

**Swami Ramanand Teerth Marathwada University, Nanded
School of Mathematical Sciences**

Two Year M. A. / M. Sc. Degree Program in Mathematics

Revised Syllabi of M. A. / M. Sc. in Mathematics

(Choice Based Credit System)

(To be implemented in the Department of Mathematics, Swami Ramanand

Teerth Marathwada University, Nanded)

(With effect from Academic Year 2014-2015)

Title of the Program: M. A. / M. Sc. in Mathematics

1. Preamble: M. A. / M. Sc. Mathematics programme is of minimum 100 credits spread over four semesters. The programme emphasizes both theory and applications of Mathematics and is structured to provide knowledge and skills in depth necessary for the employability of students in industry, other organizations, as well as in academics. The program has some unique features such as independent projects, a large number of elective courses, extensive computer training including standard software packages such as MATLAB, SciLab and TORA. The department has the academic autonomy and it has been utilized to add the new and need based elective courses. The independent project work is one of the important components of this program. The syllabus of the first year (two semesters) covers most of the core courses. In the third semester syllabus there are two core courses and eight elective courses. In the fourth semester syllabus there are two core courses and fourteen elective courses. The syllabus has been framed to have a good balance of theory, methods and applications of Mathematics.

It is possible for the students to study basic courses from other disciplines such as economics, life sciences, computer science and mathematics in place of electives.

2. Introduction: M. A. / M. Sc. Mathematics program has semester pattern and credit system with variable credits. The program consists of 100 credits. Credits of a course are specified against the title of the course. A course with T in brackets indicates that it is a theory course whereas a course with P in brackets indicates that it is a practical course. Some of the practical courses are linked with a theory course and in such a case, both the courses will have the same number with T and P, indicating a theory and a practical course respectively. A student can enroll for a practical course if the student has enrolled for the corresponding theory course (as indicated) in the same term.

➤ **Scope:** Mathematics is at the heart of science, engineering and technology, as well as being an indispensable problem-solving and decision-making tool in many other areas of life. Mathematics has got a great importance in the industrial and economic development of a country. M.Sc. in Mathematics is the postgraduate course in Mathematics which enables the candidates to use their mathematical knowledge in different areas. This course has got great

scope and there are ample opportunities available for the M.Sc. graduates.

The scope of opportunities is vast and mathematics postgraduates are equipped with skills and knowledge required for jobs in fields such as finance, education, engineering, science and business, as well as mathematics and mathematical science research.

3. The key learning outcomes of the M.Sc. Mathematics are:

- The students may get wide range of opportunities of Mathematics in industry sector.
- The students will get wide range of Mathematical skills, including problem-solving, project work and presentation; they may enable to take prominent roles in a wide spectrum of employment in academics and research.
- The fundamental and advanced concepts, principles and techniques from a range of topic areas.
- Specific knowledge and understanding will be determined by your particular choice of modules, according to your particular needs and interests.
- Understand complex mathematical ideas and arguments.
- Develop abstract mathematical thinking.

4. Eligibility: For M. A/ M.Sc. in Mathematics following candidates are eligible.

- B.A./B.Sc. with Mathematics as principal Subject at degree level.

5. Definitions:

Credits:

Credit is a kind of weightage given to the contact hours to teach the prescribed syllabus, which is in a modular form. Normally one credit is allocated to 15 contact hours.

- In each of the courses, credits will be assigned on the basis of the number of lectures / tutorials / laboratory work and other forms of learning required for completing the course contents in maximum 18 week schedule.
- The instructional days as worked out by the UGC for one academic year are 180 working days i.e. 90 days per semester.
- **Mechanics of Credit Calculation:** As per SRTMUN standard, 1Credit= 15 contact hours. o Contact hours will include all the modes of teaching like lectures / tutorials / laboratory work / fieldwork or other forms which suits to that particular course. In determining the number of hours of

instruction required for a course involving laboratory / field-work, 2 hours of laboratory / field work is generally considered equivalent to 1 hour of lecture.

Credit Point (P):

Credit point is the value obtained by multiplying the grade point (G) by the credit (C): $P = G \times C$.

Grade Point:

Grade point is an integer indicating the numerical *SEMESTER GRADE POINT AVERAGE (SGPA)*:

II. Semester Grade Point Average (SGPA) is the value obtained by dividing the sum of credit points (P) earned by a student in various courses taken in a semester by the total number of credits earned by the student in that semester. SGPA shall be rounded off to two decimal places.

II. Cumulative Grade Point Average (CGPA):

‘Cumulative Grade Point Average’ (CGPA) is the value obtained by dividing the sum of credit points in all the courses earned by a student for the entire programme, by the total number of credits. CGPA shall be rounded off to two decimal places. CGPA indicate an overall letter grade (Cumulative Grade) for the entire programme shall be awarded to a student depending on his/her CGPA. The comprehensive academic performance of a student in a programme is equivalent of the letter grade.

➤ **Evaluation System -**

In this section the broad guidelines to be followed in evaluation system and the minimum number of credits to be completed to get a degree are defined.

- The evaluation will be on Continuous Internal Assessment (CIA), End Semester Assessment (ESA). The final results shall be declared after integration of CIA and ESA
- Weightage: 50% for End Semester Assessment (ESA) & 50% for Continuous Internal Assessment (CIA)

The declaration of result is based on the grade point average (GPA) earned towards the end of each semester or the Cumulative Grade Point Average (CGPA) earned towards the end of the program.

- a) The Post-graduate degree will be awarded to those students who earn the minimum number of Credits. For the award of degree the student has to acquire minimum number of credits as per the table given below.

Name of the Faculty/course	Total credits	Average credits per semester
M.A./ M.Sc.	100	25

- b) One credit will be equivalent to 15 clock hours of teacher-student contact in a semester.
- c) Four –credit course of theory will be of four clock hours per week.
- d) Two- credit course of practical will be of 4 hours of lab exercise/field.
- e) The project / “Dissertation” will be commencing from Semester III and the final work & report will be completed during Semester IV. The marks & the credits will be allotted in semester IV.
- f) There will be no mid-way change allowed from Credit System to Non-credit (external) System or vice versa.
- g) In a case, where the PG program duration is of one year, such a program shall consist of minimum 50 credits. Certificate programs shall consist of 25 credits/ semester.
- h) In a case, where the PG program duration is of three year, such a program shall consist of minimum 150 credits.
- i) Except the credits for practical courses, wherever applicable, a student can register for less number of courses in a semester subject to the condition that such a student will have to complete the degree in a maximum of five, four and two years respectively for three, two and one year programs. This facility will be available subject to the availability of concerned courses in a given semester and with a maximum variation of 25 % credits (in case of fresh credits) per semester.
- j) CBCS: Among the minimum number of credits to be earned by a student to complete a Post Graduate degree program (100/64 credits), the student will have to earn minimum 75% credits from the core subjects and the

remaining 25 % credits could be earned from the elective/ open elective (inter/intra disciplinary and soft skills) subjects offered within and across the schools. The maximum number of credits offered across the disciplinary (including soft skills) should not exceed 10% of total credits for the program.

- k) Credit transfer from other Institutes: Depending on the feasibility and availability a maximum of four credits can be completed by the student in any of the national or reputed institutes/organizations/companies/industries (HOST). For this a student has to complete a minimum number of 15 interactive hours (not necessarily only teaching) with assigned faculty from Host. It may be 3-4 interactive hours in a day and the necessary certificate in this regard shall be issued by HOST faculty. The Director of the school can fix this credit transfer mechanism with mutual consent/understanding form any host institute. After completion of minimum required interactive/teaching hours at the chosen institute the Host has to provide course completion certificate with a grade. The assessment will be made by the concerned faculty of the host and one faculty/Director of the concerned school (Parent) and performance grade and marks will be allotted. The same marks shall be sent to university examination section along with other marks for declaration of the results by the concerned school.

6. Examination/Evaluation Rules

The evaluation of the student will be mainly on

- 1. Continuous Internal Assessment (CIA) and**
- 2. End Semester Assessment (ESA).**

The ratio of CIA and ESA is 50:50

Passing Rules:

The CIA and ESA shall have different passing heads and Minimum passing:- 40% of passing for each subject in each head. To pass the degree program, a student will have to obtain a minimum aggregate of 40% marks (C+ and above in grade point scale) in each course.

Assessment:

Continuous Internal Assessment (CIA):

CIA aims to assess values, skills and knowledge imbibed by students, internal assessment is to be done by the concerned faculty member, department, school or the centre. CIA will be done on a continuous basis during the semester with selected assessment components.

The components selected for CIA may be:

Tests, Quiz, Seminars, Assignments, essay, tutorials, term paper, seminar, laboratory work, field work, workshop practice, Comprehensive Viva, Attendance and any other best and innovative assessment practice approved by the School committee. Components of internal evaluation are to have a time frame for completion (by students), and concurrent and continuous evaluation (by faculty members).

The evaluation outcome shall be expressed initially by predetermined marks and latter converted by grades. Minimum Mark for passing in each Paper is 40% for Continuous Internal Assessment (CIA)

End Semester Assessment (ESA): This is to be carried out at the end of each semester, and will aim to assess skills and knowledge acquired by the students through classroom instruction, fieldwork, laboratory work and/or workshop practice. The End Semester Assessment (ESA) is based on written examination. These examinations shall be at the end of each semester.

Integration of CIA and ESA: A student failed in CIA shall have to appear for ESA again in that particular paper. In a particular paper if a student failed in internal (CIA), he deemed to be failed in that course and he has to reappear for CIA and ESA irrespective of the marks he got in ESA. If a student passed in CIA and failed in ESA, the student needs to appear for ESA only in his next attempt and the CIA marks shall be carried.

A candidate who does not pass the examination in any course(s) shall be permitted to appear in such failed course(s) in the subsequent examinations to be held in winter/summer season. However the student has to clear the course in the prescribed maximum period for that course.

CIA marks will not change. A student cannot repeat CIA. In case s/he wants to repeat CIA, then s/he can do so only by registering the said course during the semester in which the course is conducted and up to 4 years (2 years program) as the case may be, provided the student was failed in that course. Students who have failed in a course may reappear for the ESA only twice in the subsequent period. If student fail to acquire required Credits within four years from admission period, such student has to acquire Credits with prevailing / revised syllabus at that time. After that, such students will have to seek fresh admission as per the admission rules prevailing at that time.

A student cannot register for the third/fourth semester, if she/he fails to complete 75% credits of the total credits expected to be ordinarily completed within two semesters.

While marks will be given for all examinations, they will be converted into

grades. The semester end grade sheets will have only grades and final grade sheets and transcripts shall have grade points average and total percentage of marks (up to two decimal points).

7. Assessment and Grade point average:

7.1 The system of evaluation will be as follows: Each CIA and ESA will be evaluated in terms of marks. The marks for CIA and ESA will be added together and then converted into a grade and later a grade point average.

7.2 Results will be declared for each semester.

7.3 After the completion of minimum number of credits of a program, a student will get a grade sheet with total grades earned and a grade point average.

7.4 Marks/Grade/Grade Point:

i) Table 1: Conversion of marks to grades in credit system

Marks Obtained	Grade	Grade Points
100-90	S	10
89-80	O	09
79-70	A+	08
69-60	A	07
59-55	B+	06
54-45	B	05
44-40	C+	04
39 and Less FC	FC	0 (Fail but Continue)
39 and Less (Internal)	FR	0 (Fail and Repeat the course)

ii) A student who passes the internal tests but fails in Term End Examination of a course shall be given FC grade. Student with FC grade in a course would be granted credit for that course but not the grade for that course and shall have to clear the concerned course within 1.5 year from appearing for first time in the concerned paper, provided the number of courses with FC and FR grades together is 25% or less of the courses of that semester, failing which he/she shall be disqualified for a credit and will have to opt for another credit.

iii) Student who has failed in the internal tests of a course shall be given FR grade and shall have to repeat the concerned course to qualify to appear for term end examination of that course. The grade FC and FR will be taken into consideration while calculating Semester Performance Index (SPI). It shall be replaced only when student clears the course with passing grade within 1.5 year from appearing for first time in the concerned semester.

iv) Grade points earned in each paper shall be calculated as- Grade points obtained (vide Table 1 above) X Credits for the paper.

Maximum grade points that can be earned in a semester are 200.

v) The Semester Performance Index (SPI) gives weighted performance index of a semester with reference to the credits of a course. The SPI shall be calculated as-

SPI = Total Earned Grade Pointes (as given above) for the Semester
Total Credits for the semester

7.5 The total grade point earned in each course shall be calculated as:

Grade point obtained as shown in table -1 X Credits for the Course

7.6 Semester Grade Point Average (SGPA): The performance of the student in a semester is indicated by number called SGPA. It shall be calculated as follows:

$$SGPA = \frac{\sum_{i=1}^n c_i p_i}{\sum_{i=1}^n c_i}$$

Where C_i = The number of Credits earned in the i^{th} course of a semester for which SGPA is to be calculated.

p_i = Grade point earned in the i^{th} course.

$i = 1,2,3,4,\dots,n$ represent the number of courses in which a student is registered in the concerned semester.

That is

$$SGPA = \frac{\text{Total earned grade point for the semester}}{\text{Total credits for the semester}}$$

7.7 Final result:

The final marks after assessment will be submitted by the respective schools to the controller of Examination for finalization of the results. Up to date assessment of the overall performance of a student from the time of his / her first registration is obtained by calculating a number is called as Cumulative Grade Point Average (CGPA), which is weighted average of the grade points obtained in all courses

registered by the student since he / she entered the department.

$$\text{CGPA} = \frac{\sum_{j=1}^m c_j p_j}{\sum_{j=1}^m c_j}$$

Where C_j = The number of Credits earned in the j^{th} course up to the semester for which CGPA is to be calculated.

p_j = Grade point earned in the j^{th} course.

$j = 1, 2, 3, 4 \dots m$ represent the number of courses in which a student is registered up to the semester for which the CGPA is to be calculated.

➤ **Final Grade: Table -2**

CGPA	Grade
09.00-10.00	S: Super
08.00-08.99	O : Outstanding
07.50-07.99	A+: Excellent
07.00-07.49	A: Very Good
06.00-06.99	B+: Good
05.00-05.99	B: Satisfactory
04.00 -04.49	C+: Pass
00.00-03.99	F: Fail

7.8 'B+' Grade is equivalent to at least 55% of the marks as per circular No. UGC- 1298/ [4619] UNI- 4 dated December 11, 1999.

7.9 "A" Grade is equivalent to first class

7.10 If the (C) GPA is higher than the indicated upper limit in the three decimal digit, then higher final grade will be awarded (e.g. a student getting (C)GPA of 3.992 may be awarded 'C+' grade).

7.11 For grade improvement a student has to reappear for End Semester Examination (ESE) after the successful completion of the course for a minimum 20 credits in case of Science, Technology, Management and Pharmacy, 20 credits for other faculties and 12 credits in case of one year degree program. These courses will be from the parent Department (core subject). A student can appear only once for the Grade Improvement Program only after the successful completion of UG / PG Degree program and at the end of the next academic year after completion of the Degree and within two years of completion of the Degree.

7.12 The formula for CGPA will be based on Weighted Average. The final CGPA will not be printed unless a student earns minimum 100 credits, 80 credits or 64 credits, as the case may be, from the courses at UG / PG

programs.

7.13 If a student failed to obtain a grade other than F in a course then such a course will not be taken into account for calculating CGPA and overall grade. In fact, all the courses in which a student has passed will be taken into account for calculating the CGPA and overall grade.

8. Norms & Procedure for Extra Credit Benefit for NSS or Participation:

The following table shows the grades along with grade point to be given to the students participating in the NSS / Sports activities:

The student should avail the only one benefit neither from NSS or Sport activities.

Maximum addition of Grade point = 0.200

Sr. No.	Event	Specification	Grade point
1	NSS Performance	2 Year regular Programme [240 hrs work + Blood donation + Camp (State / National Level)]	0.200
2	Sports Performance	Intercollegiate : I /II /III	0.150
		Inter- University : I /II /III or Participation	0.200

8. Structure of the course

M.Sc. (Mathematics)-I year (CBCS Pattern)

SEMESTER-I									
Sr. No.	Course	Course Title	Theory/ Practical Paper	No. of Credits	Marks@ 25/Credit	Internal Component (50%)	Semester End Component (50%)	Grand Total	
MTU-101	Core I	Algebra-I(Groups & Rings)	L/T	4	100	50	50	100	
MTU-102	Core II	Real Analysis-I	L/T	4	100	50	50	100	
MTU-103	Core III	Complex Analysis	L/T	4	100	50	50	100	
MTU-104	Core IV	Advanced Discrete Mathematics	L/T	4	100	50	50	100	
MTU-105(A)/ (B)/(C)	Elective Group I	Multivariate Calculus/ Differential Geometry of Manifolds- I/ Dynamics and continuum Mechanics- I	L/T	4	100	50	50	100	
MTU-106	Core Practical I	Lab Course-I (Programming in C or C++ and Practicals in Numerical Analysis)	p	5	125	50	75	125	
		Total							625

SEMESTER-II									
Sr. No.	Course	Course Title	Theory/ Practical Paper	No. of Credits	Marks@ 25/Credit	Internal Component (50%)	Semester End Component (50%)	Grand Total	
MTU-201	Core I	Linear Algebra	L/T	4	100	50	50	100	
MTU-202	Core II	Real Analysis-II	L/T	4	100	50	50	100	
MTU-203	Core III	Topology	L/T	4	100	50	50	100	
MTU-204	Core IV	Elementary Number Theory	L/T	4	100	50	50	100	
MTU-205(A)/ (B)/(C)	Elective Group II	Differential Equations/ Differential Geometry of Manifolds- II/ Dynamics and continuum Mechanics- II	L/T	4	100	50	50	100	
MTU-206	Practical II	Lab Course-II (Software Scilab and Practicals in Linear algebra, Number Theory, Analysis)	p	5	125	50	75	125	
		Total							625

SEMESTER-III									
Sr. No.	Course	Course Title	Theory/ Practical Paper	No. of Credits	Marks@ 25/Credit	Internal Component (50%)	Semester End Component (50%)	Grand Total	
MTU-301	Core I	Algebra II (Field Theory and Galois Theory)	L/T	4	100	50	50	100	
MTU-302	Core II	Functional Analysis	L/T	4	100	50	50	100	
Elective Group III (MTU 303 to MTU 310- any three)									
MTU-303	Elective	Graph Theory	L/T	4	100	50	50	100	
MTU-304	Elective	Operations Research	L/T	4	100	50	50	100	
MTU-305	Elective	Advanced Number Theory	L/T	4	100	50	50	100	
MTU-306	Elective	Lattice Theory	L/T	4	100	50	50	100	
MTU-307	Elective	Coding Theory	L/T	4	100	50	50	100	
MTU-308	Elective	Riemannian Geometry	L/T	4	100	50	50	100	
MTU-309	Elective	Theory of Linear Operators	L/T	4	100	50	50	100	
MTU-310	Elective	Wave Propagation	L/T	4	100	50	50	100	
MTU-311	Core Practical III	Lab Course -III MATLAB and Programmes using MATLAB : Optimization Problems, ODE and PDE, Mathematical Models	p	5	125	50	75	125	
		Total							625

SEMESTER-IV								
Sr. No.	Course	Course Title	Theory/ Practical Paper	No. of Credits	Marks@ 25/Credit	Internal Component (50%)	Semester End Component (50%)	Grand Total
MTU-401	Core I	Boundary Value Problems	L/T	4	100	50	50	100
MTU-402	Core II	Integral Equations and transforms	L/T	4	100	50	50	100
Elective Group III (MTU 303 to MTU 310- any three)								
MTU-403	Elective	Probability Theory	L/T	4	100	50	50	100
MTU-404	Elective	Algorithms and their analysis.	L/T	4	100	50	50	100
MTU-405	Elective	Commutative Algebra	L/T	4	100	50	50	100
MTU-406	Elective	Classical Mechanics	L/T	4	100	50	50	100
MTU-407	Elective	Theory of Relativity	L/T	4	100	50	50	100
MTU-408	Elective	Representation Theory of finite groups	L/T	4	100	50	50	100
MTU-409	Elective	Algebraic Topology	L/T	4	100	50	50	100
MTU-410	Elective	Difference Equations	L/T	4	100	50	50	100
MTU-411	Elective	Fuzzy sets and their applications	L/T	4	100	50	50	100
MTU-412	Elective	Advanced Functional Analysis.	L/T	4	100	50	50	100
MTU-413	Elective	Algebraic Number Theory	L/T	4	100	50	50	100
MTU-414	Elective	Computational Geometry	L/T	4	100	50	50	100
MTU-415	Elective	Fluid Dynamics	L/T	4	100	50	50	100
MTU-416	Elective	Baer * rings.	L/T	4	100	50	50	100
MTU-417	Core Project	LATEX and Project Work	p	5	125	50	75	125
Total								625

List of Core/ Elective Subjects to be offered

Core Subjects

1. Algebra-I(Groups & Rings)
2. Real Analysis-I
3. Complex Analysis
4. Advanced Discrete Mathematics
5. Linear Algebra
6. Real Analysis-II
7. Topology
8. Elementary Number Theory
9. Algebra II (Field Theory and Galois Theory)
10. Functional Analysis
11. Boundary Value Problems
12. Integral Equations and transforms

13. Lab Course-I (Programming in C or C++ and Practicals in Numerical Analysis)
14. Lab Course-II (Software Scilab and Practicals in Linear algebra, Number Theory, Analysis)
15. Lab Course –III:MATLAB and Programmes using MATLAB :Optimization Problems, ODE and PDE, Mathematical Models
16. LATEX and Project Work

Elective Subjects

Elective Group I (Any one for First Semester)

1. Multivariate Calculus
2. Differential Geometry of Manifolds- I
3. Dynamics and continuum Mechanics-I

Elective Group II (Any one for Second Semester)

1. Differential Equations/
2. Differential Geometry of Manifolds- II
3. Dynamics and continuum Mechanics-II

Elective Group III (Any three for Third Semester)

1. Graph Theory
2. Operations Research
3. Advanced Number Theory
4. Lattice Theory
5. Coding Theory
6. Riemannian Geometry
7. Theory of Linear Operators
8. Wave Propagation

Elective Group IV (Any three for Fourth Semester)

1. Probability Theory
2. Algorithms and their analysis.
3. Commutative Algebra
4. Classical Mechanics
5. Theory of Relativity
6. Representation Theory of finite groups
7. Algebraic Topology
8. Difference Equations
9. Fuzzy sets and their applications
10. Advanced Functional Analysis.
11. Algebraic Number Theory
12. Computational Geometry
13. Fluid Dynamics
14. Baer * rings.

NOTE:

- Each semester will have five Theory papers and assessment for each theory paper will be of 100 Marks [50 External Exam+ 50 Internal Exam (02 tests each of 15 Marks+20 Marks for assignment)].
- Each Lab course viz. MTU-106, MTU-206, MTU-311 will be of 125 marks [50 internal Exam + 75 External Exam (50 marks for Practical exam + 10 marks for Practical Record + 15 marks for Practical Viva-Voce)].
- Lab course Internal Examination includes internal test + Seminars by using Power Point Presentation.
- All these Lab courses and a Project MTU-417 (for 125 marks) are compulsory to all the students.
- Each semester is of 625 marks.
- Total marks for I sem+ II sem+ III sem + IV sem = 2500.
- Total degree is of 2500 Marks, converted in the form of 100 credits CBCS system.
- One credit is of 25 marks.
- Minimum 40% Marks are required for passing in each of the above head i.e. separate passing in External Exam and that in Internal Exam.
- Project or Practical will be evaluated by one external examiner (out of University examiner) and one internal examiner.