JAI HIND COLLEGE AUTONOMOUS

Syllabus for TYBSc

Course : Mathemcatics

Semester : VI

Credit Based Semester & Grading System

With effect from Academic Year 2018-19

List of Courses

Course: Mathematics **Semester: VI**

SR. NO.	COURSE CODE	COURSE TITLE	NO. OF LECTURES / WEEK	NO. OF CREDITS
TYBSc				
1	SMAT 601	Real and Complex analysis	3	4
2	SMAT 602	Algebra II	3	4
3	SMAT 603	Metric Topology	3	4
4	SMAT 604	Numerical Analysis II	3	4
5	SMAT 6 PR1	Practical-I(Based on SMAT 601,SMAT 602)	6	4
6	SMAT 6 PR2	Practical-II(Based on SMAT 603,SMAT 604)	6	4
7	SMAT 6 AC	Applied Component Theory	4	2.5
8	SMAT 6 AC PR	Applied Component Practical	4	2.5

Course Code : SMAT 601	Corse Title: Real and Complex Analysis (No. of Credit: 4 No. of Lectures / week : 3)	
Course Description: This Course starts with sequence and series of function. Further in this paper concepts of differentiation and integration are extended on complex field Course Objective: (1) This course has a wide variety of application in physics and engineering. The main objective of the course is to make students competent in solving real world maths problem. (2) This course can help students to pursue research in applied mathematics.		
Unit I	**Sequence and series of functions** (1) Sequence of functions - pointwise and uniform convergence of sequences of real valued functions, examples. (2) Uniform convergence implies pointwise convergence, example to show converse not true, series of functions, convergence of series of functions, Weierstrass M-test. Examples. (3) 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. Examples. Consequences of these properties for series of functions, term by term differentiation and integration (4) Power series in R centered at origin and at some point x_0 in R , radius of convergence, region (interval) of convergence, uniform convergence, term by-term differentiation and integration of power series, Examples. (5) Uniqueness of series representation, functions represented by power series, classical functions defined by power series such as exponential, cosine and sine functions, the basic properties of these functions.	15 L
Unit II	**Introduction to Complex Analysis** (1) Review of complex numbers: Complex plane, polar coordinates, exponential map, pow- ers and roots of complex numbers, De Moivre's formula, C as a metric space, bounded and unbounded sets, point at infinity-extended complex plane, sketching of set in com- plex plane (No question be asked). (2) Limit at a point, theorems on limits, convergence of sequences of complex numbers and results using properties of real sequences. (3) Functions $f : C \to C$ real and imaginary part of functions, continuity at a point and algebra of continuous functions. Derivative of $f : C \to C$, comparison between differentiability in real and complex sense	15 L

	(4) Cauchy-Riemann equations, sufficient conditions for differentiability, analytic function, f, g analytic then $f+g, f-g, fg$ and f/g are analytic, chain rule. (5) Theorem: If $f(z) = 0$ everywhere in a domain D , then $f(z)$ must be constant through- out D , Harmonic functions and harmonic conjugate.	
Unit III	**Complex power series** 1) Explain how to evaluate the line integral $\int f(z)dz$ over $\lvert z-z_0\rvert = r$ and prove the Cauchy integral formula: If f is analytic in $B(z_0, r)$ then for any w in $B(z_0, r)$ we have $f(w) = \frac{1}{2\pi i}\int \frac{f(z)}{z-w}dz$, over $\lvert z-z_0\rvert = r$ (2) Taylor's theorem for analytic function. Mobius transformations definition and exam- ples. (3) Exponential function, its properties, trigonometric function, hyperbolic functions, Power series of complex numbers and related results following from Unit I, radius of conver- gences, disc of convergence, uniqueness of series representation, examples. (4) Definition of Laurent series, Definition of isolated singularity, statement (without proof) of existence of Laurent series expansion in neighbourhood of an isolated singularity (5) Type of isolated singularities viz. removable, pole and essential defined using Laurent series expansion, statement of residue theorem and calculation of residue.	**15 L**

References:

(1) Unit I:

(i) R.R. Goldberg,, Methods of Real Analysis, Oxford and International Book House (IBH) Publishers, New Delhi.

(ii) Ajit Kumar, S. Kumaresan , Introduction to Real Analysis .

(2) Unit II

(i) J. W. Brown and R. V. Churchill, Complex variables and applications: Sections 18, 19, 20, 21, 23, 24, 25

(3) Unit III

(i) J. W. Brown and R.V. Churchill, Complex analysis and Applications: sections 28, 33, 34, 47, 48, 53, 54, 55 , Chapter 5, page 231 section 65, define residue of a function at a pole using Theorem in section 66 page 234, Statement of Cauchy's residue theorem on page 225, section 71 and 72 from chapter 7.

Additional References:

(1) Robert E. Greene and Steven G. Krantz, Function theory of one complex variable. (2) T. W. Gamelin, Complex Analysis.,

Course Code : SMAT 602	Corse Title: Algebra II (No. of Credit: 4 No. of Lectures / week : 3)	
Unit I	**Group Theory**	**15 L**
	Review of Groups, Subgroups, Abelian groups, Order of a group, Finite and infinite groups 1) Cyclic groups, permutation groups, cosets, Lagrange's theorem, Normal subgroups of a group, Quotient groups. 2) Homomorphism and isomorphism of groups. First isomorphism theorem (or Fundamental Theorem of homomorphisms of groups) ,second isomorphism theorem and third isomorphism theorem of groups. 3) Cayley's theorem. 4) Classification of groups of order 7. 5) Direct product of groups.	
Reference for Unit I: 1) J. Gallian. Contemporary Abstract Algebra. Narosa, New Delhi.assi. Algebra, 2) I.N. Herstein. Algebra. 3) P.B. Bhattacharya, S.K. Jain, S. Nagpaul. Abstract		
Unit II	**Ring theory**	**15 L**
	1) Definition of a ring. (The definition should include the existence of a unity element.), Properties and examples of rings, including 2) Commutative rings. Units in a ring. The multiplicative group of units of a ring. Characteristic of a ring. 3) Ring homomorphisms. First Isomorphism theorem. Second Isomorphism theorem, third Isomorphism theorem of rings. 4) Ideals in a ring, sum and product of ideals in a commutative ring. Quotient rings. 5) Integral domains and fields. Definition and examples. A finite integral domain is a field. Characteristic of an integral domain and of a finite field.	
Reference for Unit II: 1) J. Gallian. Contemporary Abstract Algebra. Narosa, New Delhi.assi. Algebra, 2) M. Artin. Algebra. 3) N.S. Gopalkrishnan. University Algebra. 4) P.B. Bhattacharya, S.K. Jain, S. Nagpaul. Abstract Algebra.		
Unit III	**Factorization**	**15 L**
	1) Prime ideals and maximal ideals. Definition and examples. Characterization in terms of quotient rings. 2) Polynomial rings. Irreducible polynomials over an integral domain. Unique Factorization Theorem for polynomials over a field. Prime (irreducible) elements	

	in R[X], Q[X], Zp[X]. Prime and maximal ideals in polynomial rings. 3) Divisibility in an integral domain, irreducible and prime elements, ideals generated by prime and irreducible elements. 4) Definition of a Euclidean domain (ED), Principal Ideal Domain (PID), Unique Factorization Domain (UFD). Examples of ED: Z, F[X], where F is a field and Z[i]. 5) An ED is a PID, a PID is a UFD. Z[X] is not a PID. Z[X] is a UFD (Statement only).	

Reference for Unit III:

(1) J. Gallian. Contemporary Abstract Algebra. Narosa, New Delhi.assi. Algebra, (2) M. Artin. Algebra.
(3) N.S. Gopalkrishnan. University Algebra.
(4) P.B. Bhattacharya, S.K. Jain, S. Nagpaul. Abstract Algebra.

Recommended Books

1) I.N. Herstein. Topics in Algebra, Wiley Eastern Limited, Second edition.
2) N.S. Gopalakrishnan, University Algebra, Wiley Eastern Limited.
3) M. Artin, Algebra, Prentice Hall of India, New Delhi.
4) T. Banchoff and J. Wermer, Linear Algebra through Geometry, Springer.
5) L. Smith, Linear Algebra, Springer.
6) Tom M. Apostol, Calculus Volume 2, Second edition, John Wiley, New York, 1969.
7) P.B. Bhattacharya, S.K. Jain, and S.R. Nagpaul, Abstract Algebra, Second edition,
8) Foundation Books, New Delhi, 1995.
9) J.B. Fraleigh, A _rst course in Abstract Algebra, Third edition, Narosa, New Delhi.

Course Code : SMAT 603	**Corse Title: Metric Topology** **(No. of Credit: 4 No. of Lectures / week : 3)**	
	Objectives:	
	Outcomes:	
Unit I	**Continuity on Metric Spaces** ε − δ 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. Continuity of a function on a metric space. Characterization in terms of inverse image of open sets and closed sets. Uniform continuity in a metric space, definition and examples (emphasis on), open maps, closed maps.	**15 L**
Unit II	**Completeness and Connectedness**	**15 L**
	(a) Completeness: Cauchy sequences and complete metric spaces. with Euclidean metric is a complete metric space. Cantor's Intersection Theorem. **(b) Connectedness:** Definition and Examples, **(i)** Characterization of a connected space, namely a metric space X is connected if and only if every continuous function from X to {1, −1} is a constant function. **(ii)** Connected subsets of a metric space, connected subsets of . **(iii)** Acontinuous image of a connected set is connected. **(iv)** Path connectedness in , definitions and examples, Apath	

	connected subset of is connected.	
Unit III	**Functional Spaces**	**15 L**
	(a) The function space of real valued continuous functions on a metric space X. The space with sup norm. Weierstrass approximation Theorem. **(b)** Fourier series of functions on , Dirichlet kernel, Fejer kernel,Bessel's inequality and Pareseval's identity, Convergence of the Fourier series in norm.	

Course Code : SMAT 604	Corse Title: Numerical Analysis II (No. of Credit: 4 No. of Lectures / week : 3)	
Unit I	**Interpolation**	**15 L**
	(1) Interpolating polynomials, uniqueness of interpolating polynomials. Linear, Quadratic and higher order interpolation. Lagrange's Interpolation. (2) Finite difference operators: Shift operator, forward, backward and central difference operator, Average operator and relation between them. Difference table, Relation between difference and derivatives. (3) Interpolating polynomials using finite differences: Gregory-Newton forward difference inter- polation, Gregory-Newton backward difference interpolation, Stirling's Interpolation. Results on interpolation error.	
Unit II	**Polynomial approximations and numerical differentiation**	**15 L**
	(1) Piecewise Interpolation: Linear, Quadratic and Cubic. Bivariate Interpolation: La- granges Bivariate Interpolation, Newton's Bivariate Interpolation. (2) Numerical differentiation: Numerical differentiation based on Interpolation, Nu- merical dif- ferentiation based on finite differences (forward, backward and central), Numerical Partial differentiation.	
Unit III	**Numerical Integration**	**15 L**
	1) Numerical Integration based on Interpolation: Newton-Cotes Methods, Trapezoidal rule, Simpsons 1/3-rd rule, Simpsons 3/8-th rule. (2) Determination of error term for all above methods. Convergence of numerical integration: Necessary and sufficient condition (3) Composite integration methods: Trapezoidal rule, Simpsons rule.	

References

[1] E. Kendall and Atkinson, Introduction to Numerical Analysis, Wiley

[2] M. K. Jain, S.R.K. Iyengar and R. K. Jain, Numerical methods for scientific and engineering computation, New Age International Publications.

Additional references

(1) S. D. Comte and Carl De Boor Elementary Numerical Analysis, an algorithmic approach,
McGraw Hill international book comapny.

(2) S. Sastry, Introductory methods of Numerical Analysis, PHI Learning

(3) F. B. Hilderband, Introduction to Numerical Analysis, Dover publication, NY

(4) J. B. Scarborough, Numerical Mathematical Analysis, Oxford University Press, New Delhi

Exam pattern

(1) Semester End Exam (100 marks) for all 4 theory papers. (2)

Semester End Exam (50 marks) for practical papers.

(3) Semester End Exam (100 marks) for Applied component theory paper. (4) Semester

End Exam (100 marks) for Applied component practical paper.

T.Y.B.Sc. End Semester

Theory Question Paper Pattern

(1) All Questions are compulsory

(2) Question (1), (2) and (3) are based on Unit 1, Unit 2 and Unit 3 respectively. The scheme of Question is as Follows:

(A) Attempt any 2 out of 3. Each Question is of 8 Marks.
(B) Attempt any 2 out of 4. Each Question is of 6 Marks.

(3) Question 4 is Based on Unit 1, 2 and 3. Attempt any 4 out of 6. Each Question is of 4 Marks.

T.Y.B.Sc. Practical Exam Pattern

(1) At the end of the Semesters VI, Practical examinations of three hours duration and 100 marks shall be conducted for the courses SMAT 6 PR 1 and SMAT 6 PR 2.

Practical Paper Pattern

(1) Practical Paper I and Practical Paper II are divided into two parts:

(A) Objective type Question of 3 Marks each. Students have to attempt 8 out of 12

(B) Descriptive type Questions of 8 Marks each. Students have to attempt 2 out of 3.

(2) Practical Paper I and Practical Paper II : Journal 5 marks and Viva 5 marks.