V.V. VANNIAPERUMAL COLLEGE FOR WOMEN

(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Re-accredited with 'A' Grade (3rd Cycle) by NAAC
VIRUDHUNAGAR - 626 001

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM REGULATIONS AND SYLLABUS
(with effect from Academic Year 2020 - 2021)

V.V.Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 20 UG Programmes, 14 PG Programmes, 6 M.Phil. Programmes and 6 Ph.D. Programmes. The curriculums for all these Programmes, except Ph.D. Programmes, have been framed as per the guidelines given by the University Grants Commission (UGC) under Choice Based Credit System (CBCS) and the guidelines for Outcome Based Education (OBE).

The Departments of Commerce, English, History, Mathematics, Biochemistry and Tamil upgraded as Research Centres offer Ph.D. Programmes as per the norms and regulations of Madurai Kamaraj University, Madurai and do not come under the purview of CBCS.

A. CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed Courses. The CBCS is followed as per the guidelines formulated by the UGC. The performance of students is evaluated based on the uniform grading system. Computation of the Cumulative Grade Point Average (CGPA) is made to ensure uniformity in evaluation system.

List of Programmes in which CBCS/Elective Course System is implemented

UG PROGRAMMES

Arts & Humanities	:	History (E.M. & T.M.), English, Tamil
Physical & Life Sciences	:	Mathematics, Zoology, Chemistry, Physics, Biochemistry, Home Science - Nutrition and Dietetics, Costume Design and Fashion, Microbiology, Biotechnology, Computer Science, Information Technology and Computer Applications.
Commerce & Management	:	Commerce, Commerce (Computer Applications), Commerce (Professional Accounting), Business Administration.

PG PROGRAMMES

Arts & Humanities	:	History, English, Tamil
Physical & Life Sciences	:	Mathematics, Physics, Biochemistry, Home Science - Nutrition and Dietetics, Chemistry, Zoology, Computer Science, Information Technology, Computer Applications (MCA*)
Commerce & Management	:	Commerce, Business Administration (MBA*)

* AICTE approved Programmes

PRE-DOCTORAL PROGRAMMES (M.Phil.)

Arts & Humanities	:	History, English, Tamil
Physical & Life Sciences	:	Mathematics, Biochemistry
Commerce & Management	:	Commerce

OUTLINE OF CHOICE BASED CREDIT SYSTEM - PG

1. Core Courses
2. Project
3. Elective Courses
   - 3.1 Discipline Specific Elective Courses (DSEC)
   - 3.2 Non Major Elective Course (NMEC)
4. Online Course – Practice for SET/NET – General Paper
5. Extra Credit Courses (Optional)

List of Non Major Elective Courses (NMEC) Offered

PG PROGRAMMES

Name of the Course	Semester	Department
History of Freedom Movement in India (A.D. 1885 - 1947)	III	History
English for Job Aspirants	III	English
தமிழும் பிறதுறைகளும்	III	Tamil
Taxation Concepts and Assessment	III	Commerce
Entrepreneurship	III	Business Administration
Mathematics for Competitive Examinations	III	Mathematics
Digital Electronics	III	Physics
Chemistry for Competitive Examinations	III	Chemistry
Apiculture	III	Zoology
Nutrition and Health	III	Home Science - Nutrition and Dietetics
Clinical Biochemistry	III	Biochemistry
Web Programming	III	Computer Science
Fundamentals of Information Technology	III	Information Technology
Web Technology	III	Computer Applications

B. OUTCOME BASED EDUCATION (OBE) FRAMEWORK

The core philosophy of Outcome Based Education rests in employing a student - centric learning approach to measure the performance of students based on a set of pre-determined outcomes. The significant advantage of OBE is that it enables a revamp of the curriculum based on the learning outcomes, upgrade of academic resources, quality enhancement in research and integration of technology in the teaching-learning process. It also helps in bringing clarity among students as to what is expected of them after completion of the Programme in general and the Course in particular. The OBE directs the teachers to channelise their teaching methodologies and evaluation strategies to attain the Programme Educational Objectives (PEOs) and fulfill the Vision and Mission of the Institution.

Vision of the Institution

The founding vision of the Institution is to impart Quality Education to the rural womenfolk and to empower them with knowledge and leadership quality.

Mission of the Institution

The mission of the Institution is to impart liberal education committed to quality and excellence. Its quest is to mould learners into globally competent individuals instilling in them life-oriented skills, personal integrity, leadership qualities and service mindedness.

B.1 Programme Educational Objectives, Programme Outcomes and Programme Specific Outcomes

It is imperative for the Institution to set the Programme Educational Objectives (PEOs), Programme Outcomes (POs) and Course Outcomes (COs), consistent with its Vision and Mission statements. The PEOs and the POs should be driven by the Mission of the Institution and should provide distinctive paths to achieve the stated goals. The PEOs for each Programme have to fulfill the Vision and Mission of the Department offering the Programme.

Vision of the Department of Mathematics

To impart intensive knowledge and skills to rural students through quality education and to provide an environment where students become competent users of Mathematics in other disciplines.

Mission of the Department of Mathematics

To empower the students with profound knowledge in Mathematics, logical reasoning and analytical skills, to induce their passion for research and lifelong learning with a focus on moral values and social ethics.

B.1.1 Programme Educational Objectives (PEOs)

PEOs are broad statements that describe the career and professional achievements that the Programme is preparing the graduates to achieve within the first few years after graduation. PEOs are framed for each Programme and should be consistent with the Mission of the Institution.

The students will be able to

- become successful teachers in schools and Colleges, Bank officers, government officials, Statisticians and IT professionals.
- apply mathematical skills in analyzing and solving problems in real life situations.

- develop independent thinking for continuous learning and productive research contributions that would help in building a better nation

Key Components of Mission Statement	PEO1	PEO2	PEO3
Profound knowledge in Mathematics	✓	✓	✓
Logical reasoning and analytical Skills	✓	✓	✓
Focus on moral and ethical values	✓	-	✓
Passion for Research	-	-	✓

B.1.2 Programme Outcomes (POs)

POs shall be based on Graduate Attributes (GAs) of the Programme. The GAs are the attributes expected of a graduate from a Programme in terms of knowledge, skills, attitude and values. The Graduate Attributes include Disciplinary Knowledge, Communication Skills, Critical Thinking, Problem Solving, Analytical Reasoning, Research Related Skills, Co-operation/Team Work, Scientific Reasoning, Reflective Thinking, Information/Digital Literacy, Multicultural Competence, Moral and Ethical Awareness/Reasoning, Leadership Qualities and Lifelong Learning.

On successful completion of the Programme, the students will be able to

1 apply their in depth domain knowledge and practical skills in interdisciplinary fields for research-based endeavours, employment and entrepreneurship development. (*Disciplinary Knowledge)*

2 communicate proficiently and confidently with the ability to present complex ideas in a concise manner to assorted groups. (*Communication Skills*)

3 identify, formulate and solve problems in a consistent and systematic way with updated skills using modern tools and techniques. (*Scientific Reasoning and Problem Solving*)

4 analyze the data, synthesise the findings and provide valid conclusion by critical evaluation of theories, policies and practices for the betterment of society. (*Critical Thinking and Analytical Reasoning*)

5 explore and evaluate globally competent research methodologies to apply appropriately in interdisciplinary research; Develop and sustain the research capabilities to meet the emerging needs for the welfare of the society. (*Research Related Skills*)

6 use ICT to mould themselves for lifelong learning activities to face career challenges in the changing environment. (*Digital Literacy, Self - directed and Lifelong Learning*)

7 self-manage and function efficiently as a member or a leader in diverse teams in a multicultural society for nation building. (*Co-operation/Team Work and Multicultural Competence*)

8 uphold the imbibed ethical and moral values in personal, professional and social life for sustainable environment. (*Moral and Ethical Awareness*)

B.1.3 ProgrammeSpecific Outcomes (PSOs)

Based on the Programme Outcomes, Programme Specific Outcomes are framed for each PG Programme**.** ProgrammeSpecific Outcomes denote what the students would be able to do at the time of graduation. They are Programme-specific and it is mandatory that each PO should be mapped to the respective PSO.

On successful completion of M.ScProgramme, the students will be able to

PO 1: Disciplinary Knowledge

PSO 1.a: Apply the in-depth knowledge of theoretical concepts of mathematics in Research activities.

PSO 1.b: Apply the comprehensive knowledge and skill acquired in advanced mathematical courses to be employed in various sectors of the economy.

PO 2: Communication Skills

PSO 2: Communicate effectively on advanced mathematical concepts, comprehend and write reports and design documents of data to suit the needs of business concerns, institution or organization.

PO 3: Scientific Reasoning and Problem Solving

PSO 3: Apply the knowledge of advanced mathematics to formulate real life problems into mathematical models and find solution to the problems using appropriate mathematical techniques.

PO 4: Critical thinking and analytical reasoning

PSO 4.a: Apply the skill of logical and analytical reasoning in advanced mathematics to reach substantial conclusions in facing career challenges.

PSO 4.b: Employ advanced mathematical methods to various sectors considering the limits in scientific, technological, social, economical and environmental aspects.

PO 5: Research related Skills

PSO 5: Formulate need based mathematical research problems and apply appropriate research methodologies by exploring interdisciplinary research opportunities

PO 6: Digital Literacy, Self-directed Lifelong Learning

PSO 6: Engage in independent and lifelong learning in broad context of technological change.

PO 7: Cooperation/Team Work and Multi-cultural Competence

PSO 7: Demonstrate the knowledge of mathematics with team spirit in diverse environment to bring multicultural richness in mathematics.

PO 8: Moral and Ethical awareness

PSO 8: Apply ethical principles of mathematics and be committed to professional ethics and responsibilities.

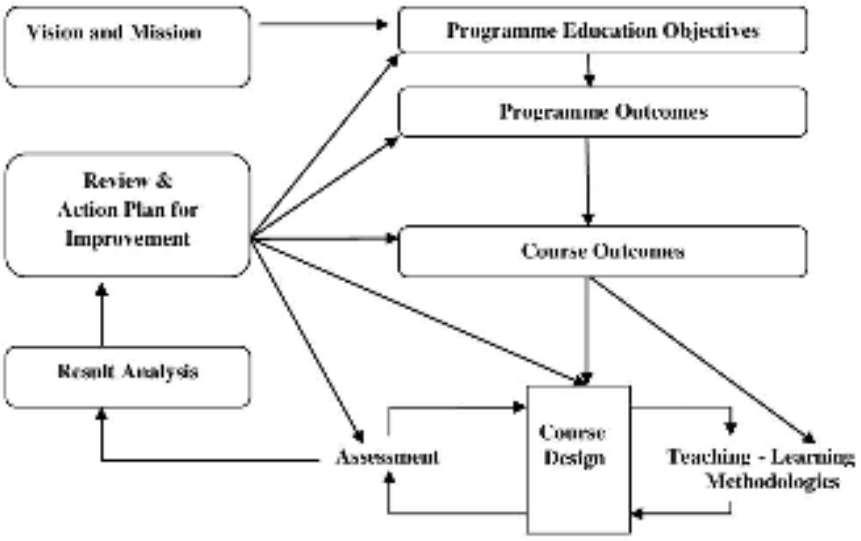
PO-PEO Mapping Matrix

Attainment of PEOs can be measured by a PO-PEO matrix. PEOs should evolve through constant feedback from alumnae, students, industry, management, *etc*. It is mandatory that each PEO should be mapped to at least one of the POs.

POs PEO / PSOs	PEO1	PEO2	PEO3
PO1/PSO1	✓	✓	✓
PO2/PSO2	✓	✓	✓
PO3/PSO3	✓	✓	✓
PO4/PSO4	✓	✓	✓
PO5/PSO5	✓	✓	✓
PO6/PSO6	✓	✓	✓
PO7/PSO7	✓	✓	✓
PO8/PSO8	-	✓	✓

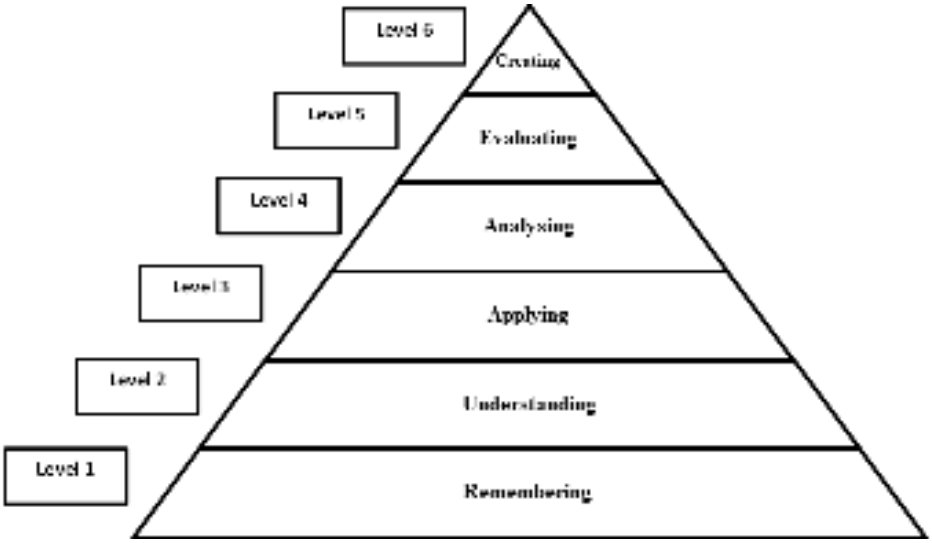
B.1.4 Course Outcomes (COs)

Course Outcomes are narrow statements restricted to the course contents given in five units. Course Outcomes describe what students would be capable of, after learning the contents of the Course. They reflect the level of knowledge gained, skills acquired and attributes developed by the students after learning of Course contents. COs are measurable, attainable and manageable in number. COs contribute to attain POs in such a way that each CO addresses at least one of the POs and also each PO is reasonably addressed by adequate number of COs.



It is important to determine the methods of assessment. A comprehensive assessment strategy may be outlined using the revised Bloom's Taxonomy levels.

BLOOM'S TAXONOMY



CO - PO Mapping of Courses

After framing the CO statements, the COs framed for each course is mapped with POs based on the relationship that exists between them. The COs which are not related toany of the POs is indicated with (-), signifying Nil. Measurement Mapping is based on Four Points Scale [High (H), Medium (M), Low (L) and Nil (-)]. For calculating weighted percentage of

contribution of each Course in the attainment of the respective POs, the weights assigned for H, M and L are 3, 2 and 1 respectively.

CO-PO/PSO Mapping Table (Course Articulation Matrix)

PO/PSOs / COs	PO1/ PSO1	PO2/ PSO2	PO3/ PSO3	PO4/ PSO4	PO5/ PSO5	PO6/ PSO6	PO7/ PSO7	PO8/ PSO8
CO1								
CO2								
CO3								
CO4								
CO5								

ELIGIBILITY FOR ADMISSION

The candidate should have passed in B.Sc. Mathematics or B.Sc. Mathematics with Computer Applications of any recognized university.

DURATION OF THE PROGRAMME

The candidates shall undergo the prescribed Programme of study for a period of two academic years (four semesters).

MEDIUM OF INSTRUCTION

English

B.2 EVALUATION SCHEME

Components	Internal Assessment Marks	External Examination Marks	Total Marks
Theory/Project	40	60	**100**

B.2.1Core Courses, Discipline Specific Elective Courses &Non Major Elective Course

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	25
Assignment	:	5
Seminar	:	10
Total	**:**	**40**

Three Periodic Tests - Average of the best two will be considered
Two Assignments - Better of the two will be considered

Question Pattern for Periodic Test **Duration: 2 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Max. Marks
A Q.No.(1 - 5)	MCQ	5	5	1	5
B Q.No.(6-10)	Internal Choice - Either Or Type	5	5	5	25
C Q.No.(11-13)	Open Choice	3	2	10	20
				Total	**50***

*The total marks obtained in the Periodic Test will be calculated for 25 marks

EXTERNAL EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A Q.No.(1 - 5)	MCQ	5	5	1	5
B Q.No.(6-10)	Internal Choice- Either Or Type	5	5	5	25
C Q.No.(11-15)	Open Choice	5	3	10	30
Total					**60**

B.2.2 Project

Project is compulsory for II PG Students in IV Semester.

Distribution of Marks

Mode of Evaluation		Marks
Internal Assessment	:	40
External Examination	:	60
Total	:	**100**

Internal Assessment: Pre-submission Presentation- 10 Marks

Review Report - 20 Marks

One Open Online Course related to the Project - 10 Marks

External Examination: Review Report - 40 Marks

Viva Voce - 20 Marks

B.2.3 Online Course

Practice for SET/NET - General Paper

Internal Examination only

- Online Test with Multiple Choice Questions will be conducted in III Semester.
- Model Examination will be conducted after two periodic tests.

Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	40
Model Examination	:	60
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.4 Extra Credit Courses

- One credit is allotted for each Extra Credit Course offered by the Department.
- Extra credits are allotted for the completion of Open Online Courses offered by MOOC to the maximum of 15 credits.
  - The Courses shall be completed within the first III Semesters of the Programme.
  - The allotment of credits is as follows

4 weeks Course	- 1 credit
8 weeks Course	- 2 credits
12 weeks Course	- 3 credits

ELIGIBILITY FOR THE DEGREE

The candidate will not be eligible for the Degree without completing the prescribed Courses of study and a minimum of 50% Pass marks in all the Courses.

- No Pass minimum for Internal Assessment for other Courses.
- Pass minimum for External Examination is 27 marks out of 60 marks for Core Courses, Discipline Specific Elective Courses and Non Major Elective Course.
- Pass minimum for Practice for SET/NET - General Paper is 50 Marks.

ATTENDANCE

- The students who have attended the classes for 76 days (85%) and above are permitted to appear for the Summative Examinations without any condition.
- The students who have only 60-75 days (66% - 84%) of attendance are permitted to appear for the Summative Examinations after paying the required fine amount and fulfilling other conditions according to the respective cases.
- The students who have attended the classes for 59 days and less – upto 45 days (50% - 65%) can appear for the Summative Examinations only after getting special permission from the Principal.
- The students who have attended the classes for 44 days or less (<50%) cannot appear for the Summative Examinations and have to repeat the whole semester.

- These rules are applicable to UG, PG and M.Phil. Programmes and come into effect from 2020-2021 onwards.
- For Certificate, Diploma, Advanced Diploma and Post Graduate Diploma Programmes, the students require 75% of attendance to appear for the Theory/Practical Examinations.

B.3 ASSESSMENT MANAGEMENT PLAN

An Assessment Management Plan that details the assessment strategy both at the Programme and the Course levels is prepared. The continuous assessment is implemented using an assessment rubric to interpret and grade students.

B.3.1 Assessment Process for CO Attainment

Assessment is one or more processes carried out by the institution that identify, collect and prepare data to evaluate the achievement of Course Outcomes and Programme Outcomes. Course Outcome is evaluated based on the performance of students in the Continuous Internal Assessments and in End Semester Examination of a course. Target levels of attainment shall be fixed by the Course teacher and Heads of the respective departments.

Direct Assessment (Rubric based) - Conventional assessment tools such as Term Test, Assignment, Quiz and End Semester Summative Examination are used.

Indirect Assessment - Done through Course Exit Survey.

CO Assessment Rubrics

For the evaluation and assessment of COs and POs, rubrics are used. Internal assessment contributes 40% and End Semester assessment contributes 60% to the total attainment of a CO for the theory courses. For the practical courses, internal assessment contributes 50% and Semester assessment contributes 50% to the total attainment of a CO. Once the Course Outcome is measured, the PO can be measured using a CO-PO matrix.

CO Attainment

Direct CO Attainment

Course Outcomes of all courses are assessed and the CO - wise marks obtained by all the students are recorded for all the assessment tools. The respective CO attainment level is evaluated based on set attainment rubrics.

Attainment Levels of COs

Assessment Methods	Attainment Levels	
Internal Assessment	Level 1	50% of students scoring more than average marks or set target marks in Internal Assessment tools
	Level 2	55% of students scoring more than average marks or set target marks in Internal Assessment tools
	Level 3	60% of students scoring more than average marks or set target marks in internal Assessment tools
End Semester Summative Examination	Level 1	50% of students scoring more than average marks or set target marks in End Semester Summative Examination
	Level 2	55% of students scoring more than average marks or set target marks in End Semester Summative Examination
	Level 3	60% of students scoring more than average marks or set target marks in End Semester Summative Examination

Target Setting for Assessment Method

For setting up the target of internal assessment tools, 55% of the maximum mark is fixed as target. For setting up the target of End Semester Examination, the average mark of the class shall be set as target.

Formula for Attainment for each CO

Attainment = Percentage of students who have scored more than the target marks

$$\text{Percentage of Attainment} = \frac{\text{Number of Students who Scored more than the Target}}{\text{Total Number of Students}} \times 100$$

Indirect CO Attainment

At the end of each Course, an exit survey is conducted to collect the opinion of the students on attainment of Course Outcomes. A questionnaire is designed to reflect the views of the students about the attainment of Course Outcomes.

Overall CO Attainment=75% of Direct CO Attainment + 25 % of Indirect CO Attainment

In each Course, the level of attainment of each CO is compared with the predefined targets. If the target is not reached, the Course teacher takes necessary steps for the

improvement to reach the target.

For continuous improvement, if the target is reached, the Course teacher can set the target as a value greater than the CO attainment of the previous year.

B.3.2 Assessment Process for Overall PO Attainment

With the help of CO against PO mapping, the PO attainment is calculated. PO assessment is done by giving 75% weightage to direct assessment and 25% weightage to indirect assessment. Direct assessment is based on CO attainment, where 75% weightage is given to attainment through End Semester examination and 25% weightage is given to attainment through internal assessments. Indirect assessment is done through Graduate Exit Survey and participation of students in Co-curricular/Extra curricular activities.

PO Assessment Tools

Mode of Assessment	Assessment Tool	Description
Direct Attainment (Weightage -75%)	CO Assessment	This is computed from the calculated CO Attainment value for each Course
Indirect Attainment (Weightage - 25%)	Graduate Exit Survey 10%	At the end of the Programme, Graduate Exit Survey is collected from the graduates and it gives the opinion of the graduates on attainment of Programme Outcomes
	Co-curricular / Extra curricular activities 15%	For participation in Co-curricular/Extra curricular activities during the period of their study.

Programme Articulation Matrix (PAM)

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Average Direct PO Attainment									
Direct PO Attainment in percentage									

Indirect Attainment of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Graduate Exit Survey								
Indirect PO Attainment								

Attainments of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Direct Attainment(Weightage - 75%)								
Indirect Attainment(Weightage - 25%)								
Overall PO Attainment								

Overall PO Attainment= [75% of Direct PO Attainment +25%of Indirect PO Attainment (Graduate Exit Survey Participation in Co- curricular andExtra curricular Activities)]

Expected Level of Attainment for each of the Programme Outcomes

POs	Level of Attainment
Value >= 70%	Excellent
Value > = 60 % and Value < 70%	Very Good
Value > = 50 % and Value < 60%	Good
Value > = 40% and Value < 50%	Satisfactory
Value < 40%	Not Satisfactory

Level of PO Attainment

Graduation Batch	Overall PO Attainment (in percentage)	Whether Expected Level of PO is Achieved? (Yes/No)

B.3.3 Assessment Process for PEOs

The curriculum is designed so that all the courses contribute to the achievement of PEOs. The attainment of PEOs is measured after 3 years of completion of the Programme only through Indirect methods.

Target for PEO Attainment

Assessment Criteria	Target (UG)	Target (PG)
Record of Employment	25 % of the class strength	30 % of the class strength
Progression to Higher Education	40 % of the class strength	5 % of the class strength
Record of Entrepreneurship	2 % of the class strength	5 % of the class strength

Attainment of PEOs

Assessment Criteria&Tool	Weightage
Record of Employment	10
Progression to Higher Education	20
Record of Entrepreneurship	10
Feedback from Alumnae	30
Feedback from Parents	10
Feedback from Employers	20
Total Attainment	**100**

$$\text{Percentage of PEO Attainment from Employment} = \frac{\text{Number of Students who have got Employment}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Higher Education} = \frac{\text{Number of Students who pursue Higher Education}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Entrepreneurship} = \frac{\text{Number of Students who have become Entrepreneurs}}{\text{Target}} \times 100$$

Expected Level of Attainment for each of the Programme Educational Objectives

POs	Level of Attainment
Value >= 70%	Excellent
Value > = 60 % and Value < 70%	Very Good
Value > = 50 % and Value < 60%	Good
Value > = 40% and Value < 50%	Satisfactory
Value < 40%	Not Satisfactory

Level of PEO Attainment

Graduation Batch	Overall PEO Attainment (in percentage)	Whether Expected Level of PEO is Achieved? (Yes/No)

C. PROCESS OF REDEFINING THE PROGRMME EDUCATIONAL OBJECTIVES

The college has always been involving the key stake holders in collecting information and suggestions with regard to curriculum development and curriculum revision. Based on the information collected, the objectives of the Programme are defined, refined and are inscribed in the form of PEOs. The level of attainment of PEOs defined earlier will be analysed and will identify the need for redefining PEOs. Based on identified changes in terms of curriculum, regulations and PEOs, the administrative system like Board of Studies, Academic Council and Governing Body may recommend appropriate actions. As per the Outcome Based Education Framework implemented from the Academic Year 2020 -2021, the following are the Programme Structure, the Programme Contents and the Course Contents of M.ScMathematics Programme.

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MASTER OF SCIENCE - MATHEMATICS (7013)

Outcome Based Education with Choice Base Credit System
Programme Structure - Allotment of Hours and Credits
For those who join in the Academic Year 2020-21

Components	Semester				Total Number of Hours (Credits)
	I	II	III	IV	
Core Course	6(4)	6(4)	6(5)	6(5)	24(18)
Core Course	6(4)	6(4)	6(5)	6(5)	24(18)
Core Course	6(4)	6(4)	6(5)	6(5)	24(18)
Core Course	6(4)	6(4)	6(5)	-	18(13)
Project	-	-	-	6(5)	6(5)
Discipline Specific Elective Course	6(4)	6(4)	-	6(5)	18(13)
Non Major Elective Course	-	-	5(4)	-	5(4)
Online Course	-	-	1(1)	-	1(1)
Total	**30 (20)**	**30 (20)**	**30 (25)**	**30 (25)**	**120 (90)**
Extra Credit Course (Optional) - offered by the Department	-	-	0(2)	-	0(2)
Extra Credit Course (Optional) - MOOC	-	-	-	-	Limited to a maximum of 15 credits

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MASTER OF MATHEMATICS
Programme Code – 7013
PROGRAMME CONTENT
M.Sc. Mathematics - SEMESTER I

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course -1	Groups and Rings	20PMTC11	6	4	3	40	60	100
2	Core Course -2	Analysis	20PMTC12	6	4	3	40	60	100
3	Core Course -3	Differential Geometry	20PMTC13	6	4	3	40	60	100
4	Core Course -4	Mathematical Methods	20PMTC14	6	4	3	40	60	100
5	DSEC-1	DSEC - Numerical Analysis/ Modern Applied Algebra/ Mechanics	20PMTE11/ 20PMTE12/ 20PMTE13	6	4	3	40	60	100
			Total	30	20				500

DSEC - Discipline Specific Elective Course

M.Sc. Mathematics - SEMESTER II

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course -5	Linear Algebra	20PMTC21	6	4	3	40	60	100
2	Core Course -6	Real Analysis II	20PMTC22	6	4	3	40	60	100
3	Core Course -7	Differential Equations	20PMTC23	6	4	3	40	60	100
4	Core Course -8	Mathematical Statistics	20PMTC24	6	4	3	40	60	100
5	DSEC-2	DSEC - Fuzzy Algebra/ Advanced Calculus/ Theory of Computations	 20PMTE21/ 20PMTE22/ 20PMTE23	6	4	3	40	60	100
Total				**30**	**20**				**500**

DSEC - Discipline Specific Elective Course

M.Sc. Mathematics - SEMESTER III

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course -9	Measure Theory	20PMTC31	6	5	3	40	60	100
2	Core Course -10	Complex Analysis	20PMTC32	6	5	3	40	60	100
3	Core Course -11	Operations Research	20PMTC33	6	5	3	40	60	100
4	Core Course -12	Topology	20PMTC34	6	5	3	40	60	100
5	NMEC	Mathematics for Competitive Examinations	20PMTN31	5	4	3	40	60	100
6	Online Course	Practice for CSIR /NET – General Paper	20PGOL32	1	1	-	100	-	100
Total				**30**	**25**				**600**

NMEC – Non Major Elective Course

EXTRA CREDIT COURSE

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Self-Study Course	SET/NET Preparation for Algebra and Analysis	20PMTO31	-	2	2	100	-	100

M.Sc. Mathematics - SEMESTER IV

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-13	Field Theory	20PMTC41	6	5	3	40	60	100
2	Core Course-14	Functional Analysis	20PMTC42	6	5	3	40	60	100
3	Core Course-15	Number Theory and Cryptography	20PMTC43	6	5	3	40	60	100
4	Core Course-16	Graph Theory	20PMTC44	6	5	3	40	60	100
5	Project	-	20PMTC41PR	6	5	6	40	60	100
Total				**30**	**25**				**500**

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VIRUDHUNAGAR - 626 001

M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester I	**GROUPS AND RINGS**	Hours/Week: 6	
Core Course-1		Credits: 4	
Course Code **20PMTC11**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concepts of abstract algebra. [K2]

CO2: apply the logical proof to characterize algebraic structures. [K3]

CO3: apply the theory to solve a variety of problems at an appropriate level of difficulty. [K3]

CO4: analyze the characteristics and equivalence criterions of various concepts of algebraic structures. [K4]

CO5: assess the algebraic structures by using advanced ideas in Groups and Rings. [K5]

Group Theory

UNIT I

Cayley 's Theorem, Another Counting Principle, Sylow's Theorem. (18 Hours)

UNIT II

Direct Products, Finite Abelian Groups. (18 Hours)

Ring Theory

UNIT III

Ideals and Quotient Rings, More Ideals and Quotient Rings, the Field of Quotients of an Integral Domain.(18 Hours)

UNIT IV

Euclidean Rings, A particular Euclidean Ring.(18 Hours)

UNIT V

Polynomial Rings, Polynomials over the Rational Field, Polynomial Rings over Commutative Rings. (18 Hours)

TEXT BOOK

Herstein.I.N., (2016).*Topics in Algebra*, Second Edition, John Wiley and Sons.

Unit	Chapter	Section
I	2	2.9, 2.11, 2.12
II	2	2.13, 2.14
III	3	3.4, 3.5, 3.6
IV	3	3.7, 3.8
V	3	3.9, 3.10, 3.11

REFERENCE BOOKS

1. John B. Fraleigh, (1982). *A First Course in Abstract Algebra*, Third Edition, Narosa Publications, Eighth Reprint, 1996.

2. Joseph A. Gallian, (2013). *Contemporary Abstract Algebra,* 8th Edition, BROOKS/COLE, Cengage Learning.

Course Code 20PMTC11	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	L	H	H	L	-	H	H	L	-
CO2	H	M	H	L	M	M	H	H	L	-
CO3	H	M	H	L	M	M	H	H	L	-
CO4	H	L	M	H	M	M	M	H	L	-
CO5	H	L	L	M	H	H	M	H	L	-

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M.Sc. Mathematics
(2020 -21 onwards)

Semester I	**ANALYSIS**	Hours/Week: 6	
Core Course-2		Credits: 4	
Course Code **20PMTC12**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental properties of real numbers. [K2]

CO2: identify the properties of metric space, sequences, series, continuity, uniform continuity and differentiation in real line. [K3]

CO3: apply the ratio test, root test and comparison test to determine the convergence of series. [K3]

CO4: analyze the characteristics and equivalence criterions of various concepts in the context of extended real number system. [K4]

CO5: establish various theorems, results and corollaries of real number system. [K5]

UNIT I

The real and complex number systems

Ordered sets, the real field (Statements only).

Basic Topology

Finite, Countable and Uncountable Sets, Metric Spaces. (10 Hours)

UNIT II

Basic Topology

Compact Sets, Perfect Sets, Connected Sets.

Numerical Sequences and Series

Convergent sequences, Subsequences, Cauchy sequences, Upper and Lower Limits, Some Special sequences. (20 Hours)

UNIT III

Numerical Sequences and Series

Series ,Series of Non-negative Terms, The Number e, The Root and Ratio Tests, Power Series, Summation by Parts, Absolute Convergence, Addition and multiplication of Series.

(20 Hours)

UNIT IV

Continuity

Limits of Function, Continuous Functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotonic Functions, Infinite Limits and Limits at Infinity.

(20 Hours)

UNIT V

Differentiation

The Derivative of a Real function, Mean Value Theorems, The Continuity of Derivatives, L'Hospital's Rule, Derivatives of Higher Order, Taylor's theorem, Differentiation of Vector-valued Functions. (20 Hours)

TEXT BOOK

Walter Rudin, (2016). *Principles of Mathematical Analysis*, Third Edition, McGraw - Hill, International Editions.

Unit	Chapter	Section
I	1	1.5- 1.11;1.19, 1.20, 1.21(Statements only)
	2	2.1 - 2.30
II	2	2.31 - 2.47
	3	3.1 – 3.20
III	3	3.21 – 3.51
IV	4	4.1 – 4.34
V	5	5.1 – 5.19

REFERENCE BOOKS

1. Binmore. K. G., (1982). *Mathematical Analysis*, Second Edition, Cambridge University Press, Reprint 1987.
2. Royden. H.L., (1988). *Real Analysis*, Third Edition, MacMillan, New York.

Course Code 20PMTC12	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	H	M	M	M	H	L	-
CO2	H	M	L	-	L	M	M	H	L	-
CO3	H	L	M	L	M	M	H	H	L	-
CO4	H	L	L	M	L	M	H	H	L	-
CO5	H	L	L	H	H	M	H	H	L	-

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M.Sc. Mathematics
(2020 -21 onwards)

Semester I	**DIFFERENTIAL GEOMETRY**	Hours/Week: 6	
Core Course-3		Credits: 4	
Course Code **20PMTC13**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the concepts of space curves and their properties. [K2]

CO2: calculate the curvature and torsion of a curve. [K3]

CO3: apply properties of surfaces and geodesics in engineering field. [K3]

CO4: analyze properties of surfaces in different settings and helicoids. [K4]

CO5: assess curvature of curves and fundamental forms for different surfaces. [K5]

UNIT I

The Theory of Space Curves - Introductory remarks about space curves, Definitions, Arc length, Tangent, normal and binomial, Curvature and torsion of a curve given as the intersection of two surfaces, Contact between Curves and Surfaces, Tangent surface, involutes and evolutes**.**

(19 Hours)

UNIT II

Intrinsic equations, fundamental existence theorem for space curves – Helices.

The Metric: Local Intrinsic Properties of a surface - Definition of a surface, Curves on surface, Surfaces of revolution, Helicoids. (16 Hours)

UNIT III

Metric, Direction Coefficients, Family of curves, Intrinsic Properties, Geodesics, Canonical geodesic equations, Normal property of geodesics. (18 Hours)

UNIT IV

Existence theorems, Geodesic parallels, Geodesic curvature, Gauss-Bonnet theorem,

The Second fundamental Form: Local Non-Intrinsic Properties of a Surface The second fundamental form. (19 Hours)

UNIT V

Principal curvatures, Lines of curvature, Developables, Developables associated with space curves, Developables associated with curves on surfaces, Minimal surfaces, Ruled surfaces**.**

(18 Hours)

TEXT BOOK

Willmore.T.G., (2004).*An introduction to Differential Geometry*, Oxford University Press.

Unit	Chapter	Section
I	1	1 - 7. (Omitting appendix)
II	1	8, 9
	2	1 - 4. (Omitting appendix)
III	2	5 – 7, 9 – 12.
IV	2	13 - 16.
	3	1
V	5	2 – 8

REFERENCE BOOKS

1. Mittal and Agarwal, (1998). *Differential Geometry*, Krishna prakasam Publishers.

2. Somasundaram. D., (2005).*Differential Geometry: A First Course,* Narosa Publishing House.

Course Code 20PMTC13	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	L	M	H	L	-	M	M	L	-
CO2	H	M	M	L	M	-	M	H	L	-
CO3	M	-	L	L	M	M	M	L	L	-
CO4	H	L	H	H	M	M	H	M	L	-
CO5	L	L	H	M	H	M	H	M	L	-

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M.Sc. Mathematics
(2020 -21 onwards)

Semester I	**MATHEMATICAL METHODS**	Hours/Week: 6	
Core Course-4		Credits: 4	
Course Code **20PMTC14**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the concepts of Integral equations, boundary value problems and Fourier transform. [K2]

CO2: apply different transformation techniques in Integral equations and Fourier transforms. [K3]

CO3: solve various Integral equations by using the suitable method. [K3]

CO4: analyze the various Integral equations and Fourier transforms. [K4]

CO5: evaluate the given integral using Fourier transforms and boundary value problems using suitable method& Green's function. [K5]

UNIT I

Conversion of ordinary differential equation into integral equation

Introduction – Initial Value Problem - Method of converting initial value problem into a Volterra integral equation – Alternative method of converting initial value problem into a Volterra integral equation - Boundary value problem - Method of converting a boundary value problem into a Fredholm integral equation.

Homogeneous Fredholm integral equation of the second kind with separable kernels

Solution of Homogeneous Fredholm integral equation of the second kind with separable kernel – Solved Examples. (18 Hours)

UNIT II

Method of successive approximations

Introduction - Iterated kernels or functions - Resolvent kernel or Reciprocal kernel-Theorem - Solution of Fredholm integral equation of the second kind by successive substitutions - Solution of Volterra integral equation of the second kind by successive approximations - Solution of Fredholm integral equation of the second kind by successive approximations:Iterative method: Neumann series – Some important theorems-Solved examples based on Solution of Fredholm integral equation of the second kind by successive approximations or Iterative method- Reciprocal functions: Volterra Solution of Fredholm integral equation of the second kind.

(18 Hours)

UNIT III

Classical Fredholm theory

Introduction - Fredholm's first fundamental theorem – Solved examples based on Fredholm's first fundamental theorem - Fredholm's second fundamental theorem - Fredholm's third fundamental theorem. (18 Hours)

UNIT IV

Singular integral equations

Singular integral equations - The solution of Abel integral equation - General form of the Abel singular integral equation – Another general form of the Abel singular integral equation – Solved examples-Cauchy principal value for integrals.

Applications of integral equation and Green's functions to ordinary differential equation

Introduction - Green's function-Conversion of a boundary value problem into Fredholm's integral equation – An important special case of results of Green's function – Solved examples based on construction of Green's functions-Solved examples based on Result 1 of Conversion of a boundary value problem into Fredholm's integral equation- Solved examples based on Result 2 of Conversion of a boundary value problem into Fredholm's integral equation- Solved examples based on Result 3 of Conversion of a boundary value problem into Fredholm's integral equation.

(18 Hours)

UNIT V

Fourier Transforms

Fourier Transforms: Definition - Fourier cosine transform- Fourier sine transform - Fourier transforms of derivatives –Convolution Integral - Parsevel's theorem for Cosine and Sine transforms. (18 Hours)

TEXT BOOKS:

1. Raisinghania. M. D., (2018). *Integral Equations and boundary value Problems*, Third Revised edition, S. Chand & Company Ltd. New Delhi.
2. Sneddon, I. N., (1974). *The use of Integral Transforms*, Tata McGraw Hill, New Delhi.

Unit	Chapter	Section
Text Book 1		
I	2	2.1-2.6
	3	3.1-3.3
II	5	5.1-5.10
III	6	6.1-6.5
IV	8	8.1-8.6
	11	11.1-11.8
Text Book 2		
V	2	2.3-2.6, 2.9, 2.10

REFERENCE BOOKS:

1. Goyal. J. K. & Gupta. K. P., (2000). *Laplace and Fourier Transforms*, 12th Edition, PragatiPrakashanMeerukt.
2. Lovitt. W. V., (1950). *Linear Integral equations*, Dover Publications, New York.

Course Code 20PMTC14	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	-	H	H	H	H	H	M	-	M
CO2	H	L	-	H	H	H	H	M	L	M
CO3	H	-	M	H	H	H	H	M	L	M
CO4	H	-	M	H	H	H	H	M	L	M
CO5	H	L	-	H	H	H	H	M	-	M

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VIRUDHUNAGAR - 626 001

M.Sc. Mathematics
(2020 -21 onwards)

Semester I	**NUMERICAL ANALYSIS**	Hours/Week: 6	
DSEC-1		Credits: 4	
Course Code **20PMTE11**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the basic principles in Numerical Methods. [K2]

CO2: apply numerical techniques to find the solution of the system of linear equations. [K3]

CO3: solve algebraic equations and ordinary differential equations.[K3]

CO4: analyze the rate of convergence of the root of the given equation usingdifferent iteration methods, solution of differential equations, numerical integration and the significance of difference operators in interpolation. [K4]

CO5: evaluate the approximate root of the given equation, the definite integral of complicated functions, Eigenvalues and Eigenvectors approximately. [K5]

UNIT I

Transcendental and Polynomial Equations - Introduction, Bisection method, Iteration methods based on first degree equation, Iteration methods based on second degree equation, Rate of convergence, General iteration methods, Methods for complex roots, Polynomial equations.

(20 Hours)

UNIT II

System of Linear Algebraic Equations and Eigen Value Problems- Introduction, Direct methods, Error analysis for direct methods, Iteration methods, Eigen values and Eigen vectors, Jacobi method for symmetric matrices. (16 Hours)

UNIT III

Interpolation and Approximation - Introduction, Lagrange and Newton interpolations, Finite difference Operators, Interpolating polynomials using finite differences, Hermite interpolation, Piecewise and spline interpolation. (20 Hours)

UNIT IV

Differentiation and Integration - Introduction, Numerical Differentiation, Extrapolation methods, Partial Differentiation, Numerical integration, Methods based on interpolation, Composite integration methods, Romberg Integration**.** (18 Hours)

UNIT V

Ordinary Differential Equations: Initial Value Problems - Introduction, Difference equations, Numerical methods, Single step methods**.** (16 Hours)

TEXT BOOK

Jain. M. K., Iyengar. S. R. K. and Jain. R. K., (2012). *Numerical Methods for Scientific and Engineering Computation,* Sixth Edition, New Age International Publishers.

Unit	Chapter	Section
I	2	2.1 - 2.6, 2.8, 2.9.
II	3	3.1 - 3.4 (Omitting SOR method, convergence Analysis of Iterative methods, Optimal Relaxation parameter for the SOR method, Iterative method to determine A^{-1}), 3.5, 3.7
III	4	4.1 - 4.6.
IV	5	5.1, 5.2, 5.4 - 5.7, 5.9, 5.10
V	6	6.1 - 6.4

(Note: Section B of the Question paper will contain only numerical problems. Scientific calculator is allowed).

REFERENCE BOOKS

1. Kandasamy. P., Thilagavathy. K., Gunavathi. K., (2006).*Numerical Methods*, Sultan chand.
2. Sastry. S.S., (2009).*Introductory Methods of Numerical Analysis*, Fourth Edition, PHI Learning Private Ltd.

Course Code 20PMTE11	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	L	L	L	-	-	-	-
CO2	H	H	M	H	L	L	-	-	-	-
CO3	H	H	M	H	M	H	M	M	L	-
CO4	H	H	L	H	M	L	M	M	M	-
CO5	H	H	H	H	H	H	M	M	M	-

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M.Sc. Mathematics
(2020 -21 onwards)

Semester I	**MODERN APPLIED ALGEBRA**	Hours/Week: 6	
DSEC-1		Credits: 4	
Course Code **20PMTE12**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concept of binary devices and states. [K2**]**

CO2: apply the programming structure of ALGOL**.** [K3]

CO3: apply the knowledge gained in binary group codes to other fields**.** [K3]

CO4: analyze the procedure for deriving prime implicants, consensus taking, Flip-flops**.** [K4]

CO5: evaluate the Boolean expression in minimized form**.** [K5]

UNIT I

Finite State Machines - Introduction, Binary devices and States, Finite - State machines, Covering and equivalence, Equivalence states, A minimization procedure, Turing machines, Incompletely specified machines – Relations between states – a minimization procedure.

(18 Hours)

UNIT II

Programming Languages-Introduction, Arithmetic expressions, Identifiers: assignment statements, Arrays, FOR statements, Block structure in ALGOL, The ALGOL grammar, Evaluating arithmetic statements, Compiling arithmetic expressions. (18 Hours)

UNIT III

Boolean Algebras - Introduction, Order, Boolean polynomials, Block diagrams for gating networks, Connections with logic, Logical capabilities of ALGOL, Boolean applications, Boolean sub algebras, Disjunctive normal form, direct products; morphisms. (18 Hours)

UNIT IV

Optimization and Computer Design - Introduction, Optimization, Computerizing Optimization, Logic design, NAND gates and NOR gates, the minimization problem, Procedure for deriving prime implicants, Consensus taking, Flip-flops, Sequential machine design. (18 Hours)

UNIT V

Binary Group Codes - Introduction, Encoding and decoding, Block codes, Matrix encoding techniques, Group codes, Decoding tables, Hamming codes.

(18 Hours)

TEXT BOOK

Birkhoff.G and Bartee.T.C., (1987).*Modern Applied Algebra*, CBS Publishers and Distributors, New Delhi.

Unit	Chapter	Section
I	3	3.1 - 3.9.
II	4	4.1 - 4.9
III	5	5.1 - 5.10
IV	6	6.1 - 6.10
V	8	8.1 - 8.7

REFERENCE BOOK

1. John E. Hopcroft Jeffery D. Ullman, (2002).*Introduction to Automata Theory, Languages, and Computation*, Narosa, 19th Reprint.

Course Code 20PMTE12	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	L	L	L	-	L	M	-
CO2	H	H	H	M	M	L	-	L	M	-
CO3	H	H	M	H	M	M	H	L	M	-
CO4	H	H	M	H	M	M	H	L	M	-
CO5	H	H	L	H	H	H	H	L	M	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester I	**MECHANICS**	Hours/Week: 6	
DSEC-1		Credits: 5	
Course Code **20PMTE13**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the elementary principles of mechanics. [K2]

CO2: solve two body central force problems. [K3]

CO3: apply D'Alembert's principle and Lagrange's equations andKepler's laws. in solving the problems. [K3]

CO4: analyze the Holonomic and non Holonomic systems. [K4]

CO5: evaluate the Hamilton equations of motion. [K5]

UNIT I

Survey of the Elementary Principles

Mechanics of a particle, Mechanics of a system of particles, Constraints (18 Hours)

UNIT II

D'Alembert's principle and Lagrange's equations, Velocity dependent potentials and the dissipation function – simple applications of the Lagrangian formulation. Variational Principles and Lagrange's EquationsHamilton's principle, Some techniques of the calculus of variations.

(18 Hours)

UNIT III

Derivation of Lagrange's equations from Hamilton's principle, Extension of Hamilton's principle to nonholonomic systems, Advantages of a variational principle formulation, Conservation theorems and symmetry properties (18 Hours)

UNIT IV

The Two -Body Central Force Problem

Reduction to the equivalent one -body problem, The equations of motion and first integrals, The equivalent one – dimensional problem and classification of orbits, The Virial theorem.

(18 Hours)

UNIT V

The differential equation for the orbit and integrable power-law potentials, Conditions for closed orbits (Bertrand's theorem), The Kepler problem: Inverse square law of force, the motion in time in the Kepler problem, The Laplace - Runge-Lenz vector.

(18 Hours)

TEXT BOOK

Goldstein. H., (1980).*Classical Mechanics*, Second edition, Addison Wesley, New York.

Unit	Chapter	Section
I	1	1.1 – 1.3
II	1	1.4 -1.6
	2	2.1 – 2.2
III	2	2.3 – 2.6
IV	3	3.1 - 3.4
V	3	3.5 - 3.9

REFERENCE BOOKS:

1. Bhatia, V.B., (2001). *Classical Mechanics*, Narosa Publishing House, Chennai.

2. John Robert Taylor, (2005). *Classical Mechanics*, University Science Books, Herndon, VA 20192.

Course Code 20PMTE13	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	L	L	L	L	H	L	L	-
CO2	H	H	L	M	M	M	H	L	L	-
CO3	H	H	L	M	M	M	H	L	L	-
CO4	H	H	L	M	M	M	H	L	L	-
CO5	H	H	L	M	H	M	H	L	L	-

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M.Sc. Mathematics
(2020 -21 onwards)

Semester II	**LINEAR ALGEBRA**	Hours/Week: 6	
Core Course-5		Credits: 4	
Course Code **20PMTC21**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain vector spaces and their properties. [K2]

CO2: apply the acquired knowledge in linear algebra in various fields. [K3]

CO3: apply the properties of trace, transpose of matrices and determinants in proving theorems. [K3]

CO4: analyze the characteristics of varioustransformations, matrices and determinants. [K4]

CO5: establish various theorems and results in linear transformations, matrices and determinants. [K5]

UNIT I

Vector Spaces & Modules - Dual Spaces - Inner Product Spaces - Modules. (18 Hours)

UNIT II

Linear Transformations: The Algebra of Linear Transformations - Characteristic roots- Matrices. (18 Hours)

UNIT III

Canonical forms: Triangular form - Nilpotent transformations - A Decomposition of V: Jordan form. (18 Hours)

UNIT IV

Canonical forms: Rational Canonical form - Trace and Transpose. (18 Hours)

UNIT V

Determinants- Hermitian, Unitary and Normal Transformations. (18 Hours)

TEXT BOOK

Herstein.I.N., (2016).*Topics in Algebra*, Second Edition, John Wiley and Sons.

Unit	Chapter	Section
I	4	4.3 - 4.5
II	6	6.1 – 6.3
III	6	6.4 – 6.6
IV	6	6.7 – 6.8
V	6	6.9 – 6.10

REFERENCE BOOKS

1. Joseph A. Gallian, (2013). *Contemporary Abstract Algebra,* 8th Edition, BROOKS/COLE, Cengage Learning.

2. David S. Dummit and Richard M. Foote, (2004).*Abstract Algebra*, Third Edition, John Wiley and Sons, Inc.

Course Code 20PMTC21	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	M	H	H	H	H	H	M	-
CO2	H	H	H	H	H	H	H	H	M	-
CO3	H	H	M	H	H	H	H	H	H	-
CO4	H	H	H	H	H	H	H	H	H	-
CO5	H	H	M	H	H	H	H	H	M	-

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VIRUDHUNAGAR - 626 001

M.Sc. Mathematics
(2020 -21 onwards)

Semester II	**REAL ANALYSIS II**	Hours/Week: 6	
Core Course-6		Credits: 4	
Course Code **20PMTC22**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1:explain the concept of the Riemann integrability, sequences and series, some special functions and functions of several variables. [K2]

CO2:apply the integral theory to prove results about specific classes of functions. [K3]

CO3:determine the convergence,uniform convergence of sequence of functions. [K3]

CO4: analyze the characteristics and equivalence criterions of various concepts of real and complex field. [K4]

CO5: evaluate Riemann integration, test the convergence of the sequences and series of functions and prove theorems in functions of several variables. [K5]

UNIT I

The Riemann- Stieltjes Integral - Definition and Existence of the Integral- Properties of the Integral- Integration and Differentiation-Integration of Vector valued functions- Rectifiable Curves.

(18 Hours)

UNIT II

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.

(19 Hours)

UNIT III

Some Special Functions - Power Series- The Exponential and Logarithmic Functions- The Trigonometric Functions- The Algebraic Completeness of the Complex Field- Fourier Series - The Gamma Function. (19 Hours)

UNIT IV

Functions of Several Variables - Linear Transformations- Differentiation- The Contraction Principle - The Inverse Function Theorem. (20 Hours)

UNIT V

The Implicit Function Theorem- Determinants. (14 Hours)

TEXT BOOK

Walter Rudin, (2016). *Principles of Mathematical Analysis*, Third Edition, McGraw Hill, International Student Edition.

Unit	Chapter	Section
I	6	6.1 – 6.27
II	7	7.1 – 7.33
III	8	8.1 – 8.22
IV	9	9.1 – 9.25
V	9	9.26 – 9.28 9.33 – 9.37

REFERENCE BOOKS

1. Binmore. K. G., (1982). *Mathematical Analysis*, Second Edition, Cambridge University Press, Reprint 1987.

2. Tom M. Apostal, (1974). *Mathematical Analysis – A Modern Approach to Advanced Calculus*, Addison-Wesley Publishing Company.

Course Code 20PMTC22	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	M	M	M	-	-	H	M	L
CO2	H	H	M	M	M	-	-	H	M	L
CO3	H	H	M	M	M	-	-	H	M	L
CO4	H	H	M	M	M	-	-	H	M	L
CO5	H	H	-	M	M	-	-	H	M	-

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M.Sc. Mathematics
(2020 -21 onwards)

Semester II	**DIFFERENTIAL EQUATIONS**	Hours/Week: 6	
Core Course-7		Credits: 4	
Course Code **20PMTC23**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concepts of linear and nonlinear differential equations. [K2]

CO2: solve problems of Ordinary Differential Equations and Partial Differential Equations arising in various fields. [K3]

CO3: apply various computational techniques to obtain the solution of Ordinary Differential Equations and Partial Differential Equations. [K3]

CO4: analyze Ordinary Differential Equations & Partial Differential Equations of various types, their solutions and fundamental concepts about their existence and uniqueness. [K4]

CO5: evaluate the first order linear and nonlinear Differential Equations by using various methods. [K5]

UNIT I

Linear Equations with Variable Coefficients -Introduction- Initial Value Problems for the Homogeneous Equation- Solutions of the Homogeneous Equation- The Wronskian and Linear Independence- Reduction of the Order of a Homogeneous Equation- The Non-Homogeneous Equation- Homogeneous Equations with Analytic Coefficients- The Legendre Equation.

(20 Hours)

UNIT II

Linear Equations with Regular Singular Points - Introduction- The Euler Equation- Second Order Equations with regular Singular points-an Example- Second Order Equations with Regular Singular Points-the General Case- The Bessel Equation- The Bessel Equation (continued).

(19 Hours)

UNIT III

Existence and Uniqueness of solutions to First Order Equations - Introduction- Equations with Variables Separated- Exact Equations- the Method of Successive Approximations TheLipschitz Condition- Convergence of the Successive Approximations- Approximations to, and Uniqueness of Solutions. (19 Hours)

UNIT IV

Partial Differential Equations of the First Order - Partial Differential Equations – Origins of First-Order Partial Differential Equations - Linear Equations of the First Order – Integral Surfaces Passing through a given Curve- Surfaces Orthogonal to a given System of Surfaces.

(15 Hours)

UNIT V

Nonlinear Partial Differential Equations of the First Order – Compatible Systems of First-Order Equations – Charpit's Method – Special Types of First-Order Equations.

(17 Hours)

TEXT BOOK

1. Coddington. E.A., (2010).*An Introduction to Ordinary Differential Equations*, Prentice Hall of India.
2. Sneddon. I.N., (1986).*Elements of Partial Differential Equations*, McGraw Hill Book Company.

Unit	Chapter	Section
Text Book – 1		
I	3	1 – 8
II	4	1 – 4, 7 - 8
III	5	1 – 6 & 8
Text Book - 2		
IV	2	2.1 – 2.2 & 2.4 – 2.6
V	2	2.7 & 2.9 – 2.11

REFERENCE BOOKS

1. George F. Simmons, *(2008). Differential Equations with Applications and Historical Notes*, 13th reprint, Tata McGraw - Hill Publishing Company Ltd.
2. Deo. S. G and Raghavendra. V., (1980).*Ordinary differential equations and stability theory*, Fifth reprint 1992, Tata McGraw Hill Education Private Limited.

Course Code 20PMTC23	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	L	L	M	L	M	L	-
CO2	H	H	M	M	H	M	H	M	L	-
CO3	H	H	H	H	H	M	H	M	L	-
CO4	H	H	M	H	H	M	H	M	L	-
CO5	H	H	M	M	H	H	H	H	L	-

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M.Sc. Mathematics
(2020 -21 onwards)

Semester II	**MATHEMATICAL STATISTICS**	Hours/Week: 6	
Core Course-8		Credits: 4	
Course Code **20PMTC24**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamentals and properties of probability, random variable, expectations and distribution functions. [K2]

CO2: solve various problems in special distributions, random variables and multivariate random variables. [K3]

CO3: apply various computational techniques to solve problems in multivariate distributions. [K3]

CO4: analyze the statistical data using appropriate probability distributions, limiting distributions and transformation of variables. [K4]

CO5: evaluate various types of probability density function for both continuous and discrete random variables and the parameters in various distributions. [K5]

UNIT I

Introduction - Set Theory - The Probability Set function - Conditional Probability and Independence - Random variables of the Discrete type - Random variables of the Continuous type - Properties of the Distribution function - Expectation of a Random variable - Some Special Expectations - Chebyshev's Inequality. (18 Hours)

UNIT II

Distributions of Two Random Variables - Conditional Distributions and Expectations - The Correlation Coefficient - Independent Random Variables - Extension to Several Random Variables. (18 Hours)

UNIT III

The Binomial and Related Distributions - The Poisson Distribution - The Gamma and Chi-Square Distributions - The Normal Distribution - The Bivariate Normal Distribution.

(18 Hours)

UNIT IV

Sampling theory - Transformations of Variables of the Discrete Type - Transformations of Variables of the Continuous Type - The Beta, t, F Distributions - Extensions of the Change-of-Variable Technique - Distributions of Order Statistics - The Moment Generating Function technique - The Distributions of $\overline{X}$ and $\frac{nS^2}{\sigma^2}$ -Expectations of Functions of Random Variables.

(18 Hours)

UNIT V

Convergence in Distribution - Convergence in Probability - Limiting Moment Generating Functions - The Central Limit Theorem - Some Theorems on Limiting Distributions. (18 Hours)

TEXT BOOK

Robert V. Hogg, Allen T. Craig, (2002). *Introduction to Mathematical Statistics*, Fifth Edition, Pearson Education.

Unit	Chapter	Section
I	1	1.1 - 1.10
II	2	2.1 - 2.5
III	3	3.1 - 3.5
IV	4	4.1-4.9
V	5	5.1-5.5

REFERENCE BOOKS

1. Alexander M. Mood, Franklin A. Graybill, Duane C. Boes, (1974). *Introduction to the theory of Statistics*, Third Edition, McGraw Hill International Book Company.
2. Kapoor. J.N. andSaxena. H.C., (2009). *Mathematical Statistics*, 25thEdition, S. Chand & Co.

Course Code 20PMTC24	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	L	L	M	L	M	L	-
CO2	H	H	M	M	H	M	H	M	L	-
CO3	H	H	H	H	H	M	H	M	L	-
CO4	H	H	M	H	H	M	H	M	L	-
CO5	H	H	M	M	H	H	H	H	L	-

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M.Sc. Mathematics
(2020 -21 onwards)

Semester II	**FUZZY ALGEBRA**	Hours/Week: 6	
DSEC -2		Credits: 4	
Course Code **20PMTE21**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the basic concepts of Fuzzy sets, relations, groups, Sylow groups and ideals. [K2]

CO2: apply the acquired knowledge in Fuzzy sets in proving theorems and solving problems. [K3]

CO3: illustrate fuzzy relations, binary fuzzy relations, fuzzy equivalence relations, groups, Sylowgroups and ideals. [K3]

CO4: analyze the concepts of fuzzy sets, relations groups and ideals in various algebraic structures. [K4]

CO5: assess the algebraic structures by using advanced ideas in Fuzzy algebra. [K5]

UNIT I

Fuzzy Sets: Basic Types – Fuzzy Sets: Basic Concepts – Additional Properties of α- Cuts – Representation of Fuzzy Sets – Extension Principle for Fuzzy Sets. (15 Hours)

UNIT II

Types of Operations - Fuzzy Complements. Crisp and Fuzzy Relations – Binary Fuzzy Relations – Binary Relations on a Single Set – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Ordering Relations - Fuzzy Morphisms. (21 Hours)

UNIT III

Definition of Fuzzy Subgroups – Examples and Properties – Union of two Fuzzy subgroups – Fuzzy subgroup generated by a Fuzzy subset– Fuzzy Normal Subgroups. (18 Hours)

UNIT IV

Fuzzy normal subgroups under homomorphisms – characteristics subgroups – Fuzzy conjugate subgroups – Fuzzy Sylow subgroups. (18 Hours)

UNIT V

Fuzzy Ideals and their Operations. Some Elementary Properties – Union of Fuzzy Subrings(Fuzzy Ideals) – Fuzzy Subring(Fuzzy Ideal) Generated by a Fuzzy Subset – Fuzzy Ideals and Homomorphisms – Fuzzy Cosets. (18 Hours)

TEXT BOOKS

1. George J.Klir and Bo Yuan, (2008). *Fuzzy Sets and Fuzzy Logic – Theory and Applications*, Second Edition, Prentice – Hall of India.
2. Rajeshkumar, (1993). *Fuzzy Algebra Vol I*, University of Delhi, Publication Division.

Unit	Chapter	Section
Text Book – 1		
I	1	1.3 – 1.4
	2	2.1 – 2.3
II	3	3.1 – 3.2
	5	5.1& 5.3 - 5.8
Text Book - 2		
III	1	1.2.16 - 1.2.21
	2	2.1- 2.3 (up to 2.3.3)
IV	2	2.3.4 - 2.3.14 & 2.4
V	3	3.1 - 3.5

REFERENCE BOOKS

1. Zimmer Mann. H.J., (2006).*Fuzzy set Theory and its applications*, Fourth Edition, Springer International Ltd.

2. John .NMordeson and Malik. T.S., (1998).*Fuzzy Commutative Algebra*, World Scientific Publishing Co. Pte.Ltd.

Course Code 20PMTE21	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	L	M	M	M	L	L	L	-
CO2	H	H	L	L	M	L	L	L	L	-
CO3	H	H	L	L	M	L	L	L	L	-
CO4	H	H	L	M	M	M	L	L	L	-
CO5	H	H	L	M	M	L	L	L	L	-

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M.Sc. Mathematics
(2020 -21 onwards)

Semester II	**ADVANCED CALCULUS**	Hours/Week: 6	
DSEC-2		Credits: 4	
Course Code **20PMTE22**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the basic idea of differentiation of transforms. [K2]

CO2: solvethe problems in Differential Geometry and Vector Calculus**.** [K3]

CO3: apply the theorems of Green, Gauss and Stoke's in solving problems. [K3]

CO4: analyze implicit function theorem. [K4]

CO5: evaluate integrals over curves and surfaces. [K5]

UNIT I

Integration

The Definite integral – Evaluation of Definite Integrals. (18 Hours)

UNIT II

Differentiation of Transforms

Differentials of Transformations – Inverses of Transformations. (18 Hours)

UNIT III

The Implicit function Theorems – Functional Dependence. (18 Hours)

UNIT IV

Applications to Geometry and Analysis

Transformations of Multiple Integrals – Integrals over curves and surfaces. (18 Hours)

UNIT V

Differential Geometry and Vector Calculus

Differential forms – Vector Analysis – The theorems of Green, Gauss, and Stoke's– Exact forms and closed forms – Applications. (18 Hours)

TEXT BOOK

Creighton Buck. R., (1978).Advanced *Calculus*, Third Edition, McGraw, HillKogakusha Ltd.

Unit	Chapter	Section
I	4	4.2- 4.3
II	7	7.4 - 7.5
III	7	7.6 - 7.7
IV	8	8.3 & 8.6
V	9	9.2- 9.6

REFERENCE BOOK

1. Robert Wrede and Murray R. Spiegel, (2005).*Advanced Calculus*, Second Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Course Code 20PMTE22	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	L	L	M	L	M	L	-
CO2	H	H	M	M	H	M	H	M	L	-
CO3	H	H	H	H	H	M	H	M	L	-
CO4	H	H	M	H	H	M	H	M	L	-
CO5	H	H	M	M	H	H	H	H	L	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester II	**THEORY OF COMPUTATIONS**	Hours/Week: 6	
DSEC-2		Credits: 5	
Course Code **20PMTE23**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explainthe concepts in automata theory and theory of computation. [K2]

CO2: apply grammars to produce strings from a specific language. [K3]

CO3: determine the decidability and intractability of computational problems.[K3]

CO4: analyze different formal language classes and their relationships. [K4]

CO5: establish theorems in automata theory using its properties. [K5]

UNIT I

Finite Automata and Regular Expressions

Finite state systems – Basic definitions – Nondeterministic finite automata – Finite automata with Є moves – Regular expressions – Finite Automata with output. (18 Hours)

UNIT II

Properties of Regular Sets

The pumping lemma for regular sets – Closure properties of regular sets – Decision algorithm for regular sets – The Myhill-Nerode theorem and minimization of finite automata.

(18 Hours)

UNIT III

Context-Free grammars

Context free grammars – Derivation trees – Simplification of context free grammars – Chomsky normal form – Greibach normal form. (18 Hours)

UNIT IV

Pushdown Automata

Definitions – pushdown automata and context free languages – The pumping lemma for CFL„s – Closure properties of CFLs. (18 Hours)

UNIT V

Turing Machines

Introduction: The Turing machine model – Computable languages and functions. Undecidability- Problems, properties of recursive and recursively enumerable languages, Universal Turing Machines and an undecidable problem, Rice„s theorem and some more undecidable problems. (18 Hours)

TEXT BOOK:

1. John E. Hopcroft and Jeffery D. Ullman, (2002).*Introduction to Automata Theory, Languages, and Computation*, Narosa.Chennai.

Unit	Chapter	Section
I	2	2.1 -2.5, 2.7
II	3	3.1-3.4
III	4	4.2-4.6
IV	5	5.2, 5.3
	6	6.1, 6.2
V	7	7.1-7.3
	8	8.1-8.4

REFERENCE BOOKS:

1. Peter Linz, Jones and Bartlett, (2006).*An Introduction to Formal Languages and Automata.* New Delhi.
2. Raymond Greenlaw and H. James Hoover, (2009).*Fundamentals of the Theory of Computation:* Principles and Practice, Morgan Kaufmann Publishers.

Course Code 20PMTE23	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	L	L	L	L	H	L	L	-
CO2	H	H	L	M	M	M	H	L	L	-
CO3	H	H	L	M	M	M	H	L	L	-
CO4	H	H	L	M	M	M	H	L	L	-
CO5	H	H	L	M	H	M	H	L	L	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester III	**MEASURE THEORY**	Hours/Week: 6	
Core Course-9		Credits: 5	
Course Code **20PMTC31**		Internal 40	External 60

COURSEOUTCOMES

On completionof thecourse,thestudentswill beableto

CO1: explain the basic concepts in measure theory and integration theory. [K2]

CO2: apply the knowledge gained from concrete cases to a general situation by means of going to general measure from Lebesgue measure. [K3]

CO3: prove theorems and determine solutions to problems in measure theory. [K3]

CO4: analyse the properties of measurable functions, Lebesgueintegrable functions, functions of bounded variations and absolutely continuous functions. [K4]

CO5: characterize measurable functions and integrable functions. [K5]

UNIT I

Lebesgue Measure

Introduction -Outer measure - Measurable sets and Lebesgue measure – A nonmeasurable set – Measurable functions- Little wood's three principles (18 Hours)

UNIT II

The Lebesgue Integral

The Riemann Integral –Lebesgue integral of a bounded function over a set of finite measure- The integral of a nonnegative function- The general Lebesgue integral

(18 Hours)

UNIT III

Differentiation and Integration

Differentiation of monotone functions-Functions of bounded variation-Differentiation of an integral – Absolute continuity. (18 Hours)

UNIT IV

Measure and Integration

Measure spaces - Measurable functions – Integration-General convergence theorems-Signed measures – The Radon-Nikodym theorem (18 Hours)

UNIT V

Measure and Outer Measure

Outer measure and measurability-The extension theorem-Product measures

(18 Hours)

TEXT BOOK

Royden.H.L., (2009), *Real Analysis,* III Edition, Prentice-Hall of India Pvt. Ltd.,

Unit	Chapter	Section
I	3	1-6
II	4	1-4
III	5	1-4
IV	11	1-6
V	12	1, 2, 4

REFERENCE BOOKS

1. de Barra. G., (2009), *Measure Theory and Integration,* New Age International Publishers.

2. Paul R.Halmos, (1981). *Measure Theory*,Narosa Publishing House, New Delhi, Springer International Student Edition.

Course Code 20PMTC31	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	H	L	-	H	H	M	-
CO2	H	H	H	M	L	-	H	H	L	-
CO3	H	H	M	H	M	L	H	H	H	-
CO4	H	H	M	M	L	L	M	H	M	-
CO5	H	H	L	M	H	-	M	H	-	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 -21 onwards)

Semester III	**COMPLEX ANALYSIS**	Hours/Week: 6	
Core Course-10		Credits: 5	
Course Code **20PMTC32**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concepts in Complex Analysis. [K2]

CO2: apply the techniques in Complex Analysis to various domains. [K3]

CO3: determine the solutions to problems in definite integrals and infinite series using suitable method. [K3]

CO4: analyze properties of sequences and series of complex functions, meromorphic, harmonic and entire functions. [K4]

CO5: evaluate zeros, poles, residues, line integrals, complex contour integrals of complex functions. [K5]

UNIT I

Complex Numbers

The Spherical Representation.

Complex Functions

Limits and Continuity - Analytic Functions –Polynomials - Rational Functions - Sequences - Series - Uniform Convergence - Power Series - Abel's Limit Theorem.

The Exponential - The Trigonometric Functions - The Logarithm. (18 Hours)

UNIT II

Analytic Functions as Mappings

Arcs and Closed Curves - Analytic Functions in Regions - Conformal Mapping - Length and Area - The Linear Group - The Cross Ratio - Symmetry. (18 Hours)

UNIT III

Complex Integration

Line Integrals - Rectifiable Arcs - Line Integrals as Functions of Arcs - Cauchy's Theorem for a Rectangle - Cauchy's Theorem in a Disk -The Index of a point with respect to a Closed Curve – The Integral Formula - Higher Derivatives. (18 Hours)

UNIT IV

Removable Singularities, Taylor's Theorem - Zeros and Poles - The Local Mapping - The Maximum Principle - Chains and Cycles - Simple Connectivity – Homology - The General Statement of Cauchy's Theorem - Proof of Cauchy's Theorem - The Residue Theorem - Argument Principle - Evaluation of Definite Integrals. (18 Hours)

UNIT V

Harmonic Functions - Definition and Basic properties - The Mean-value Property - Poisson's Formula - Schwarz's Theorem - The Reflection Principle

Series and Product Developments

Weierstrass's Theorem - The Taylor Series - The Laurent Series. (18 Hours)

TEXT BOOK

Ahlfors. L. V., (Third Edition 2013). *Complex Analysis*, McGraw Hill, ISE.

Unit	Chapter	Section
I	1	2.4
	2	1.1-1.4, 2.1-2.5, 3.1,3.2,3.4
II	3	2.1-2.4,3.1-3.3
III	4	1.1-1.5,2.1-2.3
IV	4	3.1-3.4,4.1-4.5,5.1-5.3
V	4	6.1-6.5
	5	1.1-1.3

REFERENCE BOOKS

1. Karunagaran. V., (2006). Complex *Analysis*, Narosa Publications, Second Edition.

2. Pirestley. H.A., (2006).*Introduction to Complex Analysis*, Oxford University Press, Second Edition.

Course Code 20PMTC32	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	M	L	L	-	H	L	L	-
CO2	H	H	M	L	M	-	H	L	L	-
CO3	H	H	M	L	M	-	H	L	L	-
CO4	H	H	M	L	M	L	H	L	L	-
CO5	H	H	M	L	M	-	H	L	L	-

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VIRUDHUNAGAR - 626 001

M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester III	**OPERATIONS RESEARCH**	Hours/Week: 6	
Core Course-11		Credits: 5	
Course Code **20PMTC33**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the basic concepts of network models, queuing models, classical optimization theory and nonlinear programming algorithms. [K2]

CO2: apply Operations Research techniques to find solutions to real life problems. [K3]

CO3: solve the given problem in network andqueuing models, constrained, unconstrained linear and nonlinear problems. [K3]

CO4: analyze various techniques, methods and algorithms in obtaining optimum solution to the problems. [K4]

CO5: evaluate the problems in network and queuing models constrained, unconstrained linear and nonlinear problems. [K5]

UNIT I

Network Models

Network Definitions - Minimal Spanning Tree Problem – Shortest -Route Problem - Maximal - Flow Problem - Minimum-Cost Capacitated Flow Problem.

Project Scheduling by PERT - CPM

Arrow(Network) Diagram Representations – Critical Path Calculations – Construction of the Time Chart and Resource Leveling – Probability and Cost Considerations in Project Scheduling.

(18 Hours)

UNIT II

Queueing Models

Basic Elements of the QueueingModel - Role of the Poisson and Exponential Distributions - Pure Birth and Pure Death Processes - Queues with Combined Arrivals and Departures.(18 Hours)

UNIT III

Specialized Poisson queues – (M/M/1: GD/∞/∞) , (M/M/1: GD/N/∞) , (M/M/c: GD/∞/∞), (M/M/c):GD/N/∞),c$\leq N$, $(M/M/\infty):(GD/\infty/\infty)$ -Self-ServiceModel, $(M/M/R):(GD/K/K), R \prec K$ - Machine Servicing Model. (18 Hours)

UNIT IV

Classical Optimization Theory

Unconstrained Extremal Problems – Necessary and Sufficient Conditions for Extrema – The Newton Raphson Method - Constrained Extremal Problems – Equality Constraints – Inequality Constraints. (18 Hours)

UNIT V

Non-linear Programming Algorithms

Unconstrained Nonlinear Algorithms - Direct Search Method – Gradient Method - Constrained Nonlinear Algorithms – Separable Programming – Quadratic Programming – Geometric Programming – Stochastic Programming - Linear Combinations Method – SUMT Algorithm. (18 Hours)

TEXT BOOK

HamdyA.Taha (1997). *Operations Research - An Introduction***,** Fifth Edition, Prentice-Hall of India Pvt. Ltd.

Unit	Chapter	Section
I	8, 13	8.1-8.5, 13.1-13.4 (omitting 13.4.1 and 13.5)
II	15	15.1 - 15.4
III	15	15.5
IV	19	19.1, 19.2
V	20	20.1, 20.2

REFERENCE BOOKS

1. Sharma. S.D., (2008).*Operations Research*, KedarNath, Ram NathPublications, (Fourteenth Edition).
2. KantiSwarup, Gupta. P.K and Man Mohan, (2018).*Operations Research*, Sultan Chand & Sons Publications,(Fifteenth Edition).

Course Code 20PMTC33	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	L	H	L	L	H	M	M	-
CO2	H	H	L	M	L	M	H	M	L	-
CO3	H	H	M	M	L	M	H	M	L	-
CO4	H	H	L	H	L	L	H	M	L	-
CO5	H	H	L	M	L	L	H	M	L	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester III	**TOPOLOGY**	Hours/Week: 6	
Core Course-12		Credits: 5	
Course Code **20PMTC34**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concepts of topological spaces. [K2]

CO2: determine the topological spaces and their properties in terms of continuous functions, connectedness, compactness, countability and separation axioms. [K3]

CO3: solve the problems in topological spaces with its properties and check the continuity of functions on a topological space. [K3]

CO4: analyze the topological spaces which are connected, compact, Hausdorff, regular or normal and prove theorems related to it. [K4]

CO5: assess the theorems and lemmas in topological spaces. [K5]

UNIT I

Topological Spaces and Continuous Functions

Topological Spaces – Basis for a Topology –The Order Topology –The Product Topology on X x Y –The Subspace Topology –Closed Sets and Limit points – Continuous Functions – The Product Topology. (18 Hours)

UNIT II

Topological Spaces and Continuous Functions - Continued

The Metric Topology - The Metric Topology (Continued)

Connectedness and Compactness

Connected Spaces – Connected Subspaces of the Real Line (18 Hours)

UNIT III

Connectedness and Compactness - Continued

Compact Spaces – Compact Subspaces of the Real Line (18 Hours)

UNIT IV

Countability and Separation Axioms

The Countability Axioms – The Separation Axioms – Normal spaces (18 Hours)

UNIT V

Countability and Separation Axioms- Continued

The Urysohn Lemma – The UrysohnMetrization Theorem –The Tietze Extension Theorem. (18 Hours)

TEXT BOOK

James R.Munkres, (Fifth impression 2008). *Topology,* Second Edition, Prentice-Hall of India Private Ltd,New Delhi.

Unit	Chapter	Section
I	2	12 – 19
II	2	20, 21
	3	23, 24
III	3	26, 27
IV	4	30 – 32
V	4	33 – 35

REFERENCE BOOKS

1. Simmons C.F., (2016). *Introduction to Topology and Modern analysis*, Mcgraw-hillogakusha, ltd., International student edition.

2. ChandrasekharaRao. K.,(2015).*Topology,* Narosa publishing house, Second reprint-2015.

Course Code 20PMTC34	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	L	M	H	M	M	M	L	-
CO2	H	H	L	M	H	M	M	M	L	-
CO3	H	H	M	M	M	L	L	M	L	-
CO4	H	H	M	M	M	L	L	M	L	-
CO5	M	M	L	M	L	L	L	M	L	-

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(2021 -22 onwards)

Semester III	**PRACTICE FOR CSIR / NET – GENERAL PAPER**	Hours/Week:1	
Course Code		Credits: 1	
20PGOL32		Internal 100	External -

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1 : explain various concepts related to numbers, quantitative comparison, monetary problems and logical reasoning. [K2]

CO2 : apply the analytical skills and logical reasoning in solving problems related to competitive examinations. [K3]

CO3 : solve typical problems, geometrical type problems, daily life problems in a effective manner. [K3]

CO4 : analyze the techniques used in solving complicated real life problems. [K4]

CO5 : interpret the data using logical reasoning and observational ability. [K5]

UNIT I

Typical Problems- Series formation

Numerical Ability- Numbers

UNIT II

Geometrical Type Problems

Mensuration and quantitative comparison

UNIT III

Typical Problems- Moving locomotive problem

Numerical Ability- Distance and Directions

UNIT IV

Daily Life Problems

Finding the X – Average - Monetary problems

UNIT V

Logical Reasoning

Data interpretation – Observational ability – Logical puzzles

BOOKS FOR STUDY:

Christy Varghese (2016).,*CSR – NET, General aptitude –A new outlook*, Lilly publishing house, Changanacherry, Kerala

REFERENCE BOOKS

1. Pradip Kumar Ray, General Aptitude Theory ,CSIR-NET, Previous question and answer with explanation and hint to solve, Notion Press, India

2. Ram Mohan Pandey (2021)., *CSIR-UGC-NET General Aptitude Theory and Practice*, Pathfinder Publication, a unit of Pathfinder Academy Pvt. Ltd., India.

Unit	Chapter	Section/Page Number
1	4	142-162
	5	163-192
2	12	272-294
3	3	132-141
	7	206-220
4	8	221-230
	9	231-239
	10	240-249
5	13	295-309
	14	310-323
	15	324-332

Course code 20PGOL32	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	H	H	M	M	-	M	-	-
CO2	H	H	H	H	-	M	-	-
CO3	H	H	H	H	-	H	-	-
CO4	H	M	H	H	-	H	-	-
CO5	H	M	H	H	-	H	-	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester III	**SET/NET PREPARATION FOR ALGEBRA AND ANALYSIS**	Hours/Week: -	
SELF STUDY PAPER		Credits: 5	
Course Code **20PMTO31**		Internal 100	External -

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the basic concepts in algebra and analysis. [K2]

CO2: apply the shortcut methods to get the results in an easy way. [K3]

CO3: analyze the techniques used in solving complicated problems and enrich their research levels. [K4]

CO4: select appropriate methods for solving various types of problems. [K4]

CO5: evaluate the problems at a higher level by identifying the key words. [K5]

UNIT I

Elementary set theory - Finite, countable and uncountable sets –Real number system and complete ordered field - Archimedean property -Supremum –Infimum–Sequences and series – Convergence –lim sup –liminf - Bolzano Weierstrass theorem –Heine Borel Theorem.

UNIT II

Continuity - Uniform continuity – Differentiability - Mean value theorem –Sequences and series of functions–Uniform convergence - Riemann Sums and Riemann Integral -Improper Integrals.

UNIT III

Monotonic functions – Types of discontinuity – Functions of bounded variation –

Lebesgue measure – Lebesgue integral –Functions of several variables - Directional derivative - Partial derivative - Derivative as a linear transformation – Inverse and Implicit function theorems–Metric spaces –Compactness –Connectedness -Normed linear Spaces–Spaces of continuous functions as examples.

Linear Algebra

UNIT IV

Vector spaces – Subspaces - Linear dependence – Basis – Dimension – Algebra of linear transformations–Algebra of matrices – Rank and determinant of matrices– Linear equations – Eigen values and Eigen vectors - Cayley-Hamilton theorem.

UNIT V

Matrix representation of linear transformations- Change of basis – Canonical forms- Diagonal forms -Triangular forms - Jordan forms - Inner product spaces –Orthonormal basis– Quadratic forms - Reduction and classification of quadratic forms.

REFERENCE BOOKS

1. R.Gupta's Popular Master Guide - CSIR – UGC NET Mathematical Sciences, Paper I (Section B) & Paper II - Ramesh Publishing House, New Delhi.
2. Upkar's CSIR – UGC NET/JRF/SET Mathematical Sciences, Dr.AlokKumar,UpkarPrakashan Publishers.

Course Code 20PMTO31	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	H	H	L	-	M	L	-
CO2	H	H	M	L	H	L	-	H	L	-
CO3	H	H	H	L	H	L	M	H	L	-
CO4	H	H	H	L	M	L	-	H	L	-
CO5	H	H	M	H	H	L	M	H	L	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester IV	**FIELD THEORY**	Hours/Week: 6	
Core Course-13		Credits: 5	
Course Code **20PMTC41**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1: explain the fundamental concepts and properties in Galoi's theory, finite fields and extension fields . [K2]

CO2: apply the basic ideas in proving theorems and lemmas in field theory.[K3]

CO3: solve the problems using the techniques in field theory.[K3]

CO4: analyze the relationship between different fields, roots of the polynomials and its Galoi's group, the adjoint operation in the real quaternions and the theorem of Frobenius.[K4]

CO5: assess the proofs of the statements in finite fields, extension fields, division ring and division ring of realquaternions. [K5]

UNIT I
Fields

Extension Fields - The Transcendence of e. (18 Hours)

UNIT II

Roots of Polynomials - Construction with Straightedge and Compass - More About Roots. (18 Hours)

UNIT III

The Elements of Galois Theory - Solvability by Radicals. (20 Hours)

UNIT IV

Galois Groups over the Rationals.

Selected Topics

Finite Fields- Wedderburn's Theorem on Finite Division Rings. (16 Hours)

UNIT V

Selected Topics

A Theorem of Frobenius, Integral Quaternions and the Four-Square Theorem.

(18 Hours)

TEXT BOOK

Herstein. I. N., (Reprint 2016). *Topics in Algebra*, John Wiley and Sons, Second Edition.

Unit	Chapter	Section
I	5	5.1,5.2
II	5	5.3 -5.5
III	5	5.6,5.7
IV	5	5.8
	7	7.1, 7.2
V	7	7.3,7.4

REFERENCE BOOKS

1. John B. Fraleigh, (1982). *A First Course in Abstract Algebra*, Third Edition, Narosa Publications, Eighth Reprint, 1996.

2. Joseph A. Gallian, (2013). *Contemporary Abstract Algebra,* 8th Edition BROOKS / COLE, Cengage Learning.

Course Code 20PMTC41	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	L	H	H	M	M	M	L	-
CO2	H	H	L	H	H	M	M	M	L	-
CO3	H	H	M	H	H	M	M	M	L	-
CO4	H	H	M	M	M	L	L	M	-	-
CO5	H	H	L	M	M	L	L	M	-	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester IV	**FUNCTIONAL ANALYSIS**	Hours/Week: 6	
Core Course-14		Credits: 5	
Course Code **20PMTC42**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1: explain the basic concepts in normed spaces,Banach spaces,spectrum of a bounded operator. [K2]

CO2: apply techniques in Functional analysis to determine solutions to problems in other fields. [K3]

CO3: prove theorems in normed spaces, Banach spaces, spaces of bounded variation. [K3]

CO4: analyse the properties of various functions, normed spaces,Banach spaces, Boundedoperator. [K4]

CO5: justify the proof of statements in normed spaces,Banach spaces, functions of bounded variation. [K5]

UNIT I

Fundamentals of Normed Spaces:

Normed Spaces-Spaces k^n-sequence spaces- L^p- spaces - Function spaces - Inner Product spaces - Continuity of Linear Maps - Bounded Linear Maps. (18 Hours)

UNIT II

Hahn-Banach Theorems – Hahn - Banach separation Theorem - Hahn-Banach-extension Theorem-unique Hahn-Banach Extensions - Banach limits - Banach Spaces. (18 Hours)

UNIT III

Bounded Linear Maps on Banach Spaces:

Uniform Boundedness Principle - Closed Graph Theorem - Open Mapping Theorem. (18 Hours)

UNIT IV

Bounded Inverse Theorem - Two-norm theorem - Spectrum of a Bounded Operator - Gelfand -Mazur Theorem - Spectral radius formula. (18 Hours)

UNIT V

Spaces of Bounded Linear Functionals:

Duals and Transposes - Closed range theorem of Banach. (18 Hours)

TEXT BOOK

Balmohan.V. Limaye, (Reprint 2013).*Functional Analysis*, Revised Second Edition, New Age International (P) Ltd. Publishers,.

Unit	Chapter	Section
I	II	5.1-5.7, 6.1-6.6,6.8 (except 6.5 (c) & (d))
II	II	7.1-7.11, 8.1-8.4
III	III	9.1-9.3, 10.1 – 10.7 (except 10.7 (c)& (d))
IV	III	11.1 – 11.3, 12.1 – 12.6,12.8
V	IV	13.1-13.10

REFERENCE BOOKS

1. Sharma. J.N and Vasistha. A. R., (1986). *Functional Analysis*, 5th Edition, Krishna PrakashanMandir, Meerut.
2. Somasundaram. D., (2006).*A First Course in Functional Analysis,*Alpha Science International Limited.

Course Code 20PMTC42	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	H	L	-	H	H	M	-
CO2	H	M	M	M	L	-	M	H	L	-
CO3	H	M	H	H	M	L	M	H	H	-
CO4	H	L	M	M	L	L	M	H	H	-
CO5	H	L	L	M	H	-	L	H	L	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester IV	**NUMBER THEORY AND CRYPTOGRAPHY**	Hours/Week: 6	
Core Course-15		Credits: 5	
Course Code **20PMTC43**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1: explain several basic concepts in Number Theory. [K2]

CO2: apply acquired skills in context of theory of numbers to encrypt and decrypt a message using public key cryptography. [K3]

CO3: prove results using arithmetical functions, various transformations for encryption and decryption. [K3]

CO4: analyze the various concepts related to theory of numbers. [K4]

CO5: justify the results in number theory. [K5]

UNIT I

The Fundamental Theorem of Arithmetic

Introduction – Divisibility - Greatest common divisor - Prime numbers - The fundamental theorem of arithmetic - The series of reciprocals of the primes - The Euclidean algorithm - The greatest common divisor of more than two numbers

Arithmetical Functions and Dirichlet Multiplication

Introduction -The Mobius functionμ(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 the Mobius inversion formula - The Mangoldt function Λ(n).

(18 Hours)

UNIT II

Arithmetical Functions and Dirichlet Multiplication

Multiplicative functions - Multiplicative functions and Dirichlet multiplication - The inverse of a completely multiplicative function- Liouville's function λ(n) -The divisor functions $\sigma_\alpha(n)$ - Generalized convolutions -Formal power series - The Bell series of an arithmetical function - Bell series and Dirichlet multiplication -Derivatives of arithmetical functions - The Selberg identity.

(18 Hours)

UNIT III

Congruences

Definition and basic properties of congruences - Residue classes and complete residue systems - Linear congruences - Reduced residue systems and the Euler-Fermat theorem -Polynomial congruences modulo p - Langrange's theorem - Applications of Lagrange's theorem - Simultaneous linear congruences, The Chinese remainder theorem. (18 Hours)

UNIT IV

Cryptography

Some simple crypto systems – Enciphering matrices. (18 Hours)

UNIT V

Public key

The idea of public key Cryptography- RSA - Discrete log (the index- calculus algorithm is excluded) - Knapsack. (18 Hours)

TEXT BOOKS

1. Tom M.Apostol, (Eighth Reprint 1998). *Introduction to Analytic Number Theory*, Narosa Publishing House, New Delhi, Springer International Student Edition.

2. Neal Koblitz, (Second edition, fourth Indian reprint 2010). *A Course in Number Theory and Cryptography*, Springer International Edition.

Unit	Chapter	Section
Text Book 1		
I	1	1.1 -1.8
	2	2.1- 2.8
II	2	2.9- 2.19
III	5	5.1- 5.7
Text Book 2		
IV	3	1 & 2
V	4	1- 4

REFERENCE BOOKS

1. Ivan Niven, Herbert S. Zuckerman and Hugh L.Montgomery, (2008). (Fifth edition), *An Introduction to the Theory of Numbers,* John Wiley & sons.
2. Richard A.Mollin, (2006). *An introduction to cryptography*, Chapman and Hall / CRC, Second Edition.

Course Code 20PMTC43	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	L	L	L	L	H	L	L	-
CO2	H	H	L	M	M	M	H	L	L	-
CO3	H	H	L	M	M	M	M	L	L	-
CO4	H	H	L	M	M	M	H	L	L	-
CO5	H	H	L	M	H	M	M	L	L	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester IV	**GRAPH THEORY**	Hours/Week: 6	
Core Course-16		Credits: 5	
Course Code **20PMTC44**		Internal 40	External 60

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1: explain the basic concepts in Graph Theory**.** [K2]

CO2: solve problems by identifying the properties in graph structures. [K3]

CO3: apply the graph theoretical concepts in graph structures**.** [K3]

CO4: analyze the various parameters in graph structures. [K4]

CO5: assessthe results in Graph Theory to graph structures. [K5]

UNIT I

Trees

Bridges – Trees - **Connectivity** : Cut Vertices - Blocks - Connectivity - Menger's Theorem - Geodetic Sets. (18 Hours)

UNIT II

Traversability

Eulerian - Hamiltonian Graphs - Hamiltonian Walks and Numbers - **Digraphs**: Strong Digraphs - Tournaments – Decision - Making . (18 Hours)

UNIT III

Matchings and Factorization

Matchings - Factorization - Decompositions and Graceful Labelings - Instant Insanity - The Petersen Graph – γ-Labelings of Graphs. (18 Hours)

UNIT IV

Planarity

Planar Graphs - Embedding Graphs on Surfaces

Coloring

The four color Problem -Vertex Coloring - Edge Coloring - The Heawood Map Coloring Theorem. (18 Hours)

UNIT V

Ramsey Numbers

The Ramsey Numbers of Graphs - Turan's Theorem - **Distance:** The Center of a Graph - Distant Vertices. (18 Hours)

TEXT BOOK

Gary Chartrand and Ping Zhang, (2003).*Introduction to graph Theory*, Tata McGraw – Hill Publishing Company limited, New Delhi, Edition.

Unit	Chapter	Section
I	4	4.1,4.2,5.1- 5.5
II	6	6.1-6.3,7.1-7.3
III	8	8.1-8.6
IV	9	9.1,9.2,10.1-10.4
V	11	11.1,11.2,12.1,12.2

REFERENCE BOOKS

1. Balakrishnan. B and Ranganathan.K., (2013). *A Text Book of Graph Theory*, Springer International Edition, New Delhi, Reprint 2013.
2. Bondy. J.A. and Murty.U.S.R., (1982).*Graph theory with Applications*, Elsevier

Science Publishing Co., Inc., NewYork, Fifth Printing.

Course Code 20PMTC44	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	L	L	L	L	H	L	L	-
CO2	H	H	L	M	M	M	H	L	L	-
CO3	H	H	L	M	M	M	H	L	L	-
CO4	H	H	L	M	M	M	H	L	L	-
CO5	H	H	L	M	M	M	H	L	L	-

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M.Sc. MATHEMATICS (SEMESTER)
(2020 - 21 onwards)

Semester IV	**PROJECT**	Hours/Week: 6	
Course Code **20PMTC41PR**		Credits: 5	
		Internal 40	External 60

COURSE OUTCOMES

On completion of the project, the students will be able to

CO1: use literature review to carry out the project work. [K3]

CO2: apply tahe theoretical knowledge to formulate the real life problems. [K3]

CO3: execute the project work in abstract and applied Mathematics. [K3]

CO4: analyze the existing results and frame new concepts with illustrations. [K4]

CO5: assess the project to meet the challenges at society level. [K5]

Regulations for the Project Report

- The topic of the project may be based on research articles from mathematical journals or recent papers.
- Evaluation method for the project:

Components	Max Marks		Credits
	Internal	External	
Project report	40	40	3
Viva voce		20	2
Total	**100**		**5**

- Internal examiners are the respective supervisors**.**
- Viva Voce examination to be conducted by the external examiner.
- The report of the project must be in the prescribed form. It should be typed neatly in MS word (13 pt, Times New Roman, double line spacing).
- The format of the project report should have the following components.
    - First page should contain:
        Title of the project report
        Name of the candidate
        Register number
        Name of the supervisor
        Address of the institution
        Month & year of submission
    - Contents
    - Certificate by supervisor
    - Declaration by candidate
    - Acknowledgement
    - Chapter 1 – Preliminaries
    - Other chapters
    - References
- The number of pages in the project may be 30 – 40.
- Each page should contain at least 18 lines.
- Four copies of the project report with spiral binding should be submitted.

CourseCode **20PMTC41PR**	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7	PSO 8
CO1	H	H	H	H	H	H	H	M	H	M
CO2	H	H	H	H	H	H	H	M	H	M
CO3	H	H	H	H	H	H	H	M	H	M
CO4	H	H	H	H	H	H	H	M	H	M
CO5	H	H	H	H	H	H	H	M	H	M