V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Reaccredited with 'A++' Grade (4th Cycle) by NAAC
VIRUDHUNAGAR
Quality Education with Wisdom and Values

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM REGULATIONS AND SYLLABUS
(with effect from Academic Year 2023 - 2024)

V.V.Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 13 UG Programmes (Aided), 15 UG Programmes (SF), 15 PG Programmes and 6 Ph.D. Programmes. The curricula for all these Programmes, except Ph.D. Programmes, have been framed as per the guidelines given by the and University Grants Commission (UGC) & Tamil Nadu State Council for Higher Education (TANSCHE) 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, Data Science, Computer Applications and Computer Application - Graphic Design
Commerce & Management	:	Commerce, Commerce (Computer Applications), Commerce (Professional Accounting),Business Administration

PG PROGRAMMES

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

* AICTE approved Programmes

OUTLINE OF CHOICE BASED CREDIT SYSTEM- PG

1. Core Courses
2. Elective Courses
    - Discipline Specific Elective Courses (DSEC)
    - Generic Elective Courses
    - Non-Major Elective Course (NMEC)
3. Skill Enhancement Courses
4. Self Study Course (Online)
5. Extension Activity
6. Extra Credit Courses (Optional)

List of Non Major Elective Courses (NME)
(2023-2024 onwards)

PG PROGRAMMES

Name of the Course	Course Code	Department
Tourism in Tamilnadu	23PHIN31	History
Functional English	23PENN31	English
தமிழும் பிற துறைகளும்	23PTAN31	Tamil
Taxation Concepts and Assessment	23PCON31	Commerce
Entrepreneurship	23PBAN31	Business Administration
Statistics for Life and Social Sciences	23PMTN31	Mathematics
Advanced Chemistry for Competitive Examination	23PCHN31	Chemistry
Nutrition and Health	23PHSN31	Home Science - Nutrition and Dietetics
Molecular Basis of Diseases and Therapeutic Strategies	23PBCN31	Biochemistry
Web Programming	23PCSN31	Computer Science
Fundamentals of Web Design	23PCAN31	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 M.Sc. 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 M.Sc. 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.

Programme Educational Objectives (PEOs) of M.Sc. MATHEMATICS Programme

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 both in spoken and written forms 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, synthesis the findings and provide valid conclusion by critical evaluation of theories, policies and practices for the fulfillment of the local, national, regional and global developmental needs. (*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 Programme Specific Outcomes (PSOs)

Based on the Programme Outcomes, Programme Specific Outcomes are framed for each PG Programme**.** Programme Specific 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.Sc. Mathematics Programme, 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.

PO2: *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.

PO3: *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.

PO4: *Critical thinking and Analytical Reasoning*

PSO 4 a: Apply the skill of logical and analytical reasoning in advanced mathematics for employment.

PO5: *Research Related Skills*

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

PO6: *Digital Literacy, Self - directed and Lifelong learning*

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

PO7: *Cooperation/Team Work and Multicultural Competence*

PSO 7: Demonstrate the knowledge of mathematics with team spirit in diverse Environment and become entrepreneur and bring multicultural richness in Mathematics

PO8: *Moral and Ethical awareness*

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

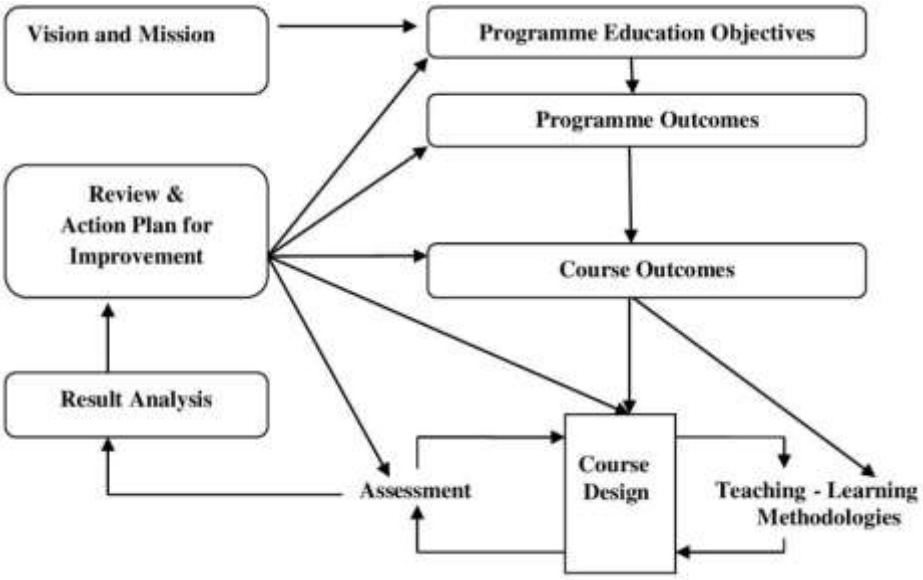
PO-PEO Mapping Matrix

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.

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

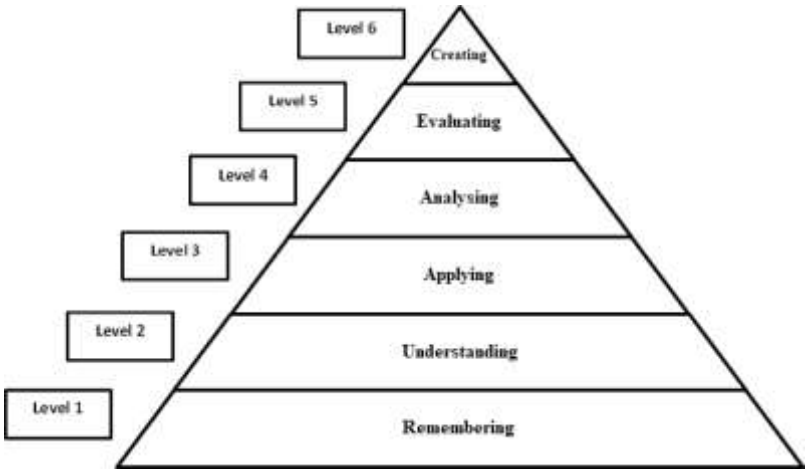
B.1.4 Course Outcomes (COs)

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 to any 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	25	75	**100**

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

INTERNAL ASSESSMENT
Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	**:**	**25**

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

Practical

Mode of Evaluation		Marks
Practical Test	:	30
Record Performance	:	10
Total	**:**	**40**

Practical Test - Average of the two Practical Tests will be considered

Performance - Attendance and Record

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

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6-9	Internal Choice – Either… or Type	4	4	5	20
C	10 - 11	Internal Choice – Either…. or Type	2	2	10	20
					Total	**45***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

SUMMATIVE EXAMINATION

External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Summative Examination	**:**	60
Seminar Presentation	**:**	15
Total	**:**	**75**

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6 - 10	Internal Choice - Either ….or Type	5	5	5	25
C	11 - 13	Internal Choice - Either …or Type	3	3	10	30
					Total	**60**

B.2.2. PROJECT

Individual 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: Project Report - 40 Marks

Viva Voce - 20 Marks

B. 2.3 SKILL ENHANCEMENT COURSES
INTERNAL ASSESSMENT
Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	:	**25**

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

Practical

Mode of Evaluation		Marks
Practical Test	:	30
Record Performance	:	10
Total	:	**40**

Practical Test - Average of the two Practical Tests will be considered
Performance - Attendance and Record

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

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 4	Internal Choice – Either… or Type	4	4	5	20
B	5	Internal Choice – Either… or Type	1	1	10	10
					Total	**30***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

SUMMATIVE EXAMINATION

External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Seminar Paper		10
Seminar Presentation	:	15
Summative Examination	:	50
Total	:	**75**

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6 - 10	Internal Choice - Either ….or Type	5	5	5	25
C	11 - 12	Internal Choice - Either …or Type	2	2	10	20
					Total	**50**

B. 2.3.1 Skill Enhancement Course - Professional Competency Skill

Types of Question – Multiple Choice Questions Only

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	**:**	**25**

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	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6-9	Internal Choice – Either… or Type	4	4	5	20
C	10 - 11	Internal Choice – Either…. or Type	2	2	10	20
	Total					**45***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

SUMMATIVE EXAMINATION

External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Summative Examination	:	60
Seminar Presentation	:	15
Total	:	**75**

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6 - 10	Internal Choice - Either ….or Type	5	5	5	25
C	11 - 13	Internal Choice - Either …or Type	3	3	10	30
					Total	**60**

B.2.4. Self Study - Online Course

Practice for CSIR NET-General Paper –Online

Internal Examination only

- Two Periodic Tests (Online) 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	:	25
Model Examination	:	75
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.5. Extension Activities

Assessment by Internal Examiner only

Distribution of Marks

Mode of Evaluation		**Marks**
Attendance	:	5
Performance	:	10
Report	:	10
Total	**:**	**25***

*The marks obtained will be calculated for 100 marks

B.2.6. EXTRA CREDIT COURSES (OPTIONAL)

2.6.1 Extra Credit Course offered by the Department.

Assessment by Internal Examiner Only (To be conducted along with the III Periodic Test)

Distribution of Marks

Mode of Evaluation		**Marks**
Quiz (Multiple Choice Questions)	:	25
Model Examination	:	75
Total	**:**	**100**

Question Pattern for Model Examination

Section	**Types of Question**	**No. of Questions**	**No. of Questions to be answered**	**Marks for each Question**	**Total Marks**
A Q.No.(1-5)	Internal Choice-Either or Type	5	5	7	35
B Q.No.(6-9)	Internal Choice-Either or Type	4	4	10	40
				Total	**75**

2.6.2 Extra credit Course offered by MOOC (Massive Open Online Course)

- The Courses shall be completed within the first III Semesters of the Programme.
- The allotment of credits is as follows **(Maximum of 15 credits)**

4weeks 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 prescribedCourses 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 60-75days (66% -84%) of attendance are permitted to appear for the Summative Examinations after paying the required fine amountand 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 therespective 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.

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

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

Attainment Levels of COs

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

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 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 - 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 and Extra-curricular Activities)

Expected Level of Attainment for each of the Programme Outcomes

POs	Level of Attainment
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment 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	15% of the class strength	30 % of the class strength
Progression to Higher Education	50% 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
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment 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 stakeholders 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.Sc. Mathematics Programme

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Quality Education with Wisdom and Values

MASTER OF 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 2023-2024

Components	**Semester**				**Total Number of Hours (Credits)**
	I	**II**	**III**	**IV**	
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	6 (4)	6 (4)	6 (4)	-	18(12)
Core Course	6 (4)	6 (4)	5(3)	-	17 (11)
Project	-	-	-	6 (5)	6 (5)
Elective Course (DSEC)	6 (4)	6 (4)	-	6 (5)	18 (13)
Elective Course (NME)	-	-	5 (3)	-	5 (3)
Skill Enhancement Course/ Professional Competency Skill	-	-	2(2)	6 (3)	8(5)
Self Study Course	-	-	0 (1)	-	0(1)
Total	**30 (22)**	**30 (22)**	**30 (23)**	**30 (23)**	**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 -7013

PROGRAMME CONTENT

SEMESTER I

(2023 – 2024 onwards)

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course -1	Algebraic Structures	23PMTC11	6	5	3	25	75	100
2	Core Course -2	Real Analysis - I	23PMTC12	6	5	3	25	75	100
3	Core Course -3	Ordinary Differential Equations	23PMTC13	6	4	3	25	75	100
4	Core Course -4	Graph Theory and Applications	23PMTC14	6	4	3	25	75	100
5	Discipline Specific Elective -1	Fuzzy Algebra / Advanced Calculus / Theory of Computations	23PMTE11 / 23PMTE12 / 23PMTE13	6	4	3	25	75	100
			Total	**30**	**22**				**500**

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	Advanced Algebra	23PMTC21	6	5	3	25	75	100
2	Core Course – 6	Real Analysis – II	23PMTC22	6	5	3	25	75	100
3	Core Course – 7	Partial Differential Equations	23PMTC23	6	4	3	25	75	100
4	Core Course – 8	Mathematical Statistics	23PMTC24	6	4	3	25	75	100
5	Discipline Specific Elective -2	Modelling and Simulation with Excel/ Wavelets/ Neural Networks	23PMTE21 / 23PMTE22 / 23PMTE23	6	4	3	25	75	100
			Total	**30**	**22**				**500**

MASTER OF SCIENCE - MATHEMATICS -7013

PROGRAMME CONTENT

(2023 – 2024 onwards)

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	Complex Analysis	23PMTC31	6	5	3	25	75	100
2.	Core Course – 10	Probability Theory	23PMTC32	6	5	3	25	75	100
3.	Core Course – 11	Topology	23PMTC33	6	4	3	25	75	100
4.	Core Course – 12	Industrial Statistics	23PMTC34	5	3	3	25	75	100
5.	Elective Course(NME)	Statistics for Life and Social Sciences	23PMTN31	5	3	3	25	75	100
6.	Skill Enhancement Course / Professional Competency Skill (SEC – 1)	Computational Mathematics using SageMath	23PMTS31	2	2	3	25	75	100
7.	Self Study Course	Practice for CSIR NET – general paper - Online	23PGOL32	-	1	2	100	-	100
			Total	**30**	**23**				**600**
8.	Extra Credit Course (Optional) offered by the Department	Documentation in LATEX	23PMTO31	-	2	3	100	-	100

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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	Functional Analysis	23PMTC41	6	5	3	25	75	100
2	Core Course – 14	Differential Geometry	23PMTC42	6	5	3	25	75	100
3.	Core Course –15 Project	Project with Viva - Voce	23PMTC41PR	6	5	-	40	60	100
4.	Elective Course (DSEC – 3)	Resource Management Techniques	23PMTE41	6	5	3	25	75	100
5.	Skill Enhancement Course / Professional Competency Skill (SEC – 2)	Mathematics for CSIR NET/SET	23PMTS41	6	3	3	25	75	100
			Total	**30**	**23**				**500**

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VIRUDHUNAGAR - 626 001

M.Sc. MATHEMATICS
(2023 - 24 onwards)

Semester I	**ALGEBRAIC STRUCTURES**	Hours/Week: 6	
Core Course-1		Credits: 5	
Course Code **23PMTC11**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concepts of class equation, solvability of groups, finite abelian groups, linear transformations, real quadratic forms. [K2]

CO2: apply the Sylow's theorem to find number of Sylow subgroups, apply the concepts of linear transformation and Jordan blocks to find invariants of linear transformation and characteristic polynomial.[K3]

CO3: apply the concepts to characterize the solvable groups, direct products, finite abelian groups and modules. [K3]

CO4: analyse the properties of matrices and nilpotent transformation to find the index of nilpotence to decompose a space into invariant subspaces. [K4]

CO5: examine the properties of finite abelian groups and and to verify whether the transformation in Hermitian, unitary and normal [K4]

UNIT I

Counting Principle - Class Equation for Finite Groups and its Applications - Sylow's Theorems (For theorem 2.12.1, First proof only). **(18 Hours)**

UNIT II

Solvable groups - Direct products - Finite abelian groups- Modules **(18 Hours)**

UNIT III

Linear Transformations: Canonical Forms: Triangular Form - Nilpotent Transformations. **(18 Hours)**

UNIT IV

Jordan Form - Rational Canonical Form**.** **(18 Hours)**

UNIT V

Trace and Transpose - Hermitian, Unitary and Normal Transformations, Real Quadratic Form. **(18 Hours)**

TEXT BOOK

I.N. Herstein, (1975). *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi.

Unit	Chapter	Section
I	2	2.11 and 2.12 (Omit Lemma 2.12.5)
II	5	5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
	2	2.13 and 2.14 (Theorem 2.14.1 only)
	4	4.5
III	6	6.4 , 6.5
IV	6	6.6 and 6.7
V	6	6.8, 6.10 and 6.11 (Omit 6.9)

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 23PMTC11	PO1		PO2		PO3	PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2, a	PSO 2.b	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	1	3	3	1	-	3	3	1	-
CO2	3	2	3	1	2	2	3	3	1	-
CO3	3	2	3	1	2	2	3	3	1	-
CO4	3	1	2	3	2	2	2	3	1	-
CO5	3	1	1	2	3	3	2	3	1	-

Strong (3) Medium (2) Low (1)

Dr. A. Uma Devi
Head of the Department

Dr.A.Uma Devi
Course Designer

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M.Sc. Mathematics
(2023 -24 onwards)

Semester I	**REAL ANALYSIS - I**	Hours/Week: 6	
Core Course-2		Credits: 5	
Course Code **23PMTC12**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concepts of Riemann-Stieltjes integral and its properties, step function, upper function, Lebesgue function and their integrals, properties of inner products, norms and measurable functions. [K2]

CO2: apply Dirichlet's test and Abel's test to test the convergence of infinite series. [K3]

CO3: apply the integral theory to prove results about specific classes of functions. [K3]

CO4: explain the concepts of metric space, continuity, uniform continuity and differentiation in real line. [K4]

CO5: analyze the proofs of various theorems in real number system. [K4]

UNIT I

Functions of Bounded Variation and Rectifiable Curves - Introduction - Properties of monotonic functions - Functions of bounded variation - Total variation - Additive property of total variation - Total variation on [a, x] as a function of x - Functions of bounded variation expressed as the difference of two increasing functions - Continuous functions of bounded variation.

Infinite Series and Infinite Products: Absolute and conditional convergence - Dirichlet's test and Abel's test - Rearrangement of series - Riemann's theorem on conditionally convergent series. **(18 Hours)**

UNIT II

The Riemann - Stieltjes Integral - Introduction - Notation - The definition of the Riemann - Stieltjes integral - Linear Properties - Integration by parts- Change of variable in a Riemann - Stieltjes integral - Reduction to a Riemann Integral – Euler's summation formula - Monotonically increasing integrators, Upper and lower integrals - Additive and linearity properties of upper, lower integrals - Riemann's condition - Comparison theorems. **(18 Hours)**

UNIT III

The Riemann-Stieltjes Integral - Integrators of bounded variation-Sufficient conditions for the existence of Riemann-Stieltjes integrals-Necessary conditions for the existence of Riemann-Stieltjes integrals- Mean value theorems for Riemann-Stieltjes integrals -Integrals as a function of the interval – Second fundamental theorem of integral calculus-Change of variable in a Riemann integral -Second Mean Value Theorem for Riemann integral- Riemann-Stieltjes integrals depending on a parameter-Differentiation under integral sign-Lebesgue criterion for existence of Riemann integrals**.** **(18 Hours)**

UNIT IV

Continuity

Limits of Function - Continuous Functions - Continuity and Compactness - Continuity and Connectedness – Discontinuities - Monotonic Functions - Infinite Limits and Limits at Infinity**.** **(18 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. **(18 Hours)**

TEXT BOOK

1. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974.
2. Walter Rudin, (2016). *Principles of Mathematical Analysis*, Third Edition, McGraw - Hill, International Editions.

Unit	Chapter	Section
I	Text Book 1	
	6	6.1 to 6.8
	8	8.8, 8.15, 8.17, 8.18
II	7	7.1 to 7.14
III	7	7.15 to 7.26
	Text Book 2	
IV	4	4.1 – 4.34
V	5	5.1 – 5.19

REFERENCE BOOKS

1. Bartle, R.G. *Real Analysis*, John Wiley and Sons Inc., 1976.
2. Malik,S.C. and Savita Arora. *Mathematical Anslysis*, Wiley Eastern Limited.New Delhi, 1991.
3. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi, 1991.
4. Gelbaum, B.R. and J. Olmsted, *Counter Examples in Analysis*, Holden day, San Francisco, 1964.
5. A.L.Gupta and N.R.Gupta, *Principles of Real Analysis*, Pearson Education, (Indian print) 2003.

Course Code 23PMTC12	PO1		PO2		PO3	PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2, a	PSO 2.b	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	3	2	2	2	2	3	1	-
CO2	3	2	1	1	1	2	2	3	1	-
CO3	3	1	2	2	2	2	3	3	1	-
CO4	3	1	1	1	1	2	3	3	1	-
CO5	3	1	1	1	3	2	3	3	1	-

Strong (3) Medium (2) Low (1)

Dr.A.Uma Devi
Head of the Department

Dr.M.Uma Maheswari
Course Designer

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M.Sc. Mathematics

(2023 -24 onwards)

Semester I	**ORDINARY DIFFERENTIAL EQUATIONS**	Hours/Week: 6	
Core Course-3		Credits: 4	
Course Code **23PMTC13**		Internal 25	External 75

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 arising in various fields. [K3]

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

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

CO5: analyze the solutions using appropriate methods and give examples. [K4]

UNIT I

Linear Equations with Constant Coefficients

Introduction - The second order homogeneous equation - Initial value problems for second order equations - Linear dependence and independence- A formula for the Wronskian - The non-homogeneous equation of order two. **(18 Hours)**

UNIT II

Linear Equations with Constant Coefficients

The homogeneous equation of order n –Initial value problems for n^{th} order equations – Equations with real constants - The non - homogeneous equation of order n – A special method for solving the non - homogeneous equation - Algebra of constant coefficient operators**.** **(18 Hours)**

UNIT III

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. **(18 Hours)**

UNIT IV

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 exceptional cases – The Bessel equation - The Bessel equation (continued).

(18 Hours)

UNIT V

Existence and Uniqueness of Solutions to First Order Equations

Introduction - Equations with variables separated – Exact equations – The method of successive approximations – The Lipschitz condition – Convergence of the Successive approximations. **(18 Hours)**

TEXT BOOK

1. E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice- Hall of India Ltd., New Delhi, 1987.

Unit	Chapter	Section
I	2	1 to 6
II	2	7 to 12.
III	3	1 to 8 (Omit section 9)
IV	4	1 to 4 and 6 to 8 (Omit sections 5 and 9)
V	5	1 to 6 (Omit Sections 7 to 9)

REFERENCE BOOKS

1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems,* John Wiley and sons, New York, 1967.
2. George F Simmons, *Differential equations with applications and historical notes,* Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965.
4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd. New Delhi 2001
6. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations,* Narosa Publishing House, New Delhi, 2002.

Course Code 23PMTC13	**PO1**		**PO2**		**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2, a**	**PSO 2.b**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	1	2	3	1	1	2	2	1	-
CO2	3	2	2	1	2	1	2	3	1	-
CO3	2	1	1	1	2	2	2	1	1	-
CO4	3	1	3	3	2	2	3	2	1	-
CO5	1	1	3	2	3	2	3	2	1	-

Strong (3) Medium (2) Low (1)

Dr.A.Uma Devi
Head of the Department

Mrs.J.Ashwini
Course Designer

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M.Sc. MATHEMATICS
(2023 - 24 onwards)

Semester I	**GRAPH THEORY AND APPLICATIONS**	Hours/Week: 6	
Core Course-4		Credits: 4	
Course Code **23PMTC14**		Internal 25	External 75

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: analyze the results in Graph Theory to find applications in real life. [K4]

UNIT I

Trees, Cut Edges and Bonds, Cut Vertices, Cayley's Formula –Applications: The Connector Problem – Connectivity, Blocks – Applications: Construction of Reliable Communication Networks. **(18 Hours)**

UNIT II

Euler Tours, Hamiltonian Cycles – Applications: The Chinese Postman Problem, The Travelling Salesman Problem. **(18 Hours)**

UNIT III

Matching's, Matching's and Coverings in Bipartite Graphs, Perfect Matching – Applications: The Personnel Assignment Problem, The Optimal Assignment Problem**.**

(18 Hours)

UNIT IV

Chromatic Number, Brook's Theorem, Hajos' Conjecture, Chromatic Polynomials, Girth and Chromatic Number – Applications: A Storage Problem. **(18 Hours)**

UNIT V

Directed Graphs, Directed Paths, Directed Cycles – Applications: A Job Sequencing Problem, Designing as Efficient Computer Drum, Making a Road System One-Way.

(18 Hours)

TEXT BOOK

J.A Bondy and U.S.R Murty, Graph Theory with Applications, North Holland, 1976.

Unit	Chapter	Section
I	2	2.1-2.5
	3	3.1-3.3
II	4	4.1-4.4.
III	5	5.1-5.5
IV	8	8.1-8.6.
V	10	10.1-10.6.

REFERENCE BOOKS

1. John Clark and D. Allan Holton; Graph theory World Scientific Publishing Co. Pvt.Ltd, 1991.

2. Narsingh Deo; Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, 1974.

Course Code 23PMTC14	PO1		PO2		PO3	PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2. a	PSO 2.b	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	1	3	1	1	1	1	2	-
CO2	3	3	1	1	2	2	2	1	1	-
CO3	3	3	1	1	2	2	2	1	2	-
CO4	3	3	1	3	2	2	2	1	1	-
CO5	3	3	1	2	2	2	2	2	1	-

Strong (3) Medium (2) Low (1)

Dr.A.Uma Devi
Head of the Department

Dr.P.Getchial Pon Packiavathi
Course Designer

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M.Sc. Mathematics
(2023 -24 onwards)

Semester I	**FUZZY ALGEBRA**	Hours/Week: 6	
DSEC - 1		Credits: 4	
Course Code **23PMTE11**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the basic concepts of Fuzzy sets, relations, Operation on Fuzzy sets. [K2]

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

CO3: apply fuzzy relations, binary fuzzy relations, fuzzy equivalence relations in real life problems. [K3]

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

CO5: analyze the algebraic structures by using advanced ideas in Fuzzy algebra. [K4]

UNIT I

From Classical (CRISP) Sets to Fuzzy sets: A Grand Paradigm Shift:

Fuzzy Sets: Basic Types – Fuzzy Sets: Basic Concepts

Fuzzy Sets versus Crisp Sets:

Additional Properties of α- Cuts – Representation of Fuzzy Sets – Extension Principle for Fuzzy Sets. **(18 Hours)**

UNIT II

Operations on Fuzzy sets:

Types of Operations - Fuzzy Complements- Fuzzy Intersection: t-Norms- Fuzzy Unions: t- Conorms – Combinations of Operations.

Fuzzy Relations:

Crisp versus Fuzzy Relations – Binary Fuzzy Relations – Binary Relations on a Single Set – Fuzzy Equivalence Relations - Fuzzy Compatibility Relations.

(18 Hours)

UNIT III

Fuzzy Subgroups:

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 Subgroups:

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. Georgr J. Klir and Bo Tuan, Fuzzy Sets and Fuzzy Logic Theory and applications, PHI Leaning private Limited, New delhi, 2009.
2. Rajeshkumar, (1993). Fuzzy Algebra Vol I, University of Delhi, Publication Division.

REFERENCE BOOKS

1. A.K. Bhargava: Fuzzy Set Theory, Fuzzy Logic and their Applications, published by S. Chand Pvt limited, 2013
2. S. Rajasekaran & Y.A. VijiaylakshmiPai, Neural Networks, Fuzzy logic and genetic algorithms, Prentice Hall of India.

Unit	Chapter	Section
Text Book - I		
I	1	1.3-1.4
	2	2.1-2.3
II	3	3.1-3.5
	5	5.1, 5.3-5.6
Text Book - II		
III	1	1.2.16 - 1.2.2
	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

Course Code 23PMTE11	**PO1**		**PO2**		**PO3**	**PO 4**	**PO5**	**PO 6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2 a**	**PSO 2.b**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	3	1	3	2	2	1	1	1	-
CO2	3	3	1	1	1	2	1	1	1	-
CO3	3	3	1	1	1	2	1	1	1	-
CO4	3	3	1	3	2	2	1	1	1	-
CO5	3	3	1	2	2	2	1	2	1	-

Strong (3) Medium (2) Low (1)

Dr.A.Uma Devi
Head of the Department

Dr.M.C. Maheswari
Course Designer

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M.Sc. Mathematics
(2023 -24 onwards)

Semester I	**ADVANCED CALCULUS**	Hours/Week: 6	
DSEC-1		Credits: 4	
Course Code **23PMTE12**		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: solve the problems in Differential Geometry and Vector Calculus**.** [K3]

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

CO4: analyze theorems in Advanced Calculus. [K4]

CO5: estimate integrals over curves and surfaces. [K4]

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 23PMTE12	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	3	3	3	1	1	2	1	2	1	-
CO2	3	3	2	2	3	2	3	2	1	-
CO3	3	3	3	3	3	2	3	2	1	-
CO4	3	3	2	3	3	2	3	2	1	-
CO5	3	3	2	2	3	3	3	3	1	-

Strong (3) Medium (2) Low (1)

Dr.A.Uma Devi
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Dr.A.Uma Devi
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VIRUDHUNAGAR - 626 001

M.Sc. MATHEMATICS
(2023- 24 onwards)

Semester I	**THEORY OF COMPUTATIONS**	Hours/Week: 6	
DSEC-1		Credits: 4	
Course Code **20PMTE13**		Internal 25	External 75

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: analyze theorems in automata theory. [K4]

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 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	3	3	1	1	1	1	3	1	1	-
CO2	3	3	1	2	2	2	3	1	1	-
CO3	3	3	1	2	2	2	3	1	1	-
CO4	3	3	1	2	2	2	3	1	1	-
CO5	3	3	1	2	3	2	3	1	1	-

Strong (3) Medium (2) Low (1)

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Dr.M.C.Maheswari
Course Designer

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M.Sc. Mathematics

(2023 -24 onwards)

Semester II	**ADVANCED ALGEBRA**	Hours/Week: 6	
Core Course-5		Credits: 5	
Course Code **23PMTC21**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concepts and properties in Galois 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 Galois group, the adjoint operation in the real quaternions and the theorem of Frobenius. [K4]

CO5: derive the proofs of the statements in finite fields, extension fields, division ring and division ring of real quaternions. [K4]

UNIT-I

Extension fields – Transcendence of e. (18 Hours)

UNIT-II

Roots or Polynomials.- More about roots (18 Hours)

UNIT-III

Elements of Galois theory. (18 Hours)

UNIT-IV

Finite fields - Wedderburn's theorem on finite division rings. (18 Hours)

UNIT-V

Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem. (18 Hours)

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper):

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved

(To be discussed during the Tutorial hour)

TEXT BOOK

I.N. Herstein. *Topics in Algebra* (II Edition) Wiley Eastern Limited, New Delhi, 1975.

Unit	Chapter	Section
I	5	5.1 and 5.2
II	5	5.3 and 5.5
III	5	5.6
IV	7	7.1 and 7.2 (Theorem 7.2.1 only)
V	5	5.7 (omit Lemma 5.7.1, Lemma 5.7.2 and Theorem 5.7.1)
	7	7.3 and 7.4

REFERENCE BOOKS:

1. M.Artin, *Algebra*, Prentice Hall of India, 1991.
2. P.B.Bhattacharya, S.K.Jain, and S.R.Nagpaul, *Basic Abstract Algebra* (II Edition) Cambridge University Press, 1997. (Indian Edition)
3. I.S.Luther and I.B.S.Passi, *Algebra*, Vol. I –Groups(1996); Vol. II *Rings*,Narosa Publishing House , New Delhi, 1999
4. D.S.Malik, J.N. Mordeson and M.K.Sen, *Fundamental of Abstract Algebra*, McGraw Hill (International Edition), New York. 1997.
5. N.Jacobson, *Basic Algebra*, Vol. I & II Hindustan Publishing Company, New Delhi.

Course Code 23PMTC21	PO1		PO2		PO3	PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2. a	PSO 2.b	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	-	3	3	3	3	3	2	-	2
CO2	3	1	-	1	3	3	3	2	1	2
CO3	3	-	2	1	3	3	3	2	1	2
CO4	3	-	2	3	3	3	3	2	1	2
CO5	3	1	-	2	3	3	3	2	-	2

Strong (3) Medium (2) Low (1)

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M.Sc. Mathematics

(2023 -24 onwards)

Semester II	**REAL ANALYSIS - II**	Hours/Week: 6	
Core Course-6		Credits: 5	
Course Code **23PMTC22**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the basic concepts of Lebesgue Outer Measure, Measurable Functions, Integration of Non- negative functions, Directional derivative and continuity, Fourierseries and Fourier integrals. [K2]

CO2: determine the measure of some sets, Riemann and Lebesgue Integrals, Fourier Seriesand Fourier Integrals, [K3]

CO3: determine the total derivative and extrema of real valued functions of severablevariables. [K3]

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

CO5: analyze the representation and convergence problems of Fourier series. [K4]

UNIT I

Measure on the Real line - Lebesgue Outer Measure - Measurable sets – Regularity - Measurable Functions - Borel and Lebesgue Measurability (18 Hours)

UNIT II

Integration of Functions of a Real variable - Integration of Non- negative functions – The General Integral - Riemann and Lebesgue Integrals (18 Hours)

UNIT III

Fourier Series and Fourier Integrals - Introduction - Orthogonal system of functions – The theorem on best approximation - The Fourier series of a function relative to an rthonormal system - Properties of Fourier Coefficients - The Riesz-Fischer Theorem - The convergence and representation problems in for trigonometric series – The Riemann - Lebesgue Lemma - The Dirichlet Integrals - An integral representation for the partial sums ofFourier series - Riemann's localization theorem (18 Hours)

UNIT IV

Multivariable Differential Calculus - Introduction - The Directional derivative - Directional derivative and continuity - The total derivative - The total derivative expressed in terms of partial derivatives - The matrix of linear function – The Jacobian matrix - The chain rule - Matrix form of chain rule – The mean - value theorem for differentiable functions – A sufficient condition for differentiability (18 Hours)

UNIT V

Implicit Functions and Extremum Problems : Functions with non-zero Jacobian determinants – The inverse function theorem-The Implicit function theorem-Extrema of real valued functions of severable variables-Extremum problems with side conditions.

(18 Hours)

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper):

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved

(To be discussed during the Tutorial hour)

TEXT BOOK

1. G. de Barra, *Measure Theory and Integration*, Wiley Eastern Ltd., New Delhi, 1981. (for Units I and II).
2. Tom M.Apostol : *Mathematical Analysis*, 2nd Edition, Addison-Wesley Publishing Company Inc. New York, 1974. (for Units III, IV and V).

Unit	Chapter	Section
Text Book 1		
I	2	2.1 to 2.5
II	3	3.1,3.2 and 3.4
Text Book 2		
III	11	11.1 to 11.11
IV	12	12.1 to 12.12
V	13	13.1 to 13.7

REFERENCE BOOKS

1. Burkill,J.C.*The Lebesgue Integral*, Cambridge University Press, 1951.
   2.Munroe,M.E.*Measure and Integration*. Addison-Wesley, Mass.1971.
3. Roydon,H.L.*Real Analysis*, Macmillan Pub. Company, New York, 1988.
4. Rudin, W. *Principles of Mathematical Analysis*, McGraw Hill Company, New York,1979.
5. Malik,S.C. and Savita Arora. *Mathematical Analysis*, Wiley Eastern Limited. New Delhi,1991.
6. Sanjay Arora and Bansi Lal, *Introduction to Real Analysis*, Satya Prakashan, New Delhi,1991

Course Code 23PMTC22	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	3	3	2	2	2	2	1	3	2	1
CO2	3	3	2	2	2	2	1	3	2	1
CO3	3	3	2	2	2	2	1	3	2	1
CO4	3	3	2	2	2	2	1	3	2	1
CO5	3	3	-	2	2	2	1	3	2	1

Strong (3) **Medium (2)** **Low (1)**

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Dr.P.Getchial Pon Packiavathi
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M.Sc. Mathematics

(2023 -24 onwards)

Semester II	**PARTIAL DIFFERENTIAL EQUATIONS**	Hours/Week: 6	
Core Course-7		Credits: 4	
Course Code **23PMTC23**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concepts of Mathematical Models and Classification of second order equation, Cauchy Problem, Method of separation of variables, Boundary Value Problems and Green's Function. [K2]

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

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

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

CO5: analyze the solutions using appropriate methods and give examples. [K4].

UNIT I

Mathematical Models and Classification of Second Order Linear Equation : Classical Equations - The Vibrating String – The Vibrating Membrane – Waves in Elastic Medium – Conduction of Heat in Solids – The Gravitational Potential - Second Order Equations in Two Independent Variables – Canonical Forms – Equations with Constant Coefficients – General Solutions (18 Hours)

UNIT II

The Cauchy Problem : The Cauchy Problem – The Cauchy-Kowalewskaya Theorem – Homogeneous Wave Equations – Initial Boundary Value Problems - Non-homogeneous Boundary Conditions - Finite String with Fixed Ends – Non - homogeneous Wave Equations – Riemann Method – Goursat Problem – Spherical Wave Equation – Cylindrical Wave Equation. (18 Hours)

UNIT III

Method of Separation of Variables: Separation of Variables- Vibrating String Problem – Existence and Uniqueness of Solution of Vibrating String Problem – Heat Conduction Problem – Existence and Uniqueness of Solution of Heat Conduction Problem – Laplace and Beam Equations (18 Hours)

UNIT IV

Boundary Value Problems : Boundary Value Problems – Maximum and Minimum Principles – Uniqueness and Continuity Theorems – Dirichlet Problem for a Circle , a Circular Annulus , a Rectangle - Dirichlet Problem Involving Poisson Equation – Neumann Problem for a circle and a rectangle.

(18 Hours)

UNIT V

Green's Functions: The Delta Function – Green's Functions – Method of Green's Function – Dirichlet's Problem for the Laplace and Helmholtz Operators – Method of Images and Eigen Functions – Higher Dimensional Problem – Neumann Problem. (18 Hours)

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper):

Questions related to the above topics, from various competitive examinations UPSC/ TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved

(To be discussed during the Tutorial hour)

TEXT BOOK

Tyn Myint-U and Lokenath Debnath, *Partial Differential Equations for Scientists and Engineers* (Third Edition), North Hollan, New York, 1987.

Unit	Chapter	Section
I	2 3	2.1 to 2.6 3.1 to 3.4 (omit 3.5)
II	4	4.1 to 4.11
III	6	6.1 to 6.6 (omit section 6.7)
IV	8	8.1 to 8.9
V	10	10.1 to 10.9

REFERENCE BOOKS

1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964.
2. I.N.Sneddon, *Elements of Partial Differential Equations*, McGraw Hill, New Delhi, 1983.
3. R.Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, New York, 1968.
4. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand & Company Ltd., New Delhi, 2001.
5. S, Sankar Rao, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004

Course Code 23PMTC23	PO1		PO2		PO3	PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2,a	PSO 2.b	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	2	2	2	2	1	3	2	1
CO2	3	3	2	2	2	2	1	3	2	1
CO3	3	3	2	2	2	2	1	3	2	1
CO4	3	3	2	2	2	2	1	3	2	1
CO5	3	3	-	2	2	2	1	3	2	1

Strong (3) Medium (2) Low (1)

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M.Sc. Mathematics
(2023 -24 onwards)

Semester II	**MATHEMATICAL STATISTICS**	Hours/Week: 6	
Core Course-8		Credits: 4	
Course Code **23PMTC24**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the basic concepts in Order Statistics, limiting distribution, probability distribution and Statistical test. [K2]

CO2: solve various problems in special distributions. [K3]

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

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

CO5: analyse the statistical data using significance tests for large and small samples. [K4]

UNIT I

Sample Moments and their functions- The notion of Sample and statistic-The distribution of arithmetic mean and independent normally distributed random variables-The χ^2 distribution- The distribution of the statistic ($\bar{X}S$); Student's t- distribution-Fisher's Z-distribution-The distribution of $\bar{X}$ for some non-normal populations.

(18 Hours)

UNIT II

The distribution of sample moment and sample correlation coefficients of a two-dimensional normal population-The distribution of regression coefficients- Limit distribution of sample moments. Order Statistics-The notion of an order statistic –the empirical distributionfunction –Stochastic convergence of sample quantiles**.**

(18 Hours)

UNIT III

Limit distribution of sample quantiles - The limit distribution of successive sample elements- the joint distribution of a group of quantiles – The distribution of the sample range- Tolerance limits- Glivenko Theorem - The theorems of Kolmogorov and Smirnov- Renyi's theorem- theproblem of k-samples. (18 Hours)

UNIT IV

An Outline of the Theory of Runs- the notion of a run- the probability distribution of the number of runs - the expected value and the variance of the runs. (18 Hours)

UNIT V

Significance Test- The concepts of a statistical test- parametric test for small samples and largesamples- The χ^2 test- Test of the Kolmogorov and Smirnov Type- the wald Wolfovitz and Mann –Whitney test- Independence test by contingency tables. (18 Hours)

TEXT BOOK

M. Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New york,1963.

REFERENCE BOOK

1. Gupta. S.C. &Kapoor,V.K. (2002) . Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi
2. Mood A. M &Graybill F. A &Boes D. G (1974) : Introduction to theory of Statistics, Mcgraw Hill.
3. Hogg R. V. & Craig A. T. 1988) : Introduction to Mathematical Statistics, Mcmillan.

Bansilal and Arora (1989).New Mathematical Statistics, Satya Prakashan, New Delhi.

Unit	Chapter	Section
I	9	9.1 – 9.8
II	9	9.9, 9.10
	10	10.1 – 10.4
III	10	10.5 – 10.13
IV	11	11.1 -11.4
V	12	12.1 -12.7

Course Code	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
23PMTC24	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	3	3	2	2	2	2	1	3	2	1
CO2	3	3	2	2	2	2	1	3	2	1
CO3	3	3	2	2	2	2	1	3	2	1
CO4	3	3	2	2	2	2	1	3	2	1
CO5	3	3	-	2	2	2	1	3	2	1

Strong (3) Medium (2) Low (1)

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M.Sc. Mathematics

(2023 -24 onwards)

Semester II	**MODELLING AND SIMULATION WITH EXCEL**	Hours/Week: 6	
DSEC-2		Credits: 4	
Course Code **23PMTE21**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: understand a model's structure, its capabilities, and its underlyingassumptions.[K2]

CO2: solve problems in Simulation using Excel. [K3]

CO3: Perform data analysis on both quantitative and qualitative data leading tomodels of general and specific behaviour. [K3]

CO4: examine models in various forms and to understand the visual models of the behaviour of a system.[K4]

CO5: analyze the critical role of Excel in the early or rapid prototyping of problems.[K4]

UNIT I

Modelling and Simulation: Introduction Model, Classifications of Models, An Example of Deterministic Modelling, A Preliminary Analysis of the Event, Understanding the Important Elements of a Model, Pre-Modelling or Design Phase, Modelling Phase.

(18 Hours)

UNIT II

Resolution of Weather and Related Attendance, Attendees Play Games of Chance, OLPS Modelling Effort, Model Building with Excel, Basic Model, Sensitivity Analysis, Controls from the Forms Control Tools, Option Buttons, Scroll Bars. (18 Hours)

UNIT III

Types of Simulation and Uncertainty, Incorporating Uncertain Processes in Models, The Monte Carlo Sampling Methodology, Implementing Monte Carlo Simulation Methods.

(18 Hours)

UNIT IV

Modelling Arrivals with the Poisson Distribution, VLOOKUP and HLOOKUP Functions, A Financial Example–Income Statement, An Operations Example–Autohaus, Status of Autohaus Model. (18 Hours)

UNIT V

Building the Brain Worksheet, Building the Calculation Worksheet, Variation in Approaches to Poisson Arrivals: Consideration of Modelling Accuracy, Sufficient Sample Size, Building the Data Collection Worksheet, Results. (18 Hours)

TEXT BOOK

1. Hector Guerrero, Excel Data Analysis Modelling and Simulation, Second Edition, Springer.

Unit	Chapter	Section
I	7	7. 1 to 7.3 7.4 – 7.4.1, 7.4.2
II	7	7.4.3 – 7.4.6 7.5.1 – 7.5.5
III	8	8.2, 8.3 – 8.3.1 only
IV	8	8.3.3 , 8.3.4 8.4 8.5 – 8.5.1
V	8	8.5.2 – 8.5.7

REFERENCE BOOKS

1. Cliff T. Ragsdale, Spreadsheet Modelling and Decision Analysis, Ninth Edition.
2. **John** A. **Sokolowski**, Catherine M. Banks, Modelling and Simulation Fundamentals,A John Wiley & Sons, Inc. Publication, 2010.

Course Code 23PMTE21	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	3	3	2	2	2	2	1	3	2	1
CO2	3	3	2	2	2	2	1	3	2	1
CO3	3	3	2	2	2	2	1	3	2	1
CO4	3	3	2	2	2	2	1	3	2	1
CO5	3	3	-	2	2	2	1	3	2	1

Strong (3) Medium (2) Low (1)

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M.Sc. Mathematics
(2023 -24 onwards)

Semester II	**WAVELETS**	Hours/Week: 6	
DSEC-2		Credits: 4	
Course Code **23PMTE22**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: understand Wavelets and to make use of the tools of Fourier Analysis. [K2**]**

CO2: apply Convergence Properties of Wavelets Series. [K3]

CO3: apply systematic method to produce orthonormal wavelets.[K3]

CO4: analyze scaling functions along with convergence properties and speed of convergence. [K4]

CO5: analyze the smoothness of functions using wavelets. **.** [K4]

UNIT I

Introduction to Wavelets, Motivation and Heuristics, Wavelet Transform, Haar Functions and Haar Series, Haar Sums and Dyadic Projections, Haar Series in C_0 and L_p Spaces, Pointwise Convergence of Haar Series. (18 Hours)

UNIT II

Multiresolution Analysis, Orthonormal Systems and Riesz Systems, Scaling Equations and Structure Constants, From Scaling Function to MRA, Meyer Wavelets**.**

(18 Hours)

UNIT III

From Scaling Function to Orthonormal Wavelet, Direct Proof that $V_1 \ominus V_0$ is spanned by $\{\psi(t-k)\}_{k\in\mathbb{Z}}$, Null Integrability of Wavelets without Scaling Functions.

. (18 Hours)

UNIT IV

Wavelets with Compact Support, From Scaling Filter to Scaling Function, Explicit Construction of Compact Wavelets, Smoothness of Wavelets, Cohen's Extension Theorem. (18 Hours)

UNIT V

Convergence Properties of Wavelets Expansions, Wavelet Series in L_p Spaces, Jackson's and Bernstein's Approximation Theorems. (18 Hours)

TEXT BOOK

Mark A. Pinsky: Introduction to Fourier Analysis and Wavelets, Cenage Learning India Pvt. Ltd, 2009.

Unit	Chapter	Section
I	6	6.1,6.2, 6.3 – 6.3.1 to 6.3.3
II	6	6.4.1 to 6.4.3
III	6	6.4.5
IV	6	6.5
V	6	6.6

REFERENCE BOOK

1. C. Sidney Burrus, Ramesh A. Gopinath, Haitao Guo: Introduction to Wavelets and Wavelet Transforms, Prentice Hall Upper Saddle River, New Jersey 07458.
2. Jonas Gomes Luiz Velho: From Fourier Analysis to Wavelets, Springer, 2015.
3. M.V. Altaisky: Wavelets Theory, Applications Implementation, University Press, 2009.
4. K.P. Soman, K.I. Ramachandran, N.G. Resmi: Insight into Waveletes from Theory to Practice, Third Edition.

Course Code 23PMTE22	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	3	2	3	1	1	1	-	1	2	-
CO2	3	2	3	2	2	1	-	1	2	-
CO3	3	2	2	3	2	2	3	1	2	-
CO4	3	2	2	3	2	2	3	1	2	-
CO5	3	2	1	3	3	3	3	1	2	-

Strong (3) Medium (2) Low (1)

Dr.A.Uma Devi
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Re-accredited with 'A' Grade (3rd Cycle) by NAAC
VIRUDHUNAGAR - 626 001

M.Sc. MATHEMATICS
(2023 - 24 onwards)

Semester II	**NEURAL NETWORKS**	Hours/Week: 6	
DSEC-2		Credits: 4	
Course Code **23PMTE23**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: understand the Basics of Artificial Neural Networks. [K2]

CO2: apply Basic Learning Laws and Activation Dynamic Models. [K3]

CO3: solve Pattern Recognition Problems. [K3]

CO4: analyze Feedforward Neural Networks, Pattern Association Networks and Pattern Classification Networks. [K4]

CO5: analyze Feedback Neural Networks, Linear Autoassociative FF Networks and Pattern Storage Networks [K4]

UNIT I

Basics of Artificial Neural Networks:

Characteristics of Neural Networks - Historical Development of Neural Network Principles. (18 Hours)

UNIT II

Basics of Artificial Neural Networks:

Artificial Neural Networks: Terminology - Models of Neuron – Topology - Basic Learning Laws

Activation and Synaptic Dynamics

Activation Dynamics Models. (18 Hours)

UNIT III

Activation and Synaptic Dynamics

Synaptic Dynamics Models - Learning Methods - Stability and Convergence.

Functional Units of ANN for Pattern Recognition Tasks

Pattern Recognition Problem (18 Hours)

UNIT IV

Functional Units of ANN for Pattern Recognition Tasks

Basic Functional Units - Pattern Recognition Tasks by the Functional

Feedforward Neural Networks

Analysis of Pattern Association Networks - Analysis of Pattern Classification Networks. (18 Hours)

UNIT V

Feedback Neural Networks

Analysis of Linear Auto associative FF Networks - Analysis of Pattern Storage Networks. (18 Hours)

TEXT BOOK

B. Yegnanarayana, Artificial Neural Networks, Prentice Hall of India, 2005.

Unit	Chapter	Section
I	1	1.1, 1.2
II	1	1.3 – 1.6
	2	2.1, 2.2
III	2	2.3 – 2.5
	3	3.1
IV	3	3.2, 3.3
	4	4.1, 4.2 ,4.3
V	5	5.1 to 5.3

REFERENCE BOOKS:

1. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer
2. Adam Gibson and Josh Patterson, Deep Learning: A Practioner's Approach, First Editio

Course Code 23PMTE23	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	3	3	1	1	1	1	3	1	1	-
CO2	3	3	1	2	2	2	3	1	1	-
CO3	3	3	1	2	2	2	3	1	1	-
CO4	3	3	1	2	2	2	3	1	1	-
CO5	3	3	1	2	3	2	3	1	1	-

Strong (3) Medium (2) Low (1)

Dr.A.Uma Devi
Head of the Department

Dr.M. C. Maheswari
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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Quality Education with Wisdom and Values

M.Sc. MATHEMATICS
(for those who join in 2023-2024)

Semester III	**COMPLEX ANALYSIS**	Hours/Week: 6	
Core Course-9		Credits: 5	
Course Code **23PMTC31**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the infinite products, canonical products and Jensen's Formula. [K2]

CO2: apply winding numbers to prove Cauchy integral formula, Cauchy's theorem, Residue theorem. [K3]

CO3: solve partial fraction and local properties of analytic functions its canonical products. [K3]

CO4: analyze the properties of harmonic functions, Gamma functions and classification of singularities, zeroes of analytical function. [K4]

CO5: examine the nature of partial fractions and entire functions. [K4]

UNIT I

Cauchy's Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions Removable Singularities- Taylors's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.

(18 Hours)

UNIT II

The general form of Cauchy's Theorem: Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy's Theorem - Proof of Cauchy's theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.

(18 Hours)

UNIT III

Evaluation of Definite Integrals and Harmonic Functions: Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.

(18 Hours)

UNIT IV

Harmonic Functions and Power Series Expansions:

Schwarz theorem - The reflection principle - Weierstrass theorem – Taylor's Series – Laurent series. (18 Hours)

UNIT V

Partial Fractions and Entire Functions: Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen's formula – Hadamard's Theorem.

(18 Hours)

TEXT BOOK

Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979

Unit	Chapter	Section
I	4	2.1 - 2.3 , 3.1 -3.4
II	4	4.1 - 4.7 , 5.1 and 5.2
III	4	5.3, 6.1 - 6.3
IV	4	6.4 and 6.5
	5	1.1 - 1.3
V	5	2.1- 2.4 , 3.1 - 3.2

REFERENCE BOOKS

1. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990.
2. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978
3. E. Hille, *Analytic function Thorey* (2 vols.), Gonm& Co, 1959.
4. M.Heins, *Complex function Theory*, Academic Press, New York,1968.

Website and e-Learning Source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,

http://www.opensource.org , http://en.wikipedia.org

Course Code 23PMTC31	PO1		PO2		PO3	PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2. a	PSO 2.b	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	1	3	3	1	-	3	3	1	-
CO2	3	2	3	1	2	2	3	3	1	-
CO3	3	2	3	1	2	2	3	3	1	-
CO4	3	1	2	3	2	2	2	3	1	-
CO5	3	1	1	2	3	3	2	3	1	-

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari
Head of the Department

Dr.P.Sooriyakala
Course Designer

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M.Sc. MATHEMATICS
(for those who join in 2023-2024)

Semester III	**PROBABILITY THEORY**	Hours/Week: 6	
Core Course-10		Credits: 5	
Course Code **23PMTC32**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the concepts of theory of probability concerning random variables, their characteristics and different types of their probability distributions. [K2]

CO2: solve functions on random variables, Regression of the first and second types, problems applying characteristic Functions, problems on Hypergeometric and Poisson distributions, Cauchy and Laplace distributions, Kolmogorov Inequality and Kolmogorov Strong Law of large numbers. [K3]

CO3: apply the acquired knowledge of various distributions to solve real life problems. [K3]

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

CO5: analyze the computational techniques for solving problems in characteristic functions and interpret the behavior of limiting distributions. [K4]

UNIT I

Random Events and Random Variables: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.

(18 Hours)

UNIT II

Parameters of the Distribution: Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types. (18 Hours)

UNIT III

Characteristic functions: Properties of characteristic functions – Characteristic functions and moments – semi invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions. (18 Hours)

UNIT IV

Some Probability distributions: One point, two point, Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions. (18 Hours)

UNIT V

Limit Theorems: Stochastic convergence – Bernaulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theorem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers. (18 Hours)

TEXT BOOK

M. Fisz, *Probability Theory and Mathematical Statistics*, John Wiley and Sons, New York, 1963.

Unit	Chapter	Section
I	1	1.1 - 1.7
	2	2.1 - 2.9
II	3	3.1 - 3.8
III	4	4.1 - 4.7
IV	5	5.1 - 5.10 (Omit Section 5.11)
V	6	6.1 to 6.4, 6.6 to 6.9, 6.11 and 6.12. (Omit Sections 6.5, 6.10,6.13 to 6.15)

REFERENCE BOOKS

1. R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972
2. K.L.Chung, *A course in Probability*, Academic Press, New York, 1974.
3. R.Durrett, *Probability : Theory and Examples*, (2nd Edition) Duxbury Press, New York, 1996.
4. V.K.Rohatgi *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
5. S.I.Resnick, *A Probability Path*, Birhauser, Berlin,1999.
6. B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999.

Website and e-Learning Source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,

http://www.opensource.org,

http://www.probability.net

Course Code 23PMTC32	PO1		PO2		PO3	PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2. a	PSO 2.b	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	1	3	3	1	2	3	3	1	-
CO2	3	2	3	1	3	2	3	3	1	-
CO3	3	3	3	1	3	2	3	3	1	-
CO4	3	1	2	3	2	2	3	3	1	-
CO5	3	1	2	2	3	2	3	3	1	-

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari
Head of the Department

Dr.R.P.Aditya
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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M.Sc. MATHEMATICS
(for those who join in 2023-2024)

Semester III	**TOPOLOGY**	Hours/Week: 6	
Core Course-11		Credits: 4	
Course Code **23PMTC33**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the fundamental concepts of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space. [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: examine the qualitative tools to characterize connectedness, compactness, second countable, Hausdorff and also to identify when two are equivalent (homeomorphic). [K4]

UNIT I

Topological spaces: Topological spaces – Basis for a topology – The order topology – The product topology on $X \times Y$ – The subspace topology – Closed sets and limit points.

(18 Hours)

UNIT II

Continuous functions: Continuous functions – the product topology – The metric topology. (18 Hours)

UNIT III

Connectedness: Connected spaces- connected subspaces of the Real line – Components and local connectedness. (18 Hours)

UNIT IV

Compactness: Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness. (18 Hours)

UNIT V

Countability and Separation Axiom: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohnmetrization Theorem – The Tietz extension theorem. (18 Hours)

TEXT BOOK

James R. Munkres, *Topology* (2nd Edition) Pearson Education Pve. Ltd., Delhi-2002 (Third Indian Reprint).

Unit	Chapter	Section
I	2	12 - 17
II	2	18 - 21 (Omit Section 22)
III	3	23 - 25
IV	3	26 - 29
V	4	30 - 35

REFERENCE BOOKS

1. J. Dugundji ,*Topology* , Prentice Hall of India, New Delhi, 1975.
2. George F.Sinmons, *Introduction to Topology and Modern Analysis*, McGraw Hill Book Co., 1963

3. J.L. Kelly, *General Topology*, Van Nostrand, Reinhold Co., New York
4. L.Steen and J.Subhash, Counter Examples in Topology, Holt, Rinehart and Winston, New York, 1970.
5. S.Willard, *General Topology*, Addison - Wesley, Mass., 1970.

Website and e-Learning Source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course Code 23PMTC33	**PO1**		**PO2**		**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2. a**	**PSO 2.b**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	1	3	3	1	-	3	3	1	-
CO2	3	2	3	1	2	2	3	3	1	-
CO3	3	2	3	1	2	2	3	3	1	-
CO4	3	1	2	3	2	2	2	3	1	-
CO5	3	1	1	2	3	3	2	3	1	-

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari
Head of the Department

Dr.P.Geetha
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M.Sc. MATHEMATICS
(for those who join in 2023-2024)

Semester III	**INDUSTRIAL STATISTICS**	Hours/Week: 5	
Core Course-12		Credits: 3	
Course Code **23PMTC34**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain the basic statistical quality control techniques, limits, and sampling plans in industrial production processes. [K2]

CO2: understand the concepts of control charts and their interpretations for various parameters. [K3]

CO3: apply the sampling techniques to the attributes of industrial applications. [K3]

CO4: analyze the continuous and sequential sampling plans by attributes. [K4]

CO5: examine the reliability and various hazard models. [K4]

UNIT I

Modified control limits – the use of control limits for moving average – difference control charts – Mid range and Median charts - design of cumulative charts and V-mask. The Exponentially Weighted Moving Average Control Chart - The Exponentially Weighted Moving average Control Chart for Monitoring the Process Mean - Design of an EWMA Control Chart - Robustness of the EWMA to Non-normality -Moving-average control chart

(15 Hours)

UNIT II

Acceptance sampling - Advantages and Disadvantages of Sampling - Types of Sampling Plans - lot formation – sampling inspection by attributes – single sampling plans for

attributes – OC function – Designing a Single-Sampling Plan with a Specified OC Curve - rectifying inspection - Double and multiple sampling plans – OC, ASN, ATI and AOQ functions – the Dodge – Romig sampling plans - AOQL, LTPD (15 Hours)

UNIT III

Acceptance sampling by variables –concept, advantage and limitations – the Shanin lot method - known and unknown sigma variables sampling plan - merits and demerits of variables sampling plan - derivation of OC curve and the parameters of the plan.(15 Hours)

UNIT IV

Continuous sampling plans by attributes - CSP-1 and its modifications - concept of AOQL in CSPs - Multi-level continuous sampling plans - Operation of multi-level CSP of Lieberman and Solomon - Wald-Wolfowitz continuous sampling plans – Sequential Sampling Plans by attributes - OC and ASN functions. (15 Hours)

UNIT V

Reliability – Definition – basic elements of reliability – bath tub curve – achievement of reliability – designing for reliability – measuring of reliability –cost of reliability – maintenance and reliability – mean time between failures (MTBF) – Mean time repair (MTTR) – Failure mode, effect and critically analysis (FMECA) – Total productive maintenance (TPM) – Hazard analysis – failure rate and hazard function – constant hazard model – linear hazard model –MTTF – system and component –parallel system-reliability of switches. (15 Hours)

TEXT BOOKS

1. Mahajan, M, Statistical Quality Control,3/e, Dhanpat Rai and Co., Delhi. (2002).
2. Montgomery, D.C. Introduction to Statistical Quality Control,6/e, Wiley India, New Delhi.(2009)

Unit	Text Book	Chapter	Sections
I	Text Book-1	7	7.5, 7.6, 7.9, 7.10, 7.11(Problems-Page. No. 248 to 257)
	Text Book-2	9	9.2, 9.2.1, 9.2.2, 9.2.3, 9.3
II	Text Book-1	10	10.1, 10.3, 10.5, 10.6, 10.8, 10.9, 10.10, (Problems-Page. No. 334 to 342)
	Text Book-2	15	15.2.4, 15.3.1, 15.5, 15.5.1, 15.5.2
III	Text Book-1	12	12.1, 12.2(Problems- Page. No.399)
	Text Book-2	16	16.2
IV	Text Book-2	16	16.6, 16.6.1
	Text Book-1	11	11.7, 11.8, 11.9, 11.10(Problems-Page. No.365 to 367)
	Text Book-2	15	15.3.3
V	Text Book-1	13	13.1-13.7(Problems- Page. No.435 to 436)

REFERENCE BOOKS

1. Bowker, A.H. and Lieberman, G.J. Engineering Statistics,2/e, Prentice Hall, New Delhi(1982)
2. Juran, J.M. and De Feo, J.A. Juran's Quality control Handbook – The Complete Guide to Performance Excellence,6/e, Tata McGraw-Hill, New Delhi (2010).
3. Schilling, E. G. and Nuebauer, D.V. Acceptance Sampling in Quality Control, 6/e, CRC Press, New York (2009).
4. Wetherill, G.B, Sampling Inspection and Quality Control, 2/e, Chapman and Hall, London. . (1977).
5. Lawless, J.F, Statistical models and methods of Lifetime Data, Wiley, New York. .(1972),
6. John T. Burr, Elementary Statistical Quality Control (Second Edition), Marcel Dekker New York, (2004).
7. Duncan, A.J. Quality Control and Industrial Statistics, Irwin - Illinois. (2006)

Website and e-Learning Source

https://dokumen.pub/john-e-freunds-mathematical-statistics-with-applications-8-ed-pearson-new-international-ed-129202500x-9781292025001.html

Course Code **23PMTC34**	PO1		PO2	PO3		PO4		PO5	PO6	PO7
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4.a	PSO 4.b	PSO 5	PSO 6	PSO 7
CO1	3	3	2	2	2	1	1	2	1	-
CO2	3	3	2	2	2	1	1	2	1	-
CO3	3	3	2	2	2	1	1	2	1	-
CO4	3	3	2	2	2	1	1	2	1	-
CO5	3	3	2	2	2	1	1	2	1	-

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari
Head of the Department

Dr.M.Uma Maheswari
Course Designer

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M.Sc. MATHEMATICS
(for those who join in 2023-2024)

Semester III	**STATISTICS FOR LIFE AND SOCIAL SCIENCES**	Hours/Week: 5	
Elective Course (NME)		Credits: 3	
Course Code **23PMTN31**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: define sampling distribution, Chi-square, F test and Yates corrections. [K1]

CO2: understand the concept of sample size for their study, probability, random variables and test of significance. [K2]

CO3: explain special probability distributions and the hypothesis testing of their samples. [K2]

CO4: apply the knowledge gained in various methods of distribution in real life problems. [K3]

CO5: analyze various distributions in real life problems. [K4]

UNIT I

Statistics - What and Why, Origin of Statistics, Growth of Statistics, Statistics Defined, Statistics: Science or Art, Functions of Statistics, Applications of Statistics, Limitations of Statistics, Distrust of Statistics, Statistical Methods vs Experimental Methods, Statistical Survey—An Introduction, Planning the Survey, Executing the Survey, COLLECTION OF DATA-Introduction, Primary and Secondary Data, Methods of Collecting Primary Data. SAMPLING AND SAMPLE DESIGNS-Introduction, Census and Sample Method, Theoretical Basis of Sampling, Essentials of Sampling, Methods of Sampling, Non-Probability Sampling Methods, Probability Sampling Methods, Size of

Sample, Merits and Limitations of Sampling, Sampling and Non-Sampling Errors. (15 Hours)

UNIT II

Classification And Tabulation of Data-Introduction, Meaning and Objectives of Classification, Types of Classification, Formation of Discrete and continuous Frequency Distribution, Tabulation of Data, Parts of a Table, General Rules of Tabulation, Types of Tables. Average-Defined, Types of Averages, Arithmetic Mean, Calculation of Arithmetic Mean—Continuous Series, Median, Calculation of Median—Continuous Series, Computation of Quartiles, Decides, Percentiles, Etc. Significance of Measuring Variation, Range, The Interquartile Range or the Quartile Deviation, Merits and Limitations, The Standard Deviation. (15 Hours)

UNIT III

Probability - Introduction, Classical or a Priori Probability, Shortcomings of the Classical Approach, Relative Frequency Theory of Probability, Subjective Approach to Probability, Axiomatic Approach to Probability, Importance of the Concept of Probability, Calculation of Probability, Theorems of Probability, Addition Theorem, Multiplication Theorem, Conditional Probability, Bayes' Theorem, Mathematical Expectation, Random Variable and Probability Distribution, Binomial, Poisson and Normal Distributions, Hypothesis Testing - Introduction, Standard Error and Sampling Distribution, Estimation, Tests of Significance for Large Samples. Tests of Significance for Small Samples. (15 Hours)

UNIT IV

Chi-Square Test - Introduction, Chi-Square Defined, Conditions for Applying Chi-Square Test, Yates' Corrections, Uses of Chi-Square Test, Additive Property of Chi-Square, Chi-Square Test for Specified Value of Population Variance, Misuse of Chi-Square Test, Limitations on the Use of Chi-Square Test. (15 Hours)

UNIT V

The F-Test or the Variance Ratio Test, Applications of F-Test, Analysis of Variance, Analysis of Variance in Two-Way Classification Model. (15 Hours)

TEXT BOOK

S. P. Gupta, Statistical Methods, Forty Sixth Revised Edition, Sultan Chand & Sons, New Delhi, 2021.

Unit	Chapter	Section
Part – I		
I	1	1.1 - 1.17
	2	2.1 -2.7
	3	3.1 - 3.6
	4	4.1 - 4.21
II	5	5.1 - 5.20
	7	7.1 -7.4 , 7.7,7.16,7.19,7.25
	8	8.1 - 8.6, 8.9 and 8.15
Part -II		
III	1	1.1 - 1.20
	2	2.2 , 2.4, 2.7, 2.8, 2.11, 2.13, 2.18, 2.19, 2.20, 2.21, 2.24, 2.25, 2.28, 2.30, 2.31, 2.33, 2.34, 2.38, and 2.46
	3	3.2, 3.8, and 3.19
IV	4	4.2 - 4.7 , 4.15 - 4.17 and 4.45
V	5	5.2 , 5.5, 5.6, 5.7, 5.12 and 5.14

REFERENCE BOOKS

1. Goon A.M. Gupta. A.K. and Das Gupta, B (1987). Fundamental of Statistics, vol.2 World Press Pvt. Ltd., Kolkatta

2. G.U.Yule and M.G. Kendall (1956). An introduction to the theory of Statistics, Charles Griffin.

Website and e-Learning Source

https://alison.com/course/the-fundamentals-of-statistics?utm_source=google&utm_medium=cpc&utm_campaign=PPC_Tier-4_First-Click_Courses-_Broad_&utm_adgroup=Course-2075_The-Fundamentals-of-Statistics&gclid=CjwKCAjw6IiiBhAOEiwALNqncf9ojFI3Uc738RVoW7KdG4FiGqFXcEA4OeJQLENoFw8gUYqltWhUkRoC1QMQAvD_BwE

Course Code 23PMTN31	**PO1**		**PO2**		**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2, a**	**PSO 2.b**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	1	3	3	1	-	3	3	1	-
CO2	3	2	3	1	2	2	3	3	1	-
CO3	3	2	3	1	2	2	3	3	1	-
CO4	3	1	2	3	2	2	2	3	1	-
CO5	3	1	1	2	3	3	2	3	1	-

Strong (3) **Medium (2)** **Low (1)**

Dr.M.C. Maheswari
Head of the Department

Mrs.G.Nagalakshmi
Course Designer

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M.Sc. MATHEMATICS
(for those who join in 2023-2024)

Semester III	**COMPUTATIONAL MATHEMATICS USING SAGEMATH**	Hours/Week: 2	
Skill Enhancement Course SEC – 1		Credits: 2	
Course Code **23PMTS31**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: gain knowledge on Computational Mathematics using SageMath. [K1]

CO2: understand the fundamental concepts in SageMath. [K2]

CO3: identify the usage of SageMath in abstract and applied Mathematics. [K2]

CO4: apply algorithms to solve problems numerically, algebraically and graphically. [K3]

CO5: analyse the problems in Algebra, Analysis and Differential Equations using SageMath [K4]

UNIT I

Sage as a Calculator: Elementary functions and Usual Constants-Online help and Automatic Completion-Python variables-Symbolic variables –First Graphics

(6 Hours)

UNIT II

Expressions and Simplifications: Symbolic Expressions-Transforming Expressions-Usual Mathematical Expressions-Assumptions-Some Pitfalls –Explicit Solving-Equations with no explicit solution**.** (6 Hours)

UNIT III

Analysis: Sums-Limits-Sequences- Power Series Expansions-Series- Derivatives-Partial Derivatives-Integrals. (6 Hours)

UNIT IV

Basic Linear Algebra: Solving Linear Systems-Vector Computations-Matrix Computations-Reduction of a Square Matrix. (6 Hours)

UNIT V

Graphics: Graphical Representation of a Function-Parametric Curve-Curve in Polar Coordinates-Curve defined by an Implicit equations-Data Plot-Displaying solutions of Differential Equations-3D curves. (6 Hours)

TEXT BOOK

Computational Mathematics with SageMath by Paul Zimmermann and others.

Unit	Chapter	Section
I	1	1.2.2 to 1.2.6
II	2	2.1.1 to 2.1.5 and 2.2.1 to 2.2.2
III	2	2.3.1 to 2.3.8
IV	2	2.4.1 to 2.4.4
V	4	4.1.1 to 4.1.1.6 and 4.2

REFERENCE BOOKS

1. Gregory V. Bard ; Sage for Undergraduates(online version)

2. Craig Finch; Sage Biginner's Guide; PACKT Publishing(Open Source)

Website and e-Learning Source

1.https://onlinecourses.nptel.ac.in/noc21_ma29/preview

2.https://mosullivan.sdsu.edu/Teaching/sdsu-sage-tutorial/sageprog.html

Course Code 24PMTS31	PO1		PO2		PO3	PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2. a	PSO 2.b	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	1	3	3	1	-	3	3	1	-
CO2	3	2	3	1	2	2	3	3	1	-
CO3	3	2	3	1	2	2	3	3	1	-
CO4	3	1	2	3	2	2	2	3	1	-
CO5	3	1	1	2	3	3	2	3	1	-

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari
Head of the Department

Dr.R.P.Aditya
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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Quality Education with Wisdom and Values

M.Sc. MATHEMATICS
(for those who join in 2023-2024)

Semester III	**DOCUMENTATION IN LATEX**	Hours/Week: -	
Extra Credit Course (Optional)		Credits: 2	
Course Code **23PMTO31**		Internal 100	External -

COURSE OUTCOMES

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

CO1: express the text, symbols, commands, document layout, mathematical formulae, presentation and compile source files. [K2]

CO2: apply various commands and packages in LaTeX in documentation. [K3]

CO3: typeset any kind of complex mathematical equations and apply text symbols, document layout for the purpose of thesis, report writing, presenting articles. [K3]

CO4: analyze the template of a thesis. [K4]

CO5: examine the various commands and environments in preparing articles and thesis. [K4]

UNIT I

Introduction to Latex: How to prepare a LaTeX input file - How to compile a LaTeX input file- LaTeX syntax: Commands- Environments-Packages-Keyboard characters in LaTeX

Font Selection: Text-mode fonts-Math-mode fonts-Colored fonts.

UNIT II

Text formatting: Sectional units- Labeling and referrinag numbered items-Quoted texts-New lines and paragraphs-Creating and filling blank space-Producing dashes within texts –Footnotes.

Listing Texts: Numbered listing through enumerate environment- Unnumbered listing through itemize environment-Listing with user –defined labels through description environment-Nesting different listing environment.

UNIT III

Table Preparation: Table through tabular environment - Table through tabularx environment-Vertical positioning of tables-Merging rows and columns of tables –Tables in multi-column documents-Tables at the end of a document.

Figure Insertion: Commands and environment for inserting figures-Inserting simple figures – Sub-numbering a group of figures – Figures in multi-column documents-Figures at the end of the document.

Equation Writing: Basic notations and delimiters-Mathematical operators-Mathematical expressions in text-mode-Simple equations-Array of equations

UNIT IV

Bibilography with BIBTEX: Preparation of BIBTEX compatible reference database- Standard bibliographic styles of LaTeX-Compiling BIBTEX based LATEX input file

Article Preparation: List of authors – Title and abstract on separate pages-Articles in multiple columns

UNIT V

Thesis Preparation: Template of a thesis- Compilation of thesis

Slide Preparation: Frames in presentation- Sectional units in presentation-Presentation structure-Title page-Appearance of a presentation (BEAMER themes)

TEXT BOOK:

A Short note on LATEX in 24 Hours – A practical guide for scientific Writing by Dilip Datta.

Unit	Chapter	Pages
I	1 and 2	2-5
II	3 and 4	5-7
III	6,7 and 8	8-13
IV	9 and 10	14-18
V	11and 12	19-21

REFERENCE BOOKS

1. LATEX Tutorials A Primer, Indian TEX users group, Trivandrum, India, 2003, September, Editor E.Krishnan.

2. LATEX A document preparation system – User's guide and reference manual, second edition, Leslie Lamport, Published by Dorling Kindersely(India) Pvt. Ltd..,licensees of Pearson Education in South Asia.

Course Code 23PMTO31	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	3	3	2	2	2	2	1	3	2	1
CO2	3	3	2	2	2	2	1	3	2	1
CO3	3	3	2	2	2	2	1	3	2	1
CO4	3	3	2	2	2	2	1	3	2	1
CO5	3	3	-	2	2	2	1	3	2	1

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari
Head of the Department

Mrs.J.Ashwini
Course Designer

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Semester III	**PRACTICE FOR CSIR NET – GENERAL PAPER**	Hours/Week: -	
Course Code		Credits: 1	
23PGOL32		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 : examine the data using logical reasoning and observational ability. [K4]

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 23PGOL32	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	3	2	2	-	2	-	-
CO2	3	3	3	3	-	2	-	-
CO3	3	3	3	3	-	3	-	-
CO4	3	2	3	3	-	3	-	-
CO5	3	2	3	3	-	3	-	-

Strong (3) Medium (2) Low (1)

Dr. M. C. Maheshwari
Head of the Department

Dr. T. Anitha
Course Designer

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M.Sc. MATHEMATICS

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Semester IV	**FUNCTIONAL ANALYSIS**	Hours/Week: 6	
Core Course-13		Credits: 5	
Course Code **23PMTC41**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: understand the basic concepts of Banach spaces, Hilbert spaces and Spectral Theory. [K2]

CO2: apply the ideas of mathematical analysis in normed linear spaces. [K3]

CO3: prove the theorems in Banach spaces, Hilbert spaces and Spectral Theory. [K3]

CO4: analyze the properties of Banach spaces and Spectral theory. [K4]

CO5: examine the proof of statements in Banach spaces, Hilbert spaces and Spectral Theory. [K4]

UNIT I

Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N^{**}- The open mapping theorem – The conjugate of an Operator. (18 Hours)

UNIT II

Hilbert Spaces: The definition and some simple properties–Orthogonal complements – Ortho normal sets–The conjugate space H^*-The adjoint of an operator–self-adjoint operators - Normal and unitary operators – Projections (18 Hours)

UNIT III

Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator –The spectral theorem. (18 Hours)

UNIT IV

General Preliminaries on Banach Algebras: The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius– The radical and semi-simplicity. (18 Hours)

UNIT V

The Structure of Commutative Banach Algebras: The Gelfand mapping – Application of the formula $r(x) = \lim \|x^n\|^{1/n}$– Involutions in Banach algebras-The Gelfand - Neumark theorem. (18 Hours)

TEXT BOOK

G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Education (India)Private Limited, New Delhi, 1963.

Unit	Chapter	Section
I	9	46 – 51
II	10	52 - 59
III	11	60 - 62
IV	12	64 - 69
V	13	70 - 73

REFERENCE BOOKS

1. W.Rudin, Functional Analysis, McGraw Hill Education (India) Private Limited, New Delhi, 1973.

2. B.V. Limaye, Functional Analysis, New Age International,1996.
3. C. Goffman and G. Pedrick, First course in Functional Analysis, Prentice Hall of India, NewDelhi,1987.
4. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.
5. M. Thamban Nair, Functional Analysis, A First course, Prentice Hall of India, New Delhi, 2002.

Website and e-Learning Source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, http://en.wikiepedia.org

Course Code 23PMTC41	PO1		PO2		PO3	PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2, a	PSO 2.b	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	3	3	3	3	3	3	3	3	-
CO2	3	3	3	3	3	3	3	3	3	-
CO3	3	3	3	3	3	3	3	3	3	-
CO4	3	3	3	3	3	3	3	3	3	-
CO5	3	3	3	3	3	3	3	3	3	-

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari — **Head of the Department**

Dr.P.Geetha — **Course Designer**

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M.Sc. MATHEMATICS

(for those who join in 2023-2024)

Semester IV	**DIFFERENTIAL GEOMETRY**	Hours/Week: 6	
Core Course-14		Credits: 5	
Course Code **23PMTC42**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: explain fundamental concepts and results of surfaces and Geodesics. [K2]

CO2: apply logical argument / algorithm for proving characterization, equivalent conditions in differential geometry. [K3]

CO3: solve problems on geodesics. [K3]

CO4: examine the nature of developable, ruled and minimal surfaces. [K4]

CO5: analyze the properties of surfaces. [K4]

UNIT I

Space curves: Definition of a space curve – Arc length – tangent – normal and binormal - curvature and torsion – contact between curves and surfaces- tangent surface - involutes and evolutes- Intrinsic equations – Fundamental Existence Theorem for space curves- Helies. (18 Hours)

UNIT II

Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves – Isometric correspondence- Intrinsic properties. (18 Hours)

UNIT III

Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem – Gaussian curvature - surface of constant curvature.

(18 Hours)

UNIT IV

Non Intrinsic properties of a surface: The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface - Minimal surfaces – Ruled surfaces.

(18 Hours)

UNIT V

Differential Geometry of Surfaces: Compact surfaces whose points are umblics- Hilbert's lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics. (18 Hours)

TEXT BOOK

T.J.Willmore, *An Introduction to Differential Geometry*, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print).

Unit	Chapter	Section
I	I	1 - 9
II	II	1 - 9
III	II	10 - 18
IV	III	1 - 8
V	IV	1 - 8 (Omit 9 to 15)

REFERENCE BOOKS

1. Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950.
2. Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry*, Inter science Publishers, 1963.
3. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978.
4. J.A. Thorpe *Elementary topics in Differential Geometry*, Under- graduate Texts in Mathematics, Springer - Verlag 1979.

Website and e-Learning Source

http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org, www.physicsforum.com

Course Code 23PMTC42	**PO1**		**PO2**		**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2.a**	**PSO 2.b**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO1	3	1	3	3	1	-	3	3	1	-
CO2	3	2	3	1	2	2	3	3	1	-
CO3	3	2	3	1	2	2	3	3	1	-
CO4	3	1	2	3	2	2	2	3	1	-
CO5	3	1	1	2	3	3	2	3	1	-

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari — **Head of the Department**

Dr.P.Sooriyakala — **Course Designer**

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M.Sc. MATHEMATICS

(for those who join in 2023-2024)

Semester IV	**PROJECT WITH VIVA - VOCE**	Hours/Week: 6	
Course Code **23PMTC41PR**		Credits: 5	
		Internal 40	External 60

COURSE OUTCOMES

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

CO1: describe the basic concepts relating to abstract and applied Mathematics. [K2]

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

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

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

CO5: analyze the project to meet the challenges at society level. [K4]

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:

Internal Assessment: Pre-submission Presentation	- 10 Marks
Review Report	- 20 Marks
One Open Online Course related to the Project	- 10 Marks
External Examination: Project Report	- 40 Marks
Viva Voce	- 20 Marks

- ❖ 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.

Course Code	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
23PMTC41PR	**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	3	3	3	3	3	3	3	2	3	2
CO2	3	3	3	3	3	3	3	2	3	2
CO3	3	3	3	3	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	3	2
CO5	3	3	3	3	3	3	3	2	3	2

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari — **Head of the Department**

Dr.P.Getchial Pon Packiavathi — **Course Designer**

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M.Sc. MATHEMATICS

(for those who join in 2023-2024)

Semester IV	**RESOURCE MANAGEMENT TECHNIQUES**	Hours/Week: 6	
Elective Course (DSEC – 3)		Credits: 5	
Course Code **23PMTE41**		Internal 25	External 75

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 and queuing models, constrained, unconstrained linear and nonlinear problems. [K3]

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

CO5: examine the problems in network and queuing models constrained, unconstrained linear and nonlinear problems. [K4]

UNIT I

Network Models: Scope and Definition of Network Models - Minimal Spanning Tree Algorithm – Shortest -Route Problem: Examples of the Shortest-Route Applications – Shortest-Route Algorithms – Linear Programming Formulation of the Shortest-Route Problem – Maximal Flow Model: Enumeration of Cuts – Maximal-Flow Algorithm – Linear Programming Formulation of Maximal Flow Mode – CPM and PERT: Network Representation – Critical Path (CPM) Computations – Construction of the Time Schedule – Linear Programming Formulation of CPM – PERT Calculations. (18 Hours)

UNIT II

Queueing Models: Elements of the Queueing Model - Role of Exponential Distributions - Pure Birth and Death Models: Pure Birth Model – Pure Death Model. (18 Hours)

UNIT III

Advanced Linear Programming: Simplex Method Fundamentals – Revised Simplex Method – Bounded – Variables Algorithm – Duality. (18 Hours)

UNIT IV

Classical Optimization Theory: Unconstrained Problems: Necessary and Sufficient Conditions– The Newton Raphson Method. Constrained Problems: Equality Constraints – Inequality Constraints – Karush-Kuhn-Tucker (KKT) Conditions. (18 Hours)

UNIT V

Non-linear Programming Algorithms

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

TEXT BOOK

Hamdy A.Taha, A.M. Natarajan, P.Balasubramanie and A.Tamilarasi, (2009). *Operations Research - An Introduction***,** Eighth Edition, Prentice-Hall of India Pvt. Ltd.

Unit	Chapter	Section
I	6	6.1 – 6.5
II	15	15.2 - 15.4
III	7	7.1 – 7.4
IV	18	18.1, 18.2
V	19	19.1, 19.2

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 **23PMTE41**	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	3	3	1	3	1	1	3	2	2	-
CO2	3	3	1	2	1	2	3	2	1	-
CO3	3	3	2	2	1	2	3	2	1	-
CO4	3	3	1	3	1	1	3	2	1	-
CO5	3	3	1	2	1	1	3	2	1	-

Strong (3) Medium (2) Low (1)

Dr. M.C.Maheswari
Head of the Department

Dr.M. C. Maheswari
Course Designer

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M.Sc. MATHEMATICS

(for those who join in 2023-2024)

Semester IV	**MATHEMATICS FOR CSIR NET / SET**	Hours/Week: 6	
(SEC – 2) Professional Competency Skill		Credits: 3	
Course Code **23PMTS41**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: recall the basic concepts of Algebra, Linear Algebra, Analysis, Operations Research and Differential Equations. [K1]

CO2: understand the concept of groups and Continuous functions in relation to compact subsets and connected subsets, Differential equations and Statistics.[K2]

CO3: identify the problems in real life situations. [K2]

CO4: apply the short cut methods to get results in an easy way. [K3]

CO5: analyze the techniques used in solving complicated problems and enrich their research levels. [K4]

UNIT I

Algebra: Group – Subgroup- Normal Subgroups and Quotient Groups – Homomorphism – Automorphism - Cayley's Theorem- Permutation Groups-Conjugate and Normalizer-Sylow's Theorem-Direct Product-Finite Abelian Group. (18 Hours)

UNIT II

Linear Algebra: Matrices, Vectors, Determinants, Linear Systems of Equations-Rank of Matrix: Linear Independence and Dependence-Characteristic Values and Characteristic Vectors-Vector Spaces and Subspaces- Bases and Dimensions-Linear Transformation-Algebra of Linear transformation-Linear Functionals -Elementary Canonical Forms-Inner Product Spaces. (18 Hours)

UNIT III

Analysis: Set theory- The Set of Natural Numbers-The Principle of Mathematical Induction-Functions-Sequence-Set Algebra-Countable Sets- Relations-The Real Number Axioms(excluding Theorems) - Extended Real Number System-Sequences of Real Numbers-Limit Superior and Limit Inferior.

Sequences- Infinite Series- Limits, Continuity & Uniform Continuity of Function- Differentiability of Function- Sequences and Series of Functions- Riemann(Stieltjes) Integrals- Improper Riemann integral.

Metric Spaces :

Element of Metric Spaces. (18 Hours)

UNIT IV

Operations Research: Linear programming Problems (excluding Theorems)- Linear programming Models-The Simplex Method-Transportation Problem-Assignment Problems.

Statistics: Point Estimation of Parameters-Statistical Intervals for A Single Sample-Tests of Hypotheses for a Single Sample- Statistical inference for Two Samples.

(18 Hours)

UNIT V

Differential Equations: First order Differential equation – General Theory of Homogeneous and Non Homogeneous Linear Ordinary Differential Equation -Existence and Uniqueness theorem for $\frac{dy}{dx} = f\,(x, y)$ - The Second Order Homogeneous Linear equations – Higher Order Linear Differential Equations-Singular Solutions-Discriminant-Partial Differential Equation of First Order- Partial Differential Equations with Constant Coefficients- The Classification of Second Order Linear Partial Differential equations-Canonical Forms- Laplace Equations- Wave Equation-Heat Equation-Green's Functions. (18 Hours)

TEXT BOOK

A.Kumar, *CSIR-UGC Net/JRF/SET Mathematical Sciences*, Upkar Publications.

Unit	Chapter	Section
I	4	11-21
II	2	1-3, 8,20-24,28 &34
III	1	1-8 ,11-20,27
IV	11 & 12	2-4,12,13 & 2-5(statistics)
V	5	2-5,10,12-13 7-14

REFERENCE BOOKS

1. Manoher Pandey, NTA CSIR UGC NET/SET (JRF & Lecturership) MathematicalSciences, Arihant Publications, 2023.
2. Rajendra Dubey, CSIR – NET/JRF Mathematics, by Kittu rani Publicatons pvt Ltd,2023.
3. Dr.Gajendra Purohit , Advanced CSIR-NET/JRF/Mathematics , InvinciblePublishers.

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Course code	PO1		PO2	PO3	PO4		PO5	PO6	PO7	PO8
23PMTS41	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	3	2	3	2	2	1	2	3	1	3
CO2	3	2	1	1	1	2	2	3	1	3
CO3	3	2	2	2	1	1	2	3	1	3
CO4	3	2	1	1	1	1	3	3	1	3
CO5	3	2	1	1	3	1	3	3	1	3

Strong (3) Medium (2) Low (1)

Dr.M.C. Maheswari Dr.S.Kohila

Head of the Department **Course Designer**