JAI HIND COLLEGE AUTONOMOUS

Syllabus for SYBSc / BA

Course : Mathematics

Semester : IV

Credit Based Semester & Grading System

With effect from Academic Year 2018-19

List of Courses

Course: Mathematics **Semester: IV**

SR. NO.	COURSE CODE	COURSE TITLE	NO. OF LECTURES / WEEK	NO. OF CREDITS
SYBSc / BA				
1	SMAT 401/ AMAT 401	Calculus IV	3	3
2	SMAT 402/ AMAT 402	Linear Algebra II	3	3
3	SMAT 403	Differential Equation	3	3
4	SMAT 4 PR1 / AMAT 4 PR 1	Practical-I(Based on SMAT 401 / AMAT 401, SMAT 402/ AMAT 402)	2	2.5
5	SMAT 4 PR2	Practical-II(Based on SMAT 403)	3	2.5

Course Code SMAT 401 AMAT 401	Course Title : Calculus IV (Credit 3 No of Lecture / week : 3)	
Unit I	**Riemann Integral** (1) Definition and existence of Riemann integral, properties of Riemann integral. (2) Fundamental theorem of integral calculus. (3) Mean value theorems of integral Calculus.	**15 L**
Unit II	**Improper integrals** (1) Definition of improper integral of first kind, comparison test. (2) Absolute and conditional convergence (3) Integral test for convergence. (4) Definition of improper integral of second kind, Cauchy principal value	**15 L**
Unit III	**Applications** (1) β and Γ functions and their properties, relationship between β and Γ functions (without proof). (2) Applications of definite Integras: Area between curves, finding volumes by sicing, volumes of solids of revolution-Disks and Washers, Cylindrical Shells, Lengths of plane curves, Areas of surfaces of revolution.	**15 L**

References

[1] Ajit Kumar and S.Kumaresan, A Basic Course in Real Analysis, CRC Press, Second Indian Reprint 2015

[2] R. R. Goldberg, Methods of Real Analysis, Oxford and I. B. H. Publication Co., 1970

[3] Robert, G. Bartle, Donald Sherbert -Introduction to real analysis, Third edition, John Wiley and Sons

Additional Reference

(1) First course in mathematical analysis, D Somsundaram, B Chuadhari, Narosa Publishing house 2009. Ch. 8, Art 8.5

(2) T. Apostol. Mathematical Analysis, Second edition, Narosa, New Delhi, 1974

(3) Shantinarayan and Mittal -A course of Mathematical Analysis, Revised edition, S. Chand and Co.(2002)

(4) S.C. Malik and Savita Arora - Mathematical Analysis , New Age International Publica- tions,Third Edition,(2008)

<table>
<tr><td>Course Code
SMAT 402
AMAT 402</td><td colspan="2">Course Title : Linear Algebra II (Credit 3 No of Lecture / week : 3)</td></tr>
<tr><td>Unit I</td><td>Quotient Spaces and Orthogonal Linear Transformations

Review of vector spaces over R , sub spaces and linear transformation.
1) Quotient Spaces: For a real vector space V and a subspace W, the cosets v +W and the quotient space V/W
2) First Isomorphism theorem of real vector spaces (fundamental theorem of homomorphism of vector spaces), Dimension and basis of the quotient space V/W when V is finite dimensional.
3) Orthogonal transformations: Isometries of a real finite dimensional inner product space, Translations and Reflections with respect to a hyperplane, Orthogonal matrices over R , Equivalence of orthogonal transformations and isometries fixing origin on a finite dimensional inner product space
4) Orthogonal transformation of R^2. Any orthogonal transformation in R^2 is a reflection or a rotation,
5) Characterization of isometries as composites of orthogonal transformations and translation.</td><td>15 L</td></tr>
<tr><td>Unit II</td><td>Eigenvalues and eigen vectors

1) Characteristic polynomial of an n n real matrix. Cayley Hamilton Theorem and its Applications.
2) Eigen values and eigen vectors of a linear transformation T : V V , where V is a finite dimensional real vector space and examples, Eigen values and Eigen vectors of n n real matrices.
3) The linear independence of eigenvectors corresponding to distinct eigenvalues of a linear transformation and of a Matrix. The characteristic polynomial of an n n real matrix and a linear transformation of a finite dimensional real vector space to itself, characteristic roots.
4) Similar matrices, Relation with change of basis, Invariance of the characteristic polynomial and hence of the eigen values of similar matrices, Every square matrix is similar to an upper triangular matrix.
5) Minimal Polynomial of a matrix, Examples like minimal polynomial of scalar matrix, diagonal matrix, similar matrix</td><td>15 L</td></tr>
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<tr><td>Unit III</td><td>Diagonalisation

1) Geometric multiplicity and Algebraic multiplicity of eigen values of an n n real matrix. Geomertic multiplicity of an eigenvalue never exceeds its algebraic multiplicity.
2) An n n matrix A is diagonalizable if and only if 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 eigen values of A coincide.
3) Examples of non diagonalizable matrices, Diagonalisation of a linear transformation T : V V , where V is a finite dimensional real vector space and examples.
4) Orthogonal diagonalisation and Quadratic Forms. Diagonalisation of real symmetric matrices, Examples, Applications to real Quadratic forms, Rank and Signature of a Real Quadratic form,
5) Classification of conics in R^2. Positive definite and semi definite matrices, Characterization of positive definite matrices in terms of principal minors.</td><td>15 L</td></tr>
<tr><td colspan="3">Recommended Books.
1) S. Kumaresan, Linear Algebra: A Geometric Approach.
2) Ramachandra Rao and P. Bhimasankaram, Tata McGrawHillll Publishing Company.</td></tr>
<tr><td colspan="3">Additional Reference Books

1) T. Bancho_ and J. Wermer, Linear Algebra through Geometry, Springer.
2) L. Smith, Linear Algebra, Springer.
3) M. R. Adhikari and Avishek Adhikari, Introduction to linear Algebra, Asian Books Private Ltd.
4) K Hoffman and Kunze, Linear Algebra, Prentice Hall of India, New Delhi.
5) Inder K Rana, Introduction to Linear Algebra, Ane Books Pvt. Ltd.</td></tr>
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Course Code SMAT 403	**Course Title : Differential Equation (Credit 3 No of Lecture / week : 3)**	
Unit I	**First order first degree differential equations** 1) Definitions of Differential Equation, Order and Degree of a Differential Equation, Ordinary Differential Equation (ODE), Partial Differential Equation, Linear ODE, non- linear ODE. 2) Definition of Lipschitz function, examples. Existence and Uniqueness Theorem for the differential equation $y_0 = f(x,y)$; $y(x_0) = y_0$ where f(x,y) is a continuous function satisfying Lipschitz condition (statement only). Solve examples verifying the first order and first degree. conditions of existence and uniqueness theorem. 3) Review of solution of homogeneous and non-homogeneous differential equations of 4) Exact Equations: General Solution of Exact equations of first order and first degree, Necessary and sufficient condition for M dx + N dy = 0 to be exact. Non-exact equations. Rules for finding integrating factors (without proof) for non exact equations Linear and reducible to linear equation, finding solutions of first order differential and finding the current at a given time.	**15 L**
Unit II	**Second order Linear Differential Equations** 1) Existence and uniqueness theorems to be stated clearly when needed in the sequel. 2) Homogeneous and non-homogeneous second order linear differentiable equations. The space of solutions of the	**15 L**

	homogeneous equation as a vector space. Wronskian and linear independence of the solutions. The general solution of homogeneous differential equation. The use of known solutions to find the general solution of homogeneous equations. 3) The general solution of a non-homogeneous second order equation. Complementary functions and particular integrals. 4) The homogeneous equation which constant coefficient, auxiliary equation. The general solution corresponding to real and distinct roots, real and equal roots and complex roots of the auxiliary equation. 5) Non-homogeneous equations: The method of undetermined coefficients. The method of variation of parameters	
Unit III	**Linear System of ODEs** 1) Existence and uniqueness theorems to be stated clearly when needed in the sequel. 2) Study of homogeneous linear system of ODEs in two variables 3) The Wronskian W(t) of two solutions of a homogeneous linear system of ODEs in two variables. 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. 4) Explicit solutions of Homogeneous linear systems with constant coefficients in two variables with examples. 5) Prey –Predator system.	**15 L**

Recommended Text Books for Unit I,II and III

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

S.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.

S.Y.B.Sc. Practical Exam Pattern

(1) At the end of the Semesters IV, Practical examinations of three hours duration and 150 marks shall be conducted for the courses SMAT 4 PR 1 and SMAT 4 PR 2.

(2) At the end of the Semesters III , Practical examinations of two hours duration and 100 marks shall be conducted for the courses AMAT 4 PR 1.

(3) In semester III, the Practical examinations for SMAT 401/AMAT 401 and SMAT 402/AMAT 402 are held together by the college. The Practical examination for SMAT 403 is held separately by the college.

Paper pattern: The question paper shall have three parts A,B, C. Every part shall have three questions of 20 marks each. Students to attempt any two question from each part.

Practical Course	Part A	Part B	Part C	Marks Out of	Duration of Course
SMAT 4 PR 1	Questions From SMAT 401	Questions From SMAT 402	Questions From SMAT 403	120	4 hours
AMAT 4 PR 1	Questions From SMAT 401	Questions From SMAT 401	-	100	2 hours.

Marks for Journals and Viva: For each course SMAT401/AMAT401, SMAT402/AMAT402, SMAT 403.

(i) Journals: 5 marks.

(ii) Viva: 5 marks. Each Practical of every course of Semester III and IV shall contain 10 (ten) problems out of which minimum 05 (Five) have to be written in the journal.