UNIVERSITY OF PUNE, PUNE.

BOARD OF STUDIES IN MATHEMATICS

Syllabus for S.Y.B.Sc

Subject: MATHEMATICS

(With effect from June 2014)

Introduction:

University of Pune has decided to change the syllabi of various faculties from June,2013.

Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects Board of studies in Mathematics with concern of teachers of Mathematics from different colleges affiliated to University of Pune has prepared the syllabus of S.Y.B.Sc. Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Aims:

i)Give the students a sufficient knowledge of fundamental principles ,methods and a clear perception of innumerous power of mathematical ideas and tools and know how to use them by modeling ,solving and interpreting.

ii) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.

iii)Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills , creative talent and power of communication necessary for various kinds of employment .

iv) Enabling students to develop a positive attitude towards mathematics as aninteresting and valuable subject of study.

Objectives:

(i) A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays ,state important facts resulting from their studies.

(ii) A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.

(iii) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.

(iv) A student be able to apply their skills and knowledge ,that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.

(v) A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.

Eligibility: F.Y.B.Sc. ,as per University rules

Structure of the course:

	Semester I		**Semester II**	
Paper I	MT 211	Multivariable Calculus I	MT 221	Linear Algebra
Paper II	MT 212(A)	Discrete Mathematics	MT 222(A)	Multivariable Calculus II
	MT212(B)	Laplace Transform and Fourier Series	MT222(B)	Numerical methods and it's applications
Paper III	MT213	Practical based on MT211,MT212	MT223	Practical based on MT221,MT222

Paper I, Paper III is compulsory .In Paper II student can opt for ,any one of MT 212(A), MT212(B) in first semester and any one of MT221(A),MT222(B) in second semester.

In paper I and II, each course is of 50 marks (40 marks theory and 10 marks internal examination)

Paper III each course is of 50 marks(32 marks theory,8 marks oral and 10 marks internal examination)

Medium of Instruction: English

Examination:

A) Pattern of examination: Semester wise

B) Standard of passing : 20 Marks out of 50 marks for each papers.

But for passing a student should obtain minimum 16 marks out of 40 in the theory and oral examination and overall total marks for theory, oral and internal should be minimum 20.

C)**Pattern of question papers: For Paper I and Paper II**

Q1. Attempt any 05 out of 07 questions each of 02 marks. [10Marks]

Q2. Attempt any 02 out of 03 questions each of 05 marks. [10 Marks].

Q.3. Attempt any 02 out of 03 questions each of 05 marks. [10 Marks].

Q.4. Attempt any 01 out of 02 questions each of 10 marks. [10 Marks].

The pattern of question paper for Paper III

Q1.A) Attempt any 01 out of 02 questions each of 08 marks. (Based on Paper I) [08 Marks]

B) Attempt any 02 out of 03 questions each of 04 marks. (Based on Paper I) [08 Marks]

Q2. A) Attempt any 01 out of 02 questions each of 08 marks. (Based on Paper II) [08 Marks]

B) Attempt any 02 out of 03 questions each of 04 marks. (Based on Paper II) [08 Marks]

D) External Students: Not allowed.

E) Variation / Revaluation: Allowed for Paper I and II.

F) Qualifications for Teacher: M.Sc. Mathematics (with NET /SET as per existing rules)

- **Textbooks will be prepared by the BOS Mathematics, University of Pune.**

Equivalence of Previous syllabus along with new syllabus:

Semester I		**Semester II**	
New Course	**Old Course**	**New Course**	**Old Course**
MT 211 Multivariable Calculus I	MT 211 Calculus of Several Variables	MT 221 Linear Algebra	MT:221 Linear Algebra
MT 212(A) Discrete Mathematics	MT:222(B)) Discrete Mathematics	MT 222(A) Multivariable Calculus II	MT:222(A)) Vector Calculus
MT212(B) Laplace Transform and Fourier Series	MT:212(A) Differential Equations	MT222(B) Numerical methods and it's applications	MT:212(B) Numerical Analysis
MT213 Practical based on MT211,MT212	MT213 Practical based on MT211,MT212	MT223 Practical based on MT221,MT222	MT213 Practical based on MT211,MT212

Details of Syllabus:

Paper I MT 211: Multivariable Calculus I

1. **Limit and Continuity of Multivariable functions**: **[06]**
   1.1. Functions of several variables, graphs and level curves of function of two variables.
   1.2. Limit and Continuity in higher dimensions.
2. **Partial Derivatives:** **[04]**
   2.1. Definition and examples.
   2.2. Second order partial derivative, the mixed derivative theorem.
   2.3. Partial derivatives of higher order.
3. **Differentiability:** **[12]**
   3.1. Differentiability, the increment theorem for functions of two variables (without proof).
   3.2. Chain rules for composite function.
   3.3. Directional derivatives, gradient vectors.
   3.4. Tangent planes, normal lines and differentials.
4. **Extreme Values:** **[10]**
   4.1. Extreme values, First derivative test and Second derivative test for local extreme values.
   4.2. Lagrange's multipliers method for finding extreme values of constraint function (One Constraint)
   4.3. Taylors Formula for two variables.
5. **Multiple Integrals:** **[16]**

   5.1. Double Integral over rectangles, Fubini's theorem for calculating double integrals (Without proof).
   5.2. Double integrals in polar form.
   5.3. Triple integrals in rectangular coordinates.
   5.4. Triple integral in cylindrical and spherical coordinates.
   5.5. Substitution in multiple integrals, Application to area and volumes.

Text book: **Prepared by the BOS Mathematics, University of Pune.**
Recommended Book: Thomas' Calculus, 11th Edition, G. B. Thomas.
Revised by Maurice D. Weir, Joel Hass and Frank R. Giordano.
Pearson Edition 2012.
Articles: 14.1 to 14.10, 15.1, 15.3, 15.4, 15.6, 15.7

Reference Books:

1. Basic Multivariable Calculus, J. E. Marsden, A. J. Tromba , A. Weinstein, Springer Verlag (Indian Edition).
2. Shanti Narayan, R.K. Mittal, A Text-book of Vector Calculus, S.Chand and Company.
3. D.V. Widder, Advanced Calculus (2nd Edition), Prentice Hall of India ,NewDelhi,(1944).
4. T.M. Apostol , Calculus Vol. II (2nd Edition), John Wiley, New York, (1967).

Paper II(A) MT 212(A):Discrete Mathematics

1. **Logic and Proofs:** **[24]**
   - 1.1 Propositional logic.
   - 1.2 Propositional equivalences.
   - 1.3 Predicates and quantifiers.
   - 1.4 Nested quantifiers.
   - 1.5 Rules of inference.
   - 1.6 Introduction to proofs.
2. **Counting:** **[20]**
   - 2.1 The basics of counting.
   - 2.2 Permutation and combinations.
   - 2.3 Generalized permutation and combinations.
3. **Advanced Counting Technique:** **[04]**
   - 3.1 Inclusion-Exclusion (without proof).

Text book: **Prepared by the BOS Mathematics, University of Pune.**

Recommended Book:

1. Discrete Mathematics and Its Applications, Kenneth H Rosen, Seventh Edition, McGraw Hill.

Sections: 1.1 to 1.6, 5.1, 5.3, 5.5, 6.5

Reference Books:

1. Symbolic Logic, I.M. Copi, Fifth Edition, Prentice Hall of India, 1995.
2. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross and Nadeem-ur-Rehman: Discrete Mathematical Structures, Fifth Edition, Pearson Education, Inc., 2004.
3. Applied Combinatorics, Fourth Edition, by Alan Tucker.

Paper II(B) MT 212(B):Laplace Transforms and Fourier Series

1. **The Laplace Transform:** **[18]**
   - 1.1 Definition, Laplace Transform of some elementary functions.
   - 1.2 Some important properties of Laplace Transform.
   - 1.3 Laplace Transform of derivatives, Laplace Transform of Integrals.
   - 1.4 Methods of finding Laplace Transform, Evaluation of Integrals.
   - 1.5 The Gamma function, Unit step function and Dirac delta function.

2. The Inverse Laplace Transform: [**18**]

2.1 Definition, Some inverse Laplace Transform.

2.2 Some important properties of Inverse Laplace Transform.

2.3 Inverse Laplace Transform of derivative, InverseLaplace Transform of integrals.

2.4 Convolution Theorem, Evaluation of Integrals.

3. Applications of Laplace Transform: [0**4]**

3.1 Solution of Ordinary Differential Equations with constant coefficients.

4. Fourier Series [0**8**]

4.1Definition and examples of Fourier Series.

Text-Book: **Prepared by the BOS Mathematics, University of Pune.**

Recommended Book:

1.Schaum's Outline Series - Theory and Problems of Laplace Transform by Murray R. Spiegel. Articles 1, 2, 3.

2.Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd. (1970).Art.12.1

Reference Books

1.Joel L. Schiff : The Laplace Transforms - Theory and Applications, Springer-Verlag New York 1999.

2.Dyke : An Introduction to Laplace Transforms and Fourier Series, Springer International Edition, Indian Reprint 2005.

TERM -II

Paper I MT 221: Linear Algebra

1. **Vector Spaces** **[16]**
   Definition, examples, linear dependence, basis and dimension, vector subspace, Necessary and sufficient condition for subspace, vector space as a direct sum of subspaces

2. **Inner Product Spaces** **[16]**
   Inner product, norm as length of a vector, distance between two vectors, orthonormal basis, orthonormal projection,Gram Schmidt processs of ortogonalization, null space, range space, rank, nullity, Sylvester Inequality

3. **Linear Transformations** **[16]**
   Definition, examples, properties of linear transformations, equality of linear transformations, kernel and rank of linear transformations, composite transformations, Inverse of a linear transformation, Matrix of a linear transformation, change of basis, similar matrices

Textbook: **Prepared by the BOS Mathematics, University of Pune.**

Recommended Book:

Matrix and Linear Algebra aided with MATLAB, Kanti Bhushan Datta, PHI learning Pvt.Ltd, New Delhi(2009**) (**Sections:5.1,5.2,5.3,5.4,5.5,5.7,6.1,6.2,6.3,6.4

Reference Books:

1. Howard Anton, Chris Rorres., Elementary Linear Algebra,John Wiley & Sons, Inc
2. K. Hoffmann and R. Kunze Linear Algebra, Second Ed. Prentice Hall of India , New Delhi, (1998).
3. S. Lang, Introduction to Linear Algebra, Second Ed. Springer-Verlag, New Yark.
4. A. Ramchandra Rao and P. Bhimasankaran, Linear Algebra, Tata McGraw Hill,New Delhi (1994).
5. G. Strang, Linear Algebra and its Applications. Third Ed. Harcourt Brace Jovanovich, Orlando, (1988).

Paper II (A) MT 222(A): Multivariable Calculus II

1. **Vector valued function:** **[14]**
   - **1.1** Vector valued function.
   - **1.2** Limit and Continuity of vector function.
   - **1.3** Derivative of vector function and motion.
   - **1.4** Differentiations rules.
   - **1.5** Constant vector function and its necessary and sufficient condition.
   - **1.6** Integration of vector function of one scalar variable.
   - **1.7** Arc length and unit tangent vector T. Curvature and the unit normal vector N.
2. **Line Integrals:** **[16]**
   - **2.1** Definition and evaluation of line integral.
   - **2.2** Properties of line integrals.
   - **2.3** Vector fields, work, circulation and flux across smooth curves.
   - **2.4** Path independence, Potential functions, Conservative fields.
   - **2.5** Green's theorem in plane, evaluating integrals using Green's theorem.
3. **Surface and volume integrals:** **[18]**
   - **3.1** Surface area and surface integrals.
   - **3.2** Surface integral for parameterized surfaces.
   - **3.3** Stokes theorem (without proof).
   - **3.4** The Gauss divergence theorem (proof for special regions).

Textbook: **Prepared by the BOS Mathematics, University of Pune.**

Recommended Book:

Thomas' Calculus, 11th Edition, G. B. Thomas.Revised by Maurice D. Weir, Joel Hass and Frank R. Giordano. Pearson Edition 2012.Articles: 13.1, 13.3, 13.4, 16.1 to 16.8.

Reference Books:

1. Basic Multivariable Calculus, J. E. Marsden, A. J. Tromba , A. Weinstein, Springer Verlag (Indian Edition).
2. Shanti Narayan, R.K. Mittal, A Text-book of Vector Calculus, S.Chand and Company.
3. John M. H. Olmsted, Advanced Calculus, Eurasia Publishing House, NewDelhi(1970).
4. T.M. Apostol , Calculus Vol. II (2nd Edition), John Wiley, New York, (1967).

Paper II(B) MT 222(B): Numerical Methods and its applications

1. Errors: **[4]**

1.1Errors and Their Computations
1.2 Rounding off numbers to n significant digits, to n decimal places.
1.3 Absolute, relative and percentage errors.
1.4 A general error formula.

2. Solution of Algebraic and Transcendental Equations: [10]

2.1Bisection method.
2.2The method of False position.
2.3The iteration method, Aitken's Δ^2 process
2.4 Newton- Raphson Method.

3. Interpolation: [16]

3.1Finite Difference Operators and their relations.
3.2Detection of Errors using difference table.
3.3Differences of a polynomial
3.4Newton's Interpolation Formulae (Forward and Backward)
3.5 Lagrange's Interpolation Formula
3.6 Divided differences and Newton's General Interpolation formula.

4.Least Squares Curve Fitting Procedures [4]

4.1 Fitting a Straight Line
4.2 Nonlinear curve fitting: Power function $y = ax^c$,polynomials of degree 2 and 3,Exponential function $y = cx^d$

5. Numerical Differentiation and Integration: [8]

5.1Numerical Differentiation
5.2Numerical Integration,General quadrature formula.
5.3 Trapezoidal rule.
5.4 Simpsons's $\frac{1}{3}$ rule.
5.5 Simpsons's$\frac{3}{8}$ rule.

6. Numerical solution of first order ordinary differential equations: [6]

6.1 Taylor Series method
6.2 Euler's method.
6.3 Modified Euler's methods.
6.4Runge - Kutta Methods 2^{nd} and4^{th} order.

Text Books : Prepared by the BOS Mathematics, University of Pune.

Recommended Book:

1. S.S. Sastry; Introductory Methods of Numerical Analysis, 3^{rd}edition, Prentice Hall of India.

Sections:1.3,1.4,2.1,2.2,2.3,2.4,2.5,3.3,3.4,3.5,3.6,3.9.1,3.10(3.10.1only), 4.2.1,4.2.2,5.2(excluding5.2.1,5.2.2),5.4.1,5.4.2,5.4.3, 7.2,7.4,7.4.1,7.4.2,7.5

Reference Book:

1. K.E. Atkinson; An Introduction to Numerical Analysis, Wiley Publications.

2. H.C. Saxena; Finite differences and Numerical Analysis, S. Chand and Company.

Modalities For Conducting The Practical and The Practical Examination:

1) There will be one 3 hour practical session for each batch of 12 students per week

2) A question bank consisting of 60 questions in all for each semester, distributed in two sections: 25 questions each of Paper I and Paer II will be the course work for this paper. Question Bank will be prepared by the individual subject teacher based on pattern of questions provided by university. The question bank of each year should be preserved by the subject teachers, which can be reviewed by the L.I.C. members visiting college.

3) University will conduct the Practical Examination each semester twice a year. The practical examination will consist of written examination of 32 marks and oral examination of 08 marks.

4) The practical exam will be of the duration of 3 hours duration.

5) **The pattern of question paper for Paper III**

Q1.A) Attempt any 01 out of 02 questions each of 08 marks. (Based on Paper I) [08 Marks]

B) Attempt any 02 out of 03 questions each of 04 marks. (Based on Paper I) [08 Marks]

Q2. A) Attempt any 01 out of 02 questions each of 08 marks. (Based on Paper II) [08 Marks]

B) Attempt any 02 out of 03 questions each of 04 marks. (Based on Paper II) [08 Marks]

6) Each student will maintain a journal to be provided by the college.

7)The internal 20 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practicals.

8) It is recommended that concept may be illustrated using computer software and graphing calculators wherever possible.

9) Trips/Study tours may be arranged at places having important mathematical institutes or historical places.

11) Special Instruction: Before starting each practical necessary introduction, basic definitions, intuitive inspiring ideas and prerequisites must be discussed.