.

10. Define Mobius transformation and Inverse transformation.

II. Answer Five Questions choosing One question from each unit.
All questions carry equal marks 5 X 8M = 40M

UNIT - I

11. The complex function $w = f(z) = u + iv$ is differentiable if and if 'u' and 'v' are differentiable and satisfies C – R equations. $u_x = v_y$, $u_y = -v_x$.

(OR)

12. Find an analytic function f (z) and its harmonic function v (x, y) when $u(x, y) = e^x (x\cos y – y\sin y)$.

UNIT – II

13. State and Prove Cauchy-Goursat Theorem.

(OR)

14. State and Prove Cauchy Integral formula.

UNIT - III

15. State and prove Taylor's theorem.

(OR)

16. State and prove Laurent's theorem.

UNIT – IV

17. State and prove Cauchy's residues theorem.

(OR)

18. Using residue theorem, evaluate the improper integral

$$\int_{\infty-}^{\infty} \frac{cosx\ dx}{(x^2+a^2)(x^2+b^2)} (a > b > 0)$$

UNIT - V

19. **S**tate and prove Rouche's Theorem.

(OR)

20. Discuss the transformation $w = z^2$.

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SEMESTER-II PAPER-II
NUMERICAL METHODS - 20 MAT 202

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40M & External: 60M)

Course Learning Objectives:

This Course is introduced a broad range of Numerical methods for solving Mathematical problems that arise in Science and Engineering and helps to choose, develop and apply the appropriate Numerical techniques for the Mathematical problems.

UNIT-I:

Transcendental and Polynomial Equations: Introduction - Bisection method - Iteration methods based on first degree equation - Secant method – Regula falsi method - Newton Raphson method - Iteration method based on second degree equation - Rate of convergence of secant method - Newton Raphson method.
[Above topics are from Chapter-2 of the Text Book]

UNIT-II:

System Of Linear Algebraic Equation And Eigen Value Problems: Direct methods - Introduction - Gauss Elimination Method- Gauss – Jordan Method - Triangularisation method - Iteration Methods- Jacobi iteration Method - Gauss-Seidel Iteration Method - Eigen values and Eigen vectors.
[Above topics are from Chapter-3 of the Text Book]

UNIT-III:

Interpolation and Approximation: Introduction - Lagrange Interpolation - Newton Divided Differences - Finite Difference Operators - Interpolating Polynomials using finite differences- Gregory- Newton forward difference interpolation- Backward difference interpolation - Stirling and Bessel interpolation – Hermite interpolation-Spline interpolation – Approximation: Least Square approximation.
[Above topics are from Chapter-4 of the Text Book]

UNIT-IV:

Numerical Differentiation and Integration: Introduction – Numerical differentiation: Methods based on finite differences.
[Above topics are from Chapter-5 of the Text Book]

UNIT-V:

Numerical integration: Composite integration methods-Trapezoidal rule- Simpsons rules – numerical solution of ODEs by Picard – Euler - Modified Euler – Runge Kutta methods.
[Above topics are from Chapter- 6 of the Text Book]

Course Learning Outcome(s):

From this Course Students are able to learn how to apply the Numerical method for various Mathematical operations and tasks such as Interpolation, Differentiation, Integration, the solution of Differential Equations analyses and evaluate the accuracy of common Numerical methods.

Text Book:

Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, R. K. Jain, New Age International (p) Limited, Publishers, 5 th Edition.

Reference Book:

An Introduction to Numerical Analysis by Kendall E. Atkinson.

S.R.R & C.V.R GOVT DEGREE COLLEGE

M.Sc., Mathematics

SEMESTER - II PAPER - II

[W.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

NUMERICAL METHODS - 20 MAT 202

Time: 3 Hours Max. Marks: 60 M

I. Answer any 5 questions out of the 10 short answer questions 5X4=20M

1. Define bisection method.
2. Write REGULA-FALSI Formula
3. Write the condition for Guass Elimination Method fails.
4. Write system of linear equations if m=n.
5. Prove that $\Delta = E - 1$
6. Find the third difference with arguments 2,4,9,10 of the function $f(x) = x^3 - 2x$
7. Write Newton's backward interpolation Formula.
8. Write Simpson's 1/3 formula.
9. Solve the differential equation $y' = x + y$ with $y\ 0 = 1$, $x \in [0,1]$ by Taylor Series expansion to obtain y for $x = 0.1$
10. Write second order Runge-Kutta formula.

II. Answer Five Questions choosing One question from each unit.
All questions carry equal marks 5X8=40M

UNIT-I

11. Use Newton-Raphson method to obtain a root, correct to 3 decimal places of the equation $x + logx = 2$.

(OR)

12. Find a root of the equation $f(x) = x^3-4x-9=0$, using the bisection method in Four stages.

UNIT-II

13. Solve the equations $10x+2y+z=9$, $2x+3y-2z=-44$, $-2x+3y+10z=22$ by Using Gauss –Seidal method.

(OR)

14. Solve the system of linear equations $x_1+x_2+x_3=1$, $4x_1+3x_2-x_3=6$, $3x_1+5x_2+3x_3=14$, by Triangulation method.

UNIT-III

15. The value of x and y are given as below:

x	5	6	9	11
f(x)	12	13	14	16

Find the value of y at x=10 by using Lagrange's formula.

(OR)

16. Given the following values of f(x) and f'(x)

x	f(x)	$f^2(x)$
-1	1	-5
0	1	1
1	3	7

Estimate the values of $f(-0.5)$ and $f'(0.5)$ using Hermite interpolation.

UNIT-IV

17. Find $f'(0.6)$ by using stirling's formula

X	0.4	0.5	0.6	0.7	0.8
f(x)	1.5836	1.7974	2.0442	2.3275	2.6510

(OR)

18. Values of x (in degrees) and sin x are given in the following table.

x (in degree)	sin x
15	0.2588190
20	0.3420201
25	0.4226183
30	0.5
35	0.5735764
40	0.6427876

Determine the value of first derivative value of $\sin 38^{\circ}$.

UNIT-V

19. i) Evaluate $\int_{-2}^{2} \frac{x}{5+2x} dx$ by using the Trapezoidal rule with five ordinates.

ii) Evaluate $\int_{0}^{2} \frac{dx}{x^3+x+1}$ by using the Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule with h= 0.25.

(OR)

20. Solve $\frac{dy}{dx} = -2xy^2$ with y(o)=1 and h=0.2 on the interval [0,1] using Runge - Kutta fourth order method.

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M.Sc (MATHEMATICS) SYLLABUS
SEMESTER-II PAPER-III
PARTIAL DIFFERENTIAL EQUATIONS -20 MAT 203

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40M & External: 60M)

Course Learning Objectives:
The goal of this course is provide the students with an understanding of the solutions of First and Second order Partial Differential Equations and applications of Partial Differential Equations.

UNIT-I
First Order PDE's: Introduction – Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ orthogonal trajectories of a system of curves on a surface- Pfaffian Differential forms and equations – Solutions of Pfaffian differential Equations in three variables – Cauchy's problem for first order PDE. [Sections 3 to 6 of Chapter 1, Sections 1 to 3 of Chapter 2]

UNIT-II
Linear Equations of the first order – Integral Surfaces – Orthogonal Surfaces – Non-Linear PDE of the first order – Cauchy's method of characteristics – compatible systems of first order equations – Charpit's method – special types of first order equations – Jacobi's method [Sections 4 to 13 of Chapter 2]

UNIT-III
Partial differential equations of the second order, their origin, linear partial differential equations with constant and variable coefficients – solutions of linear Hyperbolic equations – Method of separation of variables – Monger"s method. [Sections 1 to 5 and sections 8, 9, 11 of Chapter 3]

UNIT-IV
Laplace Equation – elementary solutions of families of equipotential surfaces, boundary value problems, method of separation of a variable of solving Laplace equation, problems with axial symmetry, Kelvin's inversion theorem. [Section 1 to 7 of Chapter 4]

UNIT-V
The wave equation, elementary solution in one dimensional form, Riemann – Volterra solution of one-dimensional wave equation. [Sections 1 to 3 of Chapter 5]
[Problematic approach is Preferred]

Course Learning Outcome(s):

From this course Student will be able to learn the study of Partial derivatives on the Existence and Uniqueness of Solutions and theory of Differential Equations widely used in formulating wave equations and Laplace equations.

Prescribed Text Book:

1. **Elements of partial differential equations** by I. N. Sneddon, McGraw-Hill, international edition, Mathematics series.

Reference Book:

1. **An Elementary Course in Partial differential equations** byT. Amaranth, Second Edition, Narosa Publishing House.

S.R.R & C.V.R GOVT DEGREE COLLEGE

M.Sc., Mathematics

SEMESTER – II PAPER III

[W.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

PARTIAL DIFFERENTIAL EQUATIONS– 20 MAT 203

Time: 3 Hours Max Marks: 60M

I. Answer any 5 questions out of the 10 short answer questions **5X4M =20M**

1. Define orthogonal trajectories on surface of the given system of curves.
2. Define Pfaffian differential equation and state the necessary and sufficient condition to be integrable.
3. Define the three classes of integrals of a Partial differential equation.
4. If the expression $(p^2 + z)\,dx + x^2 + z\,dy$is and exact differential equation.
5. Define Wave equation and Laplace equation
6. Define Greens function.
7. Write the two types of boundary value problems for Laplace equations.
8. Reduce the equation $u_{xx} - x^2 u_{yy} = 0$ to a canonical form.
9. Define Helmholtzs equation.
10. Write the Riemann-Volterra solution form one dimensional wave equation.

II. Answer Five Questions choosing One question from each unit.
All questions carry equal marks **5 X 8M=40M**

UNIT-I

11. A necessary and sufficient condition that there exists between two functions u(x, y) and v(x, y) is a relation F(u, v) = 0 not involving x or y explicitly is that $\frac{\partial(u,v)}{\partial(x,y)} = 0$

(OR)

12. Verify that the equation $(z+y^2)\,dx+z\,(z+x^2)\,dy-xy\,(x+y)\,dz=0$ is integrable and find its primitive.

UNIT-II

13. Explain the Charpit's method of solving the equation $f\,(x, y, z, p, q) = 0$.Using this method find the complete integral of the equation $(p^2 + q^2) = qz$.

(OR)

14. Find a complete integral of $p^2x+q^2y=z$ using Jacobi's method.

UNIT-III

15. Solve the equation $r + s - 2t = e^{x+y}$ with usual notation.

(OR)

16. Solve the equation $\mathbf{r+4s+t+rt-s^2=2}$ using Monge's method.

UNIT-IV

17. A rigid sphere of radius a is placed in a stream of fluid whose velocity in the undisturbed state is V. Determine the velocity of the fluid at any point of the disturbed stream.

(OR)

18. State and Prove Kelvin's inversion theorem.

UNIT-V

19. Derive D'Alembert's solution of the one-dimensional wave equation.

(OR)

20 If Ψ is determined by the differential equation $a^2\frac{\partial^2\varphi}{\partial x^2} + b^2 = \frac{\partial^2\varphi}{\partial y^2}$ where 'a' and 'b' are constants and by the conditions $y = 0, \Psi = f(x), \frac{\partial\varphi}{\partial y} = g(x)$ Show by the Riemann-Volterra Method.

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M.Sc (MATHEMATICS) SYLLABUS
SEMESTER-II PAPER-IV
LATTICE THEORY – 20 MAT 204

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40 M & External: 60 M)

Course Learning Objectives:
The course mainly designs with the aim of introducing the Lattice theory and Boolean algebra, the portion of lattice theory discuss modular, distributive lattice.

UNIT-I
Partly Ordered Sets: Set Theoretical Notations, Relations, Partly Ordered Sets, Diagrams, Special Subsets of a Partly Ordered Set, Length, Lower and Upper Bounds, The Minimum and Maximum Conditions, The Jordan–Dedekind Chain Condition, Dimension Functions.
(Sections 1 to 9 of Chapter 1)

UNIT-II
Lattices in General: Algebras, Lattices, The Lattice Theoretical Duality Principle, Semi Lattices, Lattices as Partly Ordered Sets, Diagrams of Lattices, Sub Lattices, Ideals, Bound Elements of a Lattice, Atoms and Dual Atoms, Complements, Relative Complements, Semi Complements, Irreducible and Prime Elements of a Lattice, The Homomorphism of a Lattice, Axiom Systems of Lattices.
(Sections 10 to 21 of Chapter 2)

UNIT-III
Complete Lattices: Complete Lattices, Complete Sub Lattices of a Complete Lattice, Conditionally Complete Lattices, Compact Elements and Compactly Generated Lattices, Sub Algebra Lattice of an Algebra, Closure Operations, Galois Connections, and Dedekind Cuts, Partly Ordered Sets as Topological Spaces.
(Sections 22 to 29 of Chapter 3)

UNIT-IV
Distributive and Modular Lattices: Distributive Lattices, Infinitely Distributive and Completely Distributive Lattices, Modular Lattices, Characterization of Modular and Distributive Lattices by their Sub lattices, Distributive Sub lattices of Modular Lattices, The Isomorphism Theorem of Modular Lattices, Covering Conditions, Meet Representation in Modular and Distributive Lattices.
(Sections 30 to 36 of Chapter 4)

UNIT-V
Boolean Algebras: Boolean Algebras, De Morgan Formulae, Complete Boolean Algebras, Boolean Algebras and Boolean Rings, the Algebra of Relations, the Lattice of Propositions, Valuations of Boolean Algebras.
(Sections42to47ofChapter6)

Course Learning Outcome(s): From this course students are able to understand Lattices as Algebraic structures, Homomorphism between Lattices and Boolean algebra.

PRESCRIBED BOOK:

1. **Introduction to Lattice Theory,** Gabor Szasz, Academic press.

REFERENCE BOOK:

1. **Lattice Theory,** G. Birkhoff, Amer, Math. Soc.

S.R.R & C.V.R GOVT DEGREE COLLEGE

M.Sc., Mathematics

SEMESTER II PAPER IV

[W.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

LATTICE THEORY 20 MAT 204

Time: 3 Hours Max.Marks:60M

I. Answer any 5 questions out of the 10 short answer questions 5X4=20M

1. Define a Completely ordered set
2. Define JDCC.
3. Define meet irreducible element.
4. Define a Complete Lattice.
5. Define a closure operation.
6. Define modular lattice.
7. Define distributive lattice.
8. State the Isomorphism theorem of Modular Lattices.
9. Define Boolean Ring.
10. Define Complete Boolean Algebra.

II. Answer Five Questions choosing One question from each unit.
All questions carry equal marks 5X8=40M

UNIT I

11. Prove that a partly ordered set can satisfy both the maximum and minimum conditions if and only if every one of its sub chain is finite.

(OR)

12. Show that every sub chain of a partly ordered set satisfying the maximum condition has a greatest element.

UNIT II

13. Define an Order isomorphism. Show that if two lattices are isomorphic if and only if they are also order isomorphic

(OR)

14. (i) Show that every weakly complemented lattice is semi complemented.
(ii) Show that every section complemented lattice bounded below is weakly Complemented.

UNIT III

15. Prove that every order preserving mapping of a complete lattice into itself has a fix Element.

(OR)

16. Show that every element of a compactly generated lattice can be represented as a meet of finite number of meet irreducible elements

UNIT IV

17. State and Prove Dedekind's modularity criterion.

(OR)

18.Show that all irredundant irreducible meet - representations of any element of a modular lattice have the same number of components.

UNIT V

18. For a complete Boolean algebra B, show that the following conditions are equivalent.

i. B is completely meet- distributive
ii. B is atomic
iii. B is isomorphic with the subset lattice of a set.

(OR)

19. Show that the algebra of relations R (M) of a set M forms a complete Boolean algebra

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M.Sc (MATHEMATICS) SYLLABUS

SEMESTER-II PAPER-V

GRAPH THEORY-20 MAT 205

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40M & External: 60M)

Course Learning Objectives:
The objective of the course is to understand and apply the fundamental concepts in graph theory and apply the tools in solving practical problems.

UNIT-I:

Introduction: Finite and Infinite graphs- Incidence and degree- Isolated Vertex- Pendant Vertex and Null Graph Paths and circuits: Isomorphism- Subgraphs- a puzzle with multi colored cubes- walks- Paths and Circuits- connected graphs- Disconnected graphs- Components- Euler graphs - Operations on graphs- More on Euler graphs- Hamiltonian paths and circuits- Travelling – Salesman Problem
[Chapters 1 and 2 of Text Book]

UNIT-II:
Trees and Fundamental Circuits: Trees , some properties of trees , pendant Vertices in a tree, distances and centers in a tree, rooted and binary trees, on Counting trees, spanning trees, fundamental circuits, finding all spanning trees of a graph , spanning trees in a weighted Graphs. Cut sets and Cut –vertices: Cut sets, Some Properties of a Cut Set, All cut sets in a Graph, Fundamental circuits and cut sets, connectivity and separability, network flows, 1-isomorphism, 2- isomorphism.
[Chapter 3 & 4 of Text Book]

UNIT-III:
Planar graphs: Planar graphs – Kuratowski's two graphs - Different representations of planar graphs- Detection of Planarity - Geometric Dual of a graph.
[Sections 5.1 to 5.6 Chapter 5 of the Text Book]

UNIT-IV:
Matrix representation of graphs: Incidence and circuit matrices of a graph - Fundamental Circuit Matrix - Cut set and Path Matrices - Adjacency matrices - Directed Graphs - Incidence and adjacency matrix of adigraph.
[Chapter 7 and Sections 9.1, 9.2, 9.8 and 9.9 of Chapter 9 of Text Book]

UNIT-V:
Coloring - Covering and Partitioning - Chromatic number- Chromatic Partitioning – Chromatic Polynomial – Matchings –Coverings -The four color problem - Applications of graph theory in Operations Research.
[Chapters8andSections14.1to14.3ofchapter14ofTextBook]

Course Learning Outcome(s):

From this course students are able to define basic concepts of graphs and understand the concept of planer graph.

Text Book:

1. Graph Theory with applications to Engineering and Computer Science by Narasingh Deo, Prentice – Hall of India.

Reference Books:

1. Discrete Mathematics for Computer Scientists and Mathematicians by J. L. Mott, A. Kandel and T.P. Baker, Prentice-Hall India.
2. Graph Theory with applications by Bond JA and Murthy USR, North Holland, New York.

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M.Sc., Mathematics
SEMESTER -II PAPER V
[W.e.f. 2020 - 21 Admitted Batch]
[Question paper pattern for semester end (External) examination]
GRAPH THEORY-20 MAT 205

Time: 3 Hours Max. Marks: 60M

I. Answer any 5 questions out of the 10 short answer questions 5X4=20M

1. Draw an example of Hamiltonian graph
2. Define complete graph
3. Define a binary Tree
4. Define Spanning Tree
5. Define cut-vertex.
6. Draw an example of Separable graph
7. Give relation between edge Connectivity and Vertex connectivity
8. Draw Kuratowski's Second Graph
9. Define planar graph.
10. Define incidence matrix.

II. Answer Five Questions choosing One question from each unit.
All questions carry equal marks 5X8M=40M

UNIT-I

11. Prove that a connected graph G is an Eulerian graph if and only if all vertices of G are of even degree.

(OR)

12. Prove that in a complete graph with n-vertices, there are $\frac{n-1}{2}$ edge disjoint Hamiltonian circuits, if 'n' is odd number ≥ 3.

UNIT-II

13. (i) Prove that any connected. Graph with n vertices and n - 1 edges is a tree.

(ii) Prove that the distance between vertices of a connected graph is a metric.

(OR)

14. Prove that with respect to any of its spanning trees, a connected graph of n vertices and e edges has n - 1 tree branches and e - n + I chords.

UNIT-III

15. Prove that in a connected graph G, any minimal set of edges containing at least one branch of every Spanning tree of G is a cut-set.

(OR)

16. Prove that the ring sum of two cut-sets in a graph is either a third cut-set or an edge-disjoint union of Cut-sets.

UNIT-IV

17. Prove that Kuratowski's first graph is non planar.

(OR)

18. Prove that a connected planar graph with n vertices and e edges has e - n +2 regions.

UNIT-V

19. If A(G) is an incidence matrix of a connected graph G with n-vertices, then show that the rank of A (G) is n-1.

(OR)

20. Let A_f be the reduced incidence matrix of a connected digraph. The number of spanning trees In the graph equals the value of $det\left(A_f . A_f^T\right)$

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Department of Mathematics

M.Sc. (MATHEMATICS) SYLLABUS

SEMESTER-II PAPER-VI
REAL ANALYSIS-II - 20 MAT 206

No. of hours: 04 Total credits:04
Total marks: 10 (Internal: 40 M & External: 60M)

Course learning objectives:
This course is intended to expose the ideas of real analysis by learning functions of several variables and special functions.

UNIT-I
Some Special Functions: Power Series, the Exponential and Logarithmic Functions, the Trigonometric Functions, the Algebraic Completeness of the Complex Field, Fourier series. (Sections 8.1 To 8.15 of Chapter 8)

UNIT-II
Functions of several variables: Linear Transformations, Differentiation, Contraction Principle.(Sections 9.1 To 9.23 of Chapter 9)

UNIT-III
Functions of several variables (Continued): Inverse function theorem, Implicit function theorem, The Rank theorem, Determinants, Derivatives of higher order and differentiation of Integrals.(Sections 9.24 To 9.43 of Chapter 9)

UNIT-IV
Integration of Differential Forms: Integration, Primitive Mappings, Partitions of unity, Change ofvariables, Differential forms. (Sections 10.1 To 10.25 of Chapter 10).

UNIT-V
Integration of differential forms (Cont.,): Simplexes and chains, Stokes Theorem - Closed forms andExact forms. (Sections 10.26 To 10.41 of Chapter 10)

Course Learning Outcome (s):

This Course able to help the students to learn fundamental principles of Special Functions, andadvanced topics of a differentiation and Integration.

PRESCRIBED TEXT BOOK:

1. **Principles of Mathematical Analysis** by Walter Rudin, Third Edition, Tata McGraw-Hill.

REFERENCE BOOKS:

1. **Mathematical Analysis** by Tom. M. Apostol, Second Edition, 2002, Narosa Publication.
2. **A First Course in Mathematical Analysis by** D. Somasundaram, B. Choudary, NarosaPublishing House

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M. Sc. MATHEMATICS

SEMESTER – II PAPER - VI

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

REAL ANALYSIS-II - 20 MAT 206

Time: 3 Hours **Max. Marks: 60**

Answer any 5 Questions out of 10 Short Answer Questions **5 x 4M=20 M**

1. a) Show that the function **E** is periodic, with period **$2\pi i$.**
   b) Define Orthogonal and Orthonormal System Of functions.
   c) Define Linear Transformation and Inverse operator.
   d) Show That **Dim $(R^n) = n$.**
   e) Show that a Linear operator **A** on $\mathbf{R^n}$ is invertible, then **det [A] $\neq 0$**.
   f) Let **$f(0,0) = 0$** and **$f(x, y) = xy(x^2-y^2)/x^2+y^2$** , then prove that **$(D_{12}f)(0, 0) = 1$** and **$(D_{21}f)(0, 0) = -1$.**
   g) Define Primitive mapping.
   h) Let **ω** and **λ** be **k** and **m** forms in **V** respectively, then show that $(\omega+\lambda)_T = \omega_T + \lambda_T$.
   i) Write a brief note on Affine - simplexes.
   j) Define exact form and show that every exact of class **c'** is closed.

Answer five Questions choosing One question from each unit.
All Questions Carry equal marks **5X8=40M**

UNIT I

2. a) State and Prove Taylor's Theorem.

(OR)

   b) State and Prove Bessel's Inequality.

UNIT II

3. a) A Linear Operator **A** on a finite dimensional vector space is one-one, if and only if the range of **A** is all of **X**.

(OR)

   b) Define a Contraction Mapping. State and prove Contraction Principle.

UNIT III

4. a) State and prove Inverse function theorem.

(OR)

b) Suppose f **is defined in an open set** $E \subset R^n$**, suppose that** $D_1 f$, $D_{21} f$ **and** $D_2 f$ **exists every point of** E, **and** $D_{21} f$ I **continuous at some point** (a, b) ϵ E**. Then show that** $D_{12} f$ **exists and** $(D_{12} f)(a, b) = D_{21} f(a, b)$

UNIT IV

5. a) For every **f** ϵ **C (I^K)** , Show that **L (f) = L(f ').**

(OR)

b) Suppose **E** is an open set in $\mathbf{R^n}$. If **w** is of class **¢' '** in **E**, then show that $\mathbf{d^2 w = 0}$.

UNIT V

6. a) State and prove States Theorem.

(OR)

b) Show that closed forms are exact in convex sets.

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Department of Mathematics

M.Sc. (MATHEMATICS) SYLLABUS

SEMESTER-II PAPER-VII

MATRIX THEORY - 20 OE MAT 207

(Open Elective - I)

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40M & External: 60M)

Course learning Objectives:

In this course we study a branch of Mathematics called Linear Algebra and some of its applications related to matrices. Students able to apply the concepts in Computer Science, Engineering, Biology and Commerce.

UNIT - I
Linear system of Equations: Introduction, Fundamentals of Matrices, Rank of a Matrix. (Sections 1.0, 1.1, 1.2 of unit 1 of Text book 1)

UNIT - II
Linear system of Equations: Echelon Form, Normal Form of a Matrix, Finding inverse by row operations.
(Sections 1.3, 1.4 of unit 1 of Text book 1 and concepts from Text book 2).

UNIT - III
Linear system of Equations: Solution of a System of Linear Equations, Gauss - Elimination Method, Inverse Method, Cramer's Rule.
(Sections 1.5, 1.6 of unit 1 of Text book 1 and concepts from Text book 2).

UNIT - IV
Eigen Values- Eigen Vectors: Introduction, Basic concepts, Eigen Values and Eigen Vectors.
(Sections 2.0, 2.1, 2.2 of unit 2 of Text book 1).

UNIT - V
Eigen Values- Eigen Vectors: Cayley Hamilton Theorem with proof, and its applications. (Section 2.4 of unit 2 of Text book 1).

Course Learning Outcome (s):

After completion of this course students are able to analyze and solve alinear system of equations using the concepts of matrices.

PRESCRIBED TEXT BOOK:

1) **"A text book of Engineering Mathematics - III"** by N. P. Bali & Dr. K. L. Sai Prasad. First edition 2018,University science Press, New Delhi.

2) **"Higher Engineering Mathematics"** by Dr. B. S. Grewal, 40^{th} Edition, 2007, Khanna publishers, NewDelhi.

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M.Sc. MATHEMATICS

SEMESTER - II PAPER - VII

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

MATRIX THEORY – 20 OE MAT 207
(Open Elective – I)

Time: 3 Hours **Max. Marks: 60M**

Answer Any 5 questions out of 10 Short Answer Questions **5X4=20M**

1. a) Define row matrix and column matrix.

   b) Define symmetric and skew symmetric matrix.

   c) Define transpose and inverse of a matrix A.

   d) Define Echelon form of a matrix.

   e) Define normal form of a matrix.

   f) Define homogeneous and non - homogeneous linear equations.

   g) Define consistent and inconsistent system of equati

   h) Define Eigen value and Eigen vector.

   i) Define linear transformation with example.

   j) Define Cayley - Hamilton's theorem.

Answer Five Questions Choosing one Question from each Unit.
ALL Questions carry equal Marks **5X8=40M**

UNIT I

2 a) Use Gauss - Jordan method to find the inverse of the given matrix $A=\begin{bmatrix}1 & 3 & 3\\ 1 & 4 & 3\\ 1 & 3 & 4\end{bmatrix}$

(OR)

b) Find the Rank of the matrix $A=\begin{bmatrix}1 & 2 & 3\\ 1 & 4 & 2\\ 2 & 6 & 5\end{bmatrix}$

UNIT II

3 a) Find the rank of the matrix by reducing it to Echelon form $\begin{bmatrix} 2 & 3 & 7 \\ 3 & -2 & 4 \\ 1 & -3 & -1 \end{bmatrix}$

(OR)

b) Find the rank of the matrix by reducing it to Normal form $\begin{bmatrix} 0 & 1 & 2 & -2 \\ 4 & 0 & 2 & 6 \\ 2 & 1 & 3 & 1 \end{bmatrix}$

UNIT III

4 a) Solve the following equations by Gauss - Elimination method:

3x + 4y + 5z = 18, 2x – y + 8z = 13, 5x - 2y + 7z = 20

(OR)

b) Solve the following equations by using Cramer's rule:

3x + y + 2z = 3; 2x - 3y - z = -3; x + 2y + z = 4.

UNIT IV

5 a) i) Show that the matrices **A** and $\mathbf{A^T}$ have the same Eigen values where $\mathbf{A^T}$ is the transpose of **A.**

ii) Show that if $\boldsymbol{\lambda_1, \lambda_2, \lambda_3 \ldots \lambda_n}$ are the Eigen values of a Matrix **A**, then $\mathbf{A^{-1}}$ has the Eigen values $\frac{1}{\lambda_1}, \frac{1}{\lambda_2}, \frac{1}{\lambda_3}, \ldots, \frac{1}{\lambda n}$

(OR)

b) Find the Eigen values and Eigen vectors of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 0 & -4 & 7 \\ 0 & 0 & 7 \end{bmatrix}$

UNIT V

6 a) Find the characteristic equation of the Matrix and verify that it is satisfied by **A** and hence obtain $\mathbf{A^{-1}}$, where . $\mathbf{A} = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$

(OR)

b) Verify Cayley-Hamilton theorem for the Matrix $\mathbf{A} = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 3 \\ 1 & 1 & 2 \end{bmatrix}$

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Department of Mathematics

M.Sc (MATHEMATICS) SYLLABUS

SEMESTER-II PAPER-VIII

NUMERICAL METHODS LAB - 20 L MAT 208

No. of Hours: 06 Total credits: 03
Total Marks: 100 (Internal: 40M & External: 60M)

LIST OF PROGRAMS:

1. Bisection method
2. False position method
3. Newton Raphson method
4. Secant method
5. Gauss elimination method
6. Gauss seidal method
7. Difference table method
8. Trapezoidal method
9. Simpson 1/3 rule
10. Simpson 2/3 rule2
11. Euler's method
12. Thomas method
13. LaGrange's method
14. Taylor's method
15. Runge-kutta method
16. Modified Euler

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Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER-III PAPER-I

TOPOLOGY – 20 MAT 301

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40M & External: 60M)

Course Learning Objectives:
In this course we shall come across important notions and various definitions, theorems andtheir proofs to understand the concepts of metric spaces and topological spaces.

UNIT-I
Metric Spaces: The definition and some examples – Open sets – Closed sets – Convergence,Completeness and Baire's Theorem [Section 12 of Chapter-2]

UNIT-II
Topological Spaces: Topological Spaces - the definition and some examples – Elementary concepts – Open bases and Open sub bases. [Sections 16, 17 and 18 of Chapter-3 of Text Book]

UNIT-III
Compactness: Compact spaces – Product spaces – Tychonoff's theorem and locally compactspaces – Compactness for Metric spaces – Ascoli's Theorem. [Sections 21-24 and 25 of Chapter-4 of Text Book]

UNIT-IV
Separation: T1-Spaces and Hausdorff's spaces – Completely regular spaces and normal spaces–Urysohn's lemma and the Tietze extension theorem – The Urysohn's imbedding theorem. [Sections 26-29 of Chapter-5 of Text Book]

UNIT-V
Connectedness**:** connected spaces – The components of a space – Totally disconnected spaces–Locally connected spaces. [Chapter-6 of Text Book]

Course Learning Outcome (s):
From this course students are able to know how the topology on a space is determined by the collection of open sets and basic properties of connectedness and compactness.

Text Book:

1. **Introduction to Topology and Modern Analysis** by G. F. Simmons, Edition 2004, Tata McGraw-Hill.

Reference Book:

1. **Topology** by James R. Munkres, Second Edition, Pearson Education Asia.

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M.Sc. MATHEMATICS

SEMESTER - III PAPER - I

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

TOPOLOGY - 20 MAT 301

Time: 3 Hours. **Max.Marks:60M**

Answer any 5 Questions out of 10 Short Answer Questions **5X4=20M**

1. a) Define Metric space.
   b) Define Open set and Closed set
   c) Define Topological space.
   d) Show that $\bar{A} = A \cup D(A)$.
   e) Define compact space.
   f) State Ascoli's Theorem.
   g) Define Hausdorff's space.
   h) Define connected space.
   i) Define Cantor set and show that the cantor set is compact.
   j) Define totally disconnected space.

Answer Five Questions choosing One question from each unit.
All questions carry equal marks **5X8=40M**

UNIT I

2 a) State and prove Cantor's Intersection Theorem.

(OR)

b) Let **X** be a metric space. Then prove that
   (i) Any finite intersection of open sets is open.
   (ii) Each closed sphere is a closed set.

UNIT II

3 a) State and Prove Lindelof's theorem.

(OR)

b) Show that every separable metric space is second countable.

UNIT III

4 a) State and Prove Tychonoff's Theorem.

(OR)

b) Show that every sequentially compact metric space is compact.

UNIT IV

5 a) State and Prove Urysohn's lemma.

(OR)

b) Show that every compact Hausdorff's space is normal.

UNIT V

6 a) Prove that the Product of any non - empty class of connected space is connected.

(OR)

b) Let X be a Hausdorff's space. If X has an open base whose sets are also closed, then show that X is totally disconnected.

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Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER-III PAPER-II

PROBABILITY& STATISTICS - 20 MAT 302

No. of Hours: 04 Total credits : 04
Total Marks: 100 (Internal: 40M &External:60M)

Course Learning Objectives:
The objective of this course is to introduce the basic concepts of statistics like probability theory, distributions, correlation and regression techniques and sampling distributions.

UNIT-I:
Sample Space & Events - Axioms of probability - Some theorems on probability - Boole's Inequality- probability - Multiplication theorem on probability - Independent events - Multiplication theorem on probability for independent Events - Extension of Multiplication theorem on Probability to n Events - Baye's theorem.
[3.2 to 3.95 of Chapter3 & 4.2 of Chapter4]

UNIT-II:
Distribution functions: Discrete random variable - Continuous random variable - Two- Dimensional Random variables - Mathematical expectation - Moments of a distribution function - Moment generating functions - Characteristic functions and their properties –Chebychev inequality - Probability generating functions.
[5.2 to 5.5(up to 5.5.5.) of Chapter - 5, Chapter 6 except 6.7 and 7.1, 7.2, 7.3, 7.5 and 7.9 of
Chapter 7]

UNIT-III:
Distributions: Discrete Distributions Binomial - Poisson distributions and their properties - Continuous distributions - Normal and Rectangular distributions and their properties.
[8.1 to 8.5 of Chapter 8 and 9.1 to 9.3 of Chapter 9]

UNIT-IV:
Correlation and Regression: Correlation - Karl Pearson's coefficient of correlation - Calculation of correlation coefficient for bivariant frequency distribution – Spearman's rank correlation coefficient - Linear regression - Regression coefficients and their properties - Angle between regression lines.
[10.1 to 10.5 and 10.7.1 of Chapter 10 and Chapter 11 (up to 11.2.3)]

UNIT-V:
Sampling distribution: Sampling and Large sample tests, Exact sampling distributions - χ^2, '**t**' and **F**- distributions.
[Chapter-14, Chapter 15 up to 15.6.4 and Chapter 16 up to 16.6 except 16.4]

Course Learning Outcome(s):

From this course students will be able to learn the fundamental concept of statistics andtechniques required for data analysis which is widely used in practical analysis of any data.

Text Book:

Fundamentals of Mathematical Statistics by S.C. Gupta and V.K. Kapoor , 11th Edition,Sultan Chand & Sons, New Delhi.

Reference Book:

Probability and Statistics for Engineers and Scientists, 9th edition, Walpole Myers, KeyingYe Pearson Publications.

SRR & CVR GOVT.DEGREE COLLEGE (A), NAAC B^+

M.Sc. MATHEMATICS

SEMESTER-III PAPER-II

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

PROBABILITY & STATISTICS - 20 MAT 302

Time: 3 Hours **Max. Marks: 60M**

1. Answer any 5 Questions out of 10 Short Answer Questions. **5 X4=20M**

a) Define equally likely event
b) Definition of Axiomatic probability.
c) Define Correlation.
d) Define random variable.
e) Define moment generating function.
f) Define Normal distribution.
g) Define characteristic function.
h) Write Application of Normal distribution.
i) Define chi-square distribution of goodness of fit.
j) Write properties of F- distribution.

Answer Five Questions. Choose One Question from each Unit.
ALL Questions carry equal Marks **5X8=40M**

UNIT - I

2. (a) State and prove multiplication theorem in probability

(OR)

(b) State and prove Baye's theorem.

UNIT - II

3. (a) prove that $\mathbf{M(X_1+X_2+X_3+X_4+\ldots\ldots+X_n) = MX_1+MX_2+MX_3+MX_4+\text{------}+MX_n}$

(OR)

(b) Write properties of Characteristic function.

UNIT - III

4. (a) Using MGF derive mean and variance of Binomial distribution

(OR)

(b) Write properties of Normal distribution

UNIT - IV

5. (a) Calculate Karl-Pearson's coefficient of correlation between expenditure advertising and sales from the data given below advertising.

Expenses (000's)	39	65	62	90	82	75	25	98	36	78
Sales (Lakhs Rs.)	47	53	58	86	62	68	60	91	51	84

(OR)

(b) What is linear regression? State and prove angle between two regression lines.

UNIT – V

6 (a) The number of scooter accidents per month in a certain town were as follows.

12 8 20 2 14 10 15 6 9 4

Are there frequencies in agreement with the belief that accident conditions were the same during this 10 month period?

(OR)

(b) Ten cartons are taken at random from an automatic filling machine. The mean net weight of the **10** cartons is 11.8 and **S.D.** is **0.15**. Does the sample mean differ significantly from the intended weight of **12.02**? You are given that for **v** = 9 and **t0.05=2.20**

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Department of Mathematics

M.Sc. (MATHEMATICS) SYLLABUS

SEMESTER-III PAPER-III

GALOIS THEORY - 20 MAT 303

No. of hours: 04 Total credits:04
Total marks: 100 (Internal: 40 M & External: 60M)

Course learning objectives:
This course is the study of roots of polynomials and their symmetries in terms of Galois groups, modules and extension of fields**.**

UNIT-I
Modules: Definition and examples, sub modules and direct sums, **r**-homomorphism's and quotientmodules, completely reducible modules.
(Sections 1 to 4 of chapter 14 of [1])

UNIT-II
Algebraic extensions of fields: irreducible polynomials and Eisenstein's criterion, adjunction of roots,algebraic extensions, algebraically closed fields.
(Sections 1 to 4 of chapter 15 of [1])

UNIT-III
Normal and separable extensions: splitting fields, normal extensions, multiple roots, finite fields,separable extensions.
(Sections 1 to 5 of chapter 16 of [1])

UNIT-IV
Galois Theory: Automorphism groups and fixed fields, fundamental theorem of Galois Theory,Fundamental theorem of Algebra.
(Sections 1 to 3 of chapter 17 of [1])

UNIT-V
Applications of Galois Theory to Classical Problems: roots of unity and cyclotomic polynomials - cyclic extensions - ruler and compass constructions.
(Sections 1, 2, 5 of chapter 18 of [1])

Course learning outcome (s):
This course is able to reach the students by learning modules, fundamental theorem of Galois Theory and applications of Galois Theory to classical problems.

PRESCRIBED TEXT BOOK:

1. **Basic Abstract Algebra** by Bhattacharya P. B. Jain S. K., Nagpaul s. R, second edition, Cambridge Press.

REFERENCE BOOKS:

1. **Galois Theory** by Joseph Rotman, second edition 1998, Springer.
2. **Algebra** by Artinm, 1991, PHI.
3. **Abstract Algebra** by David S Dummit and Richard M Foote, Wiley Publications, Third Edition.

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M.Sc. MATHEMATICS

SEMESTER - III PAPER - III

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

GALOIS THEORY - 20 MAT 303

Time: 3 Hours. **Max. Marks: 60**

Answer any 5 Questions out of 10 Short Answer Questions **5X4=20M**

1. a) Define **R** - Module and a sub module.
   b) Define **R** - homomorphism and irreducible **R**-module.
   c) Define a root of polynomial and monic polynomial
   d) Show that $x^2 - 2$ is irreducible over **Z**.
   e) Define the splitting field of a polynomial and give an example.
   f) Define normal extension of a field and a prime ideal.
   g) What is meant by the fixed field of a Group homomorphism?
   h) Write a Short note on the Galois extension of a field.
   i) What is Cyclotonic polynomial? Explain with an example.
   j) Define Cyclic extension and a radical extension of a field.

Answer Five Questions choosing One question from each unit.

All Questions carry equal marks **5X8=40M**

UNIT I

2. a) Let **f** be an **R** - homomorphism of an **R** - module **M** into an **R** - module Then prove that **M / kerf ≅ f(M**)

(OR)

b) Let **R** be a ring with unity, then prove that an **R** - module **M** is cyclic iff **M ≅ R/ I**, for some left ideal **I** of **R**

UNIT II

3. a) State and prove Gauss's lemma.

(OR)

b) Define algebraic element and algebraic extension of a field. If **E** is a finite extension of a field **F**, then prove that **E** is an algebraic extension of **F**.

UNIT III

4. a) State and prove Uniqueness of splitting field.

(OR)

b) Let **f(x) ϵ F[x]** be a polynomial of degree **≥ 1** with **α** as a root, then prove that **α** is a multiple root if and only if **f ' (α) = 0.**

UNIT IV

5. a) State and prove the fundamental theorem of Galois theory.

(OR)

b) State and prove Dedekind's lemma.

UNIT V

6. a) Let **F** be a field contains a primitive $\mathbf{n^{th}}$ root unity, then prove the following are Equivalent.
   i). **E** is a finite cyclic extension of degree **n** over **F.**
   ii). **E** is the splitting field of an irreducible polynomial $\boldsymbol{x^n}$**– b ϵ F[x].**

(OR)

b) If **a** and **b** are constructible numbers, then prove that
   i) **ab** is constructible.
   ii) **a/b , b ≠ 0** is constructible

SRR & CVR GOVT.DEGREE COLLEGE (A), NAAC B^{+}

Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER-III PAPER-IV

MATHEMATICAL METHODS - 20 MAT 304

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40M & External: 60M)

Course Learning Objectives:
The aim of this course is provide the students with the basic knowledge of various mathematical methods we use like Fourier series, calculus of variation. Provide basic idea of difference equations and the Laplace Transformations.

UNIT-I:
Fourier Series: Fourier coefficients- Even and Odd functions- Cosine and Sine series- Fourier Series on arbitrary intervals.
[5.1, 5.3 and 5.4 of Text Book-1]

UNIT-II:
The Calculus of variations: Euler's Equation – Functions of the form:
$\int_{x_0}^{x_1} f(x, y_1, y_2, y_3, ..., y_n, y_1^1, y_2^1, y_3^1, ... y_n^1)dx$-Functional dependence on the higher order derivatives – Variational problems in parametric form and applications.
[Text Book-1]

UNIT-III:
Difference Equations: Introduction, Definition, Formation of difference equations, Linear difference equations, Rules for finding complementary function, Rules for finding the Particular Integral.
[From Text Book 2]

UNIT- IV:
Laplace Transforms: Existence of Laplace Transform- Functions of exponential-Shifting Theorems-Scale Property-Laplace Transform of derivatives- Initial and final value theorems-Laplace Transforms of integrals-multiplication by. t^n and division by t-Laplace Transform of periodic and some special function.
[Chapter 1 of the text book3].

UNIT- V:
Inverse Laplace Transforms: Shifting theorems and Scale Property of inverse Laplace transforms-Use of partial fractions-Inverse Laplace transforms to derivatives and integrals-multiplication and division by powers of p-convolution theorem-Heaviside's expansion theorem- complex inversion formulae.
[Chapter 2 of the Text Book3]

Course Learning Outcome (s):

From this course Student will be able to learn the Fourier series and calculus of variation techniques that are very much essential for engineering applications. Also they get exposed to difference equations and Laplace Transforms which are used widely.

Text Books:

1. **Differential Equations Theory, Technique and Practice** by George F. Simmons and Steven G. Krantz, Tata McGraw-Hill Edition.
2. **Higher Engineering Mathematics** by B.S. Grewal, Khanna Publishers.
3. **Integral Transforms** by A.R. Vashishta and R.K. Gupta, Krishna Prakashan Media (P) Ltd.

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M.Sc. MATHEMATICS

SEMESTER - III PAPER - IV

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

MATHEMATICAL METHODS - 20 MAT 304

Time: 3 Hours **Max. Marks: 60M**

Answer Any 5 Questions out of 10 Short Answer Questions. **5X4=20M**

1. a) Write the Dirichlet's conditions for a Fourier series.

b) Write the Fourier series expansion of even periodic function.

c) Write Euler's function formula

d) Define covariant vector & invariant vector.

e) Solve the difference equation Solve $y_{n+2} - 5y_{n+1} - 6y_n = 0$.

f) Find the extrimal of the functional $\{\sqrt{1 + (y')^2}\} / y$

g) Write the first and second shifting theorems of Laplace Transformations.

h) Find the Laplace transformation of $e^{2t} + 4t^3 - 2\sin 3t + 3\cos 3t$.

i) Find Inverse Laplace transformation of p/p^2-a^2

j) Find Inverse Laplace transformation of $\log(p+3/p+4)$

Answer any Five Questions choosing One Question from each Unit.

All questions carry equal marks **5X8=40M**

UNIT I

2. a) Find the Fourier series of the function $(x) = x\sin x; -\pi \le x \le \pi$.

(OR)

b) Find the Fourier series of the function $(x) = x\sin x; -\pi \le x \le \pi$. Deduce that $\frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - \ldots\ldots\ldots = \frac{\pi-2}{4}$

UNIT II

3 a) Find the curve passing through the points (x_1, y_1) and (x_2, y_2) and when rotated about the **X-** axis gives a minimum surface area.

(OR)

b) Prove that the necessary condition **for** $I = \int_{x1}^{x2} f(x, y, y')dx$ to have an extrimal is $\frac{\partial f}{\partial x} - \frac{\partial}{\partial x}\left\{\frac{\partial f}{\partial y}\right\} = 0$

UNIT III

4. a) (i) Solve $\mathbf{Y_{n+2} - 4Y_{n+1} + 3Y_n = 5^n}$

(ii) Solve $\mathbf{Y_{n+2} - 2Y_{n+1} + Y_n = n^2 2^n}$

(OR)

b) Solve the difference equation $\mathbf{u_{n+3} - 2u_{n+2} - 5u_{n+1} + 6u_n = 0}$

UNIT IV

5. a) Prove the following Hypothesis:

If **F(t)** is continuous for all $\mathbf{t \geq 0}$ and be of exponential order a as $\mathbf{t \to \infty}$ and if **F(t)** is of class **A**, then the Laplace Transformation of the derivative **F'(t)** exist when $\mathbf{P > a}$ and $\mathbf{L[F'(t)] = PL[F(t) - F(0)]}$

(OR)

b) Find the Laplace transformation of $\{e^{-at} - e^{-bt}\}$ **/ t** and $\mathbf{\{J_o(t)\}}$

UNIT V

6. a) Find the inverse Laplace transformation of the following functions

(i) $\frac{2p+1}{(p+2)^2(p-1)^2}$ **(ii)** $\frac{e^{-4p}}{(p-3)^4}$

(OR)

b) State and prove Convolution Theorem

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Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER - III PAPER - V

ANALYTICAL NUMBER THEORY - 20 MAT 305

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40 M & External: 60 M)

Course Learning Objectives:
This course is introduced to illustrate how general methods of analysis can be used to obtain results about integers and prime number

UNIT-I
Arithmetical Functions and Dirichlet Multiplication: Introduction, The Mobius function **μ(n)**, The Euler Totient function **φ(n)**, A relation connecting **φ** and **μ**, A product formula for **φ(n)**, The Dirichlet product of arithmetical functions, Dirichlet inverses and Mobius inversion formula, The Mangoldt function **Λ(n)**, Multiplicative functions, Multiplicative functions and Dirichlet multiplication, The inverse of a completely multiplicative function, Liouville's function **λ(n)**, The divisor function $\sigma_Z(n)$. Generalized convolutions.
(Sections 2.1 to 2.14 of Chapter 2)

UNIT-II
Averages of Arithmetical Functions: Introduction, The big oh notation Asymptotic equality of functions, Euler's summation formula, Some elementary asymptotic formulas, The average order of **d(n)**, The average order of divisor functions $\sigma_Z(n)$, The average order of **φ(n)**, An application to the distribution of lattice points visible from the origin, The average order of **μ(n)** and **Λ(n)**, The partial sums of a Dirichlet product, Applications to **μ(n)** and **Λ(n)**, Another identity for the partial sums of a Dirichlet product.
(Sections 3.1 to 3.12 of Chapter 3)

UNIT-III
Some Elementary Theorems on the Distribution of Prime Numbers: Introduction, Chebyshev's functions **ψ(x)** and $\vartheta(x)$**.** Relations connecting $\vartheta(x)$ and **π(x),** Some equivalent forms of the prime number theorem, Inequalities of $\pi(n)$ and p_n**,** Shapiro's Tauberian theorem, Application of Shapiro's theorem, An asymptotic formulae for the partial sums $\sum_{psk}\left(\frac{1}{p}\right)$. The Partial Sums of the Mobius function.
(Sections 4.1 to 4.9 of Chapter 4)

UNIT-IV
Congruence's: Definition and basic properties of congruences, Residue classes and complete residue systems, Linear congruences, Reduced residue systems and Euler - Fermat theorem, Polynomial congruences modulo **p**, Lagrange's theorem, Applications of Lagrange's Theorem, (Sections 5.1 to 5.5 of Chapter 5)

UNIT-V

Simultaneous linear congruences, The Chinese remainder theorem, Applications of the Chinese
(5.6 to 5.9 of Chapter 5).

Course Learning Outcome (s):

From this students are able to understand better the distribution of prime numbers, and understanding the proof of Dirichlet's Theorem.

PRESCRIBED TEXT BOOK:

1. **Introduction to Analytic Number Theory** by Tom M. Apostol, Narosa Publishing House, New Delhi.

REFERENCE BOOK:

1. **An Introduction to the Theory of Numbers** by Hardy G. H. and Wright E. M., Oxford Press

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M.Sc. MATHEMATICS

SEMESTER - III PAPER - V

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

ANALYTICAL NUMBER THEORY - 20 MAT 305

Time: 3 Hours. **Max.Marks:60M**

Answer any 5 Questions out of 10 Short Answer Questions **5X4=20M**

1. a) Define Mobius function **μ(n).**
   b) Define multiplicative function.
   c) Define the average order of **d(n**).
   d) Write the average order of **μ(n)** and **∧(n).**
   e) Define Chebyshev's functions.
   f) State Shapiro's Tauberian theorem.
   g) Write an expression of an asymptotic formula for the partial sums.
   h) Prove congruence is an equivalence relation.
   i) State Little Fermat's Theorem.
   j) Solve the congruence **5x ≡ 3(mod24).**

Answer Five Questions choosing One question from each unit.
All questions carry equal marks **5X8=40M**

UNIT I

2. a) Define the Dirichlet product. State and prove Mobius Inversion formula.

(OR)

b) Show that if both **g** and **f *g** are multiplicative, and then **f** is also multiplicative.

UNIT II

3. a) State and prove Euler's summation formula.

(OR)

b) State and prove Legendre's Identity

UNIT III

4. a) Show that the following relations are logically equivalent:

(i) $\lim_{x\to\infty} \frac{\pi(x)\log x}{x} = 1$

(ii) $\lim_{x\to\infty} \frac{\vartheta(x)}{x} = 1$

(iii) $\lim_{x\to\infty} \frac{\psi(x)}{x} = 1$

(OR)

b) State and prove Abel's Identity.

UNIT IV

5. a) State and prove Chinese Remainder Theorem.

(OR)

b) State and prove Wilson's Theorem.

UNIT V

6. a) Show that a finite Abelian group **G** of order n has exactly **n** distinct characters.

(OR)

b) Let **A*** denote the conjugate transpose of a matrix **A**, then show that **AA* = nI**, where **I** is the **n x n** identity matrix and hence n^{-1} **A*** is the inverse of **A**

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Department of Mathematics

M.Sc. (MATHEMATICS) SYLLABUS

SEMESTER-III PAPER-VI

NUMERICAL METHODS - 20 OE MAT 306

(Open Elective – II)

No. of Hours: 04 Total credits: 04
Total Marks: 100 (Internal: 40M & External: 60M)

Course Learning Objectives:
This Course is introduced a broad range of Numerical methods for solving Mathematical problems that arise in Science and Engineering and helps to choose, develop and apply the appropriate Numerical techniques for the Mathematical problems.

UNIT-I
Solution of Algebraic & Transcendental Equations: Introduction - The Bisection method - The method of false position - Newton Raphson method.
[Sections 2.1, 2.2., 2.4, 2.5 from Chapter 2 of Text Book 1].

UNIT-II
Interpolation: Finite differences - Forward differences, Backward difference, Central Differences, Symbolic relations, Differences of a polynomial, Newton's formulas for interpolation, Central Difference interpolation formulae, Gauss' central difference formulae, Sterling's formula, Lagrange's Interpolation formula.
[Sections 3.3, 3.5, 3.6, 3.71, 3.72, 3.9.1 from chapter 3 of Text Book 1].

UNIT-III
Curve fitting: Least - squares curve fitting procedures - fitting a straight line, Non - linear Curve fitting, Curve fitting by a sum of exponential.
(Sections 4.2 from chapter 4 of Text Book 1).

UNIT-IV
Numerical integration: Trapezoidal rule- Simpsons 1/3 rules, Simpson's 3/8 rule.
(Sections 5.4.1, 5.4.2, 5.4.3 from chapter 5 of Text Book 1]

UNIT-V
Numerical Solution of Ordinary Differential Equations: Solution by Taylor's series, Picard's method of successive approximations, Euler's method, modified Euler's method, Runge - Kutta method fourth order only. (Sections 7.2, 7.3, 7.4, 7.5 from chapter 7 of Text Book 1)

Course Learning Outcome(s):

From this Course Students are able to learn how to apply the Numerical method for various Mathematical operations and tasks such as Interpolation, Differentiation, Integration, the solution of Differential Equations analyze and evaluate the accuracy of common Numerical methods.

PRESCRIBED TEXT BOOK:

1. **Introductory method of Numerical Analysis** by S.S. Sastry, Third Edition, 1993, Prentice Hall of India Pvt. Ltd., New Delhi.

REFERENCE BOOK:

1. **Numerical Methods for Scientific and Engineering Computation** by M. K. Jain, S. R. K. Iyengar, R. K.Jain, New Age International (P) Limited, Publishers, 5th Edition.

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M. Sc. MATHEMATICS

SEMESTER - III PAPER - VI

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

NUMERICAL METHODS - 20 OE MAT 306

(Open Elective – II)

Time: 3 Hours **Max. Marks: 60**

Answer any 5 Questions out of 10 Short Answer Questions **5X4=20M**

1. a) Write the first and second approximation formulae of the method of false position.
b) Define Algebraic and Transcendental functions.
c) Define forward differences.
d) Show that $\mathbf{E = 1+\Delta}$
e) Write the normal equations of fitting a straight line.
f) Explain briefly the power function.
g) Write the formula of Trapezoidal rule.
h) Write the formula of Simpson's $\left(\frac{3}{8}\right)^{th}$ rule.
i) Write the Taylor's series expression for any function **y(x).**
j) Write the iterative formula of Modified Euler's method.

Answer five Questions choosing One question from each unit.
All Questions Carry equal marks **5X8=40M**

UNIT - I

2. a) Find the real root of the equation $\mathbf{x^3 - 3x - 5 = 0}$ using Newton's Raphson method.

(OR)

b) Find a real root of the equation $\mathbf{f(x) = x^3 – x – 1 = 0}$ using Bisection met

UNIT – II

3. a) The population of a town in the decimal census was as given below.

Years	**1891**	**1901**	**1911**	**1921**	**1931**
Population of Y (in Thousands)	**46**	**66**	**81**	**93**	**101**

Estimate the population for the year 1895 using Newton's backward difference interpolation formula.

(OR)

b) If **y (1) = -3, y (3) = 9, y (4) = 30 and y (6) = 132**, find the four point Lagrange's Interpolation polynomial that takes the same values as the function **y** at the given points.

UNIT – III

4. a) Fit a straight line of the form $\mathbf{y = a_0 + a_1 x}$ to the data.

x	1	2	3	4	6	8
y	2.4	3.1	3.5	4.2	5.0	6.0

(OR)

b) Fit a polynomial of the second degree to the data points given in the following table.

x	0.0	1.0	2.0
y	1.0	6.0	17.0

.

UNIT – IV

5. a) Evaluate **I** = $\int_0^1 \frac{dx}{1+x}$, correct to the three decimal places using Trapezoidal rule.

(OR)

b) Apply Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule to the integral **I** = $\int_0^1 \sqrt{1-x^2}\,dx$.

UNIT – V

6. a) Solve **y' = -y, y(0) =1**, using Euler's method.

(OR)

b) Solve $\frac{dy}{dx} = y - x$, **y (0) = 2**, find **y(0.1**) and **y(0.2), c**orrect to four decimal places using Runge-Kutta fourth order formula.

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Department of Mathematics

M.Sc. MATHEMATICS SYLLABUS

SEMESTER - III PAPER -VII

Python Lab - 20 L MAT 307

No. of Hours: 03 Total credits:00
Total Marks: 100 (Internal: 40M & External: 60M)

List of Programs:

1. Write Python Program to reverse a number and also find the Sum of digits in the reversed number. Prompt the user for input.
2. Write Python code to print all prime numbers between an interval.
3. Write Python code to check if a given year is a leap year or not.
4. Write Python code to determine whether the given string is a Palindrome or not using slicing.
5. Write Python program to add two matrices and also find the transpose of the resultant matrix.
6. Write Python program to swap two numbers without using Intermediate Temporary variables. Prompt the user for input.
7. Consider a Rectangle Class and Create Two Rectangle Objects. Write Python program to Check Whether the Area of the First Rectangle is Greater than Second by Overloading > Operator.
8. Write Python program to count the number of times an item appears in the list.
9. Write Python program to convert uppercase letters to lowercase and vice versa.
10. Write Python program to perform a linear search for a given Key number in the list and report Success or Failure.
11. Write Python program to sort numbers in a list in ascending order using Bubble Sort by passing the list as an argument to the function call.
12. Write Python program to Calculate Area and Perimeter of different shapes using Polymorphism

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M.Sc. MATHEMATICS

SEMESTER IV PAPER I

MOOCS – 20 MO MAT 401

No. of Hours : 04. **Max. Marks : 100**
Total Credits : 04. **(Internal:40M & External:60M)**

MOOCS : NPTEL / SWAYAM / NSE-NCFM Any course related to **M.Sc**. Mathematics from the authentic sources with prior permission

Typical Structure of a MOOC : The common duration of **a MOOC** is from 6 to 12 weeks. A MOOC is accessible 24 hours a day, 7 days a week. The majority of the content is to delivered asynchronously (meaning students can access it in their own time and at their own place). However, sometimes there can be optional synchronous events such as 'live' webinars (interactive sessions) which require participants to join in at a specific dates/times.

- A standard class becomes in a **MOOC** a set of videos of 5-10 minutes each
- The learning of students in a **MOOC** is usually accessed by multiple choice questions
- An important component of **MOOCS** is assignments. Students have to upload assignment solutions into the **MOOC** platform

Assignments can be evaluated and graded :

- Automatically when possible
- Peer-to-Peer students evaluate and grade themselves .
- Another component is the forum , where students post questions that other students can answer

Usually, there are no pre requisites for taking **a MOOC ,** apart from having access to a computer with an internet connection .Most of the time, the educational or a academic background of students is not important. Students usually don't need to buy any books for these courses, because all reading is either be provided with in the MOOC content or is linked to open access texts.

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M.Sc. (MATHEMATICS) SYLLABUS

SEMESTER-IV PAPER-II

INTEGRAL TRANSFORMS – 20 ET MAT 402(B)

ELECTIVE -I

No. of Hours: 04 Total credits:04
Max. Marks: 100 (Internal: 40M & External: 60M)

Course Learning Objectives:
The objective of this course is to teach students to comprehend the Laplace transforms to solve Ordinary Differential Equations, Fourier and Hankel Transforms.

UNIT-I:
Laplace Transforms: Existence of Laplace Transform - Functions of exponential – Shifting Theorems - Scale Property - Laplace Transform of derivatives - Initial and final value theorems - Laplace Transforms of integrals - multiplication by. t and division by **t** – Laplace Transform of periodic and some special function.
[Chapter1of the text book].

UNIT-II:
Inverse Laplace Transforms: Shifting theorems and change of Scale Property of inverse Laplace transforms - Use of partial fractions - Inverse Laplace transforms to derivatives and integrals - multiplication and division by powers of **p**-convolution theorem - Heaviside's expansion theorem-complex inversion formulae.
[Chapter 2 of the Text Book]

UNIT-III:
Fourier Integral formula - Fourier Transform - Inversion Theorem for Complex Fourier transform
- Fourier sine transform - Inversion formula for Fourier sine transform – Fourier cosine transform - Inversion formula for Fourier cosine transform - Linearity property of Fourier transform - Change of Scale property - Shifting Property - Modulation theorem – Theorem - Multiple Fourier Transforms – Convolution - The Convolution Theorem– Parseval's identity.
[6.3to6.19 of chapter VI of the Text Book]

UNIT- IV:
Finite Fourier sine transforms-inversion formula for sine transform-Finite Fourier cosine transform - inversion formula for cosine transform - Multiple finite Fourier transforms - Operational properties of finite Fourier sine transforms - Operational properties of finite Fourier cosine transforms - Combined properties of finite Fourier sine and cosine transforms convolution.
[7.1to7.9 of chapter VII of the Text Book]

UNIT-V:

Hankel Transforms-Inversion formula for the Hankel transform-Some important Results for Bessel Functions-Linearity Property-Hankel transform of the Derivatives of a function-Hankel transform of $\frac{d^2 f}{dx^2} + \frac{1}{x}\frac{df}{dx} - \frac{n^2}{x^2} f$ – Parseval's Theorem.

[9.1 to 9.7 of chapter IX of the Text Book]

Course Learning Outcome (s):

From this course students are able to learn how to apply the concepts of transforms in solving problems in applications of Mathematics.

Text Book:

1. Integral Transforms by A.R. Vashishta and R.K. Gupta, Krishna Prakashan Media (P) Ltd.

Reference Books:

1. Hildenbrand, Methods of Applied Mathematics, PHI. New Jersey, 1960.
2. E.O. Brigham, The Fast Fourier Transforms, Prentice Hall, New Jersey, 1988.
3. E.I. Jury, Theory and Applications of Z - Transforms Method, John Wiley, 1964.

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M.Sc. MATHEMATICS

SEMESTER-IV PAPER-II

[W.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

INTEGRAL TRANSFORMS - 20 ET MAT 402 (B)

(Elective – 1)

Time: 3 Hours. **Max. Marks: 60M**

Answer Any 5 questions out of 10 Short Answer Questions **5X4M=20M**

1 a**)** Write First and Second Shifting theorems of Laplace Transformation.

b) Find the Laplace Transformation of $\mathbf{e^{2t} + 4t^3 - 2\sin 3t + 3\cos 3t}$.

c) Find Inverse Laplace Transformation of $\mathbf{p / \{p^2 - a^2\}}$

d) Find Inverse Laplace Transformation of $\mathbf{\log [p + (3/p) + 4)]}$.

e) State and Prove Modulation Theorem.

f) Find the sine and cosine Transform of $\mathbf{2e^{-5x} + 5e^{-2x}}$

g) Define Fourier finite sine and cosine Transform.

h) Find the Fourier Cosine Transform of $\mathbf{e^{-x^2}}$

i) Define Hankel Transform.

j) Write Linearity Property.

Answer any Five Questions choosing one question from each unit.

All questions carry equal marks **5X8=40M**

UNIT I

2 a) Prove the following Hypothesis:
If **F(t)** is continuous for all $\mathbf{t \geq 0}$ and be of exponential order as $\mathbf{t \to \infty}$ and if **F(t)** is of class of **A** , then the Laplace transformation of the derivative **F'(t)** exist when $\mathbf{p > a}$ and $\mathbf{L[F'(t)] = p\, L[F(t) - F(0)]}$

(OR)

b) Find the Laplace transformation of $\frac{e^{-at} - e^{-bt}}{t}$ and $\{J_0(t)\}$

UNIT II

3 a) Find the Inverse Laplace Transformation of the following functions

(i) $\frac{2p+1}{(p+2)^2(p-1)^2}$ (ii) $\frac{e^{-4p}}{(p-3)^4}$

(OR)

b) State and Prove Heaviside's Expansion Theorem.

UNIT-III

4 a) State and Prove Inversion Theorem for complex Fourier Transform.

(OR)

b) State and Prove Convolution Theorem.

UNIT-IV

5 a) Find the Inverse Fourier Cosine Transform of $\mathbf{f(x) = e^{-x}}$

(OR)

b) Find the Inverse Fourier Sine Transform of $\mathbf{f(x)} = \frac{1-cosn\pi}{n^2\pi^2}$

UNIT-V

6 a) State and Prove Inversion Theorem of Hankel Transform

(OR)

b) State and Prove Parseval's Identity of Hankel Transform.

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Department of Mathematics

M.Sc. (MATHEMATICS) SYLLABUS

SEMESTER-IV PAPER-III

LINEAR PROGRAMMING - 20 ET MAT 403(B)

(Elective-II)

No. of Hours: 04 Total credits:04
Total Marks: 100 (Internal: 40M & External:60M)

Course Learning Objectives:
The objective of Linear programming is the linear equation which is representing some quantity which is to be maximized or minimized subject to the given constraints**.**

UNIT-I:
Overview of operations research: OR models - OR Techniques- Linear Programming- Introduction - Graphical solution - The standard form of linear programming problems- Basic feasible solutions- Unrestricted variables - Simplex Method.

UNIT-II:
Concept of Duality: Artificial variables - Big **M** and Two phase methods - Degeneracy - Alternative optima - Unbounded solutions - infeasible solutions.

UNIT-III:
Duality concept- Dual problems - Relation between primal and dual Problems Complementary slackness conditions - Dual simplex method.

UNIT-IV:
Transportation and Assignment Problems: Transportation model - Basic feasible solutions - North West corner Rule - Lowest cost method - Vogel approximation method - transportation algorithm (**MODI** - method).

UNIT-V:
Assignments problem – Description and mathematical formulation of the problem - Hungarian method.

Course Learning Outcome(s):
Students are able to learn how to formulate a given real world problem as a linear programming model and solve using simplex method and also learn transportation and assignment problems.

Text Book: Operations Research, Theory and Applications by J.K. Sharma.

Reference Books: 1. Operations Research, An Introduction- Hardy A. Taha, Seventh Edition.

2. Introduction to Operations Research- Hillier Lieberman, Tata McGraw Hill.

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M.Sc. MATHEMATICS

SEMESTER - IV PAPER - III

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

LINEAR PROGRAMMING - 20 MAT 403 (B)

(Elective – II)

Time: 3 Hours **Max. Marks: 60M**

Answer Any 5 Questions out of 10 Short Answer Questions **5X4=20M**

1. a) Write the general form of a Linear Programming Problem (LPP)

. b) With reference to an LPP define slack and surplus variables

c) Explain artificial variable of a LPP

d) Explain unbounded solution of a LPP

e) State the dual primal relation ships

f) What is meant by duality in LPP?

g) State the transportation problem in the format of a LPP

h) Explain North - West corner rule.

i) Give a mathematical formulation of the assignment problem.

j) What is an assignment problem.

Answer Five Questions Choosing One Question from each Unit.

ALL Questions carry equal Marks **5X8=40M**

UNIT I

2. a). Solve the following LPP by graphical method.

Maximize $\mathbf{Z = x_1 + 3x_2}$

Subject to constraints $\mathbf{3x_1 + 6x_2 \leq 8}$

$\mathbf{5x_1 + 2x_2 \leq 10}$ and $\mathbf{x_1, x_2 \geq 0}$.

(OR)

b). Solve the following LPP by simplex procedure.

Maximize $\mathbf{Z = 5x_1 + 3x_2}$

Subject to constraints $\mathbf{x_1 + x_2 \leq 2}$

$\mathbf{5x_1 + 2x_2 \leq 10,}$

$\mathbf{3x_1 + 8x_2 \leq 12}$ and $\mathbf{x_1, x_2 \geq 0}$

UNIT II

3. a). Solve the following LPP by Big - **M** method.

Minimize $Z = 4x_1 + 3x_2$

Subject to constraints $2x_1 + x_2 \geq 10$

$-3x_1 + 2x_2 \leq 6$

$x_1 + x_2 \geq 6$ **and** $x_1, x_2 \geq 0$

(OR)

b). Use Two - phase simplex method. to

Minimize $Z = 3x_1 + 2x_2$

Subject to constraints $2x_1 + x_2 \leq 2$

$3x_1 + 4x_2 \geq 12$ **and** $x_1, x_2 \geq 0$

UNIT III

4. a). Use dual simplex method to solve the following LPP.

Minimize $Z = x_1 + 2x_2 + 3x_3$

Subject to constraints $x_1 - x_2 + x_3 \geq 4$

$x_1 + x_2 + 2x_3 \leq 18$

$x_2 - x_3 \geq 2$ **and** $x_1, x_2, x_3 \geq 0$.

(OR)

b). Use complementary slackness conditions to solve the following LPP:

Minimize $Z = 3x_1 + x_2$

Subject to constraints $x_1 + x_2 \geq 1$;

$2x_1 + 3x_2 \geq 2$; $x_1, x_2 \geq 0$

UNIT IV

4. a). Solve the following TP by considering the initial feasible solution by Vogel's approximation method.

	M_1	M_2	M_3	M_4	Supply
A	6	3	5	4	22
B	5	9	2	7	15
C	5	7	8	6	8
Demand	7	12	17	9	

(OR)

b). Find the optimal solution to the following transportation problem obtaining the initial basic feasible solution by North - West Corner rule.

	M_1	M_2	M_3	M_4	Supply
A	7	9	3	2	16
B	4	4	3	5	14
C	6	4	5	8	20
Demand	11	9	22	8	

UNIT V

5. a). Describe an algorithm for the solution of the assignment problem.

(OR)

b). Solve the following assignment problem represented by the following matrix.

	A	B	C	D
1	10	25	15	20
2	15	30	5	15
3	35	20	12	24
4	17	25	24	20

SRR & CVR GOVT.DEGREE COLLEGE (A), NAAC B^{+}

Department of Mathematics

M.Sc. (MATHEMATICS) SYLLABUS

SEMESTER-IV PAPER-IV

FUNCTIONAL ANALYSIS – 20 MAT 404

No. of Hours: 04 Total credits:04
Total Marks: 100 (Internal: 40M & External:60M)

Course Learning Objectives:
The Objective of the course is to introduce students to the ideas and some of the fundamental theorems of functional analysis on Banach Spaces, Hilbert Spaces & fixed point theory.

UNIT-I

Banach Spaces: Normed space – Banach space – properties of normed spaces – Finite dimensional normed spaces and subspaces – Compactness and finite dimension – Linear operators – Bounded and continuous linear operators – Linear functional - Linear operators and functional on finite dimensional spaces – Normed spaces of operators – Dual space. [2.2 – 2.10 of Text Book]

UNIT-II

Hilbert Space: Inner product space – Hilbert space – Properties of inner product spaces – Orthogonal complements and direct sums – Orthonormal sets and Sequences - Series related to orthonormal sequences and sets.

[3.1-3.5 of Text Book]

UNIT-III

Proper ties of Hilbert Space: Total orthonormal sets and sequences – Representation of functional on Hilbert spaces – Hilbert-Adjoint operator – Self Adjoint, unitary and normal operators.

[3.6 and 3.8-3.10 of Text Book]

UNIT-IV

Fundamental Theorems: Hahn Banach theorem for complex vector spaces and normed spaces– Adjoint operator – Reflexive space – Uniform boundedness theorem – Open mapping theorem – Closed graph theorem.

[4.3, 4.5-4.7, 4.12 and 4.13 of Text Book]

UNIT-V

Fixed point Theory: The Contraction mapping theorem and its application, Brower's fixed point theorem without proof and its applications, Schauder's fixed point theorem without proof and some related results.

[5.1 to 5.4 of Text Book]

Course Learning Outcome (s):

From this course students will be able to learn and apply the ideas from the theory of Banach Spaces, Hilbert Spaces & Fixed Point Theory.

Prescribed Text Book:

1. **Introductory Functional Analysis with Applications** by Erwin Kreyszig, John Wiley & Sons, 1989.

Reference Books:

1. **Introduction to Topology and Modern Analysis** by G. F. Simmons, McGraw-Hill Edition.
2. **Introduction to Functional analysis,** by E. Taylor, Wiley International Edition.
3. **First Course in Functional analysis,** by C. Goffman and G. Pedrick, 1991, Prentice Hall of IndiaPrivate Limited.
4. **Functional Analysis** by B.V. Limaye, New Age International Publishers, Third Edition.

SRR & CVR GOVT. DEGREE COLLEGE (A), NAAC B^{+}

M.Sc. MATHEMATICS

SEMESTER - IV PAPER - IV

[w.e.f. 2020 - 21 Admitted Batch]

[Question paper pattern for semester end (External) examination]

FUNCTIONAL ANALYSIS - 20 MAT 404

Time: 3 Hours. **Max.Marks:60M**

Answer any 5 Questions out of 10 Short Answer Questions 5X4M=20M

1. a) State Schwarz inequality and Triangle Inequality.
   b) Define inner product space & orthogonality.
   c) Define Hilbert space and Banach space.
   d) State Baire's Category Theorem in Complete metric space.
   e) Define Total Orthonormal Set.
   f) Define Hilbert - Adjoint operator.
   g) Define reflexive space.
   h) Define Closed - Linear operator.
   i) Define Contraction **T** on a metric space.
   j) Define Fred Holm and Volterra integral equations.

Answer any 5 Questions choosing One question from each unit.
All questions carry equal marks. 5X8=40M

UNIT I

2. a) Show that every finite dimensional subspace **Y** of a normal space **X** is complete. In particular, every finite dimensional normed space is complete.

(OR)

b) If **Y** is a Banach space then, prove that (the set of all bounded linear operators from **X** into **Y**) **B(X, Y**) is a Banach space.

UNIT II

3. a) State and prove Bessel's Inequality.

(OR)

b) State and prove Minimizing vector Theorem.

UNIT III

4. a) State and prove Riesz - Representation Theorem.

(OR)

b) Let the Operators **U: H → H and V: H → H** be unitary and **H** is Hilbert space. Then prove that a bounded linear operator **T** on a complete Hilbert space **H** is unitary if and only if **T** is isomeric and surjective.

UNIT IV

5. a) State and prove Generalized Hahn - Banach Theorem.

(OR)

b) State and prove Open Mapping Theorem.

UNIT V

6. a) State and prove Banach fixed point theorem.

(OR)

b) State and prove Picard's Existence and Uniqueness theorem.

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M.Sc. MATHEMATICS
SEMESTER –IV PAPER - V

MEASURE AND INTEGRATION – 20 MAT 405

No. of Hours: 04 **Total credits: 04**
Max.Marks: 100 **(Internal: 40 M & External: 60 M)**

Course Learning Objectives:
The objectives of the course are to acquire the basic knowledge of measure theory needed to understand functional analysis.

UNIT-I
Lebesgue Measure: Introduction, Outer measure, Measurable sets and Lebesgue measure, A non- measurable set, Measurable functions, Little wood‟s three principles.
(Chapter 3)

UNIT-II
The Lebesgue Integral: The Riemann Integral, The Lebesgue Integral of a bounded function over a set of finite measure, The Integral of a non- negative function Integral. (Sections 4.1 to 4.4 of Chapter 4).

UNIT-III
Differentiation and Integration: Differentiation of monotone functions, Functions of bounded variation, Differentiation of an Integral, Absolute continuity. (Sections 5.1 to 5.4 of Chapter 5)

UNIT-IV
Measure and Integration: Measure spaces, Measurable functions, Integration, General Convergence theorems, Signed Measures, The Radon-Nikodym theorem.(Sections 11.1 to 11.6 of Chapter 11)

UNIT-V
Measure and Outer Measure: Outer Measure and Measurability, The Extension theorem, Product measures.
(Sections 12.1, 12.2 & 12.4 of Chapter 12).

Course Learning Outcome(s):
From this course students are able to learn the concepts of measure theory and differentiation and integration of naonotone functions.

PRESCRIBED BOOK:

1. **Real Analysis** by H.L. Royden, Third Edition, Pearson pub.

REFERENCE BOOKS:

1. **Measure Theory** by P. R. Halmos, 1974, Springer-Verlag.
2. **Measure Theory** by V.I. Bogachev, 1997, Springer-Verlag.

S.R.R & C.V.R GOVT DEGREE COLLEGE (A), VJA.
M.Sc. MATHEMATICS
SEMESTER –IV PAPER - V
[w.e.f. 2020 - 21 Admitted Batch]
[Question paper pattern for semester end (External) examination

MEASURE AND INTEGRATION 20 MAT 405

Time: 3 Hours **Max.Marks:60M**

Answer any 5 questions out of 10 short answer questions **5X4=20M**

1.a) Define Outer measure
b) State Fatou's Lemma.
c) State bounded Convergence Theorem
d) State Jordan decomposition theorem.
e) State Radon Nikodym Theorem.
f) Define Measurable set.
g) Define Countable set.
h) Define Product measure.
i) Define Measurability.
j) Define Positive set and Negative set.

Answer Five Questions. Choose one Question from each Unit.
ALL Questions carry equal Marks

5X8=40M

UNIT I

2. (a) State and Prove Egoroff's theorem.

(OR)

(b) If{ En} is a decreasing sequence of measurable sets with mE1 finite, then Show that m(En) = lim m(En).

UNIT II

3. (a) State and Prove Lebesgue convergence theorem

(OR)

(b) Let f be a non negative function which is integrable over a set E. Then Show that given $\epsilon > 0$, there is a $\delta > 0$ such that for every set A E with $mA < \delta$, $f < \epsilon$ A.

UNIT III

4. (a) State and Prove Vitali Covering Lemma.

(OR)

(b) If f is absolutely continuous on [a,b] and f1(x)=0 a.e., then show that f is constant.

UNIT IV

5. (a) Define positive set and negative set with respect to a signed measure γ.Prove that the union of countable collection of positive sets is positive.

(OR)

(b) State and prove the Jordan Decomposition Theorem.

UNIT V

6. (a)State and prove the Caratheodary Extension Theorem.

(OR)

(b)State and prove Fubini's Theorem.

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Department of Mathematics

M.Sc. (MATHEMATICS) SYLLABUS

SEMESTER-IV PAPER-VI

SEMINAR - 20 SM MAT 406

No. of Hours: 06 Total credits: 03
Total Marks: 100 (Internal: 50M & External: 50M)

The student will be given seminar topics at the beginning of the IV semester by faculty In-charge and the student has to present the topics, submit the hard copy of seminar topicreport at the end of the IV semester. Out of a total of 100 marks, for the Seminar Evaluation, 50 marks shall be for Seminar report/record and 50 marks for the End Semester Examination (Viva - Voce). The Viva - Voce shall be conducted by a committee consisting of HOD, faculty in charge and a senior faculty member/external examiner nominated by the university.