

BENGALURU CITY UNIVERSITY

**SYLLABUS For B.Sc. MATHEMATICS
(I to IV Semester)**

CHOICE BASED CREDIT SYSTEM

2020-2021



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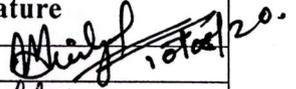
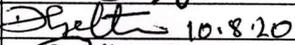
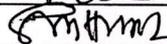
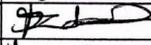
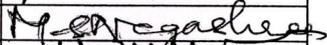
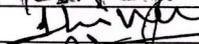
Dr. Medha Itagi Huilgol M. Sc, Ph. D
Co-ordinator

Date: 10-08-2020

Proceedings of the BOS(UG) meeting

The BOS(UG) meeting in Mathematics was held on 10-08-2020 at 12 noon in the Department of Mathematics, Bengaluru Central University, Central College Campus, Bengaluru-560001.

The following members attended the meeting.

Sl. No	Name	Designation	Signature
1.	Dr. Medha Itagi Huilgol	Chairperson	
2.	Dr. D Sujatha	Member	
3.	Prof. S. N Honnappa	Member	
4.	Dr.D.Radhakrishna	Member	
5.	Dr.M.S.Nagashree	Member	
6.	Prof.K.Shivakumar	Member	
7.	Mr.John J Binze	Member	
8.	Dr. Shivasharanappa Sigarkanti	Member	
9.	Smt. Saly Abraham	Member	Consented via email
10.	Sri. Chandrashekhar S. K	Member	

- Final drafted of the syllabus was checked.
- A discussion was held on the new syllabus.
- The syllabus was approved by the Chairperson and members present.
- The committee decided to get approval for **first four** semesters only.
- 5th and 6th semester syllabus will be decided in the next coming meetings.



(Medha Itagi Huilgol)
CO-ORDINATOR
Department of Mathematics
Bengaluru Central University
Central College Campus
Bengaluru - 560 001

MEDICAL DEPARTMENT

1910

Date of birth of the patient: _____
 Date of admission to the hospital: _____
 Date of discharge: _____

Date: 10-18-1910

Medical Department No. 1010

Progressive (1010) (1010) meeting

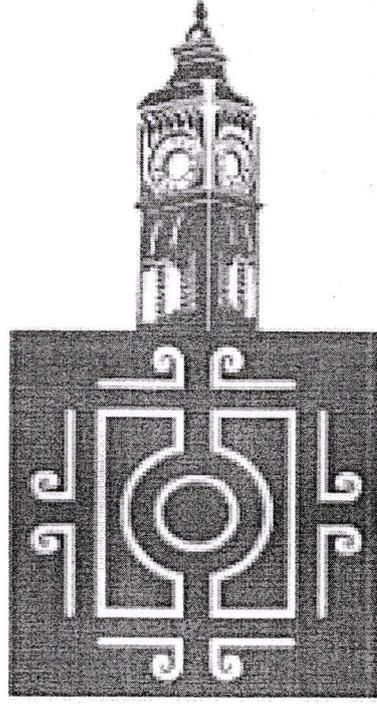
The following is a summary of the patient's progress during the last week of his stay in the hospital. The patient has been in the hospital since 10-18-1910 at 10:00 AM. He has been in the hospital for a total of 10 days. The patient has been in the hospital for a total of 10 days.

The following is a summary of the patient's progress during the last week of his stay in the hospital.

No.	Name	Age	Sex	Occupation	Address	Admitted	Discharged	Remarks
1	John Doe	35	M	Teacher	123 Main St.	10-18-1910	10-25-1910	Recovered
2	Jane Smith	28	F	Homemaker	456 Elm St.	10-18-1910	10-25-1910	Recovered
3	Robert Brown	42	M	Farmer	789 Oak St.	10-18-1910	10-25-1910	Recovered
4	Mary White	30	F	Shopkeeper	101 Pine St.	10-18-1910	10-25-1910	Recovered
5	William Black	50	M	Engineer	202 Cedar St.	10-18-1910	10-25-1910	Recovered
6	Elizabeth Green	25	F	Student	303 Birch St.	10-18-1910	10-25-1910	Recovered
7	Thomas Gray	38	M	Writer	404 Spruce St.	10-18-1910	10-25-1910	Recovered
8	Anna King	45	F	Homemaker	505 Willow St.	10-18-1910	10-25-1910	Recovered
9	Charles Lee	32	M	Teacher	606 Ash St.	10-18-1910	10-25-1910	Recovered
10	Frances Hall	27	F	Homemaker	707 Hickory St.	10-18-1910	10-25-1910	Recovered

The following is a summary of the patient's progress during the last week of his stay in the hospital. The patient has been in the hospital since 10-18-1910 at 10:00 AM. He has been in the hospital for a total of 10 days. The patient has been in the hospital for a total of 10 days.

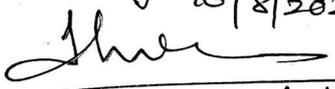
Medical Department
 Progressive (1010) (1010) meeting
 Date: 10-18-1910



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BENGALURU
CENTRAL UNIVERSITY

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BE BOUNDLESS

1. Medha Itagi Huijgol  10/08/20.
2. Dr. Sujatha. D  10.08.2020
3. S. N. Honnappa  10.08.2020
4. Dr. D. Radhakrishna  10/8/2020
5. Dr. M. S. NAGASHREE  10/8/2020
6. Major K. SHIVAKUMAR  10/8/20
7. John J. Binze  10/8/20
8. Dr. Shivasharamappa Rigenketti  10/8/20
9. Smt. Saly Abraham - Consent sent by mail

MISSION AND VISION OF THE NEW SYLLABUS IN MATHEMATICS

Mission

- Improve retention of mathematical concepts in the student.
- To develop a spirit of inquiry in the student.
- To improve the perspective of students on mathematics as per modern requirement.
- To initiate students to enjoy mathematics, pose and solve meaningful problems, to use abstraction to perceive relationships and structure and to understand the basic structure of mathematics.
- To enable the teacher to demonstrate, explain and reinforce abstract mathematical ideas by using concrete objects, models, charts, graphs, pictures, posters with the help of FOSS tools on a computer.
- To make the learning process student-friendly by having a shift in focus in mathematical teaching, especially in the mathematical learning environment.
- Exploit techno-savvy nature in the student to overcome math-phobia.
- Propagate FOSS (Free and open source software) tools amongst students and teachers as per vision document of National Mission for Education.
- To set up a mathematics laboratory in every college in order to help students in the exploration of mathematical concepts through activities and experimentation.
- To orient students towards relating Mathematics to applications.

Vision

- To remedy Math phobia through authentic learning based on hands-on experience with computers.
- To foster experimental, problem-oriented and discovery learning of mathematics.
- To show that ICT can be a panacea for quality and efficient education when properly integrated and accepted.
- To prove that the activity-centered mathematics laboratory places the student in a problem solving situation and then through self exploration and discovery habituates the student into providing a solution to the problem based on his or her experience, needs, and interests.
- To provide greater scope for individual participation in the process of learning and becoming autonomous learners.
- To provide scope for greater involvement of both the mind and the hand which facilitates cognition?
- To ultimately see that the learning of mathematics becomes more alive, vibrant, relevant and meaningful; a program that paves the way to seek and understand the world around them. A possible by-product of such an exercise is that math-phobia can be gradually reduced amongst students.
- To help the student build interest and confidence in learning the subject.

Support system for Students and Teachers in understanding and learning FOSS TOOLS:

As a national level initiative towards learning FOSS tools, IIT Bombay for MHRD, Government of India is giving free training to teachers interested in learning open source soft wares like scilab, maxima, python, octave, geogebra and others.

(website: <http://spoken-tutorial.org> ; email: contact@spoken-tutorial.org ; info@spokentutorial.org)

REVISED SYLLABUS

FIRST SEMESTER
MATHEMATICS – I

(4 lecture hours per week+3 hours of practical /week per batch of not more than 15 students)

(56 HOURS)

THEORY

1. ALGEBRA - I

Matrices

Elementary row and column transformations (operations), equivalent matrices, theorems on it. Row- reduced echelon form, Normal form of a matrix, Rank of a matrix, Problems.

Homogeneous and Non – Homogeneous systems of m linear equations in n unknowns consistency criterion – criterion for uniqueness of solutions.

Eigenvalues and Eigenvectors of a square matrix of order 2 and 3, standard properties, Matrix polynomial, Cayley-Hamilton theorem (with proof). Finding A^{-1}, A^{-2} and A^2, A^3, A^4 . Application Problems. (14 lecture hours)

2. CALCULUS – I

a) Differential Calculus

Successive Differentiation - n^{th} derivatives of the functions: e^{ax+b} , $(ax + b)^n$, $\log(ax + b)$, $\sin(ax + b)$, $\cos(ax + b)$, $e^{ax}\sin(bx + c)$, $e^{ax}\cos(bx + c)$ – Problems. Leibnitz theorem (with proof) and its applications.

Partial differentiation –Function of two and three variables - First and higher order derivatives - Homogeneous functions – derivatives- Euler's theorem and its extension (with proof) - Total derivative and differential - Differentiation of implicit functions and composite functions – Problems - Jacobians – Properties of Jacobians problems.Application Problems

b) Integral Calculus

Reduction formulae for $\int \sin^n x \, dx$, $\int \cos^n x \, dx$, $\int \tan^n x \, dx$, $\int \cot^n x \, dx$, $\int \sec^n x \, dx$, $\int \operatorname{cosec}^n x \, dx$, $\int \sin^m x \cos^n x \, dx$, with definite limit - problems. Differentiation under integral sign by Leibnitz rule- problems. **(28 lecture hours)**

3. GEOMETRY

Analytical Geometry of Three Dimensions

Recapitulation of elements of three dimensional geometry- Equation of the sphere in general and standard forms - equation of a sphere with given ends of a diameter. Tangent plane to a sphere, orthogonality of spheres.

Standard equations of right circular cone and right circular cylinder and problems.

(14 lecture hours)

Note: All the derivations (book works) must be through vector methods with reduction to corresponding Cartesian equivalents.

Suggested distribution of lecture hours

1. Matrices: 1 hour perweek
2. Differential Calculus and Integral Calculus: 2 hours perweek
3. Analytic Geometry of three dimensions: 1 hour perweek.

Text Books

1. Shanti Narayan and P K Mittal, Text book of *Matrices*, 5th ed., New Delhi, S. Chand and Co.Pvt. Ltd.,2013.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2014.
3. Shanthi Narayan and P K Mittal, *Integral Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
4. Shanthi Narayan and P K Mittal, *Analytical Solid Geometry*. New Delhi: S. Chand and Co. Pvt. Ltd., 2014.
5. Philip N. Klein, *Coding the Matrix: Linear Algebra through Computer Science Applications*, Newtonian Press, 2013.
6. Brian Heinold, *A Practical Introduction to Python Programming*, Department of Mathematics and Computer Science, Mount St. Mary's University, 2019.

Reference Books

1. B S Vatssa, *Theory of Matrices*, New Delhi: New Age International Publishers, 2005.

2. A R Vashista, *Matrices*, Krishna PrakashanaMandir, 2003.
3. G B Thomasand and R L Finney, *Calculus and analytical geometry*, Addison Wesley, 1995.
4. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
5. N P Bali, *Differential Calculus*, India: Laxmi Publications (P) Ltd., 2010.
6. S Narayanan & T. K. Manicavachogam Pillay, *Calculus.*: S. Viswanathan Pvt. Ltd., Vol. I & II, 1996.
7. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
8. SPMahajan & Ajay Aggarwal, *Comprehensive Solid Geometry*, 1st ed.: Anmol Publications , 2000.
9. H. Anton, I Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc, 2002.

Useful web links:

1. <http://www.cs.columbia.edu/~zeph/3203s04/lectures.html>
2. <http://home.scarlet.be/math/matr.htm>
3. <http://www.themathpage.com/>
4. <http://www.abstractmath.org/>
5. <http://ocw.mit.edu/courses/mathematics/>
6. <http://planetmath.org/encyclopedia/TopicsOnCalculus.html>
7. <http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm>
8. <http://mathworld.wolfram.com/Calculus.html>
9. <http://ocw.mit.edu/courses/mathematics/>
10. <http://www.univie.ac.at/future.media/moe/galerie.html>
11. <http://mathworld.wolfram.com/AnalyticGeometry.html>
12. <http://www.nptelvideos.in/2012/11/mathematics.html>
13. <https://www.my-mooc.com/en/categorie/mathematics>
14. www.python.org
15. www.rosettacode.org
16. <http://faculty.msmary.edu/heinold/python.html>
17. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>

PRACTICALS – I

Mathematics practical with Free and Open Source Software (FOSS) tool for computer programs (3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Introduction to Python: Basic syntax, variable types, basic operators, numbers, strings, lists, tuples, functions and input/output statements.

2. Some simple programs to understand the relational, conditional and logical operators.
 - i) Compare two numbers (less than, greater than) using *if* statement
 - ii) Sum of natural numbers using *while* loop
 - iii) Finding the factors of a number using *for* loop.
 - iv) To check the given number is prime or not (use *if... else* statement).
 - v) Find the factorial of a number (use *if...if...else*).
 - vi) Simple programs to illustrate *logical operators (and, or, not)*

Note: Give the structure of a while...do loop to the students and illustrate with an example.

3. Python commands to reduce given matrix to echelon form and normal form with examples.
4. Python program/command to establish the consistency or otherwise and solving system of linear equations.
5. Python command to find the n^{th} derivatives.
6. Python program to find n^{th} derivative with and without Leibnitz rule.
7. Obtaining partial derivative of some standard functions
8. Verification of Euler's theorem, its extension and Jacobean.
9. Python program for reduction formula with or without limits.
10. Python program to find equation and plot sphere, cone, cylinder.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

SECOND SEMESTER

MATHEMATICS – II

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students)

(56 HOURS)

THEORY

1. ALGEBRA - II

Group Theory

Binary operation, algebraic structure-problems on finding identity and inverse. Definitions of semigroup and group, abelian group – problems on finite and infinite groups. Properties of group with proof – standard problems on groups – A finite semi group with both the cancellation laws is a group – Any group of order less than five is abelian – permutation groups.

Subgroups- theorems on subgroups (with proof)- problems. (14 lecture hours)

2. CALCULUS - II

a) Differential Calculus

Polar coordinates - Angle between the radius vector and the tangent - Angle of intersection of curves (polar form) polar sub-tangent and polar subnormal- perpendicular from pole on the tangent - Pedal equations. Derivative of an arc in Cartesian, parametric and polar forms (with derivations).

Curvature of plane curves - formula for radius of curvature in Cartesian, parametric, polar and pedal forms - centre of curvature - evolutes. Singular points – Asymptotes – Envelopes. Application Problems

b) Integral Calculus

Applications of Integral Calculus: computation of length of arc, plane area and surface area and volume of solids of revolutions for standard curves in Cartesian and Polar forms. Application Problems.

(28 lecture hours)

3. DIFFERENTIAL EQUATIONS – I

Recapitulation of Solutions of ordinary differential equations of first order and first degree. Solutions of:

(i) Linear equations, Bernoulli's equation.

(ii) Exact equations(excluding reducible to Exact)

Equations of first order and higher degree – nonlinear first order, higher degree – solvable for p - solvable for y - solvable for x - Clairaut's equation - singular solution - Geometric meaning. Orthogonal trajectories in Cartesian and polar forms. Application Problems. **(14 lecture hours)**

Suggested distribution of lecture hours

1. Algebra-II (Group theory) : 1 hour / week
2. Calculus-II (Differential calculus & Integral Calculus): 2 hours / week.
3. Differential Equations-I: 1 hour / week.

Text Books

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
3. Shanthi Narayan and P K Mittal, *Integral Calculus*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
4. M D Raisinghania, *Ordinary and Partial Differential Equations*, S Chand and Co. Pvt. Ltd., 2014.
5. Eric Ayars, *Computational Physics with Python*, California State University, Chico.
6. Hans PetterLangtangen and Anders Logg, *Solving PDEs in Python*, Springer, 2017.

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. G B Thomasand R L Finney, *Calculus and analytical geometry*, Addison Wesley, 1995.
6. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
7. N P Bali, *Differential Calculus*, New ed. New Delhi, India: Laxmi Publications (P) Ltd., 2010.

8. S Narayanan & T. K. Manicavachogam Pillay, *Calculus*.: S. Viswanathan Pvt. Ltd., vol. I & II, 1996.
9. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
10. E Spiegel, *Schaum's Outline of Advanced Calculus*, 5th ed. USA: Mc. Graw Hill., 2009.
11. M D Raisinghania, *Advanced Differential Equations*, S Chand and Co. Pvt. Ltd., 2013.
12. F Ayres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 2010.
13. S Narayanan and T K Manicavachogam Pillay, *Differential Equations*.: S V Publishers Pvt. Ltd., 1981.
14. G F Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.
15. Hans Petter Langtangen, *A primer on Scientific programming with Python*, Springer, 2016.

Useful web links:

1. <http://www.themathpage.com/>
2. <http://www.abstractmath.org/>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <http://planetmath.org/encyclopedia/TopicsOnCalculus.html>
5. <http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm>
6. <http://mathworld.wolfram.com/Calculus.html>
7. <http://ocw.mit.edu/courses/mathematics/>
8. <http://www.univie.ac.at/future.media/moe/galerie.html>
9. <http://tutorial.math.lamar.edu/classes/de/de.aspx>
10. <http://www.sosmath.com/diffeq/diffeq.html>
11. http://www.analyzemath.com/calculus/Differential_Equations/applications.html
12. <http://www.nptelvideos.in/2012/11/mathematics.html>
13. <https://www.my-mooc.com/en/categorie/mathematics>
14. www.python.org
15. www.rosettacode.org
16. <http://faculty.msmary.edu/heinold/python.html>
17. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>

PRACTICALS –II

Mathematics practicals with *Free and Open Source Software (FOSS)* tool for computer programs(3 hours/ week per batch of not more than 15 students)

LIST OF PROGRAMMES

1. i). Verifying whether given operator is binary or not
 ii). To find identity and inverse element of a group
2. Plotting of standard Cartesian curves(Part-1)
3. Plotting of standard Cartesian curves (Part-2)
4. Plotting of standard polar curves
5. Plotting of standard parametric curves
6. Surface area and Volume of curves
7. Solution of differential equation and plotting(Part-1)
8. Solution of differential equation and plotting(Part-2)
9. Solution of differential equation and plotting(Part-3)
10. Solution of differential equation and plotting the solution(Part-4)

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

THIRD SEMESTER

MATHEMATICS-III

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students)

(56 HOURS)

THEORY

1. ALGEBRA - III

Groups

Order of an element of a group – properties related to order of an element- subgroup generated by an element of a group – Equivalence Class and partition of a set, coset decomposition of a group, Cyclic groups- properties- modulo relation- index of a group – Lagrange's theorem- consequences.

(14 lecture hours)

2. ANALYSIS – I

a) Sequences of Real Numbers

Definition of a sequences-Bounded sequences- limit of a sequences-convergent, divergent and oscillatory sequences- Monotonic sequences and their properties- Cauchy's criterion. Application Problems.

b) Series of Real Numbers

Definition of convergence, divergence and oscillation of series -properties of Convergence series - properties of series of positive terms – Geometric series Tests for convergence of series -p- series - comparison of series Cauchy's root Test -D'Alembert's test. Raabe's test, - Absolute and conditional convergence-D'Alembert test for absolute convergence - Alternating series - Leibnitz test.

Summation of binomial, exponential and logarithmic series.Application Problems.

(28 lecture hours)

3. MATHEMATICAL METHODS -I

Definition and basic properties Laplace transform of some common functions and Standard results –Laplace transform of periodic functions- Laplace transforms ,of derivatives And the integral of function- Laplace transforms, Heaviside function convolution theorem (statement only) Inverse Laplace transforms. Application Problems. (14 lecture hours)

Suggested distribution of lecture hours

1. Algebra – III (Groups): 1 hour / week.
2. Analysis-I (sequences of real numbers and series of real numbers): 2 hours /week
3. Mathematical Methods - I (1 hour / week.)

Text Books

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Pub. House Pvt. Ltd, 1991.
2. Boumslag and Chandler, *Schaum's outline series on groups*, 2010.
3. S.C.Malik and Savita Arora, *Mathematical Analysis*, 2nd ed. New Delhi, India: New Age international (P) Ltd., 1992.
4. John Kerl, Concrete abstract algebra in Python, Notes.
5. Titus Adrian Beu, Introduction to Numerical programming, CRC Press, Taylor and Francis.
6. Eric Ayars, *Computational Physics with Python*, California State University, Chico.

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakashan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishnan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. Richard R Goldberg, *Methods of Real Analysis*, Indian ed. New Delhi, India: Oxford and IBH Publishing Co., 1970.
6. Raisinghania M.D., *Laplace and Fourier Transforms*. New Delhi, India: S. Chand and Co. Ltd. , 1995.

Usefulweb links:

1. <http://www.themathpage.com/>
2. <http://www.abstractmath.org/>
3. <http://ocw.mit.edu/courses/mathematics/>
4. <http://www.math.unl.edu/~webnotes/contents/chapters.htm>

5. <http://www-groups.mcs.st-andrews.ac.uk/~john/analysis/index.html>
6. <http://web01.shu.edu/projects/reals/index.html>
7. <http://www.mathcs.org/analysis/reals/index.html>
8. <http://planetmath.org/encyclopedia/TopicsOnCalculus.html>
9. <http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm>
10. <http://mathworld.wolfram.com/Calculus.html>
11. <http://ocw.mit.edu/courses/mathematics/>
12. <http://www.nptelvideos.in/2012/11/mathematics.html>
13. <https://www.my-mooc.com/en/categorie/mathematics>
14. www.python.org
15. http://doc.sagemath.org/html/en/thematic_tutorials/group_theory.html
16. http://doc.sagemath.org/html/en/reference/groups/sage/groups/abelian_gps/abelian_group_morphism.html
17. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>

PRACTICALS –III

Mathematics practicals with Free and Open Source Software (FOSS) tool for computer programs(3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Examples for finding right and left coset and the index of a group.
2. Examples to verify Lagrange's theorem.
3. Illustration of convergent, divergent and oscillatory sequence.
4. Illustration of convergent, divergent and oscillatory series.
5. Using Cauchy's criterion to determine the convergence of a sequence.
6. To find the sum of the series.
7. Finding the Laplace transform.
8. Finding the inverse Laplace transform.
9. Laplace transform method of solving first order ordinary differential equations with constant coefficients.
10. Laplace transform method of solving second order ordinary differential equations with constant coefficients

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

FOURTH SEMESTER

MATHEMATICS – IV

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students)

(56 HOURS)

THEORY

1. ALGEBRA –IV

Groups

Normal subgroups-examples and problems –Quotient group-Homomorphism and Isomorphism of groups-Kernel and image of a homomorphism-Normality of the Kernel-Fundamental theorem of homomorphism- properties related to isomorphism-Permutation group-Cayley's theorem.(10 lecture hours)

2. ANALYSIS -II

Fourier Series

Trigonometric Fourier series of functions with period 2π and period $2L$ - Half range Cosine and sine series. Application problems. (10 lecture hours)

3. CALCULUS - III

Differential Calculus

Definition of the limit of a function in ϵ - δ form –continuity- types of discontinuities. Properties of continuous function on a closed interval (boundedness, attainment of bounds and taking every value between bounds). Differentiability - Theorem :Differentiability implies Continuity - Converse not true. Rolle's Theorem- Lagrange's and Cauchy's First Mean Value Theorem (Lagrange's form) - Maclaurin's expansion. Evaluation of limits by L' Hospital's rule

Continuity and differentiability of a function of two and three variables – Taylor's Theorem and expansion of functions of two variables- Maxima and Minima of functions of two variables. Method of Lagrange multipliers. (22 lecture hours)

4. DIFFERENTIAL EQUATIONS –II

Second and higher order ordinary linear differential equations with constant Coefficients- complementary function- particular integrals (standard types) Cauchy-Euler differential equation. Simultaneous linear differential equations (two variables) with constant coefficients. Solutions of second order ordinary linear differential equations with variable coefficients by the following methods.

- (i) When a part of complementary function is given
- (ii) Changing the independent variable
- (iii) Changing the dependent variable
- (iv) Variation of parameters
- (v) Conditions for exactness and the solution when the equation is exact.

(14 lecture hours)

Suggested distribution of lecture hours

1. Algebra – IV, Analysis – II, Calculus - III: 3 hours / week.
2. Differential Equations II: 1 hour / week.

Text Books

1. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
2. Boumslag and Chandler, *Schaum's outline series on groups*, 2010.
3. Erwin Kreyszig, *Advanced Engineering Mathematics*, 8th ed. New Delhi, India: Wiley India Pvt. Ltd., 2010.
4. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
5. M D Raisinghania, *Ordinary and Partial Differential Equations*, S Chand and Co. Pvt. Ltd., 2014.
6. John Kerl, Concrete abstract algebra in Python, Notes.

Reference Books

1. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
2. Vashista, *A First Course in Modern Algebra*, 11th ed.: Krishna Prakasan Mandir, 1980.
3. John B Fraleigh, *A First course in Abstract Algebra*, 3rd ed.: Narosa Publishing House., 1990.
4. R Balakrishan and N.Ramabadran, *A Textbook of Modern Algebra*, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
5. G B Thomas and R L Finney, *Calculus and analytical geometry*, Addison Wesley, 1995.

6. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
7. N P Bali, *Differential Calculus*, Laxmi Publications (P) Ltd., 2010.
8. S Narayanan & T. K. Manicavachogam Pillay, *Calculus.*: S. Viswanathan Pvt. Ltd., Vol. I & II, 1996.
9. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
10. E Spiegel, *Schaum's Outline of Advanced Calculus*, 5th ed. USA: Mc. Graw Hill., 2009.
11. M D Raisinghania, *Advanced Differential Equations*, S Chand and Co. Pvt. Ltd., 2013.
12. F Ayres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 2010.
13. S Narayanan and T K Manicavachogam Pillay, *Differential Equations.*: S V Publishers Private Ltd., 1981.
14. G F Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.
15. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.

Useful web links:

1. <http://www.themathpage.com/>
2. <http://www.abstractmath.org/>
3. <http://www.fourier-series.com/>
4. <http://mathworld.wolfram.com/>
5. <http://www.princeton.edu/~rvdb>
6. <http://www.zweigmedia.com/RealWorld/Summary4.html>
7. <http://ocw.mit.edu/courses/mathematics/>
8. <http://planetmath.org/encyclopedia/TopicsOnCalculus.html>
9. <http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm>
10. <http://mathworld.wolfram.com/Calculus.html>
11. <http://ocw.mit.edu/courses/mathematics/>
12. <http://www.univie.ac.at/future.media/moe/galerie.html>
13. <http://tutorial.math.lamar.edu/classes/de/de.aspx>
14. <http://www.sosmath.com/diffeq/diffeq.html>
15. http://www.analyzemath.com/calculus/Differential_Equations/applications.html
16. <http://www.nptelvideos.in/2012/11/mathematics.html>
17. <https://www.my-mooc.com/en/categorie/mathematics>

18. www.python.org
19. <http://www.auraauro.com/uncategorized/demonstration-of-fourier-series-using-python-code/>
20. <https://kitchingroup.cheme.cmu.edu/pycse/pycse.html>

PRACTICALS –IV

Mathematics practicals with Free and Open Source Software (FOSS) tool for computer programs(3 hours/ week per batch of not more than 15 students)

LIST OF PROBLEMS

1. Verification of normality of a given subgroup
2. Illustrating homomorphism and isomorphism of groups
3. To find full range trigonometric Fourier series of some simple functions with period 2π and $2L$
4. Finding the half-range sine and cosine series of simple functions and plotting them.
5. Program to illustrate continuity of a function
6. Program to illustrate differentiability of a function
7. Program to verify Rolle's theorem
8. Program to verify and Lagrange's theorem
9. Evaluation of limits by L'Hospital's rule
10. Solution of second and higher order ordinary differential equations with constant coefficients
11. Solution of second order ordinary differential equations with variable coefficients
 - i) Method of variation of parameters
 - ii) When the equation is exact

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

Structure of B.Sc. Mathematics papers

Semester	Title of the paper		Teaching hrs/week	Duration of Exam (hrs)	IA MARKS	EXAM MARKS	TOTAL MARKS	Semester Total
1	B.Sc. I	Theory	4 hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	
2	B.Sc. II	Theory	4hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	
3	B.Sc.III	Theory	4 hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	
4	B.Sc. IV	Theory	4 hrs	3 hrs	30	70	100	150
		Practical	3 hrs	3 hrs	15	35	50	

Note: In the Practical component out of 35 marks: 25 for practical exam + 5 for vivo + 5 for lab record.

PATTERN OF THE QUESTION PAPER

FROM 1st TO 4th SEMESTER

Time:3 Hours

Max.Marks:70

I	Answer any FIVE of the following (8 questions are given)	$5 \times 2 = 10$ Marks
II	Answer any THREE of the following (05 questions are given)	$3 \times 5 = 15$ Marks
III	Answer any THREE of the following (05 questions are given)	$3 \times 5 = 15$ Marks
IV	Answer any TWO of the following (03 questions are given)	$2 \times 5 = 10$ Marks
V	Answer any TWO of the following (03 questions are given)	$2 \times 5 = 10$ Marks
VI	Answer any TWO of the following (03 questions are given) Questions to be taken only from Application part	$2 \times 5 = 10$ Marks

Structure of B.Sc. Mathematics course

Semester	Title of the paper		Teaching Duration of the paper (Exam hrs)		Exam Marks	TOTAL MARKS
	Theory	Practical	Theory	Practical		
1	1	Theory	4 hrs	3 hrs	75	150
	2	Practical	2 hrs	1 hr	25	
2	3	Theory	4 hrs	3 hrs	75	150
	4	Practical	3 hrs	1 hr	25	
3	5	Theory	4 hrs	3 hrs	75	150
	6	Practical	3 hrs	1 hr	25	
4	7	Theory	4 hrs	3 hrs	75	150
	8	Practical	3 hrs	1 hr	25	

Practical work is conducted on alternate days for 15 days in each semester.

PAYMENT OF COURSE FEE

1500/- (15000/-)

1500/-

15000/-

1. A student who is admitted to the B.Sc. Mathematics course in the first semester shall pay a fee of Rs. 15000/- (Fifteen thousand rupees) at the time of admission. This fee shall be paid in two installments of Rs. 7500/- each. The first installment shall be paid at the time of admission and the second installment shall be paid at the time of the start of the second semester.

2. A student who is admitted to the B.Sc. Mathematics course in the second semester shall pay a fee of Rs. 15000/- (Fifteen thousand rupees) at the time of admission. This fee shall be paid in two installments of Rs. 7500/- each. The first installment shall be paid at the time of admission and the second installment shall be paid at the time of the start of the third semester.

3. A student who is admitted to the B.Sc. Mathematics course in the third semester shall pay a fee of Rs. 15000/- (Fifteen thousand rupees) at the time of admission. This fee shall be paid in two installments of Rs. 7500/- each. The first installment shall be paid at the time of admission and the second installment shall be paid at the time of the start of the fourth semester.

4. A student who is admitted to the B.Sc. Mathematics course in the fourth semester shall pay a fee of Rs. 15000/- (Fifteen thousand rupees) at the time of admission. This fee shall be paid in two installments of Rs. 7500/- each. The first installment shall be paid at the time of admission and the second installment shall be paid at the time of the start of the fifth semester.