Solapur University, Solapur.
Syllabus for B.Sc.-III(MATHEMATICS)
Semester Pattern
w.e.f. June 2012

Structure of the revised course:

SEMESTER-V

(I) Theory Papers

Paper	Title of the Paper	Marks
IX	Real Analysis	50
X	Abstract Algebra	50
XI	Complex Analysis	50
XII	Programming in C	50

SEMESTER-VI

(I) Theory Papers

Paper	Title of the Paper	Marks
XIII	Metric Spaces	50
XIV	Linear Algebra	50
XV	Partial Differential Equation	50
XVI	Graph Theory	50

(II) Problem Solving Sessions[PSS]

PSS No.	Topic	Marks
PSS-III(A)	**S-I:Real Analysis[6]** **S-II :Metric Spaces[6]+Seminar**	**50**
PSS-III(B)	**S-I :Abstract Algebra[6]** **S-II :Linear Algebra[6]+Project**	**50**
PSS-III(C)	**S-I :Complex Analysis[6]** **S-II: Partial Differential Equation[6]+Study Tour**	**50**
PSS-III(D)	**S-I: Programming in C[6]** **S-II: Graph Theory [6]+Viva Vocae**	**50**

Note : [ ] Number inside bracket indicates **number of assignments**.
Instructions:
   1. Each Theory Paper is allotted 40 periods per semester.
   2. All Problem Solving Sessions [PSS] (similar to Practicals) will be conducted in the batch as a whole Class.
   3. Total evaluation of B.Sc. III (**600 Marks**). [Theory papers (**400 Marks**) + PSS- III(A) to PSS- III(D) (Similar to Practicals) (**200 Marks**)]
   4. The annual Problem Solving Sessions **[** PSS- III(A) to PSS- III(D)**]** will carry **50   Marks** each.
   5. Department of Mathematics should be provided FIVE computers per Ten students.

Nature of question Paper

Semester –V Theory Papers IX, X, XI and XII
and
Semester –VI Theory Papers XIII, XIV, XV and XVI

Theory Paper   **[Marks 50]**

Q. 1: Multiple Choice Questions (Ten)   Marks 10

Q. 2 : Attempt any FIVE out of SIX (each of 2 Marks)   Marks 10
                              OR
Q. 2: Attempt any TWO out of THREE (each of 05 Marks)   Marks 10
Q. 3:(A) Attempt any TWO out of Four (each of 3 Marks)
     (B) Compulsory (Mark 4)   Marks 10
Q. 4: Attempt any TWO out of THREE (each of 05 Marks)   Marks 10
Q. 5: Attempt any TWO out of THREE (each of 05 Marks)
                              OR
Q. 5: Attempt any ONE out of TWO (each of 10 Marks)   Marks 10

Nature of paper (For PSS- III(A) to PSS- III(D))
Section-I

I) Attempt TWO out of FOUR (each of 10 marks)   Marks 20
   OR Attempt FOUR out of SIX (each of 05 Marks)
                         Section-II

II) Attempt TWO out of FOUR (each of 10) marks)   Marks 20
   OR Attempt FOUR out of SIX (each of 05 Marks)
III) Seminar/Project/Study Tour/Viva-vocae   Marks 05
III) Journal   Marks 05

                                                    Total Marks 50

SEMESTER-V
Paper-IX Real Analysis

Unit -1 : Sets and Functions   **[10]**
    1.1 Sets and elements
    1.2 Operations on sets
    1.3 Functions
    1.4 Real-valued functions
    1.5 Equivalence. Countability

Unit –2 : Sequences of real numbers   **[15]**
    2.1 Definition of sequence and subsequence
    2.2 Limit of a sequence
    2.3 Convergent sequences
    2.4 Divergent sequences
    2.5 Bounded sequences
    2.6 Monotonic sequences
    2.7 Operation on convergent sequences
    2.8 Operation on divergent sequences
    2.9 Limit superior & limit inferior
    2.10 Cauchy sequences

Unit–3: Series of real numbers
[15]
    3.1 Convergence and divergence
    3.2 Series with nonnegative terms
    3.3 Alternating series
    3.4 Conditional convergent and absolute convergence
    3.5 Test for absolute convergence (comparisons test, ratio test, root test)
    3.6 Series whose terms form a nonincreasing sequence

Recommended Book (Scope of Syllabus):
Scope : Methods of real analysis by R.R. Goldberg John Wiley & Sons 1976.

Real Analysis
Unit-1 : (Sets & Functions) Art: 1.1 to 1.5
Unit –2 : (Sequences) Art: 2.1 to 2.10
Unit–3 : (Series of real no.) Art: 3.1 to 3.4,3.6,3.7

Reference books

1. A first course in mathematical analysis by D. Somasundaram & B.Choudhary Narosa Publishing House
2. Mathematical Analysis second edition by S. C. Malik & Savita Arora
3. Principles of Mathematical analysis by Rudin W. McGraw-Hill, New York
4. A Course of Mathematical Analysis by Shanti Narayan S.Chand & Company New Delhi.

Paper –X Abstract Algebra

Unit -1: Equivalence, Congruence, Divisibilty [8]

Equivalence relation and partitions, Congruence and Division Algorithm, Integer Modulo n, Greatest Common Divisors(definition with simple examples without properties).

Unit-2: Introduction to Groups [8]

Definition and Example of Groups, Elementary Properties of Groups, Permutations, Subgroups,Cyclic groups, normal subgroups, Centralizer, normalizer.

Unit -3 : Homomorphism and Isomorphism [10]

Cosets, Lagrange's theorem, Homomorphism and Kernels, Isomorphism, Quotient groups, Fundamental theorem of Homomorphism.Isomorphism theorem (Second and Third), Cayley's theorem.

Unit -4 : Introduction to Rings [8]

Definition and Examples of Rings, Integral Domain and Fields, Subrings and ideals, Characteristic of a ring.

Unit-5 : Quotient Rings [6]

Homomorphisms of Rings, Quotient Rings.Prime and Maximal ideal.

Recommended books (Scope of Syllabus):

Modern Algebra-An Introduction, by John R. Durbin, John Wiley & Sons, Inc. Fifth Edition

Unit – 1 : Chapter-III: Art. 9,10,11,12 Ch-IV :14

Unit – 2 : Chapter-II: Art. 5,6,7

Unit – 3 : Chapter-IV : Art. 16,17,18,19,20 Ch- V :21,22,23

Unit – 4 : Chapter-VI:Art.24, 25, 26, 27

Unit – 5 : Chapter-IX : Art. 38, 39

Reference Books:

1. A First Course In Abstract Algebra J. B. Fraleigh Pearson Education 7th edition
2. University Algebra N.S. Gopalkrishnan
3. Algebra M. Artin Prentice Hall of India
4. Abstract Algebra David S. Dummit & Richard M. Foote Wiley & Sons, Inc.
5. Fundamentals of Abstract Algebra D. S. Malik & N. Mordeson & M. K. Sen Mc. Graw Hill International Edition

Paper-XI Complex Analysis

Unit -1 : Analytic Functions [15]

Complex Differentiation, Limits and Continuity, Differentiability, Necessary and Sufficient condition of analytic function, Method of constructing a regular function and analytic function, Polar form of Cauchy-Riemann Equations.

Unit -2 : Complex Integration [15]

Introduction, Some basic definitions, Complex line integral, Reduction of complex integrals to real integrals, Some properties of complex Integrals, An Estimation of a complex integral, Line integrals as functions of arcs, Cauchy's Fundamental Theorem, Cauchy Goursat Theorem [Statement Only], Expansions of Analytic functions as power series, Taylor's and Laurent's Series [Statement only]

Unit -3: Calculus of Residues [10]

Residue at simple pole, Residue at a Pole of order greater than unity, Residue at infinity, Cauchy's Residue Theorem. Evaluation of Definite integrals, Integration round the unit circle.

Evaluation of $\int_0^{2\pi} f(\cos\theta, \sin\theta) d\theta$.

Recommended Book (Scope of Syllabus):

1. Functions of Complex Variable by J. N. Sharma Revised by Dr. Shanti Swarup, (38 Edition) Krishna Prakashan Media Ltd., Meerut.

Chapter -2 (Analytic Functions): 1 to 11

Chapter-6 (Complex Integration): 1 to 8, 9(Statement Only), 19, 20, 21,22

[Theorems I to IV only] .

Chapter -7 (Calculus of Residues): 1 to 7,10.

Paper-XII Programming in C

Unit – 1 : Overview of C   **[4]**

      1.1 Introduction

      1.2 Importance of C

      1.3 Sample C programs

      1.4 Basic structure of C programs

      1.5 Programming style

      1.6 Executing a C program

      1.7 Points to remember

Unit – 2 : Constants, Variables and Data Types   **[6]**

      2.1 Introduction

      2.2 Character set

      2.3 C Token

      2.4 Constants

      2.5 Keywords and Identifiers

      2.6 Variables

      2.7 Data Types

      2.8 Declaration of variables

      2.9 Assigning values to variables

      2.10 Defining symbolic constants

Unit – 3 : Operators and Expressions   **[9]**

      3.1 Introduction

      3.2 Arthmetic operators

      3.3 Relational operators

      3.4 Logical operators

      3.5 Assignment Operators

      3.6 Increments and decrement operators

      3.7 Conditional operators

      3.8 Bit-wise operators

      3.9 Special operators

      3.10 Arithmetic expressions

      3.11 Evaluation of expressions

      3.12 Precedence of arithmetic operators

3.13 Some computational problems

3.14 Type conversions in expressions

3.15 Operators precedence and associativity

3.16 Mathematical functions

Unit –4: Managing Input and Output Operators   **[4]**

4.1 Introduction

4.2 Reading a character

4.3 Writing a character

4.4 Formatted input

4.5 Formatted output

Unit -5: Decision Making and Branching   **[6]**

5.1 Introduction

5.2 Decision making with IF statement

5.3 Simple IF statement

5.4 The IF…ELSE Staement

5.5 Nesting of IF…ELSE Staement

5.6 The ELSE…IF ladder

5.7 The SWITCH statement

5.8 The ?: operator

5.9 The GOTO statement

Unit -6 Decision Making and Looping   **[4]**

6.1 Introduction

6.2 The WHILE statement

6.3 The DO statement

6.4 The FOR statement

6.5 Jumps in loops

Unit – 7 : Arrays   **[3]**

7.1 Introducion

7.2 One dimensional arrays

7.3 Two dimensional arrays

7.4 Initialising two dimensional arrays

7.5 Multidimensional arrays

Unit – 8 : User-defined Functions   **[4]**

8.1Introduction

8.2 Need for user-defined functions

8.3 A multifunction program

8.4The form of C Functions

8.5 Return values and their types

Recommended Book (Scope of Syllabus):

[I] Programs in C by E. Balgurusamy, McGraw Hill, New-Delhi

Unit- 1 : 1.1-1.7 **Unit- 2 : 2.1 -2.10 Unit- 3** : 3.1-3.16 **Unit- 4 :**4.1-4.5

Unit- 5 : 5.1 - 5.9 **Unit- 6 :6.1-6.5 Unit- 7** : 7.1 - 7.5 **Unit- 8 :**9.1- 9.5

Reference books:

1. A Book on C, Macmillan, by Berry, R.E. and Meekings.
2. C Programming Language: An applied perspective, John Wiley & Sons
3. The C Programming Tutor, Prentice-Hall, by Wortman, L.A. and Sidebottom.
4. C made Easy, Osbone McGraw-Hill by Schildt, H. C.
5. Let us C by Yeshwant Kanetkar BPB Publications, New-Delhi.
6. Programming in C by Schaum's Outlie Series, Tata McGraw Hill, EEE.

SEMESTER-VI

Paper – XIII (Metric Space)

Unit -1: Limits and metric Spaces [10]

1.1 The class l^2 (Schwartz, Minkowski inequality)

1.2 Limit of a function on the real line

1.3 Metric spaces

1.4 Limits in metric spaces

Unit-2 : Continuous functions on metric spaces [15]

2.1Functios continuous at a point on the real line

2.2 Reformulation

2.3 Functions continuous on a metric space

2.4 Open sets

2.5 Closed sets

Unit-3 : Completeness and Compactness [15]

3.1 Bounded sets and totally bounded sets

3.2 Complete metric spaces

3.3 Compact metric spaces

3.4 Continuous functions on compact metric spaces

Recommended Book (Scope of Syllabus):
Scope : Methods of real analysis by R.R. Goldberg John Wiley & Sons 1976.

Metric Spaces

Unit-1 : Limits and metric spaces Art: 3.10, 4.1 to 4.3
Unit -2 : Continuous functions on metric spaces Art: 5.1 to 5.5
Unit-3 : Completeness and Compactness Art: 6.3 to 6.6

Reference books

1. A first course in mathematical analysis by D. Somasundaram &B.Choudhary Narosa Publishing House.
2. Mathematical Analysis second edition by S. C. Malik & Savita Arora.
3. Principles of Mathematical analysis by Rudin W. McGraw-Hill, New York.
4. A Course of Mathematical Analysis by Shanti Narayan S.Chand & Company New Delhi**.**

Paper –XIV(Linear Algebra)

Unit- 1 : Vector spaces [15]

Vector spaces, Subspaces, Linear combination and system of linear equation, Linear dependence and independence, Basis and dimensions

Unit-2 : Linear transformation and matrices [15]

Linear transformation, Null spaces and ranges, Matrix representation of linear transformation, Composition of linear transformation and Matrix multiplication, Invertibility and isomorphism.

Unit- 3 : Inner product space [10]

Inner products and Norms, Gram Schmidt Orthogonalisation process and Orthogonal complements.

Recommended book (Scope of Syllabus):

Linear Algebra Fourth Edition by Stephen H. Friedberg, Arnold J. Insel Lawrence E. Spence Prentice Hall of India New Delhi (EEE)
Chapter-I (Vector spaces): Art. 1.2, 1.3, 1.4, 1.5, 1.6
Chapter-II (Linear transformation and matrices): Art. 2.1,2.2,2.3,2.4, 2.5
Chapter-VI (Inner product space) Art. 6.1, 6.2

Reference books:-
1 .Linear Algebra by Vivek Sahai & Vikas Bist Narosa Publishing House
2. Linear Algebra And Its Application Gilbert Strang International Student Edition
3. Topics In Algebra John Wiley & Sons by I. N. Herstein
4. Hoffman & Kunj
5. K. B.Datta Matrix & Linear Algebra Prentice Hall of India Pvt. Ltd.New Delhi 2000
6. S. Kumarsen Linear Algebra A Geometric Approach Prentice Hall of India 2002.

Paper-XV PARTIAL DIFFERENTIAL EQUATION

Unit-1: **Linear partial differential equation of order one**   **[15]**
    1.1 Derivation of partial differential equation of arbitrary constants
    1.2 Derivation of partial differential equation of arbitrary functions.
    1.3 Lagrange's Method of solving linear partial differential equation of order one. Namely $Pp + Qq = R$ Working rule for solving $Pp + Qq = R$ by Lagrange's Method.
    1.4 Integral surface passing through a given curve

Unit-2: Non Linear partial differential equation of order one   **[15]**
    2.1 Solution of first order partial differential equation Charpit's Method.
    2.2 Special methods of solution applicable to certain Standard form I, II, III, IV.

Unit-3: Linear partial differential equation with constant Coefficient [10]
    3.1 Homogeneous and Non Homogeneous linear partial differential equation with constant Coefficient working rule for finding C.F. method of finding particular integral (P.I).
    3.2 Short method when f (x, y) is Ø $(ax + by)$ and $x^m y^m$, Equation reducible to linear equation with constant coefficient

Recommended Book (Scope of syllabus) :
1. Ordinary and partial differential equation by M. D.Raisinghania, S. Chand Co. [PART – III]
Unit – 1 :Chapter-1 : 1.1, 1.2, 1.2a, 1.2b, 1.3, 1.4, 1.5, 1.5a, 1.5b, 1.5c, 1.5d, 1.6
Unit – 2 :Chapter-2 : 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10,

Unit – 3 :Chapter-3: 3.1, 3.2, 3.3, 3.4, 3.4A, 3.4B, 3.5, 3.6, 3.6A, 3.6B, 3.7, 3.8, 3.9,3.10, 3.11

Reference Books :

1. Elements of partial differential equation IAN Sneddon (International students edition by Mc Graw Hill Book)
2. Differential equation
   Sharma & Gupta (Krishna Prakashan Media (P)Ltd. Meerut)
3. Partial differential equation J. M. Kar

Paper-XVI GRAPH THEORY

Unit -1: Graph Theory [10]

Graphs-undirected and directed, Simple graphs, Multigraphs, Degree of a vertex, Indegree and outdegree of a vertex, **Types:** Null graph, Complete graph, Regular graphs, Platonic, Cycles, Wheels, Bipatitte, Complete bipartite, Subgraphs, Isomorphic graphs.

Unit-2:Operations on graphs [10]

Union, Intersection, Sum, Ring sum,Complements, Product, Composition and Fusion, Paths, Cycles, Cut-vertex, Cut set, Bridge, Connectedness, Matrix representation, Adjacency matrix, Incidence matrix, Planar graphs,Eulerian and Hamiltonian graphs, Euler formula.

Unit-3 : Trees [10]

Trees and their properties, Rooted trees, Spanning trees, Construction of Spanning Trees, Weighted graphs, Minimal Spanning Tree, Tree traversal, Prefix and Postfix notation(Delete binary search tree onwards).

Unit-4 : Number Systems [10]

Base-b Number Systems, Decimal, Binary, Octal and Hexadecimal number Systems and Conversions between these systems.

Recommended Books (Scope of Syllabus):
[I] A Textbook of Discrete Mathematics by Swapan Kumar Sarkar (S. Chand Co.1ˢᵗedition 2003)
Ch -13 :13.1 to 13.12   Ch -14 : 14.1 to 14.4
[II] Essential Computer Mathematics by Seymour Lipshutz, Schaum's outline Series
Ch-1:1.1to1.3   Ch-2:2.1to2.4

Reference Books
1. Discrete Mathematics by Dr. Ranjeet Singh, Manish Soni, University Book House(P) Ltd. Jaipur.
2. Discrete Mathematics and Graph Theory by Purna Chandra Biswal, PHI,EEE.
3. Introduction to Discrete Mathematics by M. K. Sen, B. C. Chakraborty, Books and Allied (P) Ltd.
4. Fundamental Approach to Discrete Mathematics by D. P. Acharya, Sreekumar, New Age International Publishers

Problem Soving Sessions[PSS –III(A) to III(D)]

Note: Each assignment is of 1.5 periods [50+25 = 75 minutes]
(Problems on following topics)
PSS-III(A) (Real Analysis + Metric Spaces)
Section - I(Real Analysis)

Assignment-1 : Sets and Functions(Numerical examples on domain, range, mapping(one-one, many-one, into, onto) inverse mapping, extension-restrictions of f and composite functions)

Assignment-2 : Sequence- I(n^{th} term of the sequence, subsequence of sequence, relation between ε-δ in limit of sequence, existence of limit, boundedness, monotonic)

Assignment-3 : Sequence-II(Convergence, Divergence,Limit superior, Limit inferior)

Assignment-4 : Series- I(Examples on convergence, divergence, absolute and conditional convergence)

Assignment-5 : Series- II(Tests of convergence comarison test, Ratio test, p-test, Geometric series, divergence)

Assignment-6 : Series- III(Tests of convergence condensetion test, Raabe's test, Logaritmic test, Cauchy's integral test)

Section - II (Metric Spaces)

Assignment-7 : Metric Space-I(Examples on Metric spaces, open set, closed set, boundary set in Metric spaces)

Assignment-8 : Metric Space-II(Examples on bounded set, Totally bouunded set and Diameter of set in Metric spaces)

Assignment-9 : Metric Space-III(Examples on Limit of metric space, Cauchy sequence in Metric spaces)

Assignment-10 : Metric Space-IV(Examples on bounded set, Totally bouunded set and Diameter of set in Metric spaces, contraction, Isometry, homeomorphism in Metric spaces)

Assignment-11: Metric Space-V(Examples on cover, open cover, Dense in Metric spaces)

Assignment-12: Metric Space-VI(Examples on completeness and compactness in Metric spaces)

Reference books

1. A first course in mathematical analysis by D. Somasundaram & B.Choudhary Narosa Publishing House
2. Mathematical Analysis second edition by S. C. Malik & Savita Arora
3. Principles of Mathematical analysis by Rudin W. McGraw-Hill, New York
4. A Course of Mathematical Analysis by Shanti Narayan S.Chand & Company New Delhi.

PSS-III(B)(Abstract Algbra +Linear Algebra)
(Problems on the following topics)
Section - I (Abstract Algbra)

Assignment-1 : Equivalence relation and partitions
Assignment-2 : Groups and its properties
Assignment-3 : Subgroups and Cyclic groups
Assignment-4 : Quotient groups
Assignment-5 : Permutation groups
Assignment-6 : Ideals

Section – II(Linear Algebra)

Assignment-7 : Subspaces
Assignment-8 : Linear dependence, independence and basis
Assignment-9 : Linear transformation and matrices
Assignment-10 : Kernel and range
Assignment-11 : Inverse and Composite
Assignment-12 : Orthonormal basis

PSS-III(C) (Complex Analysis+ Partial Differential Equation)
(Problems on the following topics)
Section - I (Complex Analysis)

Assignment-1 : Find the reguler (analytic) function of which function (Real , Immaginery , u+v , u-v type).

Assignment-2 : Solving the complex intigration Circle , Line and Parabola.

Assignment-3 : Obtain the Taylor's and Leurent's series.

Assignment-4 : Calculus of residue.

Assignment-5 : Intigration round the unit circle.

Assignment-6 : Evaluation of integral

$$\int_0^{2\pi} f(\cos\theta, \sin\theta) d\theta,$$

Section - II(Partial Differential Equation)

Assignment-7 : Solve Linear differential equation of first order by arbitrary constant and arbitrary function, Lagrange's method.

Assignment-8 : Non linear partial differential equation of order one by Charpit method.

Assignment-9 : Non linear partial differential equation of standerd form I , II , III & IV.

Assignment-10 : Find C.F and P.I for Homogeneous linear   partial differential equation with constant coefficient.

Assignment-11 : Find C.F and P.I for Non-Homogeneous linear partial differential equation with constant coefficient.

Assignment-12 : Find C.F and P.I for eqution reducible to linear differential equation with constant coefficient.

PSS-III(D)(Programming in C +Graph Theory)
(Problems on the following Topics)
Section – I(Programming in C)
(Run and write following C programs only)

Assignment No.1: Sample Programms – I

Addition, subtraction, multiplication and division. Area, Volume of a sphere, Temperature Conversion.

Assignment No.2: Sample Programms – II

Star pattern, Reverse of a given number, Fibbonacci sequence, Factorial, ^nC_r, ^nP_r, Roots of the quadratic equation

Assignment No.3: Sample Programms – III

Maximum and Minimum, Sum of the series $1+2+3+\ldots+n$, $1^2+2^2+3^2+\ldots+n^2$, $1^3+2^3+3^3+\ldots+n^3$, $1^2+3^2+\ldots+(n-1)^2$, $2^2+4^2+6^2+\ldots+(2n)^2$

Assignment No.3: Sample Programms – IV

Sine, Cosine, Exponential series

Assignment No.5: Sample Programs – V

Ascending and descending data.

Assignment No.6: Sample Programs – IV

Matrix addition/Subtraction, Matrix multiplication.

Section – II (Graph theory)

Assignment-7 : Operations on Graphs, Eulerian and Hamiltonian Graphs

Assignment-8 : Adjacency and Incidence matrix(with Graphs)

Assignment-9 : Spanning tree and Minimum spanning tree

Assignment-10 : Infix/Prefix and Postfix and their tree

Assignment-11 : Conversion of Decimal to Binary/Octal/Hexadecimal.

Assignment-12 : Conversion of Binary/Octal/Hexadecimal to Decimal

In Problem Solving Sessions PSS-III(A) – III(D) [Project/ Seminar / Study Tour/Viva Vocae]

Project : Biography of One Mathematician or One Mathematics Topic (which is not included in the syllabus upto B.Sc. -III Mathematics) about Five Pages.   **05 Marks**

Seminar: Any topic in mathematics.   **05 Marks**

Study Tour: Visit to any Industry / Research Institution / Educational
            Institution.   **05 Marks**

Viva Voce : Viva voce on Project, Seminar and Study Tour.   **05 Marks**

    (Free internet should be availed for collection of Material for Project, Seminar.)