

UNIVERSITY OF PUNE, PUNE.

Syllabus for F.Y.B.Sc

Subject: MATHEMATICS

(With effect from June 2013)

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 F.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 innumerable 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 an interesting 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: 12th science with mathematics or equivalent examination.

Structure of the course:

Sr. No.	Paper	Theory	Oral	Internal	Total
1	MT 101 (Algebra and Geometry)	80 Marks	-	20 Marks	100 Marks
2	MT 102 (Calculus and Differential equations)	80 Marks	-	20 Marks	100 Marks
3	MT 103 (Mathematics Practicals)	72 Marks	08 Marks	20 Marks	100 Marks

All 3 above courses are compulsory.

Medium of Instruction: English

Examination:

A) Pattern of examination: Annual.

B) Standard of passing : 40 Marks out of 100 marks for each papers.

But for MT 101 and MT 102 for passing a student should obtain minimum 32 marks out of 80 in the theory examination and overall total marks for theory and internal should be minimum 40.

C)Pattern of question papers: For MT 101 and MT 102

Q1. Attempt any 08 out of 10 questions each of 02 marks. [16 Marks]
(05 questions from each term)

Q2. Attempt any 04 out of 06 questions each of 04 marks. [16 Marks].
(Based on term I)

Q.3. Attempt any 02 out of 03 questions each of 08 marks. [16 Marks].
(Based on term I)

Q4. Attempt any 04 out of 06 questions each of 04 marks. [16 Marks].
(Based on term II)

Q.5. Attempt any 02 out of 03 questions each of 08 marks. [16 Marks].
(Based on term II)

The pattern of question paper for MT 103 is given in the detailed syllabus.

D) External Students: Not allowed.

E)Verification/Revaluation: Allowed for MT 101,MT 102.

Equivalence of Previous syllabus along with new syllabus:

Sr.No	New Courses	Old Courses
1	MT 101 (Algebra and Geometry)	Paper I (Algebra and Geometry)
2	MT 102 (Calculus and Differential equations)	Paper II (Calculus)
3	MT 103 (Mathematics Practicals)	Paper III (Mathematics Practicals)

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

Details of Syllabus:

MT 101: Algebra & Geometry

FIRST TERM (Algebra)

Unit 01: Integers

15 Lectures

1.1 Well Ordering Principle for \mathbb{N} . Principle of Mathematical induction (strong form).

1.2 Divisibility in \mathbb{Z} : Definition and elementary properties. Division Algorithm, Euclidean Algorithm (Without proof) G.C.D. and L.C.M of integers, Relatively prime integers, Definition Prime numbers, Euclid's lemma, Basic properties of G.C.D., G.C.D of any two integers a and b if it exists is unique and can be expressed in the form $ax + by$, where $x, y \in \mathbb{Z}$.

1.3 Equivalence Relations, Equivalences classes, properties of Equivalences classes, Definition of partition, every partition gives an equivalence relation and vice-versa, Definition of Congruence, Congruence as equivalence relation on \mathbb{Z} , Residue classes, Partition of \mathbb{Z} , Addition modulo n , Multiplication modulo n .

Unit 02: Polynomials

6 Lectures

2.1 Definition of polynomial, Degree of polynomial, Algebra of polynomials, Division algorithm (without proof). G.C.D of two polynomials (without proof).

2.2 Remainder Theorem, Factor Theorem.

2.3 Relation between the roots and the coefficients of a polynomial, Examples.

Unit 03: Matrices and System of linear equations.

15 Lectures

3.1 Matrices, Echelon and Reduced echelon form of a matrix, Reduction of matrix to its echelon form, Definition of rank of a matrix by using echelon form.

3.2 System of linear equations, Matrix form of system of linear equations, Homogeneous and non-homogeneous system of linear equations, Gauss Elimination and Gauss Jordan Method.

3.3 Consistency of a system of linear equations, condition of consistency (without proof).

3.4 Eigen values, Eigen vectors, characteristic equation of a matrix of order up to 3×3

3.5 Statement of Cayley Hamilton theorem and its use to find the inverse of a matrix.

SECOND TERM (Geometry)

Unit 04: Analytical Geometry of two dimensions:

10 Lectures

4.1) Change of axes, Translation and rotation.

4.2) Conic Section: General equation of second degree in x and y . Centre of conic, Nature of conic, Reduction to standard form.

Unit 05: Planes in 3-dimension:

6 Lectures

Revision: Equations of the first degree in x, y, z , Transformation to the normal form, determination of plane under given conditions, Equations of the plane through three given points.

5.1 Systems of planes, two sides of a plane.

5.2 Length of the perpendicular from a point to a plane, bisectors of angles between two planes.

5.3 Joint equation of two planes, Angle between planes.

Unit 06: Lines in 3-dimension:

6 Lectures

Revision: Equations of a line, equations of a straight line in terms of its direction cosines and the co-ordinates of a point on it, equations of a line through two points, Symmetrical and unsymmetrical forms of the equations of a line. transformation of the equations of a line to the symmetrical form. Angle between a line and a plane.

6.1 The condition that a given line may lie in a given plane, the condition that two given lines are coplanar.

6.2 Number of arbitrary constants in the equations of a straight line, sets of conditions which determine a line.

6.3 The shortest distance between two lines, the length and equations of the line of shortest distance between two straight lines, length of perpendicular from a given point to a given line.

Unit 07: Sphere

8 Lectures

7.1 Definition and equation of the sphere in various forms.

7.2 Plane section of a sphere, intersection of two spheres.

7.3 Equation of a circle, sphere through a given circle, intersection of a sphere and a line.

7.4 Equation of a tangent plane.

Unit 08: Cones and Cylinders:

6 Lectures

8.1 Definition of cone and cylinder.

8.2Equation of cone and cylinder with vertex at origin and (α, β, γ) .

8.3 The right circular cone, equation of a right circular cone.

8.4 The right circular cylinder, equation of a right circular cylinder.

Text Book: Text book of Algebra &Geometry, Prepared by B.O.S. in Mathematics, University of Pune, Pune.(2013).

Reference Books:

1. Shantinayakan: Analytical Solid Geometry, S. Chand and Company Ltd, New Delhi, 1998.
2. David Burton, Elementary Number Theory, Tata McGraw Hill, Indian Edition.
3. H. Anton and C. Rorres, Elementary Linear Algebra with Applications, Seventh Ed Wiley, (1994).
4. P.K.Jain and Khalil Ahmad,A Text Book of Analytical Geometry of Three Dimensions, Wiley Estern Ltd. 1999.
5. K.B.Datta, Matrix and Linear Algebra, Prentice hall of India Pvt.Ltd, New Delhi 2000.

MT 102: Calculus and Differential Equations

FIRST TERM (Calculus)

Unit 1. The Real Numbers :

8 Lectures

- 1.1** Algebraic properties of \mathbb{R} ,
- 1.2**Order properties of \mathbb{R} , lintervals in \mathbb{R} , neighborhoods and deleted neighborhoods of a real number, bounded subsets of \mathbb{R} .
- 1.3** The Completeness Property of \mathbb{R} , denseness of \mathbb{Q} in \mathbb{R} .

Unit 2.Limit and Continuity

10Lectures

- 2.1** $\epsilon - \delta$ definition of limit of a function, Basic properties of limits.
- 2.2** Continuity of function at a point, Types of discontinuity.
- 2.3** Continuous functions on intervals.
- 2.4** Properties of continuous functions on closed and bounded interval.
(i) Boundedness. (ii) Attains its bounds. (iii) Intermediate value theorem

Unit 3. Differentiation

18 Lectures

3.1 Definition of derivative of a real valued function at a point, notion of differentiability, geometric interpretation of a derivative of a real valued function at a point.

3.2 Differentiability of a function over an interval.

3.3 Statement of rules of differentiability, chain rule of finding derivative of composite of differentiable functions (without proof), derivative of an inverse function.

3.4. Mean Value Theorems: Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem

3.5 Indeterminate forms. L-Hospital's rule.

3.6 Higher order derivatives, examples, Leibnitz Theorem and its applications

3.7 Taylor's and Maclaurin's Theorem with Lagrange's form of remainder (without proof), Examples with assuming convergence of series.

SECOND TERM (Differential Equations)

Unit 4. Integration

08 Lectures

4.1 Integration of rational function by using partial fraction.

4.2 Integration of some irrational functions:

i) $\int (ax + b)^{\frac{1}{n}} dx$ where n is a positive integer, ii) $\int \frac{Ax + B}{\sqrt{ax^2 + bx + c}} dx$
iii) $\int (Ax + B)\sqrt{ax^2 + bx + c} dx$

4.3 Reduction formula

i) $\int \frac{x^n}{\sqrt{ax^2 + bx + c}} dx$ ii) $\int \frac{dx}{(x^2 + a^2)^n}$, n is a positive integer iii) $\int (x^2 + a^2)^{n/2} dx$
iv) $\int_0^{\pi/2} \sin^n x dx$ v) $\int_0^{\pi/2} \cos^n x dx$

Unit 5. Differential Equations of first order and first degree:

16 Lectures

5.1 Introduction to function of two, three variables, homogenous functions, Partial derivatives.

5.2 Differential equations, General solution of Differential equations.

5.3 Methods of finding solution of Differential equations of first order and first degree, Variable separable form, Homogenous Differential equations, Differential equations reducible to homogeneous form. Exact Differential equations. Differential equations reducible to exact Differential equations, Integrating factors, Linear Differential equations. Bernoulli's Differential equations.

Unit 6. Application of Differential Equations :

06 Lectures

- 6.1 Orthogonal trajectories.
- 6.2 Kirchhoff's law of electrical circuit (RC & LR Circuit)

Unit 7. Methods of finding general solution of Differential Equations of first order and higher degree:

06 Lectures

- 7.1 Equations solvable for p .
- 7.2 Equations solvable for x .
- 7.3 Equations solvable for y .
- 7.4 Equation in Clairaut's form.

Text Book: Text book of Calculus and Differential Equations, Prepared by B.O.S. in Mathematics, University of Pune, Pune.(2013).

Reference Books:

1. Introduction to Real Analysis by Robert G. Bartle and Donald R. Sherbert, Third Edition, John Wiley and Sons, 2002
2. Integral Calculus, Shantinayakan, S.K.Mittal, S. Chand and Co. Publication 2006.
3. R.Courant and F.John, Introduction to Calculus and Analysis, Vol. 1, Reprint of the first Ed., Springer-Verlag, New York, 1999.
4. Principles of Mathematical Analysis, W. Rudin, Third Edition, McGrawHill, 1976
5. Elementary Differential Equations, Macmillan Publication, by Rainville and Bedient.
6. Ordinary and partial Differential equations, M.D. Raisingania, S. Chand and Company, 2009.

MT 103: Mathematics Practical

(Practicals based on the applications of articles in MT 101 and MT 102)

List of Practicals:

TERM I

1. Integers.
2. Partition and residue class in \mathbb{Z} .
3. Polynomials.
4. Solution of system of linear equations.
5. Eigen values and Eigen vectors.
6. Miscellaneous.
7. Real numbers.
8. Limit and Continuity
9. Differentiation.
10. Application of differentiation
11. Integration..
12. Drawing graphs of elementary functions

TERM II

13. Changes of axes and conic section.
14. Planes in three dimensions.
15. Lines in three dimensions.
16. Sphere.
17. Cone and Cylinder.
18. Miscellaneous.
19. Preliminaries of differentials equation.
20. Solution of differential equation of first order and first degree-I
21. Solution of differential equation of first order and first degree-II
22. Application of differential equation.
23. Differential equation of first order and higher degree.
24. Miscellaneous.

Modalities For Conducting The Practical and The Practical Examination

- 1) There will be one 3 hour practical session for each batch of 15 students per week
- 2) A question bank consisting of 100 problems in all for the whole year, distributed in four Sections: 50 questions for each term (25 questions on MT 101 and 25 on MT 102) will be the course work for this paper. Question Bank will be prepared by the individual subject teacher and the problems included should be changed every year, based on the list of practicals given above. 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) The College will conduct the Practical Examination at least 15 days before the commencement of the Main Theory Examination. The practical examination will consist of written examination of 72 marks and oral examination of 08 marks.
- 4) There will be no external examiner, the practical exam will be of the duration of 3 hours.
- 5) The subject teacher will set a question paper based on pattern as follows:
 - Q1.** (a) Any 1 out of 2 worth 8 marks on MT101 (first term).
(b) Any 1 out of 2 worth 8 marks on MT 102. (first term).
 - Q2*.** Any 5 out of 7 each of 4 marks on MT 101.
 - Q3*.** Any 5 out of 7 each of 4 marks on MT 102..
 - Q4.** (a) Any 1 out of 2 of 10 marks on MT 101(second term).
(b) Any 1 out of 2 worth 10 marks on MT 102 (second term).

(*In Q2 and Q3, there will be 3 questions from first term and 4 questions from the second term or vice-versa)

- 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) The subject teachers can include computer practicals based on use of free mathematical software's like Scilab, Maxima, mu-pad, etc. for solving problems in the miscellaneous practical mentioned above.

10) 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.
