University of Mumbai

PROPOSED SYLLABUS OF

F.Y.B.A/B.Sc. (Mathematics)

(Effective from June 2008)

Preamble

Mathematics has been fundamental to the development of science and technology. In recent decades, the extent of application of Mathematics to real world problems has increased by leaps and bounds. It is imperative that the content of an undergraduate syllabi of Mathematics should support other branches of science such as Physics, Statistics and Computer Science. The present syllabi of F.Y.B.Sc. Paper I and Paper II has been designed so that the students learn Mathematics needed for these branches, learn basic concepts of Mathematics and are exposed to rigorous methods gently and slowly. Paper I is 'Calculus and Analytic Geometry'. Calculus is applied and needed in every conceivable branch of science. Paper II, 'Discrete Mathematics' develops mathematical reasoning and algorithmic thinking and has applications in science and technology.

F.Y.B.Sc & F.Y.B.A

Teaching Pattern

		Title
F.Y.B.Sc.	Paper I	Calculus and Analytic Geometry
	Paper II	Discrete Mathematics
F.Y.B.A.	Paper I	Calculus and Analytic Geometry

Teaching Pattern

1. Three lectures per week per paper.
2. One tutorial per week per batch per paper. (The batches of tutorials to be formed as prescribed by the University).
3. One assignment per unit in each paper.

F.Y.B.A/B.Sc. Paper I
Calculus and Analytic Geometry

Prerequisites

(i) Limits of some standard functions as x approaches a ($a \in \mathbb{R}$), such as constant function, x, x^n, $\sin x$, $\cos x$, $\tan x$, $\dfrac{x^n - a^n}{x - a}$ $n \in \mathbb{Q}$ ($a > 0$), exponential and logarithmic functions, $\lim\limits_{x \to 0} \dfrac{\sin x}{x}$, continuity in terms of limits.

(ii) Derivatives, Derivatives of standard functions such as constant function, x^n, trignometric functions, e^x, a^x ($a > 0$), $\log x$.

Term I

Unit 1. Limit and continuity of functions of one variable (15 Lectures)

(a) (i) Absolute value of a real number and the properties such as $|-a| = |a|$, $|ab| = |a||b|$ and $|a + b| \leq |a| + |b|$.

(ii) Intervals in $\mathbb{R}$, neighbourhoods and deleted neighbourhoods of a real number, bounded subsets of $\mathbb{R}$.

(b) (i) Graphs of functions such as $|x|$, $\dfrac{1}{x}$, $ax^2 + bx + c$, $\lfloor x \rfloor$ (flooring function), $\lceil x \rceil$ (Ceiling function), x^3, $\sin x$, $\cos x$, $\tan x$, $\sin \dfrac{1}{x}$, $x \sin \dfrac{1}{x}$ over suitable intervals.

(ii) Graph of a bijective function and its inverse. Examples such as x^2 and $x^{1/2}$, x^3 and $x^{1/3}$, $ax + b$ ($a \neq 0$) and $\frac{1}{a}x - \frac{b}{a}$ over suitable domains.

(c) (i) Statement of rules for finding limits, sum rule, difference rule, product rule, constant multiple rule, quotient rule.

(ii) Sandwich theorem of limits (without proof).

(iii) Limit of composite functions (without proof).

(d) $\varepsilon - \delta$ definition of limit of a real valued function, simple illustrations like $ax + b$, $\sqrt{x + a}$ ($a \geq 0$), x^2, $\sin x$, $\cos x$. (In general, evaluation of limits to be done using rules in (c)).

$\varepsilon - \delta$ definition of one sided limit of a real valued function. Formal definition of infinite limits, examples such as $\lim\limits_{x \to 0^+} \dfrac{1}{x}$, $\lim\limits_{x \to 0^-} \dfrac{1}{x}$.

(e) (i) Continuity of a real valued function at a point in terms of limits, and two sided limits. Graphical representation of continuity of a real valued function.
   (ii) Continuity of a real valued function at end points of domain.
   (iii) Removable discontinuity at a point of a real valued function and extension of a function having removable discontinuity at a point to a function continuous at that point.
   (iv) Continuity of polynomials and rational functions.
   (v) Constructing a real valued function having finitely many prescribed points of discontinuity over an interval.

(f) Continuity of a real valued function over an interval. Statements of properties of continuous functions such as the following:

   (i) Intermediate value property.
   (ii) A continuous function on a closed and bounded interval is bounded and attains its bounds.

   Elementary consequences such as if $f : [a, b] \to \mathbb{R}$ is continuous then range of f is a closed and bounded interval.

   Applications.

(g) Definition of limit as x approaches $\pm\infty$, examples. Limits of rational functions as x approaches $\pm\infty$.

Reference for Unit 1: *Chapter Preliminaries*, *Section* 1 and *Chapter* 1, *Sections* 1.2, 1.3, 1.4, 1.5 *of* **Calculus and Analytic Geometry**, G.B. Thomas *and* R. L. Finney, *Ninth Edition*, *Addison-Wesley*, 1998.

Unit 2. Differentiability of functions of one variable (15 Lectures)

(a) 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, differentiability of a function over an interval, statement of rules of differentiability, chain rule of finding derivative of composite differentiable functions, derivative of an inverse function (without proof). Intermediate value property of derivative (without proof) and its applications, implicit differentiation.

(b) (i) Differentiable functions are continuous, but the converse is not true.
   (ii) Higher order derivatives, examples of functions $x^n|x|$, $n = 0, 1, 2, \ldots$ which are differentiable n times but not $(n + 1)$ times.
   (iii) Leibnitz Theorem for n^{th} order derivative of product of two n times differentiable functions.

Reference for Unit 2: *Chapter* 2, *Sections* 2.1, 2.2, 2.3, 2.5, 2.6 *of* **Calculus and Analytic Geometry**, G.B. Thomas *and* R. L. Finney, *Ninth Edition*, *Addison-Wesley*, 1998. and *Chapter* 4, *Section* 4.1 *of* **A Course in Calculus and Real Analysis**, Sudhir. R. Ghorpade *and* Balmohan V. Limaye, *Springer International Edition.*

Unit 3. Applications of derivatives (15 Lectures)

(a) (i) Mean Value Theorems: Rolle's Mean Value Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem.

(ii) Taylor's polynomial and Taylor's Theorem with Lagrange's form of remainder.

(b) Extreme values of functions, absolute and local extrema, critical points, increasing and decreasing functions, the second derivative test for extreme values.

(c) Graphing of functions using first and second derivatives, the second derivative test for concavity, points of inflection.

(d) Limits as x approaches $\pm\infty$. Asymptotes - horizontal and vertical.

Reference for Unit 3: *Chapter* 3, *Sections* 3.1, 3.2, 3.4, 3.5 and *Chapter* 8, *Section* 8.9 *of* **Calculus and Analytic Geometry**, G.B. THOMAS *and* R. L. FINNEY, *Ninth Edition*, *Addison-Wesley*, 1998. and *Chapter* 4, *Sections* 4.2, 4.3, 4.4 and *Chapter* 5, *Sections* 5.1, 5.2 *of* **A Course in Calculus and Real Analysis**, SUDHIR. R. GHORPADE *and* BALMOHAN V. LIMAYE, *Springer International Edition.*

Term II

Unit 4. Analytic Geometry in Euclidean spaces (15 Lectures)

(a) Review of vectors in $\mathbb{R}^2$, $\mathbb{R}^3$, component form of vectors, basic notions such as addition and scalar multiplication of vectors, dot product of vectors, orthogonal vectors, length (norm) of a vector, unit vector, distance between two vectors, cross product of vectors in $\mathbb{R}^3$, scalar triple product (box product), vector projections.

(b) Lines and planes in space, equation of sphere, cylinders and quadric surfaces.

(c) Polar co-ordinates in $\mathbb{R}^2$, polar graphing with examples like $r = \sin\theta$, $r = \cos 2\theta$, $r = a(1 - \cos\theta)$.

(d) Relationship between polar and cartesian co-ordinates in $\mathbb{R}^2$, cylindrical and spherical co-ordinates in $\mathbb{R}^3$ and relationships of these co-ordinates with cartesian co-ordinates and each other.

Reference for Unit 4: *Chapter* 9, *Sections* 9.4, 9.6, 9.7, *Chapter* 10 *of* **Calculus and Analytic Geometry**, G.B. THOMAS *and* R. L. FINNEY, *Ninth Edition*, *Addison-Wesley*, 1998.

Unit 5. Limits and continuity of functions of two and three variables (15 Lectures)

(a) (i) Open disc in $\mathbb{R}^2$ and $\mathbb{R}^3$, boundary of open disc, closed disc in $\mathbb{R}^2$ and $\mathbb{R}^3$, bounded regions, unbounded regions in $\mathbb{R}^2$ and $\mathbb{R}^3$.

(ii) Real valued functions of two or three variables, examples. Level curves for functions of two variables. Use of level curves to draw graphs of $z = f(x, y)$, especially quadric surfaces. $\varepsilon - \delta$ definition of a limit of a real valued function of two variables (only brief statement).

(b) Statement of rules of limits in two (or three) variables: Sum rule, difference rule, product rule, constant multiple rule, quotient rule, power rule.

Applying these rules to determine limits of polynomial and rational functions.

Definition of continuity of functions of two (or three) variables in terms of limits.

(c) Definition of a path. Limit of a function along paths. Two path test for non-existence of a limit. Examples of functions such as $\frac{2xy}{x^2+y^2}, \frac{2x^2y}{x^4+y^2}, \frac{-xy}{x^2+y^2}$ etc. Sandwich theorem for a function of two variables (without proof).

(d) Calculating $\lim_{(x,y)\to(0,0)} f(x, y)$ by changing to polar co-ordinates (illustrating with examples).

(e) Vector valued functions of one and several variables, planar and space curves, component functions, vector fields, graphs of vector valued functions like $(\cos t, \sin t)$, $(\cos t, \sin t, 1)$, $(\cos t, \sin t, t)$. Limits of vector valued function by taking limits of component functions.

Reference for Unit 5: *Chapter* 12, *Sections* 12.1, 12.2 *of* **Calculus and Analytic Geometry**, G.B. Thomas *and* R. L. Finney, *Ninth Edition*, *Addison-Wesley*, 1998.

Unit 6. Differentiability of functions of two variables (15 Lectures)

(a) (i) Partial derivatives of a real valued function of two variables, the relationship between continuity and the existence of partial derivatives at a point. Second order partial derivatives, Mixed derivative theorem for two variables (without proof). The increment theorem for two variables (without proof).

(ii) Differentiabiliy of a function of two variables at a point over a disc, linearization of a differentiable function at a point.

(iii) Chain rule for composite function of the type $\mathbb{R}^2 \xrightarrow{f} \mathbb{R} \xrightarrow{g} \mathbb{R}$ (without proof).

(iv) Implicit differentiation.

(b) Directional derivatives in a plane, interpretation of directional derivatives, gradient vector, relation between directional derivative and gradient.

(c) Geometric interpretation of partial derivatives and its relation to the tangent plane at a point.

(d) Extreme values of a function of two variables. Local maximum, local minimum and first derivative test for local extreme values (without proof). Critical points, saddle points, second derivative test for local extreme values (without proof).

(e) The method of Lagrange's Multiplier to obtain extrema of a function of two variables (one constraint only).

(f) Derivative of vector valued function as derivative of component functions. Statement of rules of differentiation - sum, difference, product, constant multiple. Chain rule for composite function of the type $\mathbb{R} \xrightarrow{f} \mathbb{R}^2 \xrightarrow{g} \mathbb{R}$ (without proof). Geometric interpretation of derivatives. Derivative of dot and cross products.

Reference for Unit 6: *Chapter* 12, *Sections* 12.3, 12.6, 12.7, 12.8, 12.9 *of* **Calculus and Analytic Geometry**, G.B. Thomas *and* R. L. Finney, *Ninth Edition*, *Addison-Wesley*, 1998.

Note:

1. The scheme of lectures recommended is suggestive.
2. It is recommended that the concepts may be illustrated using computer softwares, and graphing calculators wherever possible.
3. Applications and mathematical modelling of concepts to be done wherever possible.

Recommended Books

1. G.B. Thomas and R. L. Finney, *Calculus and Analytic Geometry*, Ninth Edition, Addison-Wesley, 1998.
2. Sudhir. R. Ghorpade and Balmohan V. Limaye, *A Course in Calculus and Real Analysis*, Springer International Edition.
3. Howard Anton, *Calculus - A new Horizon*, Sixth Edition, John Wiley and Sons Inc, 1999.
4. James Stewart, *Calculus*, Third Edition, Brooks/cole Publishing Company, 1994.

Additional Reference Books

1. Tom Apostol, *Calculus Volume 1, One variable calculus with an introduction to Linear Algebra*, Second Edition, Wiley Publications. (Evaluation copy available for instructors).

2. Deborah Hughes-Hallet, Andrew Gleason, Daniel Flath, Patti Frazer, Thomas Tucker, David Lomen, David Lovelock, David Mumford, Brad Osgood, Douglas Quinney, Karen Rhea, Jeff Tecosky-Fredman, *Calculus, Single and Multivariable*, Fourth Edition, Wiley Europe Higher Education, (Online version of texbook and online grade book available).

3. Satunio L. Salas, Garret J. Eigen, Einar Hille, *Calculus : One variable*, Wiley Europe Higher Education (online version and online grade book available).

Suggested topics for Tutorials/Assignments

(1) Graphs and functions.

(2) Limits of functions using $\varepsilon - \delta$ definition. (Simple functions recommended in the syllabus).

(3) Calculating limits using rules of limits and Sandwich theorem.

(4) Continuity over an interval (intermediate value property, maxima, minima over closed interval.

(5) Differentiability, chain rule, implicit differentiation.

(6) Higher order derivatives and Leibnitz theorem.

(7) Mean Value Theorems; Applications.

(8) Taylor's Theorem, Taylor's polynomials.

(9) Extremas; Local and absolute.

(10) Graphing of functions, Asymptotes.

(11) Vectors in $\mathbb{R}^2$ and $\mathbb{R}^3$, Cartesian, spherical and cylindrical co-ordinates in $\mathbb{R}^3$.

(12) Polar graphing.

(13) Level curves of functions of two variables.

(14) Limits and continuity at a point of functions of two variables, calculating limits, where they exist, and non-existence of limits using two path test.

(15) Partial derivatives of first order, second order.

(16) Differentiability of a function at a point, linearization.

(17) Derivatives of composite functions.

(18) Directional Derivatives, gradient, tangent planes.

(19) Exteme values using second derivative test and Langrage's multiplier method.

F.Y.B.Sc. Paper II
Discrete Mathematics

Prerequisites

(i) Set Theory: Set, subset, union and intersection of two sets, empty set, universal set, complement of a set, De Morgan's laws, cartesian product of two sets.

(ii) Relations, functions.

(iii) First Principle of finite induction.

(iv) Permutations and combinations, ${}^nC_r$, ${}^nP_r$.

(v) Complex numbers: Addition and multiplication of complex numbers, modulus, amplitude and conjugate of a complex number.

Term I

Unit 1. Integers and divisibility (15 Lectures)

(a) (i) Statements of well-ordering property of non-negative integers.

(ii) Principle of finite induction (first and second) as a consequence of well-ordering property.

Binomial Theorem for non-negative exponents, Pascal Triangle. Recursive definitions.

(b) Divisibility in integers, division algorithm, greatest common divisor (g.c.d.) and least common multiple (l.c.m.) of two integers, basic properties of g.c.d. such as existence and uniqueness of g.c.d. of integers a and b and that the g.c.d. can be expressed as $ma + nb$ for some $m, n \in \mathbb{Z}$, Euclidean algorithm.

(c) Primes, Euclid's lemma, Fundamental Theorem of Arithmetic.

Reference for Unit 1: *Chapter* 1, *Sections* 1.1, 1.2, *Chapter* 2, *Sections* 2.1, 2.2, 2.3, and *Chapter* 3, *Section* 3.1 *of* **Elementary Number Theory**, David M. Burton, *Second Edition, UBS, New Delhi.*

Unit 2. Functions and Counting Principles (15 Lectures)

(a) (i) Review of functions, domain, codomain and range of a function, composite functions.
  (ii) Direct image $f(A)$ and inverse image $f^{-1}(B)$ of a function f.
  (iii) Injective, surjective, bijective functions. Composite of injective, surjective, bijective functions are injective, surjective and bijective respectively.
  (iv) Invertible functions and finding their inverse. Bijective functions are invertible and conversly.
  (v) Examples of functions including constant, identity, projection, inclusion.

(b) Binary operation as a function, properties, examples.

(c) (i) There is no injection from $\mathbb{N}_n$ to $\mathbb{N}_m$ if $n > m$, $\mathbb{N}_n = \{1, 2, \ldots, n\}$.
  (ii) Pigeon Hole Principle and its applications.
  (iii) Finite and infinite sets, cardinality of a finite set.
  (iv) The number of subsets of a finite set having n elements is 2^n.

Reference for Unit 2: *Chapter* 2 *of* **Discrete Mathematics**, Norman L. Biggs, *Revised Edition*, *Clarendon Press*, *Oxford* 1989.

Unit 3. Integers and Congruences (15 Lectures)

(a) (i) The set of primes is infinite.
  (ii) The set of primes of the type $4n - 1$ (or $4n + 1$ or $6n - 1$) is infinite.

(b) Congruences: Definition and elementary properties.

(c) Euler-φ function, invertible elements modulo n

(d) (i) Euler's Theorem (without proof).
  (ii) Fermat's Little Theorem.
  (iii) Wilson's Theorem.
  (iv) Applications: Solution of linear congruences.

Reference for Unit 3: *Chapter* 4, *Chapter* 5, *Sections* 5.2, 5.3, 5.4 and *Chapter* 7, *Sections* 7.1, 7.2, 7.3 *of* **Elementary Number Theory**, David M. Burton, *Second Edition*, *UBS, New Delhi*.

Term II

Unit 4. Principles of Counting and Equivalence Relations (15 Lectures)

(a) (i) Addition and multiplication Principles.
    (ii) Counting sets of pairs.

(b) Cartesian product of n sets.

(c) Partition of a set, $S(n,k)$, the Sterling numbers of second kind defined in terms of partitions. Properties of $S(n,k)$.

(d) (i) Equivalence relation. Equivalence classes. Properties. Examples including the relation modulo n on $\mathbb{Z}$.
    (ii) An equivalence relation induces partition of a set and a partition of a set defines an equivalence relation.

(e) (i) Equivalent sets, countable, uncountable sets.
    (ii) Examples of countable sets including $\mathbb{Z}$, $\mathbb{Q}^+$ (the set of positive rational numbers), $\mathbb{Q}$, $\mathbb{N} \times \mathbb{N}$.
    (iii) Examples of uncountable sets including $(0,1)$, $\mathbb{R}$, (a,b).
    (iv) A set is not equivalent to its power set.

Reference for Unit 4: *Chapter* 3, *Sections* 3.1, 3.2, 3.3 and *Chapter* 5, *Sections* 5.1, 5.2 *of* **Discrete Mathematics**, Norman L. Biggs, *Revised Edition*, *Clarendon Press*, *Oxford* 1989.

Unit 5. Principles of Counting and permutations (15 Lectures)

(a) Distribution of objects, multinomial numbers, combinatorial interpretations, multinomial theorem.

(b) Inclusion and Exclusion (Sieve) Principle.

(c) (i) Number of funcions from a finite set X to a finite set Y.
    (ii) Number of injective functions from a finite set X to a finite set Y, where $|X| \leq |Y|$.
    (iii) Number of surjective functions from a finite set X to a finite set Y, where $|X| \geq |Y|$.

(d) Permutaions:

    (i) Permutations on n symbols. The set S_n and the number of permutations in S_n is $n!$.
    (ii) Composition of two permutations, as a binary operation in S_n, composition of permutations is non-commutative if $n \geq 3$.

(iii) Cycles and transpositions, representation of a permutation as product of disjoint cycles. Listing permutations in S_3, S_4, etc.

(iv) Sign of a permutation, sign of transposition is -1, multiplicative property of sign, odd and even permutations, number of even permutations in S_n is $\frac{n!}{2}$.

(v) Partition of a positive integer, its relation to decomposition of a permutation as product of disjoint cycles, conjugate of a permutation.

(e) (i) Derangements on n symbols, d_n, the number of derangements of $\{1, 2, \ldots, n\}$.

(ii) Arithmetic applications including Euler-φ function.

(f) Recurrence relations: formulation and solutions. Solving homogeneous linear recurrence relations.

Reference for Unit 5: *Chapter* 3, *Sections* 3.3, 3.5, 3.6 and *Chapter* 5, *Sections* 5.3, 5.5, 5.6 *of* **Discrete Mathematics**, Norman L. Biggs, *Revised Edition*, *Clarendon Press*, *Oxford* 1989 and *Chapter* 3, *Sections* 3.3, 3.5, 3.6 and *Chapter* 5, *Sections* 5.3, 5.5, 5.6 *of* **Discrete Mathematics and its applications**, Kenneth H. Rosen, *McGraw Hill International Edition*, *Mathematics Series*.

Unit 6. Polynomials (15 Lectures)

(a) (i) The set $F[X]$ of polynomials in one variable over F, where $F = \mathbb{Q}$, $\mathbb{R}$, or $\mathbb{C}$. Addition, Multiplication of two polynomials, degree of a polynomial, basic properties.

(ii) Division algorithm in $F[X]$ (without proof) and g.c.d. of two polynomials, and its basic properties (without proof), Euclidean algorithm (without proof), applications.

(iii) Roots of a polynomial, multiplicity of a root, Factor theorem. A polynomial of degree n over F has at most n roots. Necessary condition for $p/q \in \mathbb{Q}$ to be a root of polynomial in $\mathbb{Z}[X]$.

(iv) Statement of Fundamental Theorem of Algebra and its elementary consequences.

(v) Complex number z is a root of a polynomial $f(X)$ over $\mathbb{R}$ if and only if its conjugatge $\overline{z}$ is a root of $f(X)$.

(vi) Polynomials in $\mathbb{R}[X]$ can be expressed as a product of linear and quadratic polynomials in $\mathbb{R}[X]$.

(vii) Statement of De Moivre's Theorem, n^{th} roots of unity, Primitive n^{th} roots of unity, n^{th} roots of a complex number α.

Reference for Unit 6: *Chapter* 15, *Sections* 15.4, 15.5, 15.6 *of* **Discrete Mathematics**, Norman L. Biggs, *Revised Edition*, *Clarendon Press*, *Oxford* 1989.

Recommended Books

1. NORMAN L. BIGGS, *Discrete Mathematics*, Revised Edition, Clarendon Press, Oxford 1989.
2. DAVID M. BURTON, *Elementary Number Theory*, Second Edition, UBS, New Delhi.
3. KENNETH H. ROSEN, Discrete Mathematics and its applications, McGraw Hill International Edition, Mathematics Series.
4. G. BIRKOFF and S. MACLANE, A Survey of Modern Algebra, Third Edition, Mac Millan,New York, 1965.
5. I. NIVEN and S. ZUCKERMAN, Introduction to the theory of numbers, Third Edition, Wiley Eastern, New Delhi, 1972.

Additional Reference Books

1. K.D. JOSHI, *Foundations in Discrete Mathematics*, New Age Publishers, New Delhi, 1989.
2. GRAHAM, KNUTH and PATASHNIK, *Concrete Mathematics*, Pearson Education Asia Low Price Edition.

Suggested topics for Tutorials/Assignments

(1) Mathematical induction (The problems done in F.Y.J.C. may be avoided).

(2) Division Algorithm and Euclidean algorithm, in $\mathbb{Z}$.

(3) Primes and the Fundamental Theorem of Arithmetic.

(4) Functions (direct image and inverse image). Injective, surjective, bijective functions, finding inverses of bijective functions.

(5) Pigeon Hole Principle.

(6) Congruences and Euler φ-function.

(7) Fermat's Little Theorem, Euler's Theorem and Wilson's Theorem.

(8) Partitions and $S(n, k)$.

(9) Equivalence relation.

(10) Equivalent sets (finite, countable and uncountable).

(11) Multinomial Theorem, Inclusion-exclusion Principle.

(12) Permutations.

(13) Derangements and Recurrence relation.

(14) Polynomials - Factor Theorem, relation between roots and coefficients.

(15) Polynomials, factorization.

(16) Reciprocal polynomials.

Note. The above scheme of lectures for Paper I and II is **suggested** and **not prescriptive**.

Evaluation Scheme and Paper Pattern

Evaluation Scheme (For Paper I and Paper II)

Examination	**Maximum Marks**	**Maximum Marks after conversion**
First Term	60	40
Second Term	60	40
Tutorial		10
Assignment		10
Total		**100**

Theory and tutorials/assignments will be separate heads of passing. To pass in the tutorials/assignments, the student must secure at least 7 marks out of 20. In case a student fails in tutorials/assignments, he/she will have to submit the same before the commencement of the next examination.

In case a student fails in theory but passes in tutorials/assignments, the marks of these will be carried over in each paper. However, in that case, the student will not be eligible for award of class when he/she will pass in theory.

To pass in theory, the candidate must secure at least 20 percent marks in each paper and 35 percent on the aggregate.

Paper Pattern - Term End Examination

For Paper I and Paper II

Duration for Term End Examination - 2 Hrs.
Maximum marks - 60.
All questions are compulsory.

Questions	Term I	Term II	Maximum Marks	Maximum Marks with Options
Q1	Based on Unit 1, Unit 2 and Unit 3	Based on Unit 4, Unit 5 and Unit 6	15	not exceeding 23
Q2	Based on Unit 1	Based on Unit 4	15	not exceeding 23
Q3	Based on Unit 2	Based on Unit 5	15	not exceeding 23
Q4	Based on Unit 3	Based on Unit 6	15	not exceeding 23
	Total Marks		**60**	

Paper Pattern - A.T.K.T

For Paper I and Paper II

Duration for A.T.K.T Examination - 3 Hrs.
All questions are compulsory.

Questions	Section I	Maximum Marks	Maximum Marks with Options
Q1	Based on Unit 1	15	not exceeding 23
Q2	Based on Unit 2	15	not exceeding 23
Q3	Based on Unit 3	15	not exceeding 23
	Section II		
Q4	Based on Unit 4	15	not exceeding 23
Q5	Based on Unit 5	15	not exceeding 23
Q6	Based on Unit 6	15	not exceeding 23
	Total Marks	**90**	

In A.T.K.T. Examination, the marks secured by the student in each paper out of 90 to be converted out of 80, rounded off to the next integer.

Guidelines about conduct of Tutorials/Assignments.

1. **Tutorials**

   Conduct and Evaluation: The tutorials should be conducted in batches formed as per the University guidelines. During each tutorial class, there should be a discussion of the tutorial question between the teacher and the student. The same should be entered in the tutorial book. Each tutorial should be evaluated out of 10 marks on the basis of participation and performance of a student and the average of the total aggregate should be taken. The tutorial note book should be maintained throughout the year and should be certified by the concerned teacher and the head of the department/senior teacher in the department.

2. **Assignments**

   Conduct and Evaluation: The topic of the assignment and the questions should be given to the students at least one week in advance. The duration of assignment should be 45 - 50 minutes. The teachers may resolve the doubts of the students during the week, after which the students should submit the assignment. Each assignment should be evaluated out of 10 marks and the average of the total aggregate should be taken. The assignment note book should be maintained throughout the year and should be certified by the concerned teacher and the head of the department/senior teacher in the department.

The syllabus committee recommended that a one day workshop should be held to orient the teachers.

Proposal for One Day Workshop in the Revised Syllabus of F.Y.B.A/B.Sc.

1. No. of participants expected for the workshop : 60
2. Details of workshop expenditure:

Sr.No.	**Particulars**	**Amount in Rs.**
1.	Breakfast, lunch, tea/coffee @Rs.150/- per participant	9000.00
2.	Stationery, typing, Xeroxing @Rs.150/- per participant	9000.00
3.	Honorarium to resource persons @Rs.250/- per person	1000.00
4.	Portfolio bags to the participants @Rs.50/- per participant	3000.00
5.	Contingencies	3000.00
	Total	**25000.00**

3. Proposed venue for the workshop: **University of Mumbai**
   Vidyanagari, Kalina,
   Mumbai - 400 076.
4. Proposed Co-ordinator: **Professor (Smt.) Poornima Raina**
   Department of Mathematics,
   Vidyanagari, Kalina,
   Mumbai - 400 076.
5. Tentative dates of the workshop - 2^{nd} **week of June, 2008**.
6. It is proposed to collect Rs.250/- form each teacher participant and request the University to contribute Rs.10,000/- for the workshop.