JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program : B.Sc.

Proposed Subject: Mathematics

Semester IV

Credit Based Semester and Grading System (CBGS) with effect from the academic year 2020-21

S.Y.B. Sc. Mathematics Syllabus

Academic year 2020-2021

Semester IV			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SMAT401	Calculus-IV	3	3
SMAT402, AMAT401	Linear Algebra-II	3	3
SMAT403, AMAT402	Data Analytics-II	3	3
SMAT4PR	Practical (Based on SMAT401,402, 403)	6	5
AMAT4PR	Practical (Based on AMAT401,402)	4	2

Semester IV – Theory

Course: SMAT401	Calculus-IV (No. of Credit: 3 , No. of Lectures / week : 3)	

Course Learning Objectives

A goal of this course is to help students develop effective strategies for solving both mathematical and real world problems. Although students often do not like "word problems" probing applications of their mathematical skills, it is very important that instructors emphasize these types of problems so that students become experts at them. In particular, students should be taught how to create mathematical models, develop
effective strategies for solving problems in applied settings and non- routine situations.

Course Learning Outcomes

This course is a pre-requisite for multi-variable and Metric Spaces. Mastery of this course would be manifested in improved reading, writing, thinking, and problem solving skills. Students should have an increased ability to understand, visualize, categorize, model, and solve complicated calculus problems.

Unit I	**Riemann Integral** **(a)** Definition of the Riemann Integral **(b)** The Cauchy criterion for integrability **(c)** Integrability of continuous and monotonic functions **(d)** Properties of Riemann Integral **(e)** The Fundamental theorem of Calculus **(f)** Mean value theorems of Integral Calculus	**15 L**
Unit II	**Applications of Riemann Integral** **(a)** Integration by parts **(b)** Area of a region between curves **(c)** Volume using cross sections and using Cylindrical shells **(d)** Arc length of a curve and Area of surfaces of revolution **(e)** Quadrature Rule	**15 L**
Unit III	**Improper Integral** **(a)** Definition of improper integral **(b)** Absolute and conditional convergent of improper integral **(c)** Integral test for convergence of series **(d)** Beta and Gamma functions	**15 L**

References:

- Sudhir R. Ghorpade, Balmohan V. Limaye, A Course in Calculus and Real Analysis, Springer.
- George B. Thomas, Maurice Weir, and Joel Hass , Calculus , 13th Edition 2014
- http://www.maths.sci.ku.ac.th/suchai/417167/thomas.pdf

Additional References:

- R. R. Goldberg, Methods of real analysis, Oxford & I. B. H. Publications, 1970
- T. Apostol. Calculus, Vol. 2 (Second Edition), John Wiley.
- Robert, G. Bartle, Donald Sherbert - Introduction to real analysis, Third edition, John Wiley and Sons
- Ajit Kumar and S.Kumaresan, A Basic Course in Real Analysis, CRC Press, Second Indian Reprint 2015
- Howard Anton, Calculus - A new Horizon, Sixth Edition, John Wiley and Sons Inc, 1999

Course: SMAT402, AMAT401	Linear Algebra-II (No. of Credit: 3 , No. of Lectures / week : 3)	

Course Learning Objectives:

This Course is part of algebra and is studied in all applied and pure mathematics courses. Basic Knowledge of set theory and multivariable function is helpful for learning the course. This course can be extended from fields to Rings in higher classes. The course has application in face detection software's and mathematical modelling

Course Learning Outcomes:

To equip students with knowledge of eigen values and eigen vectors which is applied everywhere in all sciences. To increase the computational ability of students and help them to relate application of mathematics in real situations.

Unit I	**Inner Product Spaces** • Definition and examples • Norm of a vector in an inner product space and distance and angle between two vectors. • Cauchy-Schwarz inequality, Triangle inequality, Orthogonality of vectors, Pythagoras theorem and geometric applications in R^2 • Projections on a line, the projection being the closest approximation • Orthogonal complements of a subspace, Gram-Schmidt orthogonalization process, orthogonal transformation.	**15 L**
Unit II	**Eigenvalues and eigenvectors** • Definition and examples, Eigen spaces. • Characteristic polynomial of an (n×n) matrix. • Cayley-Hamilton theorem and its applications. • Similar matrices and their relationship with change of basis. • Every square matrix is similar to an upper triangular matrix.	**15 L**
Unit III	**Diagonalization and orthogonal diagonalization** • Diagonalizable matrices, algebraic and geometric multiplicity of an eigenvalue of an (n×n) real matrix, • Equivalent conditions regarding diagonalizable matrices, • Orthogonal diagonalization of an (n×n) real symmetric matrix, • Application to real quadratic forms. • Characterization of positive definite matrices.	**15 L**

References:

- Contemporary abstract algebra by Joseph A. Gallian , 4th edition, Narosa
- Abstract Algebra by Dummit and Foote , Wiley India Pvt. Ltd.

Additional References:

- Basic abstract algebra by Bhattacharya, Jain, Nagpaul, 2nd edition, Cambridge University Press
- A first course in abstract algebra by J.B.Fraleigh, Narosa

Course: SMAT403, SMAT402	**Data Analytics-II (No. of Credit: 3 , No. of Lectures / week : 3)**	
Course Learning Objectives: This course is in continuation with semester III and is based on application of central limit theorem. Various hypothesis test is covered to bring an ease to the concept sampling techniques. Areas like simple and multiple regression with applications like prediction will be covered. Last unit is the introduction of machine learning which is continued in final year. This course is widely applied in data analysis. **Course Learning Outcomes:** To make students comfortable with data analysis in quantitative research. To enhance the skills of mathematical modelling. To create interest in statistical mathematics. To motivate students towards machine learning and data analytics. To equip students with required knowledge for higher studies and specialization in applied mathematics.		
Unit I	**Testing of Statistical Hypothesis** • Statistics and parameters, statistical inference: problem of estimation and testing of hypothesis. Estimator and estimate. Unbiased estimator (definition and illustrations only). Statistical hypothesis, null and alternative hypothesis, one sided and two-sided alternative hypothesis, critical region, type I error, type II error, level of significance, p-value. Confidence interval. • Tests for mean using critical region approach • Central limit theorem (using critical region approach and p value approach) • Tests for proportion • Chi-square and Student's t-distribution, Snedecore's F- distribution	**15 L**
Unit II	**Learning-Standard Linear and non-Linear methods** • **Statistical Learning:** Assessing Model Accuracy. Linear Regression: Simple Linear Regression, Multiple Linear Regressions, Other Considerations in the Regression Model, Comparison of Linear Regression with K-Nearest Neighbour's. LogisticRegression. • **Non-Linear Learning methods:** Polynomial Regression, Step Functions, Basis Functions, Regression Splines, Smoothing Splines, Local Regression	**15 L**

Unit III	**Supervised and Unsupervised Learning** • Challenges, Fraud detection, Distance based Algorithm: K nearest Neighbours and kD- Trees. • **Rules-Based Classifiers:** Rule Sets, Rule Lists, Constructing Rules- based Classifiers: 1R; PRISM;RIPPER. • **Trees Classifiers:** Tree Learning Algorithm, Attribute Splitting Decisions: Random, Purity Count, Entropy (ID3), Information Gain Ratio, pruning Pre- and Post-Pruning; C4.5's error estimation, From Trees to Rules. • **Statistical based classifiers:** Bayesian classification, Bayesian Networks.	**15 L**

References:

- Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition,The World Press Pvt. Ltd., Calcutta
- Goon A. M., Gupta, M. K. and Dasgupta, B. (1986), Fundamentals of Statistics, Vol. 2, World Press, Kolkata.
- Gupta, S. C. and Kapoor, V. K. (2002), Fundamentals of Mathematical Statistics, (Eleventh Edition), Sultan Chand and Sons, 23, Daryaganj, New Delhi , 110002 .
- Gupta, S. C. and Kapoor V. K. (2007), Fundamentals of Applied Statistics (Fourth Edition), Sultan Chand and Sons, New Delhi.
- Dunham, Margaret H, Data Mining: Introductory and Advanced Topics, Prentice Hall.
- Witten, Ian and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Morgan Kaufmann.

Additional References:

- Gupta, S. P. (2002), Statistical Methods (Thirty First Edition), Sultan Chand and Sons, 23, Daryaganj, New Delhi 110002.
- Hogg, R. V. and Craig, A. T. , Mckean J. W. (2012), Introduction to Mathematical Statistics (Tenth Impression), Pearson Prentice Hall.
- *Han and Kamber (2006), Data Mining: Concepts and Techniques, Second Edition, Morgan Kaufmann*
- *Berry, Browne(2006), Lecture Notes in Data Mining, World Scientific.*

Semester IV – Practical

Course: SMAT4PR	**Practical (Based on SMAT 401, 402 and 403) (Credits 6 : Practical /Week: 5)**
Course: AMAT4PR	**Practical (Based on AMAT401 and 402) (Credits 4 : Practical /Week: 2)**

Problems based on SMAT401

- Problems on Riemann integral.
- Problems on fundamental theorem of calculus, mean value theorems
- Integration by parts . Find area of a region between curves, volume using cross sections and using Cylindrical shells
- Find the arc length of a curve and area of surfaces of revolution
- Approximation of definite integrals using quadrature Rule
- Example on improper integral, Beta and Gamma functions

Problems based on SMAT402/AMAT401

- Examples of Inner product spaces and to find length and angle.
- Gram-Schimdt process to obtain an orthogonal set from a given set.
- Problems based on Cayley-Hamilton theorem
- Finding eigenvalues and eigenvectors.
- Diagonalization of a matrix
- Orthogonal diagonalization and quadratic forms

Problems based on SMAT403/AMAT402

- Diagrammatic representation of statistical data: simple and subdivided bar diagrams, multiple bar diagram, percentage bar diagram, pie diagram
- Graphical representation of statistical data: histogram, frequency curve and ogive curves. Determination of mode and median graphically
- Computation of measures of central tendency and dispersion (grouped data)
- Fitting of binomial distribution and computation of expected frequencies
- Fitting of binomial distribution and computation of expected frequencies
- Fitting of Poisson distribution and computation of expected frequencies.
- Fitting of normal and exponential distributions, plot of observed and expected frequencies

Evaluation Scheme

Evaluation Scheme for Theory courses

I. Continuous Assessment (C.A.)- 40 % - 40 Marks

Sr. No.	Evaluation type	Marks
1.	**C.A.-I :** It will be conducted either using any open source learning management system or by taking a test	20
2.	**C.A.-II :** Assignments / Project (maximum 5 students in a group)	20

II. Semester End Examination (SEE) - 60 % - 60 Mark , Duration 2 Hrs

Theory Question Paper Pattern:-

All Questions are Compulsory			
Question	**Options**	**Based on**	**Marks**
1.	Any 3 out of 5	**Unit I**	**15**
2.	Any 3 out of 5	**Unit II**	**15**
3.	Any 3 out of 5	**Unit III**	**15**
4.	Any 3 out of 5	**Unit IV**	**15**

Evaluation scheme for Practical courses- 150 / 100 Marks

Each student will maintain a Journal. After every practical, student will upload his practical in the form of documents along with the screen shots of output on any LMS.

Sr. No.	Heading	Marks
1.	Journal	15
2.	Practical (Based on SMAT401, SMAT 402 and SMAT 403)	120
3.	Viva	15
Total		150

Sr. No.	Heading	Marks
1.	Journal	10
2.	Practical (Based on AMAT401, AMAT 402)	80
3.	Viva	10
Total		100

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