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 2025 - 2026)

V.V.Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 13 UG Programmes (Aided), 13 UG Programmes (SF), 13 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 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, Biochemistry, Home Science - Nutrition and Dietetics, Biotechnology, Computer 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 Courses (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)
(2024-2025 onwards)

PG PROGRAMMES

Name of the Course	Semester	Course Code	Department
Introduction to Epigraphy	II	24PHIN21	History
Communication Strategies for Leadership Success	III	24PHIN31	
Functional English	II	24PENN21	English
English for Careers	III	24PENN31	
ஆளுமை மேம்பாடு	II	24PTAN21N	Tamil
தகவல் தொடர்பியல்	III	24PTAN31	
Accounting for Managers -1	II	24PCON21N	Commerce
Accounting for Managers -II	III	24PCON31	
Entrepreneurship Development	II	24PBAN21	Business Administration
Employability Skills	III	24PBAN31	
Mathematics for Life Sciences	II	24PMTN21	Mathematics
Statistics for Life and Social Sciences	III	24PMTN31	
Solid Waste Management	II	24PPHN21	Physics
Sewage and Waste Water Treatment and Reuse	III	24PPHN31	
Chemistry in Everyday Life	II	24PCHN21	Chemistry

Industrial Chemistry	III	24PCHN31	
Food Preservation	II	24PHSN21	Home Science - Nutrition and Dietetics
Nutrition and Health	III	24PHSN31	
Nutritional Biochemistry	II	24PBCN21	Biochemistry
Molecular Basis of Diseases and Therapeutic Strategies	III	24PBCN31	
Tissue engineering	II	24PBON21	Biotechnology
Gene manipulation Technology	III	24PBON31	
Web Programming	II	24PCSN21	Computer Science
Python Programming	III	24PCSN31	
Fundamentals of Web Design	II	24PCAN21N	Computer Applications
Fundamentals of Cyber Security	III	24PCAN31	

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.

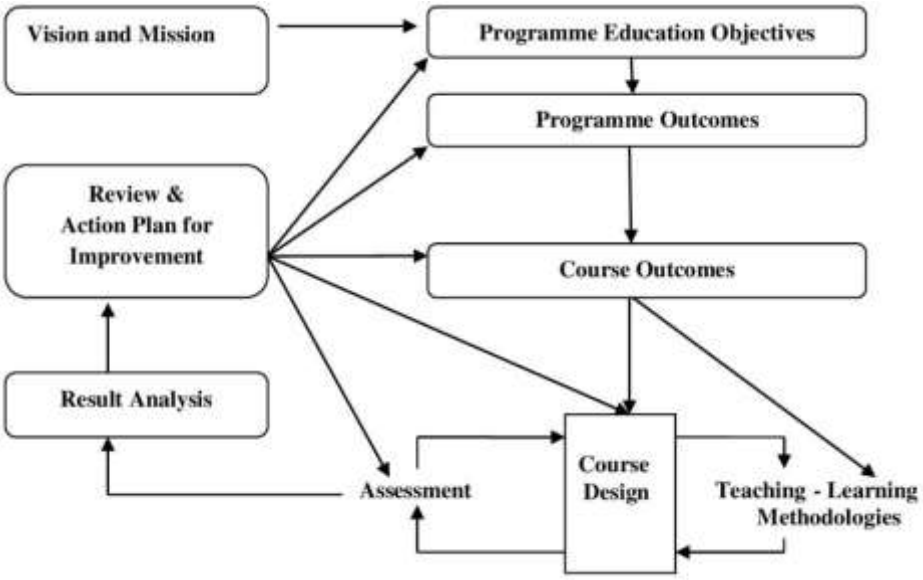
PO-PEO Mapping Matrix

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	✓	✓	-

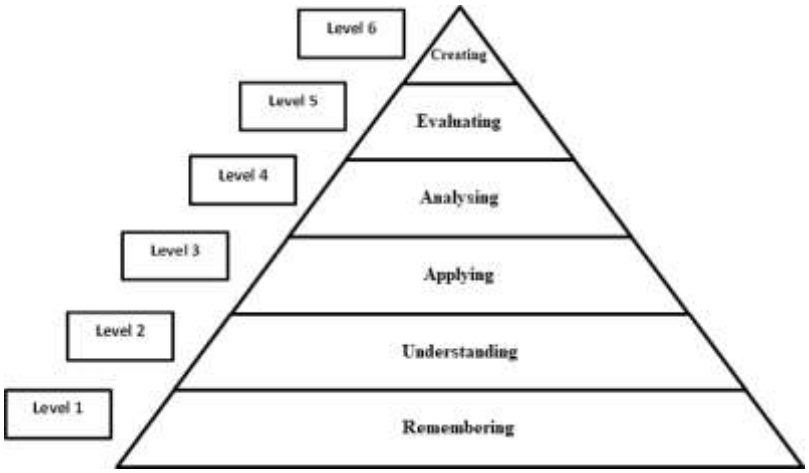
B.1.4 Course Outcomes (COs)

Course Outcomes are narrow statements restricted to the course contents given in five units. Course Outcomes describe what students would be capable of, after learningthe 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 Assessment	:	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 Assessment:

Project Report - 40 Marks

Viva Voce - 20 Marks

B. 2.3 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 Internship / Industrial Training

Internship / Industrial Training is mandatory for all the Students

- **Internship:** Students have to involve in a designated activity, working in an organization for maximum of 30 days (not less than 20 days) under the guidance of an identified mentor.
- **Industrial Training:** Students have to undertake in-plant training in industries individually or in group for maximum of 30 days (not less than 20 days)
- Internship / Industrial Training must be done during the second semester holidays

Distribution of Marks

Mode of Evaluation		Marks
Internal Assessment	:	75
External Assessment	:	25
Total	:	**100**

Internal Assessment

Mode of Evaluation		Marks
Onsite Learning/Survey	:	50
Report	:	25
Total		**75**

External Assessment

Mode of Evaluation		Marks
Viva-Voce	:	25
Total		**25**

B.2.5. 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.2.6. 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.2.7 Transfer of credits earned through MOOC (UGC recognized Courses)

- Students can opt for minimum of
  - 12 weeks Courses for Core Courses
  - 8 weeks Courses for Elective Courses
  - 4 weeks Courses for Skill Enhancement Course
- The Online Courses opted by the students will be verified and approved by the Head of the Department and forwarded to the Controller of Examinations through the Principal.
- Students are required to register for the equivalent Online Courses through the Institution's SWAYAM-NPTEL Local Chapter after submitting a Permission letter to the Head of the Department.
- The Course should be completed before the beginning of that particular Semester in which the selected Course is offered.
- The student should submit the Course Completion Certificate immediately after receiving it, to the Department.

- The Head of the Department has to send the list of the students and their Course Completion Certificates to the Controller of Examinations through the Principal.
- The students who have submitted the Completion Certificate are exempted from appearing the Periodic Tests and Summative Examinations of the respective course but without any exemption for class attendance.
- Credits allotted for the particular Course in the Curriculum will be transferred after the completion of the Online Course
- Students can earn up to 10 credits within the mandatory credits requirements of the Degree Programme by completing UGC recognised Online Courses.

B.2.8. EXTRA CREDIT COURSES (OPTIONAL)

2.8.1 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**

2.8.2 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 prescribed Courses of study and a minimum of 50% Pass marks in all the Courses.

- No Pass minimum for Internal Assessment for all the 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 amount and fulfilling other conditions according to the respective cases.
  - The students who have attended the classes for 59 days and less – upto 45 days (50% - 65%) can appear for the Summative Examinations only after getting special permission from the Principal.
  - The students who have attended the classes for 44 days or less (<50%) cannot appear for the Summative Examinations and have to repeat the whole semester.
  - 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

Outcome Based Education with Choice Base Credit System

Programme Structure - Allotment of Hours and Credits

For those who join in the Academic Year 2024-2025

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 (5)	-	18(13)
Core Course	-	-	6(4)	-	6 (4)
Project	-	-	-	6 (5)	6 (5)
Elective Course (DSEC)	6 (3)	4 (3)	3 (3)	-	13 (9)
Elective Course (Generic)	6 (3)	4 (3)	-	-	10 (6)
Elective Course (NME)	-	4 (2)	3(2)	-	7 (4)
Elective Course- (Industry / Entrepreneurship)	-	-	-	6 (3)	6 (3)
Skill Enhancement Course/ Professional Competency Skill	-	-	-	6(3)	6 (3)
Self Study Course	-	-	0 (1)	-	0(1)
Internship/Industrial Activity			0 (2)	-	0 (2)
Extension Activity	-	-	-	0 (1)	0 (1)
Total	**30 (20)**	**30 (22)**	**30 (27)**	**30 (22)**	**120 (91)**
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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SEMESTER II

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam Hours	Marks		
							Int.	Ext.	Total
1	Core Course – 4	Advanced Algebra	24PMTC21	6	5	3	25	75	100
2	Core Course – 5	Real Analysis – II	24PMTC22	6	5	3	25	75	100
3	Core Course – 6	Partial Differential Equations	24PMTC23	6	4	3	25	75	100
4	Elective Course -3 (DSEC)	Statistical Data Analysis Using R-Programming	24PMTE21N	4	3	3	25	75	100
5	Elective Course - 4 (Generic)	Modeling and Simulation with Excel	24PMTE22	4	3	3	25	75	100
6	Elective Course -5 (NME)	Mathematics for Life Sciences	24PMTN21	4	2	3	25	75	100
			Total	**30**	**22**				**600**

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SEMESTER III

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1.	Core Course – 7	Complex Analysis	24PMTC31	6	5	3	25	75	100
2.	Core Course – 8	Probability Theory	24PMTC32	6	5	3	25	75	100
3.	Core Course – 9	Topology	24PMTC33	6	5	3	25	75	100
4.	Core Course – 10	Industrial Statistics	24PMTC34	6	4	3	25	75	100
5.	Elective Course -6 (DSEC)	Algebraic Number Theory	24PMTE31	3	3	3	25	75	100
6..	Elective Course- 7 (NME)	Statistics for Life and Social Sciences	24PMTN31	3	2	3	25	75	100
7.	Self-Study Course	Practice for CSIR NET – general paper	24PGOL32	-	1	-	100	-	100
8.	Internship/ Industrial Activity	Internship	24PMTI31	-	2	-	75	25	100
			Total	**30**	**27**				**800**
9.	Extra Credit Course (Optional) offered by the Department	Documentation in LATEX	24PMTO31	-	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 – 11	Functional Analysis	24PMTC41	6	5	3	25	75	100
2	Core Course – 12	Differential Geometry	24PMTC42	6	5	3	25	75	100
3.	Project	Project	24PMTC43PR	6	5	-	40	60	100
4.	Elective Course -8 (Industry/ Entrepreneurship)	Optimization Techniques	24PMTE41	6	3	3	25	75	100
5.	Skill Enhancement Course/ Professional Competency Skill	Practice for CSIR NET/SET Paper-II- Mathematics	24PMTS41	6	3	3	25	75	100
6.	Extension Activity			-	1	-	100	-	100
			Total	**30**	**22**				**600**

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M.Sc. Mathematics
(2024-2025 onwards)

Semester II	**STATISTICAL DATA ANALYSIS USING R-PROGRAMMING**	Hours/Week: 4	
Elective Course -3 (DSEC)		Credits: 3	
Course Code **24PMTE21N**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: explain the notion of R Programme to relate the Statistical parameters. [K2]

CO2: apply R Programming for Statistical perspectives. [K3]

CO3: solve the various problems in Statistics using R Programming in real life situations. [K3]

CO4: analyse various methods in solving problems using R Programming. [K4]

CO5: examine different distributions using R Programming. [K4]

UNIT I

Getting Started - Installing R- Running R -The Comprehensive R Archive Network - Manuals- Contributed documentation -Getting help in R -Worked examples of functions- Demonstrations of R functions- Packages in R - Contents of packages - Installing packages - Command line versus scripts- Data editor- Changing the look of the R screen - Good housekeeping - Linking to other computer languages. (12 Hours)

UNIT II

Essentials of the R Language - Calculations - Complex numbers in R - Rounding - Arithmetic -Modulo and integer quotients --Variable names and assignment - Operators

- Integers – Factors. Writing R functions- Arithmetic mean of a single sample - Median of a single sample - Geometric mean - Harmonic mean - Variance - Degrees of freedom - Variance ratio test. (12 Hours)

UNIT III

Graphics- Plots with two variables - Plotting with two continuous explanatory variables: Scatterplots - Adding other shapes to a plot- Drawing mathematical functions - Shape and size of the graphics window - Plotting with a categorical explanatory variable - Plots for single samples - Plots with multiple variables- Special plots- Saving graphics to file- Summary. (12 Hours)

UNIT IV

Probability functions - Continuous probability distributions - Normal distribution - The central limit theorem - Maximum likelihood with the normal distribution - Generating random numbers with exact mean and standard deviation - Comparing data with a normal distribution - Other distributions used in hypothesis testing - The chi-squared distribution - Fisher's F distribution -Student's t distribution - The gamma distribution - The exponential distribution -The beta distribution - The Cauchy distribution - The lognormal distribution - The logistic distribution - The log-logistic distribution - The Weibull distribution - Multivariate normal distribution -The uniform distribution - Plotting empirical cumulative distribution functions (12 Hours)

UNIT V

Discrete probability distributions - The Bernoulli distribution - The binomial distribution - The geometric distribution - The hyper geometric distribution - The multinomial distribution - The Poisson distribution - The negative binomial distribution - The Wilcoxon rank-sum statistic- Analysis of Variance- ANOVA (one- way)

(12 Hours)

TEXT BOOK

Michael J. Crawley. (2013). *Statistics An Introduction Using R*, John Wiley & Sons, Ltd., Publication, Imperial College London, UK.

Unit	Chapter	Section
I	1	1.1 – 1.11
II	2	2.1 and 2.15 (2.15 .1 – 2.15.7)
III	5	5.1- 5.11
IV	7	7.2, 7.3
V	7, 11	7.4, 11.1

REFERENCE BOOKS

1. Sudha G. Purohit et.al., (2008) Statistics Using R, Narosa Publishing House, , India.
2. John Verzani, S*imple R-Using R for Introductory Statistics.* (http://www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple.)
3. Venables, W. N., Smith, D. M. and the R Core Team, *An Introduction to R , Notes on R: A Programming Environment for Data Analysis and Graphics*, Version 2.15.2 (2012-10-26) (http://www.r-project.org)
4. Knuth, D. E. (1986). The TEX Book. Addison-Wesley, Reading, second edition.

Course Code 24PMTE21N	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**

Dr.M.Uma Maheswari — **Course Designer**

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M.Sc. MATHEMATICS
(2024-2025 onwards)

Semester III	**COMPLEX ANALYSIS**	Hours/Week: 6	
Core Course-7		Credits: 5	
Course Code **24PMTC31**		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. (1979). *Complex Analysis*, (3rd edition) McGraw Hill Co., New York.

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

Website and e-Learning Source

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

Course Code 24PMTC31	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

(2024-2025 onwards)

Semester III	**PROBABILITY THEORY**	Hours/Week: 6	
Core Course-8		Credits: 5	
Course Code **24PMTC32**		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 – Bernoulli law of large numbers –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

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

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 6.3, 6.6 to 6.9, 6.11 and 6.12. (Omit Sections 6.4, 6.5, 6.10,6.13 to 6.15)

REFERENCE BOOKS

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

Website and e-Learning Source

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

http://www.opensource.org,

http://www.probability.net

Course Code 24PMTC32	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

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M.Sc. MATHEMATICS

(2024-2025 onwards)

Semester III	**TOPOLOGY**	Hours/Week: 6	
Core Course-9		Credits: 5	
Course Code **24PMTC33**		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. (2002). Munkres, *Topology* (2nd Edition) Pearson Education Pve. Ltd., Delhi. (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. Dugundji, J. (1975). *Topology* , Prentice Hall of India, New Delhi.
2. George F. Sinmons. (1963). *Introduction to Topology and Modern Analysis*, McGraw Hill Book Co.

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

Website and e-Learning Source

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

Course Code 24PMTC33	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
Course Designer

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M.Sc. MATHEMATICS
(2024-2025 onwards)

Semester III	**INDUSTRIAL STATISTICS**	Hours/Week: 6	
Core Course-10		Credits: 4	
Course Code **24PMTC34**		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: use 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

(18 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 (18 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.(18 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. (18 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. (18 Hours)

TEXT BOOKS

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

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

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 **24PMTC34**	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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Quality Education with Wisdom and Values

M.Sc. MATHEMATICS
(2024-2025 onwards)

Semester III	**ALGEBRAIC NUMBER THEORY**	Hours/Week: 3	
Elective Course -6 (DSEC)		Credits: 3	
Course Code **24PMTE31**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: understand the notions of divisibility, congruences, quadratic residues and some functions of number theory. [K2]

CO2: illustrate the implications of properties of divisibility, congruences and Quadratic residues. [K3]

CO3: apply the concepts of divisibility, congruences, quadratic residues, quadratic reciprocity and some arithmetic functions in solving the problems in Number Theory. [K3]

CO4: analyse the conceptualization of prime power moduli, Primitive roots and Power Residues, Quadratic reciprocity [K4]

CO5: assess the theorems in divisibility, congruences, quadratic residues, quadratic reciprocity and some functions of Number Theory. [K4]

UNIT I

Divisibility: Introduction-Divisibility- Primes. (9 Hours)

UNIT II

Congruence-Solutions of congruence - the Chinese Remainder theorem. (9 Hours)

UNIT III

Prime Power moduli -Prime modulus - Primitive roots and Power Residues.

(9 Hours)

UNIT IV

Quadratic residues - Quadratic reciprocity -The Jacobi symbol. (9 Hours)

UNIT V

Some functions of number theory: Greatest integer function - Arithmetic functions -The Mobius inversion formula. (9 Hours)

TEXT BOOK

Ivan Niven, Zuckerman. H. S and Montgombry. H.L. (1994). *An Introduction to the Theory of Numbers*, Fifth Edition, Wiley Eastern Limited, New Delhi.

Unit	Chapter	Section
I	1	1.1-1.3
II	2	2.1-2.3
III	2	2.6-2.8
IV	3	3.1-3.3
V	4	4.1-4.3

REFERENCE BOOKS

1. Apostol, T.M. (1980). *Introduction to Analytic Number Theory*, Narosa Publ. House, Chennai.
2. Silverman, J. H. (2006). *A friendly introduction to number theory*, Pearson Prentice Hall.
3. Burton, D. M. (2001). *Elementary Number Theory*, Universal Book, Stall, New Delhi.

Website and e-Learning Source

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

http://www.opensource.org, www.algebra.com

Course Code 24PMTE31	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

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M.Sc. MATHEMATICS

(2024-2025 onwards)

Semester III	**STATISTICS FOR LIFE AND SOCIAL SCIENCES**	Hours/Week: 3	
Elective Course-7 (NME)		Credits: 2	
Course Code **24PMTN31**		Internal 25	External 75

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: define sampling and sample designs, measures of dispersion, Chi-square, F test and Yates corrections. [K1]

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

CO3: explain special 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

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.

Measures of Central Value: Types of Averages-Arithmetic Mean- Calculation of Arithmetic Mean—Continuous Series- Median- Calculation of Median—Continuous Series- Computation of Quartiles- Deciles-Percentiles, Etc. (9 Hours)

UNIT II

Measures of Dispersion: Significance of Measuring Variation-Range-The Interquartile Range or the Quartile Deviation-Merits and Limitations-The Standard Deviation.

(9 Hours)

UNIT III

Theoretical Distribution: Binomial-Poisson and Normal Distributions.

Statistical Inference-Tests of Hypotheses: Hypothesis Testing- Introduction- Standard Error and Sampling Distribution-Estimation-Tests of Significance for Large Samples-Tests of Significance for Small Samples. (9 Hours)

UNIT IV

Chi-Square Test and Goodness of Fit: 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.

(9 Hours)

UNIT V

F-Test and Analysis of Variance: The F-Test or the Variance Ratio Test-Applications of F-Test-Analysis of Variance- Analysis of Variance in Two-Way Classification Model.

(9 Hours)

TEXT BOOK

Gupta, S. P. (2017). *Statistical Methods*, Forty Fifth Revised Edition, Sultan Chand & Sons, New Delhi.

Unit	Volume	Chapter	Page No.
I	I	3	39-47
		4	63-89
		7	178-189, 196-203, 206-211
II		8	273-293
III	II	2	833-846, 852-859, 860-879
		3	906-918, 925-930, 934-948
IV		4	977-1005
V		5	1030-1060

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. Yule, G.U. and Kendall, M.G. (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=CjwKCAjw6IiiBhAOEiwALNqncf9ojFI3Uc738RVoW7KdG4FiGqFX cEA4OeJQLENoFw8gUYqltWhUkRoC1QMQAvD_BwE

Course Code 24PMTN31	**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. T.Anitha — **Course Designer**

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M.Sc. MATHEMATICS

(2024-2025 onwards)

Semester III	**PRACTICE FOR CSIR NET – GENERAL PAPER**	Hours/Week: -	
Self-Study Course		Credits: 1	
Course Code **24PGOL32**		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). *CSIR – 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 24PGOL32	**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. Maheswari
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M.Sc. MATHEMATICS

(2024-2025 onwards)

Semester III	**INTERNSHIP**	Hours/Week: -	
		Credits: 2	
Course Code **24PMTI31**		Internal 75	External 25

COURSE OUTCOMES

On completion of the Internship/Field Project, students will be able to

CO1: relate their theoretical insights with hands-on experience. [K3]

CO2: develop technical skills to their respective field of study. [K3]

CO3: demonstrate the attributes such as observational skills, team spirit and inter personal skills built through site visits. [K3]

CO4: analyze the observations and results and communicate their academic and technological knowledge appropriately oral means. [K4]

CO5: evaluate the report of internship to meet the challenges at society level. [K5]

Guidelines/ Regulations:

- Each student must go for Internship training in a reputed Industry/Company/ Organization/ Educational Institution.
- Students should produce the Completion Certificate after the Completion of Internship period.
- A report of 15 – 20 pages must be submitted by each student after the completion of the Internship period.
- External Viva-voce examination will be conducted.

Course code 24PMTI31	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	2	3	2
CO2	3	3	3	3	3	2	3	2
CO3	3	3	3	3	3	2	3	2
CO4	3	3	3	3	3	2	3	2
CO5	3	3	3	3	3	2	3	2

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

Dr.M.C.Maheswari
Head of the Department

Dr.R.P.Aditya
Course Designer

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M.Sc. MATHEMATICS

(2024-2025 onwards)

Semester III	**DOCUMENTATION IN LATEX**	Hours/Week: -	
Extra Credit Course (Optional)		Credits: 2	
Course Code **24PMTO31**		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.

CO2: apply various commands and packages in LaTeX in documentation.

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

CO4: analyze the template of a thesis.

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

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 - Text-mode fonts-Math-mode fonts-Colored fonts.

UNIT II

Text formatting: Sectional units- Labeling and referring 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 tabular 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 24PMTO31	**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 IV	**FUNCTIONAL ANALYSIS**	Hours/Week: 6	
Core Course-11		Credits: 5	
Course Code **24PMTC41**		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 and Banach Algebras. [K2]

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

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

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

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

UNIT I

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

UNIT II

Banach Spaces: The open mapping theorem- The conjugate of an Operator.

Hilbert Spaces: The definition and some simple properties–Orthogonal complements – Orthonormal sets. (18 Hours)

UNIT III

Hilbert Spaces: The conjugate space H^* - The adjoint of an operator–Self-adjoint operators - Normal and unitary operators – Projections. (18 Hours)

UNIT IV

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

UNIT V

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)

TEXT BOOK

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

Unit	Chapter	Section
I	9	46 – 49
II	9	50 - 51
	10	52-54
III	10	55- 59
IV	11	60 - 62
V	12	64 - 69

REFERENCE BOOKS

1. Rudin, W. (1973). *Functional Analysis*, McGraw Hill Education (India) Private Limited, New Delhi.
2. Limaye, B.V. (1996). *Functional Analysis*, New Age International.
3. Goffman, C. and Pedrick, G. (1987). *First course in Functional Analysis*, Prentice Hall of India, NewDelhi.
4. Kreyszig, E. (1978). *Introductory Functional Analysis with Applications*, John Wiley & Sons, New York.
5. Thamban Nair, M. (2002). *Functional Analysis, A First course*, Prentice Hall of India, New Delhi.

Website and e-Learning Source

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

Course Code 24PMTC41	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
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M.Sc. MATHEMATICS

(2024-2025 onwards)

Semester IV	**DIFFERENTIAL GEOMETRY**	Hours/Week: 6	
Core Course-12		Credits: 5	
Course Code **24PMTC42**		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

The theory of Space Curves: Introductory remarks about space curves-Definition– Arc length – Tangent, normal and binormal - Curvature and torsion of a curve given as the intersection of two surfaces – Contact between curves and surfaces- Tangent surface- involutes and evolutes. (18 Hours)

UNIT II

Intrinsic equations – Fundamental Existence Theorem for space curves- Helices.

The Metric: Local Intrinsic Properties of a Surface - Definition of a surface – Curves on a surface – Surfaces of revolution – Helicoids. (18 Hours)

UNIT III

Metric- Direction coefficients – Families of curves – Isometric correspondence –Intrinsic properties.- Geodesics – Canonical geodesic equations – Normal property of geodesics (18 Hours)

UNIT IV

Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem.

The Second Fundamental Form: Local Non Intrinsic properties of a surface: The second fundamental form. (18 Hours)

UNIT V

Principle curvature – Lines of curvature – Developable - Developable associated with space curves Developable associated with curves on surfaces - Minimal surfaces – Ruled surfaces. (18 Hours)

TEXT BOOK

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

Unit	Chapter	Section
I	I	1 - 7
II	I	8,9
	II	1-4
III	II	5 – 12
IV	II	13 - 16
	III	1
V	III	2 - 8

REFERENCE BOOKS

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

Website and e-Learning Source

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

Course Code 24PMTC42	**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
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<table>
<tr><td>Semester IV</td><td rowspan="3">PROJECT</td><td colspan="2">Hours/Week: 6</td></tr>
<tr><td rowspan="2">Course Code
24PMTC43PR</td><td colspan="2">Credits: 5</td></tr>
<tr><td>Internal
40</td><td>External
60</td></tr>
</table>

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

Regulations for the Project Report

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

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**
24PMTC43PR	**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**

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

M.Sc. MATHEMATICS

(2024-2025 onwards)

Semester IV	**OPTIMIZATION TECHNIQUES**	Hours/Week: 6	
Elective Course (DSEC – 3)		Credits: 3	
Course Code **24PMTE41**		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, Natarajan, A.M. Balasubramanie, P. and Tamilarasi, A. (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. Kanti Swarup, Gupta. P.K. and Man Mohan. (2018). *Operations Research*, Sultan Chand & Sons Publications,(Fifteenth Edition).

Course Code 24PMTE41	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

(2024-2025 onwards)

Semester IV	**PRACTICE FOR CSIR NET/SET PAPER-II- MATHEMATICS**	Hours/Week: 6	
(SEC – 2) Professional Competency Skill		Credits: 3	
Course Code **24PMTS41**		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

Kumar, A. *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. (2023). *NTA CSIR UGC NET/SET (JRF & Lecturership) Mathematical Sciences*, Arihant Publications.
2. Rajendra Dubey, (2023). *CSIR – NET/JRF Mathematics*, by Kittu rani Publications pvt Ltd.
3. Dr. Gajendra Purohit , *Advanced CSIR-NET/JRF/Mathematics*, Invincible Publishers.

Website and e-Learning Source https://nptel.ac.inht https://www.mathwarehouse.com/ https://www.mathhelp.com/

Course code 24PMTS41	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	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 — **Head of the Department**

Dr.S.Kohila — **Course Designer**