B. K. BIRLA COLLEGE OF ARTS, SCIENCE AND COMMERCE

(AUTONOMOUS)

KALYAN (W)

Affiliated to University of Mumbai

DEPARTMENT OF MATHEMATICS

Programme: Bachelor of Science (B.Sc.)

SYLLABUS FOR:

Science Faculty	**:**	**F. Y. B. Sc., S. Y. B. Sc., T. Y. B. Sc.**
Commerce Faculty	**:**	**F. Y. B. Com., T. Y. B. Com.**
Community College	**:**	**Certificate course, Advance Certificate Course, Diploma in Accounting and Taxation**
Certificate Course	**:**	**1. Basic and advance Excel and LaTeX.** **2. SciLab**

Choice Based Credit System (CBCS) with effect from the academic year 2018-19

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Faculty of Science

Guidelines

Syllabus Structure:

1. In F.Y.B.Sc. (CBCS) in Semester I and II, there will be two papers each with 2 credits and one practical of 2 credits in each semester
2. In S.Y.B.Sc (CBCS) in Semester III and Semester IV, there will be three papers with 2 credits each in both the semesters and one practical of 3 credits in each semester.
3. In T.Y.B.Sc. (CBCS) in Sem V and VI, there will be three compulsory paper each with 2.5 credits in each semester, one elective paper and one applied component with 2.5 credits each in each semester and three practicals of 3 credits each in each semester.

Evaluation:

1. In F.Y.B.Sc. (CBCS) in Sem I and II the Core Course will be theory and practical. The College will conduct all the semester examinations of 100 marks per Core Course in the prescribed pattern of 40 marks of internal assessment and 60 marks for semester end examination. The student will have to secure a minimum of 40% marks in internal assessment as well as semester end examination. The college will conduct a practical examination of 50 marks for each paper.

2. In each semester, the student will have to submit Project/ Assignment/Journal for Core Courses in the College before appearing for the Semester End Examination. The last date of submission of the Project will be officially declared by the College.
3. The Project work will be carried out by the student with the guidance of the concerned faculty member who will be allotted to the student as the Guide for the Project.
4. In each semester, for Core Courses the student will have to secure a minimum of 40% marks in aggregate and a minimum of 40% in each component of assessment i.e. 16 out of 40 marks in Internal Evaluation and 24 out of 60 marks in semester end examination/ Practical Examination.
5. In S.Y.B.Sc. (CBCS) in Sem III and IV the Core Course will be theory and practical. The College will conduct all the semester examinations of 100 marks per Core Course in the prescribed pattern of 40 marks of internal assessment and 60 marks for semester end examination. The student will have to secure a minimum of 40% marks in internal assessment as well as semester end examination. The college will conduct a practical examination of 50 marks for each paper.
6. In each semester, the student will have to submit Project/ Assignment/Journal for Core Courses in the College before appearing for the Semester End Examination. The last date of submission of the Project will be officially declared by the College.
7. The Project work will be carried out by the student with the guidance of the concerned faculty member who will be allotted to the student as the Guide for the Project.
8. In each semester, for Core Courses, the student will have to secure a minimum of 40% marks in aggregate and a minimum of 40% in each component of assessment i.e. 16 out of 40 marks in Internal Evaluation and 24 out of 60 marks in semester end examination/ Practical Examination.

9. In T.Y.B.Sc. (CBCS) in Sem V and VI the Core Course and Elective Courses will be theory and practical. The College will conduct all the semester examinations of 100 marks per Core Course and Elective Courses in the prescribed pattern of 40 marks of internal assessment and 60 marks for semester end examination. The student will have to secure a minimum of 40% marks in internal assessment as well as semester end examination. The college will conduct a practical examination of 50 marks for each core course and elective course and 100 marks for applied component
10. In each semester, the student will have to submit Project/ Assignment/Journal for Core Courses and Elective Courses in the College before appearing for the Semester End Examination. The last date of submission of the Project will be officially declared by the College.
11. The Project work will be carried out by the student with the guidance of the concerned Faculty Member who will be allotted to the student as the Guide for the Project.
12. In each semester, for Core Courses and Elective Courses, the student will have to secure a minimum of 40% marks in aggregate and a minimum of 40% in each component of assessment i.e. 16 out of 40 marks in Internal Evaluation and 24 out of 60 marks in semester end examination/ Practical Examination.

Note: All other rules regarding Standard of Passing, ATKT, etc., will be as per those decided by the Faculty of Science passed by the Academic Council from time to time.

Faculty of Commerce

Guidelines

Syllabus Structure:

4. In F.Y.B.Com. (CBCS) in Sem I and II, there will be one compulsory paper Mathematical and Statistical Techniques each with 3 credits in each semester.
5. In T.Y.B.Com. (CBCS) in Sem V and Sem VI, there will be one Elective paper Computer System and Applications with 3 credits each in both the semesters.

Evaluation:

2. In F.Y.B.Com. (CBCS) in Sem I and II the Core Course Mathematical and Statistical Techniques will be theory. The College will conduct all the semester examinations of 100 marks per Core Course in the prescribed pattern of 40 marks of internal assessment and 60 marks for semester end examination. The student will have to secure a minimum of 40% marks in internal assessment as well as semester end examination.
3. In T.Y.B.Com. (CBCS) in Sem V and Sem VI course, Computer System and Applications will be Electives. The College will conduct the semester examination of 100 marks per course in the prescribed pattern of 40 marks of Internal assessment/Project Work and 60 marks for semester end examination/Practical examination. The student will have to secure a minimum of 40% marks in internal assessment as well as semester end examination per above Elective Course.
13. In each semester, the student will have to submit Project/ Assignment/Journal for Core Courses and Elective Courses in the College before appearing for the Semester End Examination. The last date of submission of the Project will be officially declared by the College.
14. The Project work will be carried out by the student with the guidance of the concerned Faculty Member who will be allotted to the student as the Guide for the Project.
15. In each semester, for Core Courses and Elective Courses, the student will have to secure a minimum of 40% marks in aggregate and a minimum of 40% in each

component of assessment i.e. 16 out of 40 marks in Internal Evaluation and 24 out of 60 marks in semester end examination/ Practical Examination.

Note: All other rules regarding Standard of Passing, ATKT, etc., will be as per those decided by the Faculty of Commerce passed by the Academic Council from time to time.

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CONTENT

Programme- Bachelor of Science (B.Sc.)

Sr. No.	Course	Code	Credits
1	**F.Y.B. Sc.–** Calculus-I	**BUSMT101**	**02**
2	**F.Y.B. Sc. –** Algebra-I	**BUSMT102**	**02**
3	**F.Y.B. Sc. –** Practicals based on BUSMT101 & BUSMT102	**BUSMTP01**	**02**
4	**F.Y.B. Sc.–** Calculus-II	**BUSMT201**	**02**
5	**F.Y.B. Sc. –** Linear Algebra-I	**BUSMT202**	**02**
6	**F.Y.B. Sc. –**Practicals based on BUSMT201 & BUSMT202	**BUSMTP02**	**02**
7	**S.Y. B. Sc. –**Calculus-III	**BUSMT301**	**02**
8	**S.Y. B. Sc. –** Linear Algebra-II	**BUSMT302**	**02**
9	**S.Y. B. Sc. –** Discrete Mathematics	**BUSMT303**	**02**
10	**S.Y. B. Sc. –** Practicals Based on BUSMT301, BUSMT302 and BUSMT303	**BUSMTP03**	**03**
11	**S.Y. B. Sc. –**Calculus-IV	**BUSMT401**	**02**
12	**S.Y. B. Sc. –** Linear Algebra-III	**BUSMT402**	**02**
13	**S.Y. B. Sc. –**Ordinary Differential Equation	**BUSMT403**	**02**
14	**S.Y. B. Sc. –** Practicals Based on BUSMT 401, BUSMT 402 and BUSMT 403	**BUSMTP04**	**03**
15	**T.Y.B.Sc –** Multivariable Calculus	**BUSMT501**	**2.5**
16	**T.Y.B.Sc –** Algebra-II	**BUSMT502**	**2.5**
17	**T.Y.B.Sc –** Topology of Metric Spaces	**BUSMT503**	**2.5**
18	**T.Y.B.Sc –** Numerical Analysis I	**BUSMT5A4**	**2.5**
19	**T.Y.B.Sc –**Number Theory and its Application I	**BUSMT5B4**	**2.5**

20	**T.Y.B.Sc –** Graph Theory	**BUSMT5C4**	**2.5**
21	**T.Y. B. Sc. –** Practicals Based on BUSMT501, BUSMT502.	**BUSMTP05**	**3**
22	**T.Y. B. Sc. –** Practicals Based on BUSMT503 and BUSMT5A4 OR BUSMT5B4 OR BUSMT5C4.	**BUSMTP06**	**3**
23	**T.Y.B.Sc –** Basic Complex Analysis	**BUSMT601**	**2.5**
24	**T.Y.B.Sc –** Algebra-III	**BUSMT602**	**2.5**
25	**T.Y.B.Sc –** Topology of Metric Spaces and Real Analysis	**BUSMT603**	**2.5**
26	**T.Y.B.Sc –** Numerical Analysis II	**BUSMT6A4**	**2.5**
27	**T.Y.B.Sc –**Number Theory and its Application II	**BUSMT6B4**	**2.5**
28	**T.Y.B.Sc –** Graph Theory and Combinatorics	**BUSMT6C4**	**2.5**
29	**T.Y. B. Sc. –** Practicals Based on BUSMT601, BUSMT602.	**BUSMTP07**	**3**
30	**T.Y. B. Sc. –** Practicals Based on BUSMT603 and BUSMT6A4 OR BUSMT6B4 OR BUSMT6C4.	**BUSMTP08**	**3**

Programme – Bachelor of Commerce (B.Com.)

Compulsory Course			
Sr. No.	**Course**	**Code**	**Credits**
1	**F.Y.B.Com. –** Mathematical and Statistical Techniques -I	**BUBCOMFSI.6**	**03**
2	**F.Y.B.Com. –** Mathematical and Statistical Techniques-II	**BUBCOMFSII.6**	**03**
Elective Course			
Sr. No.	**Course**	**Code**	**Credits**
3	**T.Y.B.Com. –** Computer System and Applications -I	**BUCCAS506**	**03**
4	**T.Y.B.Com. –** Computer System and Applications -II	**BUCCAS606**	**03**

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Evaluation Pattern for F.Y.B.Sc., S.Y.B.Sc. and T.Y.B.Sc.

1.	**INTERNAL ASSESSMENT**	**40 marks**
1.1 1.2 1.3	One class test (Objectives/ Multiple Choice) Assignment/ Project/ Presentation Active participation, Overall performance	15 marks 20 marks 05 marks
2.	**EXTERNAL ASSESSMENT (Semester End Examination)**	**60 marks**
	N.B. 1. All questions are compulsory 2. All questions carry equal marks.	
	Q.1 Unit-I (with internal option) A. Attempt any two from B, C, D. B. C. D.	15 marks
	Q.2 Unit-II (with internal option) A. Attempt any two from B, C, D. B. C. D.	15 marks
	Q.3 Unit-III (with internal option) A. Attempt any two from B, C, D. B. C. D.	15 marks

	Q.4 Attempt any three A. B. C. D. E. F.	15 marks

1.	**PRACTICAL ASSESSMENT**	**50 marks**
1.1 1.2	Journal Viva	05 marks 05 marks
	N.B. 1. All questions are compulsory 2. All questions carry equal marks.	
	Q.1 Attempt any eight MCQ out of 12. (Three Marks each) Based on Unit-1, Unit-2, Unit-3.	24 marks
	Q2. Attempt any two from A, B, C . (Eight Marks Each) Based on Unit-1, Unit-2, Unit-3.	16 marks

Evaluation Pattern for F.Y.B.Com.

1.	**INTERNAL ASSESSMENT**	**40 marks**
1.1 1.2 1.3	One class test (Objectives/ Multiple Choice) Assignment/ Project/ Presentation Active participation, Overall performance	15 marks 20 marks 5 marks
2.	**EXTERNAL ASSESSMENT (Semester End Examination)**	**60 marks**
	N.B. 1. All questions are compulsory 2. All questions carry equal marks.	
	Q.1 Unit-I **Attempt any TWO out of four sub questions. (6 marks each)**	12 marks
	Q.2 Unit-II **Attempt any TWO out of four sub questions. (6 marks each)**	12 marks

	Q.3 Unit-III and Unit-IV(with internal option) **Attempt any TWO out of four sub questions. (9 marks each)**	18 marks
	Q.4 Unit-IV and Unit-V (with internal option) **Attempt any TWO out of four sub questions. (9 marks each)**	18 marks

Evaluation Pattern for T.Y.B.Com.

1.	**INTERNAL ASSESSMENT**	**40 marks**
1.1 1.2 1.3	One class test (Objectives/ Multiple Choice) Assignment/ Project/ Presentation Active participation, Overall performance	15 marks 20 marks 5 marks
2.	**EXTERNAL ASSESSMENT (Semester End Examination)**	**60 marks**
	N.B. 1. All questions are compulsory 2. All questions carry equal marks.	
	Q.1 Module-I (with internal option) A. B.	15 marks
	Q.2 Module-II(with internal option) A. B.	15 marks
	Q.3 Module-III(with internal option) A. B.	15 marks
	Q.4 Module-VI(with internal option) A. B.	15 marks

B. K. Birla College of Arts, Science and Commerce, Kalyan (W.)

Syllabus w.e.f. Academic Year, 2018-19 (CBCS)

F.Y.B.Sc. Semester- I

Calculus I

COURSE CODE: **BUSMT101 (2018-19)** Credits- **02**

Objectives: To learn about

- Real Numbers and the Axiom of Completeness
- Sequences and Limits of Sequences
- Limits of Functions and Continuity

Sr. No.	Units	Lectures (45)
1	**Real Number System**	**15**
1.1	Real number system $\mathbb{R}$ and order properties of $\mathbb{R}$, Absolute value and its properties.	
1.2	Bounded sets, statement of l.u.b. axioms, g.l.b axioms and its consequences, Supremum and Infimum, Maximum and Minimum, Archimedean property and it's applications, density of rationals.	
1.3	AM-GM inequality, Cauchy-Schwarz inequality, Intervals and neighbourhoods, Hausdorff property.	
2	**Sequences**	**15**
2.1	Definition of a sequence and examples, Convergent and Divergent sequences, Bounded Sequences, Every convergent sequence is bounded, Limit of a convergent sequence and its uniqueness. Algebra of convergent sequences, Sandwich theorem.	
2.2	Convergence of some standard sequences namely $\left(n^{\frac{1}{n}}\right), \left(\frac{1}{1+na}\right)\ \forall\ a > 0,\ (b^n)\ , \lvert b\rvert < 1,\ \left(c^{\frac{1}{n}}\right)\ \ \forall\ \ c > 0.$	
2.3	Monotone sequences, Monotone convergence theorem and consequences such as convergence of $\left(\left(1+\frac{1}{\text{n}}\right)^{\text{n}}\right)$.	

2.4 2.5	Subsequences: Definition, Subsequence of a convergent sequence is convergent and it converges to the same limit. Every sequence in $\mathbb{R}$ has a monotonic subsequence. Bolzano-Weierstrass Theorem Definition of Cauchy sequence, Every convergent sequence is a Cauchy sequence and its converse.	
3 3.1 3.2 3.3 3.4	**Limits and Continuity** Brief review : Domain and range of a function, injective function, surjective function, bijective function, composite of two functions (when defined). Inverse of a bijective function. Graphs of some standard functions such as $e^x, \lvert x\rvert, \log x, \frac{1}{x}, ax^2+bx+c, x^n\ (n \le 3)$, $\sin x$, $\cos x$, $\tan x$, $\sin\left(\frac{1}{x}\right), x\ \sin\left(\frac{1}{x}\right), x^2\ \sin\left(\frac{1}{x}\right)$ over suitable intervals of $\mathbb{R}$. $\varepsilon - \delta$ definition of limit of a real valued function of real variable, Evaluation of limit of simple functions using the definition, uniqueness of limit if it exists. Algebra of limits (with proof), Limit of composite functions, Sandwich theorem, Left hand limits and Right hand limits, non-existence of limits, $lim_{x\to-\infty} f(x)$, $lim_{x\to\infty} f(x)$ and $lim_{x\to a} f(x) = \pm\infty$ Continuity of a real valued function on a set in terms of limits, examples, $\varepsilon - \delta$ definition of continuity, Continuity of a real valued function at end points of domain, Sequential continuity, Algebra of continuous functions, discontinuous functions, examples of removable and essential discontinuity.	**15**

References:

1. R. G. Bartle – D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.
2. Sudhir R. Ghorpade – Balmohan V. Limaye, A Course in Calculus and Real Analysis, Springer International Ltd., 2000.

3. S. C. Malik and SavitaArora, Mathematical Analysis, Wiley Eastern Ltd., : Chapter 1, 3, and 5.
4. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
5. James Stewart, Calculus, Third Edition, Brooks/Cole Publishing Company, 1994.

Practicals:

1. Application based examples of Archimedian property, Intervals, Neighbourhood.
2. Finding upper bound, lower bound, supremum and infimum of finite and infinite sets.
3. Calculating limits of sequences.
4. Problems on Cauchy sequences and monotone sequences.
5. Finding limits of real valued functions, applications of Sandwich theorem.
6. Examples of continuous and discontinuous functions.
7. Miscellaneous theory questions based on full paper.

Algebra I

COURSE CODE: **BUSMT102(2018-19)** Credits- **02**

Objectives: To learn about

- Integers and divisibility of integers
- Functions and Equivalence relations
- Polynomials.

Sr. No.	Units	Lectures (45)
1 1.1	**Prerequisite:** **Set Theory:** Set, subsets, union and intersection of two sets, empty set, Universal set, complement of set, De Morgan laws, Cartesian Product of two sets, Permutation and Combinations **.** **Complex Numbers:** Addition and multiplication of complex numbers, modulus and amplitude, conjugate of complex number, De Moivere's Theorem **Integers and divisibility** Statements of well-ordering property of non-negative integers, Principle of finite induction (first and second) as a consequence of well-ordering property, Binomial theorem for non-negative exponents, Pascal Triangle.	**15**

1.2	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 $ma+nb,\ m,n\ \in \mathbb{Z}$, Euclidean algorithm, Primes, Euclid's lemma, Fundamental theorem of arithmetic, The set of primes is infinite. 1.3 Congruence relation: definition and elementary properties, Euler's ϕ function, Statements of Euler's theorem, Fermat's theorem and Wilson theorem, Applications.	
2 2.1	**Functions and Equivalence relations** Definition of a relation, definition of a function, domain, co-domain and range of a function, composite functions, examples, image $f(A)$and inverse image $f^{-1}(B)$ of a function f , Injective, surjective, bijective functions, Composite of injective, surjective, bijective functions when defined. 2.2 Invertible functions, Bijective functions are invertible and conversely, Examples of functions including constant, identity, projection, inclusion, Binary operation as a function, properties, examples. 2.3 Equivalence relations, Equivalence classes, properties such as two equivalences classes are either identical or disjoint, Definition of partition of a set, every partition gives an equivalence relation and vice versa. 2.4 Congruence modulo n is an equivalence relation on $\mathbb{Z}$, Residue classes, Partition of $\mathbb{Z}$, Addition modulo n , Multiplication modulo n, examples such as $[x]=\{gxg^{-1}: g\in G\}$.	**15**
3 3.1	**Polynomials** Definition of polynomial, polynomials over the field F, where $F=\ \mathbb{Q},\mathbb{R},\mathbb{C}$, Algebra of polynomials, degree of polynomial, basic properties. 3.2 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, Roots of a polynomial,	**15**

	relation between roots and coefficients, multiplicity of a root, Remainder theorem, Factor theorem.	
3.3	Complex roots of a polynomial in $\mathbb{R}[X]$ occur in conjugate pairs, Statement of Fundamental Theorem of Algebra, A polynomial of degree n in $\mathbb{C}[X]$ has exactly n complex roots counted with multiplicity, A non constant polynomial in $\mathbb{R}[X]$ can be expressed as a product of linear and quadratic factors in $\mathbb{R}[X]$, Necessary condition for a rational number $\frac{p}{q}$ to be a root of a polynomial with integer coefficients, simple consequences such as $\sqrt{p}$ is an irrational number where p is a prime number, roots of unity, sum of all the n^{th} roots of unity.	

References:

1. David M. Burton**,** Elementary Number Theory, Seventh Edition, McGraw Hill Education (India) Private Ltd.
2. Andre Weil, Very Basic Number Theory.
3. Norman L. Biggs, Discrete Mathematics Second Edition, Oxford University Press, USA.
4. Niven and S. Zuckerman, Introduction to the theory of numbers, Third Edition, Wiley Eastern, New Delhi.
5. G. Birkhoff and S. Maclane, A Survey of Modern Algebra, Third Edition, MacMillan.
6. Kenneth Rosen, Discrete Mathematics and its applications, Mc-Graw Hill International Edition, Mathematics Series.
7. Lindsay N. Childs, Concrete Introduction to Higher Algebra, Springer.
8. J. Stillwell, Element of Algebra, Springer.

Practicals

1. Mathematical induction Division Algorithm and Euclidean algorithm in$\mathbb{Z}$, Primes and the Fundamental theorem of Arithmetic.
2. Convergence and Euler's-function, Fermat's little theorem, Euler's theorem and Wilson's theorem.
3. Functions (direct image and inverse image), Injective, surjective, bijective functions,
4. Finding inverses of bijective functions. Equivalence relation.

5. Factor Theorem, relation between roots and coefficients of polynomials,
6. Factorization and reciprocal of polynomials.
7. Miscellaneous theory questions based on full paper.

F.Y.B.Sc. Semester- II

Calculus II

COURSE CODE: **BUSMT201 (2018-19)** Credits**-** **02**

Objectives: To learn about

- Continuity of real valued functions
- Differentiability of real valued functions and its Application
- Series of real numbers

Sr. No.	Units	Lectures (45)
1	**Continuity of a function on an interval**	15
1.1	Review of the definition of continuity (at a point and on the domain). Properties of Continuous functions: (1) Intermediate value theorem (with proof) and its applications. (2) A continuous function on a closed and bounded interval is bounded and attains its bounds. (3) If a continuous function on an interval is injective then it is strictly monotonic and inverse function is continuous and strictly monotonic.	
1.2	Definition of Uniform Continuity, Every Continuous function defined on closed and bounded intervals is uniformly continuous.	
2	**Differentiability and Application**	15
2.1	Differentiation of a real valued function of one variable: Definition of differentiation at a point of an open interval, examples of differentiable and non-differentiable functions, differentiable functions are continuous but converse is not true.	
2.2	Algebra of differentiable functions, chain rule, Higher order derivatives, Leibnitz rule, Derivative of inverse functions, Implicit differentiation (only examples).	

	2.3	Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorems, applications and examples.	
	2.4	Taylor's theorem with Lagrange's form of remainder (with proof), Taylor's polynomial and its applications.	
	2.5	Monotone increasing and decreasing functions with examples,	
	2.6	Definition of local maximum and local minimum, necessary condition for existence of local maximum and local minimum, stationary points, second derivative test to find maxima and minima, concave and convex functions, points of inflection.	
	2.7	L-hospital rule (without proof), examples of indeterminate forms.	
3	3.1	**Series** Series $\sum_{n=1}^{\infty} a_n$ of real numbers, simple examples of series, Sequence of partial sums of a series, convergent and divergent series, Necessary condition of convergence: $\sum_{n=1}^{\infty} a_n$ converges implies $a_n \to 0$ but converse not true.	**15**
	3.2	Algebra of convergent series, Cauchy criterion, divergence of Harmonic series, $\sum_{n=1}^{\infty} \frac{1}{n^p}$ converges for $p > 1$, comparison test, limit comparison test, alternating series, Leibnitz theorem (alternating series test) and convergence of $\sum_{n=1}^{\infty} \frac{(-1)^n}{n^p}$	
	3.3	Absolute convergence, conditional convergence, absolute convergence implies convergence but not conversely, ratio test (without proof), root test (without proof) and examples.	

References:

1. R. G. Bartle – D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.
2. Sudhir R. Ghorpade – Balmohan V. Limaye, A Course in Calculus and Real Analysis, Springer International Ltd., 2000.
3. S. C. Malik and SavitaArora, Mathematical Analysis, Wiley Eastern Ltd.: Chapter 4, 5, 6 and 7.

4. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
5. T. M. Apostol, Calculus , Volume 1, Wiley and Sons(Asia) Pte.Ltd.
6. James Stewart, Calculus, Third Edition, Brooks/Cole Publishing Company, 1994.

Practicals:

1. Calculating limit of a series, Applications of Convergence Test
2. Examples of Differentiable function, Higher order derivatives
3. Applications of Leibnitz theorem, Mean Value Theorem.
4. Finding maxima and minima of a real valued function.
5. Applications of Taylor's Theorem
6. Problems on L-Hospital Rules.
7. Miscellaneous theory questions based on full paper.

Linear Algebra

COURSE CODE: **BUSMT202 (2018-19)** Credits- **02**

Objectives: To learn about

- System of Linear equations and Matrices
- Vector spaces
- Basis and Linear Transformation

Sr. No.	Units	Lectures (45)
1	**System of Linear equations and Matrices**	**15**
1.1	Parametric equation of lines and planes, System of homogeneous and non-homogeneous linear equations, the solution of system of m homogeneous linear equations in n unknowns by elimination and their geometrical interpretation for $(m,n) = (1,2),(1,3),(2,2),(2,3),(3,3)$; Definition of n −tuples of real numbers, sum of n -tuples and scalar multiple of n-tuple.	
1.2	Matrices with real entries, addition, scalar multiplication and multiplication of matrices, Transpose of a matrix, Type of matrices: zero matrix, identity matrix, scalar, diagonal, upper triangular, lower triangular, symmetric, skew-symmetric matrices, Invertible matrices, identities such as $(AB)^t = B^t\,A^t$, $(AB)^{-1} = B^{-1}A^{-1}$.	
1.3	System of linear equations in matrix form, elementary row	

	operations, row echelon form, Gaussian elimination method, to deduce that system of m homogeneous linear equations in n unknowns has a non-trivial solution if $m < n$.	
2 2.1 2.2 2.3 2.4	**Vector spaces** Definition of real vector space, examples such as $\mathbb{R}^n$, $\mathbb{R}[X]$, space of $m \times n$ matrices over $\mathbb{R}$, space of real valued functions on a non empty set X . Subspace: Definition, examples of subspaces of $\mathbb{R}^2$ and $\mathbb{R}^3$ such as lines, plane passing through origin, set of upper triangular, lower triangular, diagonal, symmetric and skew-symmetric matrices as subspaces of $M_n(\mathbb{R})(n = 2, 3)$, the space of all solutions of m homogeneous linear equations in n unknowns as a subspace of $\mathbb{R}^n$, space of continuous real valued functions on a nonempty set is a subspace. Properties of subspace such as necessary and sufficient condition for a non-empty subset to be a subspace of a vector space, arbitrary intersection of subspaces of a vector space are a subspace; union of two subspaces is a subspace if and only if one is a subset of the other. Linear combinations of vectors in a vector space, Linear span $L(S)$ of a non empty subset S of a vector space, S is the generating set of $L(S)$, linear span of a non empty subset of a vector space is a subspace of the vector space, Linearly independent & Linearly dependent sets in a vector space, examples	**15**
3 3.1 3.2	**Basis and Linear Transformation** Basis of a finite dimensional vector space, dimension of a vector space, maximal linearly independent subset of a vector space is a basis of a vector space, minimal generating set of a vector space is a basis of a vector space, any set of $n + 1$ vectors in a vector space with n elements in its basis is linearly dependent, any two basis of a vector space have the same number of elements, any set of n linearly independent vectors in an n dimensional vector space is a basis of a vector space. If W_1, W_2 are subspaces of vector space V then $W_1 + W_2$ is also a subspace of vector space V, $\dim(W_1 + W_2) = \dim(W_1) + \dim W_2 - \dim(W_1 \cap W_2)$. Extending the basis of a subspace to a basis of a vector space.	**15**

3.3	Linear transformation, kernel, image of Linear Transformation, Rank T, Nullity T, Matrix associated with a linear transformation, properties such as; kernel of a linear transformation is a subspace of the domain space and Img T is a subspace of codomain space of T. If $V = \{v_1, v_2, \dots, v_n\}$ is a basis of V and $W = \{w_1, w_2, \dots, w_n\}$ is any vectors in W then there exist unique linear transformation $T: V \to W$ such that $T(v_j) = w_j$,$\forall 1 \leq j \leq n$, Rank Nullity theorem (Statement only) and examples.	

Reference Books:

1. Serge Lang, Introduction to Linear Algebra, Second edition Springer.
2. S. Kumaresan, Linear Algebra, Prentice Hall of India Pvt limited.
3. K. Hoffmann and R. Kunze Linear Algebra, Tata McGraw Hill, New Delhi, 1971
4. Gilbert Strang, Linear Algebra and it's Applications, International Student Edition.
5. L. Smith , Linear Algebra, Springer Verlang
6. A. Ramchandran Rao, P. Bhimashankaran; Linear Algebra Tata McGraw Hill.

Practicals

1. Solving homogeneous system of m equations in n unknowns by elimination for $(m, n) = (1,2), (1,3), (2,2), (2,3), (3,3)$, row echelon form.
2. Solving system $AX = B$ by Gauss elimination, Solutions of system of linear Equations.
3. Examples of Vector spaces , Subspaces
4. Linear span of an non-empty subset of a vector space, Basis and Dimension of Vector Space
5. Examples of Linear Transformation, Computing Kernel, Image of a linear map
6. Verifying Rank Nullity Theorem.
7. Miscellaneous theory questions based on full paper.

B.K. Birla College of Arts, Science and Commerce, Kalyan (W)

Syllabus w.e.f. Academic Year, 2019-20 (CBCS)

S.Y.B.Sc. Semester- III

Calculus III

COURSE CODE: **BUSMT301 (2019-20)** Credits- **02**

Objectives: To learn about

- Riemann Integration
- Indefinite and Improper integrals
- Applications of definite integrals

Sr. No.	**Units**	**Lectures (45)**
1 1.1 1.2	**Riemann Integration** • Approximation of area, Upper/Lower Riemann sums and properties, Upper/Lower integrals. • Definition of Riemann Integral on a closed and bounded interval, Criterion of Riemann integrability. Properties of Riemann Integration: • $f, g \in R[a,b]$ then $f+g \in R[a,b]$ and $\int_a^b f+g = \int_a^b f + \int_a^b g$ • If $f \in R[a,b]$ then $\lambda f \in R[a,b]$ and $\int_a^b \lambda f = \lambda \int_a^b f$ • If $a < c < b$, then $f \in R[a,b]$ if and only if $f \in R[a,c]$ and $f \in R[c,b]$ further $\int_a^b f = \int_a^c f + \int_c^b f$ • $f \in R[a,b]$ then $\|f\| \in R[a,b]$ and $\left\|\int_a^b f\right\| \le \int_a^b \|f\|$ • If $f \in C[a,b]$ then $f \in R[a,b]$ • If f is bounded with finite number of discontinuities then $f \in R[a,b]$. • Every monotone bounded function is Riemann integrable	**15**

2 2.1 2.2 2.3	**Indefinite and Improper integrals** • Indefinite integral $F(x) = \int_a^x f(t)dt$ where $f \in R[a,b]$. Continuity of $F(x) = \int_a^x f(t)dt$, Fundamental theorem of Integral Calculus. • Mean value theorem for integrals. Integration by parts, Leibnitz rule, Change of variable formula. • Definitions of two types of improper integrals, necessary and sufficient conditions for convergence. • Absolute convergence, comparison and limit comparison test for convergence. Abel's and Dirichlet's tests. • Gamma and Beta functions and their properties.	**15**
3 3.1 3.2	**Applications of Integration** • Average Value function • Area between the two curves. • Arc length of a curve. • Surface area of surfaces of revolution. • Volume of solids of revolution, Washer method and shell method. • Definition of the natural logarithm $\ln(x)$ as $\int_1^x \frac{1}{t} dt$, $x > 0$, basic properties. • Definition of the exponential function $\exp(x)$ as the inverse of $\ln(x)$, basic properties. • Power functions with fixed exponent or with fixed base, basic properties.	**15**

References:

1. S. R. Ghorpade, B. V. Limaye, A Course in Calculus and Real Analysis, Springer International Ltd., 2000.
2. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
3. A. Kumar, S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.
4. Calculus Thomas Finney, ninth edition section 5.1, 5.2, 5.3, 5.4, 5.5, 5.6.
5. T. M. Apostol, Calculus Volume I, Wiley and Sons (Asia) Pvt. Ltd.
6. K. Stewart, Calculus, Booke/Cole Publishing Co, 1994.
7. J. E. Marsden, A.J. Tromba and A. Weinstein, Basic multivariable calculus.
8. Bartle and Sherbet, Real analysis.

Practicals

1. Calculation of upper sum, lower sum and Riemann integral.
2. Problems on properties of Riemann integral.
3. Problems on fundamental theorem of calculus, mean value theorems, integration by parts,Leibnitz rule.
4. Convergence of improper integrals, applications of comparison tests, Abel's and Dirichlet'stests, and functions, Beta Gamma Functions
5. Sketching of regions in $\mathbb{R}^2$ and $\mathbb{R}^3$, graph function, level sets, conversion from one coordinate system to another.
6. Application to compute average value, area, volumes of solids of revolution, surface area of surfaces of revolution, moment, centre of mass.
7. Miscellaneous Theoretical Questions based on full paper.

Linear Algebra II

COURSE CODE: **BUSMT302 (2019-20)** Credits- **02**

Objectives: To learn

- dimensions of vector spaces.
- concept of determinants.
- inner product spaces.
- properties of inner products.

Sr. No.	**Units**	**Lectures (45)**
1 1.1	**Linear Transformations and Matrices** Review of: Linear Transformation, kernel and image of a linear transformation. Rank-Nullity theorem (with proof), linear isomorphism, inverse of a linear isomorphism, isomorphic spaces, any $n-$dimensional real vector space is isomorphic to $\mathbb{R}^n$, The following are equivalent for a linear map $T: V \to V$ of a finite dimensional real vector space: 1. T is an isomorphism. 2. $\ker(T) = \{0\}$ 3. $\mathrm{Im}(T) = V$.	**15**

1.2	Matrix Units: Row operations, Elementary Matrices and their properties, Row space, Column space of an $m \times n$ matrix, row rank and column rank of a matrix, equivalence of a row and column rank of a matrix, invariance of rank upon elementary row or column operations.	
1.3	Matrix representation of a linear transformation, algebra of linear transformation with matrix representation (Addition, Scalar Multiplication and Composition), equivalence of rank of an $m \times n$ matrix A and rank of the corresponding linear transformation.	
1.4	The dimension of solution space of the system of the linear equations $Ax = 0$, the solution of non-homogeneous system of linear equations represented by $Ax = b$, existence of a solution when $\text{rank}(A) = \text{rank}(A\|b)$. The general solution of the system is the sum of a particular solution of the system and the solution of the associated homogeneous system.	
2	**Determinants and System of Linear Equations**	**15**
2.1	Definition of determinant as an $n-$ linear skew symmetric function from $\mathbb{R}^n \times \mathbb{R}^n \times \ldots \times \mathbb{R}^n \to \mathbb{R}$ such that determinant of $(E^1, E^2, \ldots E^n)$ is 1, where E^j denote the j^{th} column of the $n \times n$, identity matrix I_n.	
2.2	Existence and uniqueness of determinant function via permutations, computation of determinant of 2×2, 3×3 matrices, triangular matrices, basic results on determinants such as $\det A^T = \det A$, $\det(AB) = \det(A).\det(B)$, Laplace expansion of determinant, Vandermonde determinant.	
2.3	Linear dependence and independence of vectors in $\mathbb{R}^n$ using determinants, the existence and uniqueness of the solution of system $Ax = b$, where A is an $n \times n$ matrix with $\det A \neq 0$, cofactors and minors, adjoint of $n \times n$ matrix, basic results such as $A(\text{adj}(A)) = (\det A)(I_n)$, an $n \times n$ real matrix is invertible if and only if $\det A \neq 0$ and $A^{-1} = \frac{1}{\det A} \text{adj} A$ for an invertible matrix A, Cramer's rule.	
3	**Inner Product Spaces**	**15**
3.1	Dot product in $\mathbb{R}^n$, Definition of an inner product on a vector space over $\mathbb{R}$, examples of inner product.	
3.2	Norm of a vector in an inner product space, Cauchy Schwartz	

	Inequality, triangle inequality, orthogonality of vectors, Pythagoras theorem and geometric applications in $\mathbb{R}^2$, Projections on a line, the projection being the closest approximation, Orthogonal complement of a subspace, Orthogonal complements in $\mathbb{R}^2$ and $\mathbb{R}^3$, orthogonal sets and orthonormal set in an inner product space, orthogonal and orthonormal bases, Gram-Schmidt orthogonalization process with examples in $\mathbb{R}^2, \mathbb{R}^3$ and $\mathbb{R}^4$.	

References:

1. K. Hoffman and R. Kunze: Linear Algebra, Tata McGraw- Hill, New Delhi
2. S. Kumaresan: Linear Algebra A Geometric Approach, Prentice Hall of India Pvt. Ltd
3. Gilbert Strang: Linear Algebra and Its Applications, International student addition.
4. Serge Lang: Introduction to Linear Algebra, Springer Verlag.
5. M. Artin: Algebra, Prentice Hall of India Private Limited.
6. S. Axler , Linear Algebra done right, Springer Verlag, New York, 2015.

Practicals:

1. Problems on finding kernal, image, rank and nullity of a linear transformation, problems on linear isomorphism.
2. Problems on elementary matrices and finding column rank, row rank and hence rank of a matrix.
3. Calculating determinants using Laplace expansion.
4. Problems on finding inverse of a matrix using adjoint and solving system of equations.
5. Problems on inner product spaces, norms, Pythagoras theorem, orthogonal and orthonormal sets, projections, orthogonal complements.
6. Gram-Schmidt orthogonalization.
7. Miscellaneous Theoretical Questions based on full paper.

Discrete Mathematics

COURSE CODE: **BUSMT303 (2019-20)** Credits- **02**

Objectives: To learn about

- Permutations and Recurrence relation
- Preliminary Counting
- Advanced Counting

Sr. No.	Units	Lectures (45)
1 1.1 1.2	**Permutations and Recurrence relation** Permutation of objects, S_n, composition of permutations, results such as every permutation is a product of disjoint cycles, every cycle is a product of transpositions, even and odd permutation, rank and signature of a permutation, cardinality of S_n, A_n . Recurrence Relations, definition of homogeneous, non-homogeneous, linear, non-linear recurrence relation, obtaining recurrence relation in counting problems, solving homogeneous as well as non-homogeneous recurrence relations by using iterative methods, solving a homogeneous recurrence relation of second degree using algebraic method proving the necessary result.	**15**
2 2.1 2.2 2.3 2.4	**Preliminary Counting** Finite and infinite sets, countable and uncountable sets examples such as $\mathbb{N}, \mathbb{Z}, \mathbb{N} \times \mathbb{N}, \mathbb{Q}, (0,1), \mathbb{R}$. Addition and multiplication Principle, counting sets of pairs, two ways counting. Sterling numbers of second kind. Simple recursion formulae satisfied by $S(n,k)$ for $k = 1,2,3, \ldots, n-1, n$. Pigeonhole principle and its strong form, its applications to geometry, monotonic sequences etc.	**15**
3 3.1	**Advanced Counting** Binomial and Multinomial Theorem, Pascal identity, examples of standard identities such as the following: 1. $\sum_{k=0}^{r} \binom{m}{k}\binom{n}{r-k} = \binom{m+n}{r}$ 2. $\sum_{i=r}^{n} \binom{i}{r} = \binom{n+1}{r+1}$	**15**

	3. $\sum_{i=0}^{k} \binom{k}{i}^2 = \binom{2k}{k}$ 4. $\sum_{i=0}^{n} \binom{n}{i} = 2^n$	
3.2	Permutations and combinations of multi-sets, circular permutations, emphasis on solving problems.	
3.3	Non-negative and positive integral solutions of the equation: $x_1 + x_2 + \cdots + x_r = n$.	
3.4	Principle of Inclusion and Exclusion, its applications, derangements, explicit formulae for d_n, various identities involving d_n, deriving formula for Euler's phi function $\phi(n)$.	

References:

1. Norman Biggs: Discrete Mathematics, Oxford University Press.
2. Richard Brualdi: Introductory Combinatorics, John Wiley and sons.
3. V. Krishnamurthy: Combinatorics-Theory and Applications, Affiliated East West Press.
4. S. S. Sane, Combinatorial Techniques, Hindustan Book Agency, 2013.
5. Schaum's outline series: Discrete mathematics,
6. Applied Combinatorics: Allen Tucker, John Wiley and Sons.

Practicals:

1. Derangement and rank signature of permutation.
2. Recurrence relation.
3. Problems based on counting principles, Two way counting.
4. Sterling numbers of second kind, Pigeon hole principle.
5. Multinomial theorem, identities, permutations and combinations of multi-sets.
6. Inclusion-Exclusion principle, Derangements, Euler's phi function.
7. Miscellaneous theory questions from all units.

S.Y.B.Sc. Semester- IV

Calculus IV

COURSE CODE: **BUSMT401 (2019-20)** Credits- **02**

Objectives:

- Learner will be able to compare properties of functions of several variables with those of functions of one variable.
- Learner will be able to deduce geometrical properties of surfaces and lines.
- Learner will be able to apply the concept of differentiability to other sciences.

Sr. No.	Units	Lectures (45)
1	**Functions of Several Variables**	**15**
1.1	Euclidean space, $\mathbb{R}^n$ -norm, inner product, distance between two points, open ball in $\mathbb{R}^n$, definition of an open set in $\mathbb{R}^n$, neighbourhood of a point in $\mathbb{R}^n$, sequences in $\mathbb{R}^n$, convergence of sequences- these concepts should be specifically discussed for $\mathbb{R}^2$ and $\mathbb{R}^3$.	
1.2	Functions from $\mathbb{R}^n$ to $\mathbb{R}$ (scalar fields) and functions from $\mathbb{R}^n \to \mathbb{R}^m$ (vector fields), sketching of regions in $\mathbb{R}^2$ and $\mathbb{R}^3$. Graph of a function, level sets, cartesian coordinates, polar coordinates, spherical coordinates, cylindrical coordinates and conversions from one coordinate system to other. Iterated limits, limits and continuity of functions, basic results on limits and continuity of sum, difference, scalar multiples of vector fields, continuity and components of a vector field.	
1.3	Directional derivatives and partial derivatives of scalar fields.	
1.4	Mean value theorem for derivatives of scalar fields.	
2	**Differentiation**	**15**
2.1	Differentiability of a scalar field at a point (in terms of linear transformation) and in an open set , the total derivative, uniqueness of total derivative of a differentiable function at a point, basic results on continuity, differentiability, partial derivative and directional derivative	
2.2	Gradient of a scalar field, geometric properties of gradient, level sets and tangent planes.	
2.3	Chain rule for scalar fields.	

2.4	Higher order partial derivatives, mixed partial derivatives, sufficient condition for equality of mixed partial derivatives.	
3 3.1	**Application of Derivatives** Second order Taylor's formula for scalar fields.	**15**
3.2	Differentiability of vector fields, definition of differentiability of a vector field at a point, Jacobian matrix, Hessian matrix, differentiability of a vector field at a point implies continuity, the chain rule for derivative of vector fields (statements only).	
3.3	Mean value inequality.	
3.4	Hessian matrix, Maxima, minima and saddle points.	
3.5	Second derivative test for extrema of functions of two variables.	
3.6	Method of Lagrange Multipliers.	

References:

1. Sudhir R. Ghorpade and Balmohan V. Limaye, A Course in Multivariable Calculus and Analysis, Springer International Edition.
2. T. Apostol: Calculus, Vol. 2, John Wiley.
3. J. Stewart, Calculus, Brooke/ Cole Publishing Co.
4. G.B. Thoman and R. L. Finney, Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley, 1998.
5. Howard Anton, Calculus- A new Horizon, Sixth Edition, John Wiley and Sons Inc, 1999.
6. S.C. Malik, SavitaArora, Mathematical Analysis, third edition, New Age International Publishers, India.

Practicals

1. Sequences in $\mathbb{R}^2, \mathbb{R}^3$, limits and continuity of scalar fields and vector fields, using"definition and otherwise" , iterated limits.
2. Computing directional derivatives, partial derivatives and mean value theorem of scalar fields.
3. Total derivative, gradient, level sets and tangent planes.

4. Chain rule, higher order derivatives and mixed partial derivatives of scalar fields.
5. Taylor's formula, differentiation of a vector field at a point, finding Hessian/Jacobean matrix, Mean Value Inequality.
6. Finding maxima, minima and saddle points, second derivative test for extrema of functions of two variables and method of Lagrange multipliers.
7. Miscellaneous Theoretical Questions based on full paper.

Linear algebra III

COURSE CODE: **BUSMT402 (2019-20)** Credits- **02**

Objectives: To learn about

- Quotient Vector spaces and Orthogonal Transformations
- Eigenvalues and Eigenvectors
- Diagonalisation

Sr. No.	Units	Lectures (45)
1	**Quotient Vector spaces and Orthogonal Transformations**	15
1.1	Review of vector spaces over $\mathbb{R}$, subspaces and linear transformations. Quotient Spaces: For a real vector space V and a subspace W, the cosets $v + W$ and the quotient space V/W. First Isomorphism theorem for real vector spaces (Fundamental theorem of homomorphism of vector spaces), dimension and basis of the quotient space V/W when Vis finite dimensional.	
1.2	Inner product spaces: Examples of inner product including the inner product$\langle f, g\rangle = \int_{-\pi}^{\pi} f(x)g(x)$on $\mathcal{C}[-\pi, \pi]$, the space of continuous real valued functions on $[-\pi, \pi]$. Orthogonal sets and orthonormal sets in an inner product space. Orthogonal and orthonormal bases. Gram-Schmidt orthogonalization process and simple examples in$\mathbb{R}^3, \mathbb{R}^4$. Real Orthogonal transformations and isometries of $\mathbb{R}^n$. Translations and Reflections with respect to a hyper plane. Orthogonal matrices over $\mathbb{R}$.	
1.3	Equivalence of orthogonal transformations and isometries of $\mathbb{R}^n$ fixing the origin. Characterization of isometries as composites of orthogonal transformations and translations. Orthogonal transformation of $\mathbb{R}^2$. Any orthogonal transformation in	

	$\mathbb{R}^2$is a reflection or a rotation.	
2 2.1 2.2 2.3	**Eigenvalues and Eigenvectors** Eigenvalues and eigenvectors of a linear transformation $T : V \to V$ where V is a finite dimensional real vector space and examples, eigenvalues and eigenvectors of $n \times n$ real matrices, linear independence of eigenvectors corresponding to distincteigenvalues of a linear transformation / Matrix. Characteristic polynomial of an$n \times n$real matrix. Result: A real numberλ is an eigenvalues of an $n \times n$ matrix A if and only if λ is a root of the characteristic polynomial of Cayley-Hamilton Theorem, Characteristic roots. Similar matrices and relation with a change of basis. Invariance of the characteristic polynomial and (hence of the) eigenvalues of similar matrices	**15**
3 3.1 3.2 3.3	**Diagonalisation** Diagonalizability of an $n \times n$ real matrix and a linear transformation of a finite dimensional real vector space to itself. Definition: Geometric multiplicity and Algebraic multiplicity of eigenvalues of an $n \times n$ real matrix and of a linear transformation. Examples of non-diagonalisable matrices over $\mathbb{R}$. An $n \times n$ real matrix A is diagonalisable if and only if $\mathbb{R}^n$ has a basis of eigenvectors of A if and only if the sum of dimension of eigen spaces of A is n if and only if the algebraic and geometric multiplicities of eigenvalues of A coincide. Diagonalisation of real Symmetric matrices and applications to real quadratic forms, rank and signature of a real quadratic form, classification of conics in $\mathbb{R}^2$ and quadric surfaces in $\mathbb{R}^3$.	**15**

References:

1. Introduction to Linear Algebra (Second Edition) by Serge Lang.
2. M. Artin, Algebra, Pearson India.
3. S. Kumaresen, Linear Algebra: A Geometric Approach, PHI.
4. L. smith, Linear Algebra, Springer.
5. 4. T. Banchoff and J. Wermer, Linear Algebra through geometry, Springer.

Practicals:

1. Quotient spaces.
2. Orthogonal transformations, Isometries.
3. Eigenvalues, eigenvectors of $n \times n$ matrices over $\mathbb{R}, \mathbb{C}$ $(n = 2, 3)$.
4. Cayley-Hamilton Theorem
5. Diagonalisation.
6. Orthogonal Diagonalisation.
7. Miscellaneous Theoretical Questions based on full paper.

Ordinary Differential Equations

COURSE CODE: **BUSMT403 (2019-20)** Credits- **02**

Objectives:

- Learner will be able to classify the ODE according to degree and order of ODE.
- Learner will be able to solve an ODE.
- Learner will be able to apply the concepts of ODE to biological sciences and physics.

Sr. No.	Units	Lectures (45)
1	**First order First degree Differential equations**	**15**
1.1	Definition of a differential equation, order, degree, ordinary differential equation and partial differential equation, linear and non linear ODE.	
1.2	Existence and Uniqueness Theorem for the solution of a second order initial value problem (statement only), Definition of Lipschitz function, Examples based on verifying the conditions of existence and uniqueness theorem	
1.3	Review of Solution of homogeneous and non-homogeneous differential equations of first order and first degree. Notion of partial derivatives. Exact Equations: General solution of exact equations of first order and first degree. Necessary and sufficient condition for $Mdx + Ndy = 0$ to be exact. Non-exact equations: Rules for finding integrating factors (without proof) for non exact equations,	

	such as i) $\frac{1}{Mx+Ny}$ is an I.F. if $Mx + Ny \neq 0$ and $Mdx + Ndy$ is homogeneous. ii) $\frac{1}{Mx-Ny}$ is an I.F. if $Mx - Ny \neq 0$ and $Mdx + Ndy$ is of the form $f_1(x,y)ydx + f_2(x,y)xdy = 0$. . iii) $e^{\int f(x)dx}$ (res $e^{\int g(y)dy}$) is an I.F. if $N \neq 0$ (res $M \neq 0$) and $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)\left(res\,\frac{1}{M}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)\right)$ is a function of x(res y) alone, say $f(x)$ (res $g(y)$). iv) Linear and reducible linear equations of first order, finding solutions of first order differential equations of the type for applications to orthogonal trajectories, population growth, and finding the current at a given time.	
2 2.1 2.2 2.3	**Second order Linear Differential equations** Homogeneous and non-homogeneous second order linear differentiable equations: The space of solutions of the homogeneous equation as a vector space. Wronskian and linear independence of the solutions. The general solution of homogeneous differential equations. The general solution of a non-homogeneous second order equation. Complementary functions and particular integrals. The homogeneous equation with constant coefficients. auxiliary equation. The general solution corresponding to real and distinct roots, real and equal roots and complex roots of the auxiliary equation. Non-homogeneous equations: The method of undetermined coefficients. The method of variation of parameters.	**15**
3 3.1	**Linear System of ODEs** Existence and uniqueness theorems to be stated clearly when needed in the sequel. Study of homogeneous linear system of ODEs in two variables: Let $a_1(t)$, $a_2(t)$, $b_1(t)$, $b_2(t)$ be continuous real valued functions defined on $[a,b]$. Fix $t_0 \in [a,b]$. Then there exists a unique solution $x = x(t), y = y(t)$ valid throughout $[a,b]$ of the following system: $$\frac{dx}{dt} = a_1(t)x + b_1(t)y,$$	**15**

	$$\frac{dy}{dt} = a_2(t)x + b_2(t)y$$ satisfying the initial conditions $x(t_0) = x_0 \& y(t_0) = y_0$.	
3.2	The Wronskian W (t) of two solutions of a homogeneous linear system of ODEs in two variables, result: W (t) is identically zero or nowhere zero on [a, b]. Two linearly independent solutions and the general solution of a homogeneous linear system of ODEs in two variables.	
3.3	Explicit solutions of Homogeneous linear systems with constant coefficients in two variables, examples	

References

1. G. F. Simmons, Differential equations with applications and historical notes, McGraw Hill.
2. E. A. Coddington, An introduction to ordinary differential equations, Dover Books.
3. G. F. Simmons, Differential equations with applications and historical notes, McGraw Hill.

Practicals

1. Solving exact and non exact equations.
2. .Linear and reducible to linear equations, applications to orthogonal trajectories, population growth, and finding the current at a given time.
3. Finding general solution of homogeneous and non-homogeneous equations, use of known solutions to find the general solution of homogeneous equations.
4. Solving equations using method of undetermined coefficients and method of variation of parameters.
5. Solving second order linear ODEs
6. Solving a system of first order linear ODES.
7. Miscellaneous Theoretical questions from all units.

B. K. Birla College of Arts, Science and Commerce, Kalyan (W.)

Syllabus w.e.f. Academic Year, 2018-19 (CBCS)

T.Y.B.Sc. Semester- V

Multivariable Calculus

COURSE CODE: **BUSMT501** **(2018-19)** Credits- **2.5**

Objectives: To learn about

- Multiple Integral
- Line Integral
- Surface Integral

Unit I	**Multiple Integral**	**Lectures**
1.1	Definition of double and triple integral of a function bounded on a rectangle and box. Geometric interpretation as area and volume.	**15**
1.2	Fubini's Theorem over rectangles and any closed bounded sets, Iterated Integrals, Basic properties of double and triple integrals proved using the Fubini's theorem such as: i. Integrability of the sums, scalar multiples, products, and under suitable conditions quotients of integrable functions, Formulae for the integrals of sums and scalar multiples of integrable functions. ii. Integrability of continuous functions. More generally, integrability of bounded functions having finite number of points of discontinuity	
1.3	Domain additivity of the integral, Integrability and the integral over arbitrary bounded domains, Change of variables formula (Statement only).	
1.4	Polar, cylindrical and spherical coordinates and integration using these coordinates. Differentiation under the integral sign, Applications to finding the center of gravity and moments of inertia.	

Unit II	Line Integral	
2.1 2.2 2.3	Review of Scalar and vector fields on $\mathbb{R}^n$, Vector differential operators, Gradient, Curl and divergence. Paths (parameterized curves) in $\mathbb{R}^n$ (for $n = 2,3$), Smooth and piecewise smooth paths, closed paths, Equivalence and orientation preserving equivalence of paths, definition of line integral of a vector field over a piecewise smooth path, basic properties of line integral including linearity, path-additivity and behavior under change of parameters. Line integral of a gradient vector field, Fundamental theorem of Calculus for line integrals, Necessary and sufficient conditions for a vector field to be conservative, Green's theorem (with proof in rectangular domain), applications to evaluation of line integrals.	**15**
Unit III	**Surface Integral**	
3.1 3.2 3.3 3.4 3.5	Parameterized surfaces, Smoothly equivalent parameterizations, Area of such surfaces. Definition of surface integrals of scalar-valued functions as well as of vector fields defined on a surface. Curl and divergence of a vector field, Elementary identities involving gradient, curl and divergence. Stoke's Theorem (proof assuming the general form of Green's Theorem), Examples. Gauss' Divergence Theorem (proof only in the case of cubical domains), Examples	**15**
Reference Books:	**Unit I:** 1. T. Apostol: Calculus, Vol. 2, John Wiley (Section 1.1 to 11.8) 2. J. Stewart, Calculus, Brooke/ Cole Publishing Co. (Section 15) 3. J.E. Marsden and A.J. Tromba, Vector Calculus, Fourth Edition, New York (Section 5.2 to 5.6) **Unit II:** 1. T. Apostol: Calculus, Vol. 2, John Wiley (Section 10.1 to 10.5, 10.10 to 10.18) 2. J. Stewart, Calculus, Brooke/ Cole Publishing Co. (Section 16.1 to 16.4) 3. J.E. Marsden and A.J. Tromba, Vector Calculus, Fourth Edition, New York (Section 6.1, 7.1, 7.4) **Unit III:** 1. T. Apostol: Calculus, Vol. 2, John Wiley (Section 1.1 to 11.8) 2. J. Stewart, Calculus, Brooke/ Cole Publishing Co. (Section 16.5 to 16.9) 3. J.E. Marsden and A.J. Tromba, Vector Calculus, Fourth Edition, New York (Section 6.2 to 6.4)	
Practicals:	1. Evaluation of Double and Triple Integral.	

	2. Change of variables in Double and Triple Integral and applications 3. Line integral of Scalar and Vector fields. 4. Greens Theorem, conservative fields and its applications. 5. Evaluation of Surface Integral. 6. Stokes and Gauss Divergence theorem	
Algebra II COURSE CODE: **BUSMT502** Credits- **2.5** **Objectives:** To learn about • Groups and Subgroups • Cyclic groups and Cyclic subgroups • Lagrange's Theorem and Group Homomorphism		
Unit I	**Groups and Subgroups**	
1.1 1.2 1.3	Definition of a group, Abelian group, order of a group, finite and infinite groups. Examples of groups including: i. $\mathbb{Z}, \mathbb{Q}, \mathbb{R}, \mathbb{C}$ under addition. ii. $\mathbb{Q}^*(\mathbb{Q}\backslash\{0\}), \mathbb{R}^*(\mathbb{R}\backslash\{0\}), \mathbb{C}^*(\mathbb{C}\backslash\{0\}), \mathbb{R}^+, \mathbb{Q}^+$ (Positive rational numbers) under multiplication. iii. $\mathbb{Z}_n$, set of residue classes modulo n under addition. iv. $U(n)$, the group of prime residue classes modulo n under multiplication. v. Symmetric group S_n. vi. Group of symmetries of a plane figure. vii. Dihedral group D_n as a group of symmetries of a regular polygon of n sides ($n = 3,4$) viii. Klein- 4 group. ix. Matrix groups $M_{n\times n}(\mathbb{R})$ under addition of matrices, group of invertible matrices $GL_n(\mathbb{R})$ under multiplication of matrices. x. S^1 as a subgroup of $\mathbb{C}$, μ_n as a subgroup of n^{th} roots of unity. Properties of group such as: 1. In the group $(G, .)$ the following are true for $a, b \in G$ and for all integers n, m: i. $a^n a^m = a^{n+m}$ ii. $(a^n)^m = a^{nm}$ iii. $(ab)^n = a^n b^n$, whenever $ab = ba$ 2. In the group $(G, .)$ the following are true for $a, b \in G$:	**15**

	i. Identity element e of G is unique. ii. Inverse of every element is unique. iii. $(a^{-1})^{-1} = a$ iv. $(a.b)^{-1} = b^{-1}a^{-1}$ v. If $a^2 = e$ for every $a \in G$, then $(G, \ .)$ is an abelian group. vi. If $(aba^{-1})^n = ab^n a^{-1}$, for every $n \in \mathbb{Z}$. vii. If $(a.b)^2 = a^2.b^2$ for every $a, b \in G$, then $(G, \ .)$ is an abelian group. viii. $(\mathbb{Z}_n^*, \ .)$ is a group if and only if n is prime.	
1.4	Properties of order of an element (n and m are in $\mathbb{Z}$): i. If $o(a) = n$, then $a^m = e$ if and only if n/m. ii. If $o(a) = nm$, then $o(a^n) = m$. iii. If $o(a) = n$, then $o(a^m) = \frac{n}{(n,m)}$, where (n,m) is the gcd of n and m. iv. $o(aba^{-1}) = o(b)$ and $o(ab) = o(ba)$. v. If $o(a) = m$ and $o(b) = m, ab = ba$ and $(n,m) = 1$, then $o(ab) = nm$.	
1.5	Subgroups, necessary condition for a non-empty set to be a subgroup i. Centre of a group $Z(G)$ is a subgroup. ii. Intersection of subgroups is a subgroup. iii. Union of two subgroups is not a subgroup in general. Union of two subgroups is a subgroup if and only if one is contained in the other. iv. If H and K are subgroups of a group G, then HK is a subgroup of G if and only if $HK = KH$.	
Unit II	**Cyclic groups and Cyclic**	
2.1	Cyclic Groups, Cyclic subgroup of a group, (examples including $\mathbb{Z}, \mathbb{Z}_n$ and $U(n)$)	
2.2	Properties such as i. Every cyclic group is abelian. ii. Finite cyclic groups has exactly $\phi(n)$ generators, iii. Infinite cyclic groups have only two generators. iv. Finite cyclic group has a unique subgroup for each divisor of the order of the group. v. Subgroup of a cyclic group is cyclic. vi. In a finite group $G, G =< a >$ if and only if $O(G) = O(a)$. vii. If $G =< a >$ and $o(a) = n$ then $G =< a^m >$ if and only if $(n,m) = 1$. viii. If G is a cyclic group of order p^n and H and K are subgroups of G then either $H \subseteq K$ or $K \subseteq H$.	**15**

Unit III	**Lagrange's Theorem and Group Homomorphism**	
3.1 3.2 3.3	Definition of coset and properties such as i. If H is subgroup of a group G and x ∈ G then a) $xH = H \Leftrightarrow x \in H$ b) $Hx = H \Leftrightarrow x \in H$ **ii.** If H is subgroup of a group G and x, y ∈ G then a) $xH = yH \Leftrightarrow x^{-1}y \in H$ b) $Hx = Hy \Leftrightarrow xy^{-1} \in H$ iii. Lagrange's theorem and its consequences such as Fermat's Little Theorem, Euler's Theorem, if a group G has no non trivial subgroup then O(G) is a prime and Gis cyclic. Definition of Group Homomorphism and Isomorphism, Automorphism, Kernel and Image of a group homomorphism, Examples including inner Automorphism Properties such as i. If $f: G \to G'$ is a group homomorphism then Ker$f \subseteq G$ ii. If $f: G \to G'$ is a group homomorphism then Ker$f = \{e\} \Leftrightarrow$ f is oneone. iii. If $f: G \to G'$ is a group homomorphism then a) $G$is abelian if and only if G' is abelian. b) $G$is cyclic if and only if G' is cyclic.	**15**
Reference Books:	1. I. N. Herstein: Topics in Algebra 2. J. Gallian: Contemporary Abstract Algebra, Narosa, New Delhi. 3. M. Artin: Algebra, Prentice Hall of India Private Limited. 4. J. B. Fraleigh: A First Course in Abstract Algebra, Third Edition, Narosa, New Delhi. 5. D. Dummit, R. Foote: Abstract Algebra, John Wiley & Sons, Inc.	
Practicals:	**1.** Examples and properties of Group and Subgroups. **2.** Group of symmetries of equilateral triangle, rectangle and square. **3.** Problems on order of a group. **4.** Problems on cyclic groups, cyclic subgroups, finding generators of every subgroup of a cyclic group. **5.** Problems on left coset, right coset and Lagrange's theorem. **6.** Problems on group homomorphism, isomorphism, automorphism.	

	7. Miscellaneous Theoretical Questions based on full paper.	

Topology of Metric Spaces

COURSE CODE: **BUSMT503**Credits- **2.5**

Objectives: To learn about

- Metric spaces
- Sequences and complete metric spaces
- Compact sets

Unit I	**Metric spaces**	**Lectures**
1.1	Definition, examples of metric spaces $\mathbb{R}$, $\mathbb{R}^2$, Euclidean space $\mathbb{R}^n$ with its Euclidean sup and sum metric, $\mathbb{C}$ (complex numbers), the spaces ℓ^1 and ℓ^2 of sequences and the space $C[a,b]$ of real valued continuous functions on $[a,b]$, Discrete metric space. Distance metric induced by the norm, translation invariance of the metric induced by the norm.	**15**
1.2	Metric subspaces, Product of two metric spaces. Open balls and open sets in a metric space, examples of open sets in various spaces, Hausdorff property.	
1.3	Interior of a set, Properties of open sets, Structure of an open set in $\mathbb{R}$, Equivalent metrics. Distance of a point from a set, between sets, diameter of a set in a metric space and bounded sets, Closed ball in a metric space, Closed sets- definition, examples.	
1.4	Limit point of a set, Isolated point, A closed set contains all its limit points, Closure and boundary of a set.	
Unit II	**Sequences and complete metric spaces**	
2.1	Sequences in a metric space, Convergent sequence in a metric space, Cauchy sequence in a metric space, subsequence, examples of convergent and Cauchy sequence in finite metric spaces, $\mathbb{R}^n$ with different metrics and other metric spaces. Characterization of limit points and closure points in terms of sequences.	**15**
2.2	Definition and examples of relative openness/closeness in subspaces, Dense subsets in a metric space and Separability. Definition of complete metric spaces, Examples of complete metric spaces, Completeness property in subspaces.	
2.3	Nested Interval theorem in $\mathbb{R}$, Cantor's Intersection Theorem, Applications of Cantors Intersection Theorem: i. The set of real Numbers is uncountable. ii. Density of rational Numbers (Between any two real numbers	

	there exists a rational number) iii. Intermediate Value theorem: Let $f: [a, b] \to \mathbb{R}$ be continuous, and assume that $f(a)$ and $f(b)$are of different signs say, $f(a) < 0$ and $f(b) > 0$. Then there exists $c \in (a, b)$such that $f(c) = 0$.	
Unit III	**Compact sets**	
2.1 2.2 2.3	Definition of compact metric space using open cover, examples of compact sets in different metric spaces $\mathbb{R}$, $\mathbb{R}^2$, $\mathbb{R}^n$ and other metric spaces. Properties of compact sets—compact set is closed and bounded (converse is not true), A closed subset of a compact set is compact. Union and Intersection of Compact sets. . Equivalent statements for compact sets in $\mathbb{R}$. i. Heine-Borel property: Let $I = [a, b]$ be a closed and bounded interval. Let $\{G_\alpha: \alpha \in I\}$ be a family of open Cover of $[a, b]$. Then it admits finite subcover i.e. $[a, b]$ is compact. ii. Sequentially compactness property. iii. Closed and boundedness property. iv. Bolzano-Weierstrass property: Every non empty infinite subset of A has limit point in A. Finite intersection property of closed sets for compact metric space, hence every compact metric space is complete.	**15**
Reference Books:	1. S. Kumaresan, Topology of Metric spaces. 2. E. T. Copson. Metric Spaces. Universal Book Stall, New Delhi, 1996. 3. W. Rudin, Principles of Mathematical Analysis. 4. T. Apostol. Mathematical Analysis, Second edition, Narosa, New Delhi, 1974 5. E. T. Copson. Metric Spaces. Universal Book Stall, New Delhi, 1996. 6. R. R. Goldberg Methods of Real Analysis, Oxford and IBH Pub. Co., New Delhi 1970. 7. P. K. Jain. K. Ahmed. Metric Spaces. Narosa, New Delhi, 1996. 8. W. Rudin. Principles of Mathematical Analysis, Third Ed, McGraw-Hill, Auckland, 1976. 9. D. Somasundaram, B. Choudhary. A first Course in Mathematical Analysis. Narosa, New Delhi 10. G.F. Simmous, Introduction to Topology and Modern Analysis, McGraw-Hii, New York, 1963. 11. Sutherland. Topology.	
Practicals:	1. Examples of Metric Spaces, Normed Linear Spaces. 2. Sketching of Open Balls in $\mathbb{R}^2$, Open and Closed sets,	

	Equivalent Metrics 3. Subspaces, Interior points, Limit Points, Dense Sets and Separability, Diameter of a set, Closure. 4. Limit Points, Sequences, Bounded , Convergent and Cauchy Sequences in a Metric Space 5. Complete Metric Spaces and Applications 6. Examples of Compact Sets 7. Miscellaneous Theory Questions	

Numerical Analysis I

COURSE CODE: **BUSMT5A4** Credits- **2.5**

Objectives: To learn about

- Error Analysis and Iteration method based on first degree equations
- Iteration method based on second degree equations, Methods for multiple roots and complex roots
- Methods to solve linear system of equations

Unit I	**Error Analysis and Iteration method based on first degree equations**	
1.1 1.2 1.3	Measures of errors: Relative error, absolute error and percentage error, Types of error: Inherent error, round-off error, truncation error, Significant digit and numerical stability, error tolerance. Taylor's series expansion with remainder term, Intermediate value theorem (without proof), simple and multiple roots, Iterative methods, rate of convergence of an iterative method. Iteration methods based on first degree equation: Newton Raphson Method, Secant Method, Regula Falsi Method and Iteration method. (Rate of convergence and Geometrical interpretation of all the methods have to be covered).	**15**
Unit II	**Iteration method based on second degree equations, Methods for multiple roots and complex roots**	
2.1 2.2 2.3	Iteration methods based on first degree equation: Muller method, Chebyshev method, Multipoint iteration method. Iterative methods for polynomial equations: Descartes' rule of signs, Birge-Vieta method, Bairstow method. Methods for multiple roots- Newton Raphson method, Methods for complex roots. System of non-linear equations by Newton Raphson method. (Rate of convergence and Geometrical interpretation of all the methods have to	**15**

	be covered).	
Unit III	**Methods to solve linear system of equations**	
3.1 3.2 3.3 3.4	Matrix representation of linear system of equations, pivoting, partial and complete pivoting. Direct Methods: Gauss elimination method, forward and backward substitution method, Triangularization Methods- Doolittle method, Crout's method, Cholesky method, error analysis of direct methods. Iteration Method: Jacobi iteration method, Gauss-Siedal method, convergence analysis of iterative method. Eigen value problem, Jacobi method for symmetric matrices, Power method to determine largest Eigen value, Inverse power method.	**15**
Reference Books:	1. M.K. Jain, S.R.K. Iyengar and R. K. Jain: Numerical Analysis for Scientific and Engineering Computation, New Age International Publications. 2. S. Sastry: Introductory methods of Numerical Analysis, PHI Learning. 3. Kendall E. and Atkinson: An introduction to Numerical Analysis, Wiley. 4. Scarborough James B.: Numerical Mathematical Analysis, Oxford University Press, New Delhi.	
Practicals:	1. Problems on Newton Raphson method, Secant method, RegulaFalsi method, and Iteration method. 2. Problems on Muller method, Chebyshev method, Multipoint iteration method. 3. Problems on Descartes rule of sign, BirgeVieta method and Bairstow method. 4. Problems on Gauss elimination, forward and backward substitution methods, triangularization methods (Doolittle and Crout), Cholesky methods. 5. Problems on Jacobi iteration, Gauss Siedal method. 6. Eigen value problem, Jacobi method for symmetric matrices, Power method to determine largest Eigen value, Inverse power method. 7. Miscellaneous Theoretical Questions based on full paper.	

Number Theory and its Applications I

COURSE CODE: **BUSMT5B4** Credits- **2.5**

Objectives: To learn about

- Congruences and Factorization
- Diophantine equations and their solutions
- Primitive Roots and Cryptography

Unit I	**Congruences and Factorization**

	Review of Divisibility, Primes and The fundamental theorem of Arithmetic. Congruences : Definition and elementary properties, Complete residue system modulo m, Reduced residue system modulo m, Euler's function and its properties, Fermat's little Theorem, Euler's generalization of Fermat's little Theorem, Wilson's theorem, Linear congruence, The Chinese remainder Theorem, Congruences of Higher degree, The Fermat-Kraitchik Factorization Method.	**15**
Unit II	**Diophantine equations and their solutions**	
	The linear equation $ax + by = c$. The equations $x^2 + y^2 = p$, where p is a prime. The equation $x^2 + y^2 = z^2$, Pythagorean triples, primitive solutions, The equations $x^4 + y^4 = z^2$ and $x^4 + y^4 = z^4$ have no solutions $(x; y; z)$ with $xyz \neq 0$. Every positive integer n can be expressed as sum of squares of four integers, Universal quadratic forms $x^2 + y^2 + z^2 + t^2$. Assorted examples: section 5.4 of Number theory by Niven-Zuckermann-Montgomery.	**15**
Unit III	**Primitive Roots and Cryptography**	
	Order of an integer and Primitive Roots. Basic notions such as encryption (enciphering) and decryption (deciphering), Cryptosystems, symmetric key cryptography, Simple examples such as shift cipher, Affine cipher, Hillll's cipher, Vigenere cipher. Concept of Public Key Cryptosystem; RSA Algorithm. An application of Primitive Roots to Cryptography.	**15**
Reference Books:	1. Elementary number theory, David M. Burton, Chapter 8 sections 8.1, 8.2 and 8.3, Chapter 10, sections 10.1, 10.2 and 10.3 2. David M. Burton, Elementary number theory. 3. Niven, H. Zuckerman and H. Montogomery, An Introduction to the Theory of Numbers, John Wiley & Sons. Inc. 4. David M. Burton, An Introduction to the Theory of Numbers. Tata McGraw Hill Edition. 5. G. H. Hardy and E.M. Wright. An Introduction to the Theory of Numbers. Low priced edition. The English Language Book Society and Oxford University Press, 1981. 6. Neville Robins. Beginning Number Theory. Narosa Publications. 7. S.D. Adhikari. An introduction to Commutative Algebra and Number Theory. Narosa Publishing House. 8. N. Koblitz. A course in Number theory and Cryptography, Springer. 9. M. Artin, Algebra. Prentice Hall.	

	10. K. Ireland, M. Rosen. A classical introduction to Modern Number Theory. Second edition, Springer Verlag. 11. William Stalling. Cryptology and network security.	
Practicals:	1. Congruences. 2. Linear congruences and congruences of Hilgher degree. 3. Linear diophantine equation. 4. Pythagorean triples and sum of squares. 5. Cryptosystems (Private Key). 6. Cryptosystems (Public Key) and primitive roots. 7. Miscellaneous theoretical questions based on full paper	
Graph Theory COURSE CODE: **BUSMT5C4** Credits- **2.5** **Objectives:** To learn about • Basics of Graphs • Trees • Eulerian and Hamiltonian graphs		
Unit I	**Basics of Graphs**	
	Definition of general graph, Directed and undirected graph, Simple and multiple graph, Types of graphs- Complete graph, Null graph, Complementary graphs, Regular graphs Sub graph of a graph, Vertex and Edge induced sub graphs, Spanning sub graphs. Basic terminology- degree of a vertex, Minimum and maximum degree, Walk, Trail, Circuit, Path, Cycle. Handshaking theorem and its applications, Isomorphism between the graphs and consequences of isomorphism between the graphs, Self complementary graphs, Connected graphs, Connected components. Matrices associated with the graphs Adjacency and Incidence matrix of a graph- properties, Bipartite graphs and characterization in terms of cycle lengths. Degree sequence and Havel-Hakimi theorem, Distance in a graph- shortest path problems, Dijkstra's algorithm.	**15**
Unit II	**Trees**	
	Cut edges and cut vertices and relevant results, Characterization of cut edge, Definition of a tree and its characterizations, Spanning tree, Recurrence relation of spanning trees and Cayley formula for spanning trees of K_n , Algorithms for spanning tree-BFS and DFS, Binary and m-ary tree, Prefix codes and Huffman coding, Weighted graphs and minimal spanning trees - Kruskal's algorithm for minimal spanning trees.	**15**
Unit III	**Eulerian and Hamiltonian graphs**	
	Eulerian graph and its characterization- Fleury's Algorithm-(Chinese	

	postman problem), Hamiltonian graph, Necessary condition for Hamiltonian graphs using G- S where S is a proper subset of $V(G)$, Sufficient condition for Hamiltonian graphs- Ore's theorem and Dirac's theorem, Hamiltonian closure of a graph, Cube graphs and properties like regular, bipartite, Connected and Hamiltonian nature of cube graph, Line graph of graph and simple results.	**15**
Reference Books:	1. Bondy and Murty Grapgh, Theory with Applications. 2. Balkrishnan and Ranganathan, Graph theory and applications. 3. West D G. , Graph theory. 4. Behzad and Chartrand Graph theory. 5. Choudam S. A., Introductory Graph theory.	
Practicals:	1. Handshaking Lemma and Isomorphism. 2. Degree sequence and Dijkstra's algorithm 3. Trees, Cayley Formula 4. Applications of Trees 5. Eulerian Graphs. 6. Hamiltonian Graphs. 7. Miscellaneous theoretical questions based on full paper.	
	Applied Component **Computer Programming and System Analysis-I** COURSE CODE: **BUSAC501** Credits- <u>2.5</u>	
Unit-I 1.1 1.2 1.3 1.4 1.5	**Introduction to SciLab** Basic introduction to SciLab, using SciLab as an advanced calculator. Defining vectors and matrices and basic operations. Plotting graphs of 2D and 3D in various forms. Exploring concept of calculus using SciLab. Solving ODE in SciLab.	
Unit-II 2.1 2.2 2.3	**Programming in SciLab** If -Else conditions, loops, user-defined function, etc. Developing programmes to find roots and algebraic and transcendental equation and solving system of linear equations (Gaussian Elimination Method , Gauss-Jacobi Method and Gauss-Siedel Method). Exploring applied linear algebra using SciLab (eigenvalues, eigenvectors and various properties, applications to solve ODE, matrix factorization and its applications).	
Unit-III 3.1 3.2	**Introduction to LaTeX** Introduction, document structure - creating title, sections, table of	

3.3	contents, labelling. Typesetting text - fonts, text colour, lists. Tables, equations.	
Unit-IV 4.1 4.2 4.3	**Presentation using slides and articles** Layout of page, cross references. Footnotes, definitions ? Page style, presentation slides.	

T.Y.B.Sc. Semester- VI
Basic Complex Analysis
COURSE CODE: **BUSMT601** Credits- **2.5**

Objectives: To learn about

- Introduction to Complex Analysis
- Cauchy Integral Formula
- Complex power series

Unit I	**Introduction to Complex Analysis**	**Lectures**
1.1	Review of complex numbers: Complex plane, polar coordinates, exponential map, powers and roots of complex numbers, De Moivre's formula.	**15**
1.2	$\mathbb{C}$ as a metric space, bounded and unbounded sets, point at infinity, extended complex plane, sketching of set in complex plane.	
1.3	Limit at a point, theorems on limits, convergence of sequences of complex numbers and results using properties of real sequence, functions $f: \mathbb{C} \to \mathbb{C}$, real and imaginary part of functions.	
1.4	Continuity at a point and algebra of continuous functions.	
1.5	Derivative off $f: \mathbb{C} \to \mathbb{C}$, comparison between differentiability in real and complex fields, Cauchy- Riemann equations, sufficient conditions for differentiability.	
1.6	Analytic function. If f, g analytic then $f + g$, $f - g$, fg, f/g for $g \neq 0$ are analytic. Chain rule theorem.	
1.7	If $f(z) = 0$ everywhere in a domain D, then $f(z)$ must be constant throughout D, Harmonic functions and harmonic conjugates.	
Unit II	**Cauchy Integral Formula**	
2.1	Evaluating the line integral $\int f(z)dz$ over $\lvert z - z_0 \rvert = r$, Cauchy integral formula: If f is analytic in B (z_0, r) then for any w in B (z_0, r) we have $f(w) = \frac{1}{2\pi i}\int \frac{f(z)}{z-w}dz$.	**15**

2.2	Taylor's theorem for analytic function, Mobius transformation, definition and examples. Exponential function and its properties, Trigonometric function, hyperbolic functions.	
Unit III	**Complex power series, Laurent series and Isolated singularities**	
3.1 **3.2** **3.3**	Power series of complex numbers and related results following from Unit I, radius of convergences, disc of convergence. Uniqueness of series representation, examples, definition of Laurent series, definition of isolated singularity, statement of existence of Laurent series expansion in neighbourhood of an isolated singularity (without proof). Types of isolated singularities viz. removable, pole and essential singularities defined using Laurent series expansion, statement of residue theorem and calculation of residue.	**15**
Reference Books:	1. J. W. Brown and R. V. Churchill, Complex Variables and its Applications, McGraw Higher Education. 2. S. Ponnuswamy, Foundations of Complex Analysis, Narosa Publications.	
Practicals:	1. Limit continuity and derivatives of functions of complex variables, 2. Steriographic Projection , Analytic function, _nding harmonic conjugate, 3. Contour Integral, Cauchy Integral Formula ,Mobius transformations 4. Taylors Theorem , Exponential , Trigonometric, Hyperbolic functions 5. Power Series , Radius of Convergence, Laurents Series 6. Finding isolated singularities- removable, pole and essential, Cauchy Residue theorem. 7. Miscellaneous Theoretical Questions based on full paper.	

Algebra-III

COURSE CODE: **BUSMT602** Credits- **2.5**

Objectives: To learn about

- Normal Subgroups
- Ring Theory
- Polynomial Rings and Field theory

Unit I	**Normal Subgroups**	
1.1	Review of Groups, Subgroups, Abelian groups, Order of a group,	

	Finite and infinite groups, Cyclic groups, The Center $Z(G)$ of a group G,Cosets, Lagranges theorem, Group homomorphism, isomorphism, automorphisms, inner automorphisms.	
1.2	Normal subgroups: Normal subgroups of a group, definition and examples including center of a group, Quotient group, Alternating group A_n, Cycles. List of all normal subgroups of A_3, S_3.	**15**
1.3	First Isomorphism theorem (Fundamental Theorem of homomorphism of groups), Second Isomorphism theorem, third Isomorphism theorem.	
1.4	Cayleys theorem (statement only). External direct product of a group, properties of external direct products, order of an element in a direct product, criterion for direct product to be cyclic. The classification of groups of order up to 7.	
Unit II	**Ring Theory**	
2.1	Definition of a ring (the definition should include the existence of a unity element). Properties and examples of rings including $\mathbb{Z}, \mathbb{Q}, \mathbb{R}, \mathbb{C}, M_n(\mathbb{R}), \mathbb{Q}[X], \mathbb{R}[X], \mathbb{C}[X], \mathbb{Z}[i], \mathbb{Z}[\sqrt{2}], \mathbb{Z}[\sqrt{5}], \mathbb{Z}_n$.	
2.2	Commutative rings. Units in a ring. The multiplicative group of units of a ring. Characteristic of a ring.	**15**
2.3	Ring homomorphism. First Isomorphism theorem of rings.	
2.4	Ideals in a ring, sum and product of ideals in a commutative ring.	
2.5	Quotient rings. Integral domains and fields. Definition and examples.	
2.6	A finite integral domain is a field. Characteristic of an integral domain, and of a finite field. Construction of quotient field of an integral domain (emphasis on $\mathbb{Z}, \mathbb{Q}$). A field contains a subfield isomorphic to $\mathbb{Z}_p$or $\mathbb{Q}$.	
Unit III	**Polynomial Rings and Field theory**	
3.1	Prime ideals and maximal ideals. Definition and examples. Characterization in terms of quotient rings.	**15**
3.2	Polynomial rings. Irreducible polynomials over an integral domain. Unique Factorization Theorem for polynomials over a field (statement only). Divisibility in an integral domain, irreducible and prime elements, ideals generated by prime and irreducible elements.	
3.3	Definition of a Euclidean domain (ED), Principal Ideal Domain (PID),	
3.4	Unique Factorization Domain (UFD). Examples of ED including $\mathbb{Z}, \mathbb{F}[X]$ where F is a field, and $\mathbb{Z}[i]$: An ED is a PID, a PID is a UFD.	
3.5	Prime (irreducible) elements in $\mathbb{R}[X]; \mathbb{Q}[X]; \mathbb{Z}_p[X]$: Prime and maximal ideals in polynomial rings. $\mathbb{Z}[X]$ is not a PID, $\mathbb{Z}$ [X] is a UFD (Statement only).	
Reference	1. Contemporary Abstract Algebra by Joseph Gallian.	

Books:	2. P. B. Bhattacharya, S. K. Jain, and S. R. Nagpaul, Abstract Algebra, Cambridge University Press, 1995. 3. N. Herstein, Topics in Algebra, Wiley indiaPvt. Ltd, 2015. 4. M. Artin, Algebra, Pearson India, Fifth Edition, 2017.Introduction to Linear Algebra (Second Edition) by Serge Lang. 5. N.S. Gopalkrishnan, University Algebra, New Age International, third edition, 2015.	
Practicals:	1. Normal Subgroups and quotient groups. 2. Cayleys Theorem and external direct product of groups. 3. Rings, Ring Homomorphism and Isomorphism. 4. Ideals, Prime Ideals and Maximal Ideals. 5. Euclidean Domain, Principal Ideal Domain and Unique Factorization Domain. 6. Fields. 7. Miscellaneous theory questions based on full paper.	

Topology of Metric Spaces and Real Analysis

COURSE CODE: **BUSMT603** Credits- **<u>2.5</u>**

Objectives: To learn about

- Continuous functions on metric spaces
- Connected sets
- Sequence and Series of functions

Unit I	**Continuous functions on metric spaces**	**Lectures**
1.1 1.2 1.3 1.4	Epsilon-delta definition of continuity at a point of a function from one metric space to another. Characterization of continuity at a point in terms of sequences, open sets and closed sets and examples. Algebra of continuous real valued functions on a metric space, Continuity of composite of continuous functions. Continuous image of compact set is compact. Uniform continuity in a metric space, definition and examples, If (X, d) is compact metric, then $f : X \to Y$ is uniformly continuous. Contraction mapping and fixed point theorem, Applications.	**15**
Unit II	**Connected sets**	
2.1 2.2 2.3	Separated sets- definition and examples, disconnected sets, disconnected and connected metric spaces, Connected subsets of a metric space. Connected subsets of $\mathbb{R}$, A subset of $\mathbb{R}$ are connected if and only if it is an interval. A continuous image of a connected set is connected, Characterization of a connected space, viz. a metric space is connected if and only if	

3.4 3.5	every continuous function from X to $\{-1,1\}$ is a constant function. Path connectedness in $\mathbb{R}^n$, definition and examples, A path connected subset of $\mathbb{R}^n$ is connected, convex sets are path connected, Connected components, An example of a connected subset of $\mathbb{R}^n$ which is not path connected.	**15**
Unit III	**Sequence and Series of functions**	
2.1 2.2 2.3 2.4	Sequence of functions - point wise and uniform convergence of sequences of a real valued functions, examples, Uniform convergence implies point wise convergence, with examples to show converse is not true. Series of functions, convergence of series of functions, Weierstrass M-test, Examples. Properties of uniform convergence: Continuity of the uniform limit of a sequence of continuous function. Conditions under which integral and the derivative of sequence of functions converge to the integral and derivative of uniform limit on a closed and bounded interval with Examples. Consequences of these properties for series of functions, term by term differentiation and integration. Power series in $\mathbb{R}$ centered at origin and at some point x_0 in $\mathbb{R}$, radius of convergence, region (interval) of convergence, uniform convergence, term by-term differentiation and integration of power series, Examples. Uniqueness of series representation, functions represented by power series, classical functions defined by power series such as exponential, cosine and sine functions, with basic properties of these functions.	**15**
Reference Books:	1. S. Kumaresan, Topology of Metric spaces. 2. E. T. Copson. Metric Spaces. Universal Book Stall, New Delhi, 1996. 3. Robert Bartle and Donald R. Sherbert, Introduction to Real Analysis, Second Edition,John Wiley and Sons. 4. Ajit Kumar, S. Kumaresan, Introduction to Real Analysis 5. R.R. Goldberg, Methods of Real Analysis, Oxford and International Book House (IBH) Publishers, New Delhi. 6. W. Rudin, Principles of Mathematical Analysis. 7. T. Apostol. Mathematical Analysis, Second edition, Narosa, New Delhi, 1974 8. R. R. Goldberg Methods of Real Analysis, Oxford and IBH Pub. Co., New Delhi 1970. 9. P. K. Jain. K. Ahmed. Metric Spaces. Narosa, New Delhi, 1996. 10. W. Rudin. Principles of Mathematical Analysis, Third Ed,	

	McGraw-Hill, 11. Auckland, 1976. 12. D. Somasundaram, B. Choudhary. A first Course in Mathematical Analysis. Narosa, New Delhi 13. G.F. Simmous, Introduction to Topology and Modern Analysis, McGraw-Hii, New York, 1963. 14. Sutherland. Topology.	
Practicals:	1. Continuous functions on metric spaces 2. Uniform continuity, fixed point theorem 3. Examples of connected sets and connected metric spaces 4. Path connectedness, convex sets, equivalent condition for connected set using continuous function. 5. Problems on convergence of Sequences of functions and its properties. 6. Problems on convergence of Series of functions and its properties. 7. Miscellaneous theory questions based on full paper.	

Numerical Analysis II

COURSE CODE: **USMT6A4** Credits- **2.5**

Objectives: To learn about

- Interpolation
- Polynomial approximation and Numerical Differentiation
- Numerical Integration

Unit I	**Interpolation**	
1.1 1.2 1.3	Interpolating polynomial, uniqueness of interpolating polynomials, linear, quadratic and higher order interpolation and Lagrange's interpolation. Finite difference operator: Shift operator, forward, backward central difference operator, average operator and relation between them. Difference table, relation between difference operators and derivatives, Interpolating polynomials using finite differences: Gregory-Newton forward difference interpolation, Gregory-Newton forward difference interpolation, Stirling's interpolation, Interpolation error.	**15**
Unit II	**Polynomial approximation and Numerical Differentiation**	
2.1	Piecewise interpolation: Linear, Quadratic and Cubic. Bivariate Interpolation: Lagrange's and Newton's Bivariate	**15**

2.2 2.3	interpolation. Numerical Differentiation based on Interpolation, Numerical Differentiation based on finite differences (forward, backward and central). Numerical partial differentiation.	
Unit III	**Numerical Integration**	
3.1 3.2 3.3	Numerical integration based on interpolation: Newton-Cotes method, Trapezoidal rule, Simpson's $1/3$ rd rule, Simpson's $3/8$ th rule, determination of error term for these methods. Convergence of numerical integration: Necessary and sufficient condition (with proof). Composite integration methods: Trapezoidal rule, Simpson's rule.	**15**
Reference Books:	1. M.K. Jain, S.R.K. Iyengar and R. K. Jain: Numerical Analysis for Scientific and Engineering Computation, New Age International Publications. 2. S. Sastry: Introductory methods of Numerical Analysis, PHI Learning. 3. Kendall E. and Atkinson: An introduction to Numerical Analysis, Wiley. 4. Scarborough James B.: Numerical Mathematical Analysis, Oxford University Press, New Delhi.	
Practicals:	1. Problems on linear, quadratic and higher order interpolation, interpolating polynomial by Lagrange's interpolation. 2. Problems on interpolating polynomial by Gregory-Newton forward difference interpolation, Gregory-Newton forward difference interpolation, Stirlings interpolation. 3. Problems on piecewise interpolation (Linear, Quadratic and Cubic), Bivariate Interpolation by Lagrange's and Newton's Bivariate interpolation. 4. Problems on numerical differentiation based on Interpolation and finite differences (forward, backward and central), numerical partial differentiation. 5. Problems on Numerical integration based on interpolation: Newton-Cotes method, Trapezoidal rule, Simpson's $\frac{1}{3}$ rd rule, Simpson's $\frac{3}{8}$ th rule. 6. Problems on composite integration methods: Trapezoidal rule, Simpson's rule. 7. Miscellaneous theory questions based on full paper.	

Number Theory and its applications II (Elective B) COURSE CODE: **USMT6B4** Credits- **2.5** **Objectives:** To learn about • Quadratic Reciprocity • Continued Fractions • Pells equation, Arithmetic function and Special numbers		
Unit I	**Quadratic Reciprocity**	
	Quadratic residues and Legendre Symbol, Gausss Lemma, Theorem on Legendre Symbol $\left(\frac{2}{p}\right)$, the result: If p is an odd prime and a is an odd integer with $(a,p) = 1$ Then $\left(\frac{a}{p}\right) = (-1)^t$ where $= \sum_{k-1}^{\frac{p-1}{2}}[\frac{ka}{p}]$, Quadratic Reciprocity law. Theorem on Legendre Symbol $\left(\frac{3}{p}\right)$. The Jacobi Symbol and law of reciprocity for Jacobi Symbol. Quadratic Congruences with Composite moduli.	**15**
Unit II	**Continued Fractions**	
	Finite continued fractions. Infinite continued fractions and representation of an irrational number by an infinite simple continued fraction, rational approximations to irrational numbers and order of convergence, Best possible approximations. Periodic continued fractions.	**15**
Unit III	**Pells equation, Arithmetic function and Special numbers**	
	Pell's equation $x^2dy^2 = n$, where d is not a square of an integer. Solutions of Pell's equation (The proofs of convergence theorems to be omitted). Arithmetic functions of number theory: $d(n)(or\tau(n)), \sigma(n), \sigma k(n), \omega(n)$ and their properties, $\mu(n)$ and the Mbius inversion formula. Special numbers: Fermat numbers, Mersenne numbers, Perfect numbers, Amicable numbers, Pseudo primes, Carmichael numbers.	**15**
Reference Books:	1. Niven, H. Zuckerman and H. Montogomery. An Introduction to the Theory of Numbers. John Wiley & Sons. Inc. 2. David M. Burton. An Introduction to the Theory of Numbers. Tata McGraw-Hill Edition. 3. G. H. Hardy and E.M. Wright. An Introduction to the Theory of Numbers. Low priced edition. The English Language Book Society and Oxford University Press, 1981.	

	4. Neville Robins. Beginning Number Theory. Narosa Publications. 5. S. D. Adhikari. An introduction to Commutative Algebra and Number Theory. Narosa Publishing House 6. N. Koblitz. A course in Number theory and Crytopgraphy. Springer. 7. M. Artin. Algebra. Prentice Hall. 8. K. Ireland, M. Rosen. A classical introduction to Modern Number Theory. Second edition, Springer Verlag. 9. William Stalling. Cryptology and network security.	
Practicals:	1. Legendre Symbol. 2. Jacobi Symbol and Quadratic congruences with composite moduli. 3. Finite continued fractions. 4. Infinite continued fractions. 5. Pells equations and Arithmetic functions of number theory. 6. Special Numbers. 7. Miscellaneous Theoretical questions based on full paper.	

Graph Theory and Combinatorics (Elective C)

COURSE CODE: **USMT6C4** Credits- **2.5**

Objectives: To learn about

- Colorings of graph
- Planar graph
- Combinatorics

Unit I	**Colorings of graph**	
	Vertex coloring- evaluation of vertex chromatic number of some standard graphs, critical graph. Upper and lower bounds of Vertex chromatic Number- Statement of Brooks theorem. Edge coloring- Evaluation of edge chromatic number of standard graphs such as complete graph, complete bipartite graph, cycle. Statement of Vizing Theorem. Chromatic polynomial of graphs Recurrence Relation and properties of Chromatic polynomials. Vertex and Edge cuts vertex and edge connectivity and the relation between vertex and edge connectivity. Equality of vertex and edge connectivity of cubic graphs. Whitney's theorem on 2-vertex connected graphs.	**15**
Unit II	**Planar graph**	
	Definition of planar graph. Euler formula and its consequences. Non planarity of $K5, K(3,3)$. Dual of a graph. Polyhedran in $\mathbb{R}^3$ and existence of exactly five regular polyhedra- (Platonic solids)	

	Colorabilty of planar graphs- 5 color theorem for planar graphs, statement of 4 color theorem. Networks and flow and cut in a network- value of a flow and the capacity of cut in a network, relation between flow and cut. Maximal flow and minimal cut in a network and Ford- Fulkerson theorem.	**15**
Unit III	**Combinatorics**	
	Applications of Inclusion Exclusion Principle- Rook polynomial, Forbidden position problems Introduction to partial fractions and using Newtons binomial theorem for real power find series, expansion of some standard functions. Forming recurrence relation and getting a generating function. Solving a recurrence relation using ordinary generating functions. System of Distinct Representatives and Hall's theorem of SDR. Introduction to matching, M alternating and M augmenting path, Berge theorem. Bipartite graphs.	**15**
Reference Books:	1. Bondy and Murty Grapgh, Theory with Applications. 2. Balkrishnan and Ranganathan, Graph theory and applications. 3 West D G. , Graph theory. 3. Richard Brualdi, Introduction to Combinatorics. 4. Behzad and Chartrand Graph theory. 5. Choudam S. A., Introductory Graph theory. 3 Cohen, Combinatorics.	
Practicals:	1. Coloring of Graphs 2. Chromatic polynomials and connectivity. 3. Planar graphs 4. Flow theory. 5. Inclusion Exclusion Principle and Recurrence relation. 6. SDR and Matching. 7. Miscellaneous Theoretical questions based on full paper.	
	8.	

Applied Component
Computer Programming and System Analysis-II

COURSE CODE: **BUSAC601** Credits- **2.5**

Unit-I	**Introduction to Python**	
	1. A brief introduction about Python and installation of anaconda. 2. Numerical computation in Python including square roots, trignometrical functions using math and cmath module. Different data type in Python such as list, tuple and dictionary. 3. If statements, For loop and While loops and simple programmes using this,	

	4. User-defined functions and models. Various use of lists, tuple and dictionary. 5. Use of Matplotlib to plot graphs in various format.	
Unit-II	**Advanced topics in Python**	
	1. Classes in Python. 2. Use of Numpy and Scripy for solving problems in a linear algebra and calculus, differential equations. 3. Data handling using Pandas	
Unit-III	**Introduction to SageMath**	
	1. SageMath installation and use in various platforms. Using SageMath as an advanced calculator. 2. Defining functions and exploring concept of Calculus. 3. Finding roots of functions and polynomials. 4. Plotting graph of 2D and 3D in SageMath 5. Define vectors and matrices and exploring concepts in linear algebra.	
Unit-IV	**Programming in SageMath**	
	1. Basic single and multivariable calculus Sage. 2. Developing Python programmes in Sage to solve problems in numerical analysis and linear algebra. 3. Exploring concepts in graph theory and number theory.	

B. K. Birla College of Arts, Science and Commerce, Kalyan (W.)

Syllabus w.e.f. Academic Year, 2018-19 (CBCS)

F.Y.B.Com. Semester- I

Mathematical and Statistical Techniques -I

COURSE CODE: **BUBCOMFSI.6 (2018-19)** Credits- **03**

Objectives:

The main objective of this course is to introduce mathematics and statistics to undergraduate students of commerce, so that they can use them in the field of commerce and industry to solve the real life problems.

Note:

One introductory lecture for basic mathematical computations like BODMAS rule, percentage, logarithm, powers etc.

Sr. No.	Modules/Units	Lectures (60)
1	**Commissions, Shares and Mutual Fund**	**15**
1.1	Commission and Brokerage, Simple examples on calculation of commission and brokerage, Partnership.	
1.2	Concept of Shares, face value, market value, dividend, bonus shares, simple examples.	
1.3	Mutual Funds, Simple problems on calculation of Net income after considering entry load, dividend, change in Net Asset Value (N.A.V.) and exit load. Averaging of price under the Systematic Investment Plan (S.I.P.)	
2	**Permutations, Combinations and Linear Programming**	**15**
2.1	Permutations and Combinations: Factorial Notations, Fundamental Principle of counting, permutations as arrangements, simple examples, combinations as selection, simple examples, Relation between n_{C_r} and n_{P_r} . Examples on commercial applications of permutation and combination.	
2.2	Linear Programming Problem: Sketching of graphs of (i) Linear equation $Ax + By + C = 0$ (ii) Linear inequalities. Mathematical Formulation of Linear Programming Problems up to 3 variables, Solution of Linear Programming Problems using graphical method up to two variables.	

3 3.1 3.2	**Summarization Measures** Measures of Central Tendencies: Definition of Average, Types of Averages: Arithmetic Mean, Median, and Mode for grouped as well as ungrouped data. Quartiles, Deciles and Percentiles. Using Ogive locate median and Quartiles. Using Histogram locate mode. Combined and Weighted mean. Measures of Dispersions: Concept and idea of dispersion. Various measures Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Combined Variance.	**15**
4 4.1 4.2	**Elementary Probability Theory** Probability Theory: Concept of random experiment/trial and possible outcomes; Sample Space and Discrete Sample Space; Events their types, Algebra of Events, Mutually Exclusive and Exhaustive Events, Complimentary events. Classical definition of Probability, Addition theorem (without proof, conditional probability.Independence of Events: $P(A \cap B) = P(A) P(B)$. Simple examples. Random Variable: Probability distribution of a discrete random variable. Expectation and Variance of random variable, simple examples on probability distributions.	**15**
5 5.1 5.2	**Decision Theory** Decision making situation, Decision maker, Courses of Action, States of Nature, Pay-off and Pay-off matrix; Decision making under uncertainty, Maximin, Maximax, Minimax regret and Laplace criteria; simple examples to find optimum decision. Formulation of Payoff Matrix. Decision making under Risk, Expected Monetary Value (EMV); Decision Tree; Simple Examples based on EMV. Expected Opportunity Loss (EOL), simple examples based on EOL.	**15**

References:

1) Mathematics for Economics and Finance Method and Modeling by Martin Anthony and Norman Biggs, Cambridge University press, Cambridge low- priced edition, 2000, chapters 1,2,4,6,to 9 & 10.
2) Applied Calculus : By Stephrn Waner and Steven Constenoble, Books/ Cole Thomson Learning, second edition, chapter 1 to 5
3) Business Mathematics by D. C. Sancheti and V. K. Kapoor, Sultan Chand & Sons, 2006, chapter 1, 5,7,9& 10
4) Mathematics for Business Economics: By J.D. Gupta, P.K Gupta and Man Mohan, Tata Mc-Graw Hill Publishing Co. Ltd., 1987, Chapter 9 to 11 & 16.

5) Quantitative Method- Part- I By Saha and S. Mukerji, New Central Book Agency,1996 Chapter 7& 12
6) Mathematical Basis of Life Insurance By S.P.Dixit, C.S. Modi and R.V. Joshi, Insurance Institute of India, Chapter 2 ; unit 2.6, 2.9, 2.20 & 2.21

F.Y.B.Com. Semester- II

Mathematical and Statistical techniques -II

COURSE CODE: **BUBCOMFSII.6 (2018-19)** Credits- **03**

Objectives:

The main objective of this course is to introduce mathematics and statistics to undergraduate students of commerce, so that they can use them in the field of commerce and industry to solve the real life problems.

Sr. No.	**Modules/Units**	**Lectures (60)**
1	**Interest and Annuity**	**15**
1.1	Interest: Simple Interest, Compound Interest (Nominal & Effective Rate of Interest), Calculations involving up to 4 time periods. Annuity: Annuity Immediate and its Present value, Future value, Equated Monthly Instalments (EMI) using reducing balance method. Stated Annual Rate & Affective Annual Rate Perpetuity and its present value. Simple problems involving up to 4 time periods.	
1.2	Annuity: Annuity Immediate and its Present value, Future value, Equated Monthly Instalments (EMI) using reducing balance method. Stated Annual Rate & Affective Annual Rate Perpetuity and its present value. Simple problems involving up to 4 time periods.	
2	**Functions, Derivatives and Their Applications**	**15**
2.1	Concept of limit, Definition of e using limit. .	
2.2	Concept of real functions: Constant function, linear function, x^n, e^x, a^x, log x. Demand, Supply, Total Revenue, Average Revenue, Total cost, Average cost and Profit function. Equilibrium Point, Break - even point.	
2.3	Derivative of functions: Derivative as rate measure, Derivative of x^n, e^x, a^x, log x. Rules of derivatives: Scalar multiplication, sum, difference, product, quotient (Statements only), Simple problems. Second	

	order derivatives. Applications: Marginal Cost, Marginal Revenue, Elasticity of Demand. Maxima and Minima for functions in Economics and Commerce. (Examination Questions on this unit should be application oriented only.)	
3 3.1 3.2	**Bivariate Linear Correlation and Regression** Correlation Analysis: Meaning, Types of Correlation, Determination of correlation: Scatter diagram, Karl Pearson's method of Correlation Coefficient (excluding Bivariate Frequency Distribution Table) and Spearman's Rank Correlation Coefficient. Regression Analysis: Meaning, Concept of Regression equations, Slope of the Regression Line and its interpretation. Regression Coefficients (excluding Bivariate Frequency Distribution Table), Relationship between Coefficient of Correlation and Regression Coefficients , Finding the equations of Regression lines by method of Least Squares.	**15**
4 4.1 4.2	**Time series and Index Numbers** Time series: Concepts and components of a time series. Representation of trend by Freehand Curve Method, Estimation of Trend using Moving Average Method and Least Squares Method (Linear Trend only). Estimation of Seasonal Component using Simple Arithmetic Mean for Additive Model only (For Trend free data only). Concept of Forecasting using Least Squares Method. Index Numbers: Concept and usage of Index numbers, Types of Index numbers, Aggregate and Relative Index Numbers, Lasperye's, Paasche's, Dorbisch-Bowley's, Marshall-Edgeworth and Fisher's ideal index numbers, Test of Consistency: Time Reversal Test and Factor Reversal Test. Chain Base Index Nos. Shifting of Base year. Cost of Living Index Numbers, Concept of Real Income, Concept of Wholesale Price Index Number. (Examples on missing values should not be taken)	**15**
5 5.1	**Elementary Probability Distribution** Probability Distributions: Discrete Probability Distribution: Binomial, Poisson (Properties and applications only, no derivations are expected) Continuous Probability distribution: Normal Distribution. (Properties and applications only, no derivations are expected)	**15**

References:

1) Mathematics for Economics and Finance Method and Modeling by Martin Anthony and Norman Biggs, Cambridge University press, Cambridge low- priced edition, 2000, chapters 1,2,4,6,to 9 & 10.
2) Applied Calculus : By Stephrn Waner and Steven Constenoble, Books/ Cole Thomson Learning, second edition, chapter 1 to 5
3) Business Mathematics by D. C. Sancheti and V. K. Kapoor, Sultan Chand & Sons, 2006, chapter 1, 5,7,9& 10
4) Mathematics for Business Economics: By J.D. Gupta, P.K Gupta and Man Mohan, Tata Mc-Graw Hill Publishing Co. Ltd., 1987, Chapter 9 to 11 & 16.
5) Quantitative Method- Part- I By Saha and S. Mukerji, New Central Book Agency,1996 Chapter 7& 12
6) Mathematical Basis of Life Insurance By S.P.Dixit, C.S. Modi and R.V. Joshi, Insurance Institute of India, Chapter 2 ; unit 2.6, 2.9, 2.20 & 2.21

B. K. Birla College of Arts, Science and Commerce, Kalyan (W)

Syllabus w.e.f. Academic Year, 2018-19 (CBCS)

T.Y.B.Com. Semester- V

Computer System and Applications -I

COURSE CODE: **BUCCAS506 (2018-19)** Credits- **03**

Objectives:

The main objective of this course is to introduce programming language and some office oriented software to undergraduate students of commerce, so that they can use them in the field of commerce and industry to solve the real life problems.

Sr. No.	Modules/Units	Lectures (60)
1	**Data Communication, Networking and Internet**	**18**
1.1	Data Communication Component, Data representation, Distributed processing. (Concepts only)	
1.2	Network Basics and Infrastructure i. Definition, Types (LAN, MAN, WAN) Advantages. ii. Network Structures – Server Based, Client server, Peer to Peer. iii. Topologies – Star, Bus, Ring. iv. Network Media, Wired and Wireless. v. Network Hardware: Hubs, Bridges, Switches, Routers. vi. Network Protocols – TCP/IP, OSI Model.	
1.3	Internet i. Definition, Types of connections, sharing internet connection, Hot Spots. ii. Services on net- WWW, Email-Blogs. iii. IP addresses, Domain names, URLs. iv. Searching Directories, Search engines, Boolean search (AND, OR, NOT), Advanced search, Meta Search Engines. v. Email – POP/SMTP accounts in Email, Different parts of an Email address. Receiving and sending emails with attachments by scanning attachments for viruses. vi. Cyber-crime, Hacking, Sniffing, Spoofing	
2	**Database and SQL**	**09**
2.1	Introduction to databases: Relational and Non-relational database system	

2.2	MySQL as a Non-procedural Language. View of data. SQL Basics : Statements (Schema Statements, Data statements, Transaction statements, names (table & column names), data types (Char, Varchar, Text, Mediumtext, Longtext, Smallint, Bigint, Boolean, Decimal, Float, Double, Date, Date Time, Timestamp, Year, Time, Creating Database, Inserting data, Updating data, Deleting data, Expressions, Built-in-functions, Missing data(NULL and NOT NULL DEFAULT values) CREATE, USE, ALTER (Add, Remove, Change columns),RENAME, SHOW, DESCRIBE (CREATE TABLE, COLUMNS, STATUS and DATABASES only) and DROP (TABLE, COLUMN, DATABASES statements), PRIMARY KEY FOREIGN KEY (One and more columns) Simple Validity checking using CONSTRAINTS.		
3 3.1 3.2 3.3	**Database and SQL** Simple queries: The SELECT statement (From, Where, Group By, Having, Order By, Distinct, Filtering Data by using conditions. Simple and complex conditions using logical, arithmetic and relational operators (=, !, =, <, >, < >, AND, OR, NOT, LIKE, BETWEEN). Multi-table queries: Simple joins (INNER JOIN), SQL considerations for multi table queries (table aliases, qualified column names, all column selections self joins). Nested Queries (Only up to two levels) : Using sub queries, sub query search conditions, sub queries & joins, nested sub queries, correlated sub queries, sub queries in the HAVING clause. Simple Transaction illustrating START, COMMIT, and ROLLBACK.	**09**	
4 4.1 4.2	**MS-Excel** a) Creating and Navigating worksheets and adding information to worksheets i. Types of data, entering different types of data such as texts, numbers, dates, functions. ii. Quick way to add data Auto complete, Autocorrect, Auto fill, Auto fit. Undo and Redo. iii. Moving data, contiguous and non contiguous selections, Selecting with keyboard. Cut-Copy, Paste. Adding and moving columns or rows. Inserting columns and rows. iv. Find and replace values. Spell check. v. Formatting cells, Numbers, Dates, Times, Fonts, Colors, Borders, Fills. Multiple Spread sheets	**09**	

	i. Adding, removing, hiding and renaming worksheets. ii. Add headers/Footers to a Workbook. Page breaks, preview. iii. Creating formulas, inserting functions, cell references, Absolute, Relative (within a worksheet, other worksheets and other workbooks). Functions i. Financial functions: FV, PV, PMT, PPMT, IPMT, NPER, RATE, NPV, IRR ii. Mathematical and statistical functions. ROUND, ROUNDDOWN, ROUNDUP, CEILING, FLOOR, INT, MAX, MIN, MOD, SQRT, ABS, AVERAGE Data Analysis i. Sorting, Subtotal. ii. Pivot Tables- Building Pivot Tables, Pivot Table regions, Rearranging Pivot Table.		

References:

1) Data Communication and Networking -Behrouz A Forouzan.
2) Introduction to Computers – Peter Norton, Tata McGraw Hill.
3) Fundamentals of Database Systems - Elmasri Navathe, Somayajulu, Gupta.
4) Database Systems and Concepts - Henry F. Korth, Silberschatz, Sudarshan McGraw Hill. DBMS – Date.
5) The complete reference SQL - Vikram Vaswani TMH.
6) The complete reference SQL - James R. Groff & Paul N. Weinberg TMG.
7) Learning SQL - Alan Beaulieu O'REILLY.
8) Learning MySQL - Seyed M. M. and Hugh Williams, O'REILLY.
9) SQL a complete reference - Alexis Leon & Mathews Leon TMG.
10) Microsoft Excel 2016 Bible: The Comprehensive Tutorial Resource
11) Excel: Quick Start Guide from Beginner to Expert (Excel, Microsoft Office)

T.Y.B.Com. Semester- VI

Computer System and Applications -II

COURSE CODE: **BUCCAS606 (2018-19)** Credits**- <u>03</u>**

Objectives:

The main objective of this course is to introduce programming language and some office oriented software to undergraduate students of commerce, so that they can use them in the field of commerce and industry to solve the real life problems.

Sr. No.	**Modules/Units**	**Lectures (60)**
1	**E–Commerce**	**18**
1.1	Definition of E-commerce	
1.2	Features of E-commerce	
1.3	Types of E-commerce (B2C, B2B, C2C, P2P)	
1.4	Business Models in E-commerce (Advertising, Subscription, Transaction Fee, Sales Revenue, Affiliate Revenue)	
1.5	Major B2C models (Portal, Etailer, Content Provider, Transaction Broker,Market Creator, Service Provider, Community Provider).	
1.6	E-Commerce Security: Integrity, Non repudiation, Authenticity, Confidentiality, Privacy Availability.	
1.7	Encryption: Definition, Digital Signatures, SSL.	
1.8	Payment Systems: Digital Cash, Online stored value, Digital accumulating	
1.9	How an Online credit card transaction works. SET protocol.	
1.10	M-commerce (Definition and Features).	
1.11	Limitation of E-commerce.	
2	**Advanced Spread Sheet**	**09**
2.1	Multiple Spreadsheets	
	Creating and using templates, Using predefined templates, Adding protection option.	
	Creating and Linking Multiple Spreadsheets.	
	Using formulas and logical operators.	
	Creating and using named ranges.	
	Creating Formulas that use reference to cells in different worksheets.	
2.2	Functions	
	Database Functions LOOKUP, VLOOKUP, HLOOKUP	

		Conditional Logic functions IF, Nested IF, COUNTIF, SUMIF, AVERAGEIF. String functions LEFT, RIGHT, MID, LEN, UPPER, LOWER, PROPER, TRIM, FIXED.	
3		**Advanced Spread Sheet**	**09**
	3.1	Functions Date functions TODAY, NOW, DATE, TIME, DAY, MONTH, YEAR, WEEKDAY, DAYS360 Statistical Functions COUNTA, COUNTBLANK, CORREL, LARGE, SMALL	
	3.2	Data Analysis Filter with customized condition. The Graphical representation of data Column, Line, Pie and Bar charts. Using Scenarios, creating and managing a scenario. Using Goal Seek Using Solver Understanding Macros, Creating, Recording and Running Simple Macros. Editing a Macro(concept only)	
4		**Visual Basic**	**09**
	4.1	Introduction to Visual Basic, Introduction Graphical User Interface (GUI). Programming Language (Procedural, Object Oriented, Event Driven), Writing VB Projects. The Visual Basic Environment	
	4.2	Introduction to VB Controls Text boxes, Frames, Check boxes, Option button, Designing the User Interface, Default & Cancel property, tab order, Coding for controls using Text, Caption, Value property and Set Focus method	
	4.3	Variables, Constants, and Calculations Variable and Constant, Data Type (String, Integer, Currency, Single, Double, Date), Naming rules/conventions Constants (Named & Intrinsic), Declaring variables, Val Function, Arithmetic Operations, Formatting Data.	
	4.4	Decision and Condition Condition, Comparing numeric variables and constants, Comparing Strings, Comparing Text Property of text box, Compound Conditions (And, Or, Not). If Statement, if then-else Statement, LCase and Ucase function, Using If statements with Option Buttons & Check Boxes. Msgbox (Message box) statement Input Validation : Is Numeric function.	
	4.5	Sub-procedures and Sub-functions, Using common dialog box, Creating a new sub–procedure, Writing a Function procedure.	

	Simple loops using For Next statements and Do while statement and display output using MsgBox Statement.		

References:

1) E- Commerce - Kenneth Laudon, Carol Traver , Pearson Education
2) Frontiers of Electronic Commerce - Kalakota & Whinston
3) E- Commerce - Rajaraman
4) E- Commerce - Whitley
5) E- Commerce concepts and cases - Rao and Deshpande.
6) Programming in VB 6.0 - Julia case Bradley, Anita C. Milspaugh, TMH
7) Visual Basic 6.0 Programming - Content Development Group, TMH
8) The Complete Reference to Visual Basic 6 - Noel Jerke, TMH
9) Visual Basic 6 Programming Black Book - Steven Holzner, Dreamtech Press.
10) Microsoft Excel 2016 Bible: The Comprehensive Tutorial Resource
11) Excel: Quick Start Guide from Beginner to Expert (Excel, Microsoft Office)

B. K. Birla College of Arts, Science and Commerce, Kalyan (W)

Syllabus w.e.f. Academic Year, 2018-19 (CBCS)

Community College

Certificate Course

Mathematics and Statistics-1A

COURSE CODE: **B1.1A.4** **(2018-19)** Credits- **1.5**

Objectives: To learn about

- Permutation and Combination and Linear Programming
- Basic Statistical Concepts, Collection of Data and Measures on Central Tendency

Sr. No.	Modules	Lectures (14)
1 1.1 1.2	**Permutation and Combination and Linear Programming** Permutation and Combination: Factorial Notation, Fundamental Principles of counting, Permutation as arrangement, Simple example, combination as selection, Simple example, relation between nCr and nPr , Examples on commercial application of permutation and combination. Linear Programming: Sketching of graph, linear equation, $Ax + By + C = 0$, linear inequalities. Mathematical formulation of linear programming problems upto 3 variables.	**07**
2 2.1 2.2	**Basic Statistical Concepts, Collection of Data and Measures on Central Tendency** Introduction, Meaning, Scope and Limitation of Statistics. Basic Statistical Concepts: Population Sample, Variable, Attribute , Parameters, Statistics Collection of Data: Primary and Secondary, Sample and Census Survey (Concept Only), Tabulation of Data upto Three Characteristics (Simple Example)	**07**

2.3	Measures on Central Tendency: Arithmetic Mean, Weighted Mean, Combine Mean, Median, Mode, Quartiles (No Examples on Missing Frequency), Deciles, Percentiles.	

Advance Certificate Course

Mathematics and Statistics-1B

COURSE CODE: **B1.1B.4** **(2018-19)** Credits- **1.5**

Objectives: To learn about

- Shares and Mutual Funds
- Measure of Dispersion

Sr. No.	Modules	Lectures (14)
1 1.1 1.2	**Shares and Mutual Funds** Shares: Concept of Shares, Face Value, Market Value, Dividend, Equity Shares, Preferential Shares, Bonus Shares, Simple Examples Mutual Funds: Simple Problems On Calculation Of Net Income After Considering Entry Load , Dividend , Change In Net Asset Value (N. A.V) And Exit Load. Averaging Of Price under the Systematic Investment Plan (S.I.P) .	**07**
2 2.1 2.2	**Measure of Dispersion** Range, Quartile Deviation, Mean Deviation from Mean, Median and Mode. Standard Deviation and their Relative Measures. (Concept of	**07**

	Shift of Origin and Change of Scale Are Not to be done), Combined Variance and Standard Deviation, Co-efficient of Variation.	

Diploma in Accounting and Taxation

Mathematics and Statistics

COURSE CODE: **B1.2.4** **(2018-19)** Credits- **03**

Objectives: To learn about

- Functions, Derivatives and Their Applications
- Interest and Annuity
- Bivariate Linear Correlation and Regression
- Time series and Index Numbers

Sr. No.	Modules	Lectures (27)
1 1.1 1.2	**Interest and Annuity** Interest: Simple Interest, Compound Interest (Nominal & Effective Rate of Interest), Calculations involving up to 4 time periods. Annuity: Annuity Immediate and its Present value, Future value. Equated Monthly Instalments (EMI) using reducing balance method & amortization of loans. Stated Annual Rate & Affective Annual Rate Perpetuity and its present value. Simple problems involving up to 4 time periods.	**07**
2 2.1	**Functions, Derivatives and Their Applications** Concept of limit, Definition of e using limit.	**07**

2.2	Concepts of real functions : Constant function, linear function , $x^n, e^x, a^x, log\ x$, Demand, Supply, Total Revenue, Average Revenue, Total cost, Average cost and Profit function. Equilibrium Point, Break-even point. Derivative of functions: i. Derivative as rate measure, Derivative of $x^n, e^x, a^x, \log x$. ii. Rules of derivatives: Scalar multiplication, sum, difference, product, quotient (Statements only), Simple problems. Second order derivatives. iii. Applications: Marginal Cost, Marginal Revenue, Elasticity of Demand. Maxima and Minima for functions in Economics and Commerce. (Examination Questions on this unit should be application oriented only.)	
3 3.1 3.2	**Bivariate Linear Correlation and Regression** Correlation Analysis: Meaning, Types of Correlation, Determination of Correlation: Scatter diagram, Karl Pearson's method of Correlation Coefficient (excluding Bivariate Frequency Distribution Table) and Spearman's Rank Correlation Coefficient. Regression Analysis: Meaning, Concept of Regression equations, Slope of the Regression Line and its interpretation. Regression Coefficients (excluding Bivariate Frequency Distribution Table), Relationship between Coefficient of Correlation and Regression Coefficients , Finding the equations of Regression lines by method of Least Squares.	**07**

4 4.1 4.2	**Time series and Index Numbers** Time series: Concepts and components of a time series. Representation of trend by Freehand Curve Method, Estimation of Trend using Moving Average Method and Least Squares Method (Linear Trend only). Index Numbers: Concept and Usage of Index numbers, Types of Index Numbers, Aggregate and Relative Index Numbers, Lasperye's, Paasche's and Drobish-Bowley's, Marshall-Edgeworth and Fisher's Index Number.	**06**

References:

1) Mathematics for Economics and Finance Method and Modeling by Martin Anthony and Norman Biggs, Cambridge University press, Cambridge low- priced edition, 2000, chapters 1,2,4,6,to 9 & 10.
2) Applied Calculus : By Stephrn Waner and Steven Constenoble, Books/ Cole Thomson Learning, second edition, chapter 1 to 5
3) Business Mathematics by D. C. Sancheti and V. K. Kapoor, Sultan Chand & Sons, 2006, chapter 1, 5,7,9& 10
4) Mathematics for Business Economics: By J.D. Gupta, P.K Gupta and Man Mohan, Tata Mc-Graw Hill Publishing Co. Ltd., 1987, Chapter 9 to 11 & 16.
5) Quantitative Method- Part- I By Saha and S. Mukerji, New Central Book Agency,1996 Chapter 7& 12
6) Mathematical Basis of Life Insurance By S.P.Dixit, C.S. Modi and R.V. Joshi, Insurance Institute of India, Chapter 2 ; unit 2.6, 2.9, 2.20 & 2.21

B. K. Birla College of Arts, Science and Commerce, Kalyan (W)

Certificate Course in Excel and Latex

With effect from the academic year 2018-19

Sr. No.	Modules	Lectures (30)
1 1.1 1.2 1.3	**Basic Excel** Creating and Navigating worksheets and adding information to worksheets: 1. Types of data, entering different types of data such as texts, numbers, dates, functions. 2. Quick way to add data Auto complete, Autocorrect, Auto fill, Auto fit. Undo and Redo. 3. Moving data, contiguous and non-continuous selections, Selecting with keyboard. Cut-Copy, Paste. Adding and moving columns or rows. Inserting columns and rows. 4. Find and replace values. Spell check. 5. Formatting cells, Numbers, Date, Times, Font, Colors, Borders, Fills. Multiple Spreadsheets : 1. Adding, removing, hiding and renaming worksheets. 2. Add headers/Footers to a Workbook. Page breaks, preview. 3. Creating formulas, inserting functions Functions : 1. Financial functions: FV, PV, PMT, PPMT, IPMT, NPER, RATE, NPV, IRR 2. Mathematical and statistical functions. ROUND, ROUNDDOWN, ROUNDUP, CEILING, FLOOR, INT, MAX, MIN, MOD, SQRT,ABS, AVERAGE	**10**
2 2.1	**Advance Excel** Multiple Spreadsheets: 1. Creating and using templates, Using predefined templates, Adding protection option. 2. Creating and Linking Multiple Spreadsheets.	**15**

		3. Using formulas and logical operators. 4. Creating and using named ranges. 5. Creating Formulas that use reference to cells in different worksheets	
	2.2	Functions 1. Database Functions LOOKUP, VLOOKUP, HLOOKUP 2. Conditional Logic functions IF, Nested IF, COUNTIF, SUMIF, AVERAGEIF 3. String functions LEFT, RIGHT, MID, LEN, UPPER, LOWER, PROPER, TRIM, FIXED 4. Date functions TODAY, NOW, DATE, TIME, DAY, MONTH, YEAR, WEEKDAY, DAYS360 5. Statistical Functions COUNTA, COUNTBLANK, CORREL, LARGE, SMALL	
	2.3	Data Analysis 1. Filter with customized condition. 2. The Graphical representation of data Column, Line, Pie and Bar charts. 3. Using Scenarios, creating and managing a scenario. 4. Using Goal Seek 5. Using Solver	
3		**LaTeX**	**05**
	3.1	Installation of the Software LaTex, Understanding Latex compilation, Basic Syntax, Writing equations, Matrix, Tables, Classes: article, book, report, beamer, slides.	
	3.2	Packages: Geometry, Hyperref, amsmath, amssymb, color, tilez listing.	
	3.3	Page Layout , Titles, Abstract Chapters, Sections, References, Equation references, citation, List making environments, Table of contents, Generating new commands, List of figures, List of tables, Generating index.	
	3.4	Applications to: (i) Writing Resume (ii) Writing articles/ research papers (iii) Presentation using beamer.	

B. K. Birla College of Arts, Science and Commerce, Kalyan (W)

Certificate Course in SciLab

With effect from the academic year 2018-19

Sr. No.	Modules	Lectures (30)
1	**Introduction to SciLab** 1. Basic introduction to SciLab, using SciLab as an advanced calculator. 2. Defining vector and matrices and basic operations. 3. Finding roots of polynomial. 4. Plotting graphs: 2D, 3D and polar plots. 5. Exploring concept of calculus using SciLab. 6. Solving ODE in SciLab.	10
2	**Programming in Scilab** 1. User define Function. 2. Logical operators 3. If__Else condition, If___Elseif___else condition 4. For loops, While Loops 5. Developing programmes to find roots of transcendental and algebraic equations, Area and circumference of circle	10
3	**Linear Algebra in Scilab**: 1. Eigenvalues and eigenvectors and various properties 2. Applications to solve ODE 3. Matrix factorisation and its applications. 4. Gaussian Elimination Method, Gauss-jacobi method and Gauss-Seidel Method	10

References:

1. SciLab textbook Companion for Higher Engineering Mathematics, B. S. Grewal.
2. SciLab textbook Companion for Linear algebra and its Applications, D. C. Lay.
3. SciLab textbook Companion for Numerical Methods, E. Balguruswamy.