PANJAB UNIVERSITY, CHANDIGARH-160014 (INDIA)
(Estd. under the Panjab University Act VII of 1947–enacted by the Govt. of India)

FACULTY OF SCIENCE

SYLLABI

FOR

M.Sc. MATHEMATICS (1st & 2nd Semester)
EXAMINATIONS, 2011-2012

© The Registrar, Panjab University, Chandigarh.
All Rights Reserved.
APPLICABILITY OF REGULATIONS FOR THE TIME
BEING IN FORCE

Notwithstanding the integrated nature of a course spread over more than one academic year, the regulations in force at the time a student joins a course shall hold good only for the examinations held during or at the end of the academic year. Nothing in these regulations shall be deemed to debar the University from amending the regulations subsequently and the amended regulations, if any, shall apply to all students whether old or new.
GUIDELINES FOR CONTINUOUS INTERNAL ASSESSMENT (20%) FOR REGULAR STUDENTS OF POST-GRADUATE COURSES OF M.Sc. Mathematics (Semester System)
(Effective from the First Year Admission for the Academic Session 2007-2008)

1. The Syndicate has approved the following guidelines, mode of testing and evaluation including Continuous Internal Assessment of students:
   (i) Terminal Evaluation : 80 %
   (ii) Continuous Assessment : 20 %
   (iii) Continuous Assessment may include written assignment, snap tests, participation in discussions in the class, term papers, attendance etc.
   (iv) In order to incorporate an element of Continuous Internal Assessment of students, the Colleges/Departments will conduct one written test and one snap test as quantified below:
      (a) Written Test : 25 (reduced to 5)
      (b) Snap Test : 25 (reduced to 5)
      (c) Participation in Class discussion : 15 (reduced to 3)
      (d) Term Paper : 25 (reduced to 5)
      (e) Attendance : 10 (reduced to 2)

      Total : 100 reduced to 20

2. Weightage of 2 marks for attendance component out of 20 marks for Continuous Assessment shall be available only to those students who attend 75% and more of classroom lectures/seminars/workshops. The break–up of marks for attendance component for theory papers shall be as under:

   Attendance Component | Mark/s for Theory Papers
   -----------------------|------------------------
   (a) 75% and above upto 85% : 1
   (b) Above 85% : 2

3. It shall not be compulsory to pass in Continuous Internal Assessment. Thus, whatever marks are secured by a student out of 20% marks, will be carried forward and added to his/her score out of 80 % i.e. the remaining marks allocated to the particular subject and, thus, he/she shall have to secure pass marks both in the University examinations as well as total of Internal Continuous Assessment and University examinations.

4. Continuous Internal Assessment awards from the affiliated Colleges/Departments must be sent to the Controller of Examinations, by name, two weeks before the commencement of the particular examination on the proforma obtainable from the Examination Branch.

SPECIAL NOTE :
(i) The theory question paper will be of 80 marks and 20 marks will be for internal assessment.
(ii) In the case of Postgraduate Course in the Faculties of Arts, Science, Languages, Education, Design & Fine Arts, and Business Management & Commerce (falling under the purview of Academic Council), where such a provision of Internal Assessment/Continuous Assessment already exists, the same will continue as before.
PANJAB UNIVERSITY, CHANDIGARH

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR SEMESTER I & II of M.Sc. (PASS COURSE) IN MATHEMATICS FOR THE ACADEMIC SESSION 2011-12

Outlines of Tests

M.Sc. (Pass Course) in Mathematics

SEMESTER-I

MATH-601S : Real Analysis-I
MATH-602S : Algebra-I
MATH-603S : Differential Equations
MATH-604S : Complex Analysis-I
MATH-605S : Number Theory-I

SEMESTER-II

MATH-621S : Real Analysis-II
MATH-622S : Algebra-II
MATH-623S : Vector analysis and Mechanics
MATH-624S : Complex Analysis-II
MATH-625S : Number Theory-II
SEMESTER-I

MATH 601S : Real Analysis-I

Total Marks : 100
Theory : 80 Marks
Internal Assessment : 20 Marks
Time : 3 hrs.

Note : 1. The question paper will consist of 9 questions. Candidates will attempt total five questions.

2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.

3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.

4. All questions carry equal marks.

UNIT-I


UNIT-II


Scope

As in relevant sections of Chapters 2,3,4,6,7 of the book at Sr. No. 6 in the list of references.
References:


Math 602S : Algebra-I

Total Marks : 100
Theory : 80 Marks
Internal Assessment : 20 Marks
Time : 3 hrs.

Note:

1. The question paper will consist of 9 questions. Candidates will attempt total five questions.

2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.

3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.

4. All questions carry equal marks.

UNIT-I

UNIT-II

Survey of some finite groups, Groups of order $p^2$, pq (p and q primes). Solvable groups, Normal and subnormal series, composition series, the theorems of Schreier and Jordan Holder [Scope as in Chapters 6 of Modern Algebra by Surjeet Singh and Qazi Zameerudin, Eighth Edition and Chapter 7 of Algebra, Vol. I by Luther and Passi].

Review of basic concepts of rings with emphasis on exercises. Polynomial rings, formal power series rings, matrix rings, the ring of Guassian Integers. [Scope as in Chapters 7, 8 and 9 of Modern Algebra by Surjeet Singh and Qazi Zameerudin, Eighth Edition, 2006].

References:

Math 603S : Differential Equations

Total Marks : 100
Theory : 80 Marks
Internal Assessment : 20 Marks
Time : 3 hrs.

Note :
1. The question paper will consist of 9 questions. Candidates will attempt total five questions.
2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.
4. All questions carry equal marks.

UNIT-I

Differential Equations

Existence and uniqueness of solution of first order equations. Boundary value problems and Strum-Liouville theory. ODE in more than 2-variables.


UNIT-II


References :

Math 604S : Complex Analysis-I

Total Marks : 100
Theory : 80 Marks
Internal Assessment : 20 Marks
Time : 3 hrs.

Note : 1. The question paper will consist of 9 questions. Candidates will attempt total five questions.
2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.
4. All questions carry equal marks.

UNIT-I

Complex plane, geometric representation of complex numbers, joint equation of circle and straight line, stereographic projection and the spherical representation of the extended complex plane. Topology on the complex plane, connected and simply connected sets. Complex valued functions and their continuity. Curves, connectivity through polygonal lines.

Analytic functions, Cauchy-Riemann equations, Harmonic functions and Harmonic conjugates.

Power series, exponential and trigonometric functions, \(\arg z\), \(\log z\), \(a^z\) and their continuous branches.

(Scope as in “Theory of Functions of a Complex Variable” by Shanti Narain, Chapter 1, 2, §39-44 and §47-50, 53, 54 of Chapter 4, §59-64 of Chapter 5., §79-88 of Chapter 6).

UNIT-II

Complex Integration, line integral, Cauchy’s theorem for a rectangle, Cauchy’s theorem in a disc, index of a point with respect to a closed curve, Cauchy’s integral formula, Higher derivatives, Morrera’s theorem, Liouville’s theorem, fundamental theorem of Algebra, Maximum Modules principle, Schwarz Lemma. The general form of Cauchy’s theorem. Taylor series and Laurent series. (Scope as in “Complex Analysis” by D. V. Ahlfors, Chapter 4, §1, 2 §4.1 to 4.5 and §5.1 and the book “Theory of Functions Complex Variable” by Shanti Narain, and in “Theory of Functions Complex Variable” by Shanti Narain, §111-113, §117-118 of Chapter 9)
References:


MATH-605S : Number Theory-1

Total Marks : 100
Theory : 80 Marks
Internal Assessment : 20 Marks
Time : 3 hrs.

Note:

1. The question paper will consist of 9 questions. Candidates will attempt total five questions.

2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.

3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.

4. All questions carry equal marks.
UNIT-I

Divisibility, Greatest common divisor, Euclidean Algorithm, The Fundamental Theorem of arithmetic, congruences, Special divisibility tests, Chinese remainder theorem, Fermat’s little theorem, Wilson’s theorem, residue classes and reduced residue classes, Euler’s theorem, An Application to cryptography, Arithmetic functions $\phi(n)$, $d(n)$, $\sigma(n)$, $\mu(n)$, Mobius inversion Formula, the greatest integer function, perfect numbers, Mersenne primes and Fermat numbers.

UNIT-II

Primitive roots and indices. Quadratic residues, Legendre symbol, Quadratic reciprocity law, Jacobi symbol, Binary quadratic forms and their reduction, sums of two and four squares, positive definite binary quadratic forms, Diophantine equations $ax + by = c$, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^2$.


References:

MATH-621S : Real Analysis-II

Total Marks : 100
Theory : 80 Marks
Internal Assessment : 20 Marks
Time : 3 hrs.

Note :
1. The question paper will consist of 9 questions. Candidates will attempt total five questions.
2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.
4. All questions carry equal marks.

UNIT-I

(i) Differentiation : Differentiation of vector-valued functions.
(ii) Functions of Several Variables : The space of linear transformations on \( \mathbb{R}^n \) to \( \mathbb{R}^m \) as a metric space. Differentiation of a vector-valued function of several variables. The Inverse function theorem. The implicit function theorem.

UNIT-II


Scope

(i) For items (i) & (ii) as in relevant sections of Chapters 5 &9 of the book at Sr. No. 5 in the list of references.
(ii) For items (iii) to (v) as in relevant sections of Chapters 3 to 5 of the book at Sr. No. 4 of references.
References:


Math 622S: Algebra-II

Total Marks: 100
Theory: 80 Marks
Internal Assessment: 20 Marks
Time: 3 hrs.

Note:

1. The question paper will consist of 9 questions. Candidates will attempt total five questions.
2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.
4. All questions carry equal marks.

UNIT-I

Factorization Theory in Integral Domains, Divisibility, Unique factorization Domain (UFD), Principal Ideal Domain (PID), Euclidian Domain (ED) and their relationships. Noetherian and Artinian Rings, Examples and Counter Examples, Artinian Rings without zero divisors, Nil Ideals in Artinian Rings, Hilbert Basis Theorem. [Scope as in Chapters 10 and 15 of Modern Algebra by Surjeet Singh and Qazi Zameerudin, Eighth Edition, 2006].

UNIT-II

Modules, Difference between Modules and Vector Spaces, Module Homomorphisms, Quotient Module, Completely reducible or Semisimple Modules, Free Modules, Representation and Rank of Linear Mappings, Smith normal Form over a PID, Finitely generated modules over a PID, Rational Canonical Form, Applications to finitely generated abelian groups [Scope as in Chapters 14, 20 and 21 (Sections 1, 2, 3, 4) of Basic Abstract Algebra by P.B.Bhattacharya, S.K.Jain, and S.R.Nagpal, Cambridge University Press, 1986].
References:


**Math 623S : Vector Analysis and Mechanics**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>80 Marks</td>
</tr>
<tr>
<td>Internal Assessment</td>
<td>20 Marks</td>
</tr>
<tr>
<td>Time</td>
<td>3 hrs.</td>
</tr>
<tr>
<td>Total Marks</td>
<td>100</td>
</tr>
</tbody>
</table>

**Note:**
1. The question paper will consist of 9 questions. Candidates will attempt total five questions.
2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.
4. All questions carry equal marks.
UNIT-I

Vectors
Scalar and vector point functions, Differentiation and integration of vectors, Gradient divergence and curl operators, Green's and Stoke's theorems, Gauss' divergence theorem, Curvilinear co-ordinates.


UNIT-II

Mechanics


References:
1. Weatherburn, C.E., Advanced Vector Analysis.

MATH 624S : Complex Analysis-II

<table>
<thead>
<tr>
<th>Total Marks</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>80 Marks</td>
</tr>
<tr>
<td>Internal Assessment</td>
<td>20 Marks</td>
</tr>
<tr>
<td>Time</td>
<td>3 hrs.</td>
</tr>
</tbody>
</table>

**Note:**
1. The question paper will consist of 9 questions. Candidates will attempt total five questions.
2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.
4. All questions carry equal marks.
UNIT-I


UNIT-II

Infinite products, Weierstrass theorem, Mittag-Leffler’s theorem, Canonical product, Analytic Continuation through power series (basic ideas), Natural boundary, the Gamma function and Riemann Zeta function.

(Scope as in “Complex Analysis” by D. V. Ahlfors Chapter 5 §2.3, 2.4, 4.1, 4.2, and in “Theory of Functions Complex Variable” by Shanti Narain, Chapter 3, §65-67 of Chapter 5, Chapter 7 §120-129 of Chapter 10, §130-136 of Chapter 11)

References:

MATH-625 : Number Theory-II

Total Marks : 100
Theory : 80 Marks
Internal Assessment : 20 Marks
Time : 3 hrs.

Note :  
1. The question paper will consist of 9 questions. Candidates will attempt total five questions.
2. Question No.1 is compulsory and will consist of short answer type questions covering the whole syllabus.
3. There will be four questions from each Unit and the candidates will be required to attempt two questions from each Unit.
4. All questions carry equal marks.

UNIT-I

Farey sequences, Continued fractions, Approximation of reals by rationals, Pell’s equations, Minkowski’s theorem in Geometry of Numbers and its applications.


UNIT-II


[Scope as in Chapters 3 & 4 of ‘Introduction to Analytic Number theory’ by T. M. Apostol.]

References :


5. Hardy & Wright : Number Theory (Oxford Univ. Press).


Published by: Prof. A.K. Bhandari, Registrar, Panjab University, Chandigarh.