ಆಗು ನೀ ಅನಿಕೇತನ
BE BOUNDLESS

BENGALURU CITY UNIVERSITY

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

CHOICE BASED CREDIT SYSTEM

2020-2021

ಬೆಂಗಳೂರು
ಕೇಂದ್ರ ವಿಶ್ವವಿದ್ಯಾಲಯ
BENGALURU
CENTRAL UNIVERSITY
ಆರು ನಲ ಅನಿಕೆತನ
BE BOUNDLESS

Department of Mathematics
Central College Campus, Dr. Ambedkar Veedhi,
Bengaluru – 560 001.

Phone : 0091+-80-22961440 (O)
Email : medha@bub.ernet

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.

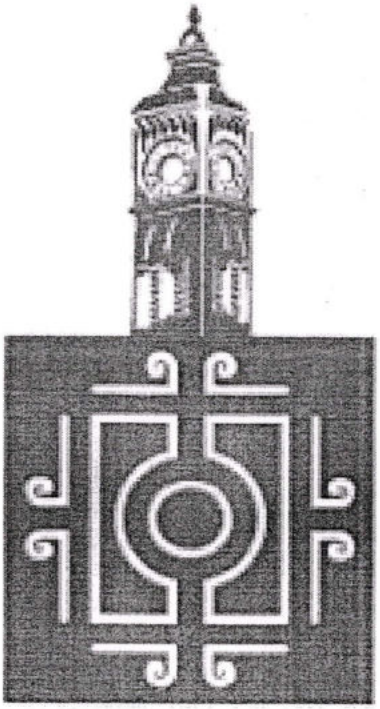
The following members attended the meeting.

Sl. No	Name	Designation	Signature
1.	Dr. Medha Itagi Huilgol	Chairperson	
2.	Dr. D Sujatha	Member	10.8.20
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

ಬೆಂಗಳೂರು
ಕೇಂದ್ರ ವಿಶ್ವವಿದ್ಯಾಲಯ



BENGALURU
CENTRAL UNIVERSITY

ಆಗು ನೀ ಅನಿಕೇತನ
BE BOUNDLESS

1 Medha Itagi Hulgol 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. Shivasharanappa S Igarkanti

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 integratedand 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, geogebraand 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: withapplications 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 practicalwith 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 findequation 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 AdvancedCalculus*, 5th ed. USA: Mc. Graw Hill., 2009.
11. M D Raisinghania, *Advanced Differential Equations*, S Chand and Co. Pvt. Ltd., 2013.
12. FAyres, *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 PetterLangtangen, *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'stest ,- 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 Fransis.
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 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. 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 variables 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 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*, 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. FAyres, *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 thePractical 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)	2x 5 = 10 Marks
V	Answer any TWO of the following (03 questions are given)	2x 5 = 10 Marks
VI	Answer any TWO of the following (03 questions are given) Questions to be taken only from Application part	2x 5 = 10 Marks

ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
BENGALURU CITY UNIVERSITY

BENGALURU CITY UNIVERSITY, BENGALURU

DEPARTMENT OF MATHEMATICS

Syllabi for Mathematics Papers of

BSc Fifth and Sixth Semesters

Under

Choice Based Credit System (CBCS)

Effective from the academic year

2022 – 2023

Structure of B.Sc. Mathematics Papers

Subjects	Paper	Instruction hrs/week	Duration of Exam(3hrs)	Marks			Credits
				IA	Exam	Total	
I Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
II Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
III Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
IV Semester							
Mathematics paper with practicals of 3credits	Theory Prac.	4 3	3 3	30 15	70 35	100 50	2 1
V Semester							
Mathematics papers with practicals of 3 credits each	Theory Prac. Theory Prac.	3 3 3 3	3 3 3 3	30 15 30 15	70 35 70 35	100 50 100 50	2 1 2 1
VI Semester							
Two Mathematics papers with practicals of 3 credits each	Theory Prac. Theory Prac.	3 3 3 3	3 3 3 3	30 15 30 15	70 35 70 35	100 50 100 50	2 1 2 1

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 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 software like Scilab, maxima, octave, Geogebra, Python and others.

FIFTH SEMESTER

MATHEMATICS V

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students) (42 hours)

THEORY

1. ALGEBRA - IV
Rings, Integral Domains, Fields

Rings, Types of Rings properties of rings – Rings of integers modulo n – Subrings – Ideals, Principal, Prime and Maximal ideals in a commutative ring – examples and standard properties following the definition – Homomorphism, Isomorphism – Properties – Quotient rings – Integral Domain- Fields - properties following the definition – Fundamental Theorem of Homomorphism of Rings - Every field is an integral domain – Every finite integral domain is a field – Problems.

(14 hours)

2. MATHEMATICAL METHODS - II
Calculus of Variation

Variation of a function $f = f(x, y, y')$ – variation of the corresponding functional – extremal of a functional – variational problem – Euler's equation and its particular forms – Examples – standard problems like geodesics, minimal surface of revolution, hanging chain, Brachistochrone problem –Isoperimetric problems. Application Problems.

(14 hours)

3. NUMERICAL METHODS - I

Finite differences – Definition and properties of $\Delta, \nabla, \delta, \mu$ and E, the relation between them – The n^{th} differences of a polynomial, Factorial notations, Separation of symbols, Divided differences and related theorems.

Newton –Gregory forward and backward interpolation formulae – Lagrange's and Newton's interpolation formulae for unequal intervals - Inverse interpolation.

Numerical Integration: Quadrature formula – Trapezoidal rule -Simpon's 1/3 and 3/8 rules- problems. Application Problems.

(14 hours)

Suggested distribution of lecture hours.

1. Algebra IV: 1 hour /week.
2. Calculus Of Variation: 1 hours/week
3. Numerical Methods I : 1 hours/week

Text Books/open source materials

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. M D Raisinghania, *Vector calculus*,S Chand Co. Pvt. Ltd., 2013.
4. M K Jain, S R K Iyengar, and R K Jain, *Numerical Methods for Scientific and Engineering Computation*, 4th ed. New Delhi, India: New Age International, 2012.
5. www.scilab.org.
6. **wxmaxima**.sourceforge.net
7. www.geogebra.org

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. B Spain,*Vector Analysis* , ELBS, 1994.
7. D E Bournesand, P C Kendall, *Vector Analysis,* ELBS, 1996.
8. S S Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall of India,2012.
9. Numerical Analysis by R L Burden and J D Faires.

Useful web links:

http://www.themathpage.com/

1. http://www.abstractmath.org/
2. http://ocw.mit.edu/courses/mathematics/

3. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
4. http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm
5. http://mathworld.wolfram.com/Calculus.html
6. http://www.univie.ac.at/future.media/moe/galerie.html
7. http://www.math.gatech.edu/~harrell/calc/
8. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
9. http://math.fullerton.edu/mathews/numerical.html
10. http://www.onesmartclick.com/engineering/numerical-methods.html

PRACTICALS –V

Mathematics practicals with F*ree and* O*pen* S*ource* S*oftware* (FOSS) tools for computer programs
(3 hours/ week per batch of not more than 15 students)

Sl. No.	Title
	I. Ring Theory
1	To verify given ring is a commutative ring.
2	To verify given ring is a ring with unity.
3	To verify given ring is a ring with/without zero divisors
4	To verify given ring is a field.
	II MATHEMATICAL METHODS (Calculus Of Variation)
5	Variational problems-using Euler's general form
6	Variational problems-using Particular forms of Euler's equation with equations independent of both x and y
7	Variational problems-using Particular forms of Euler's equation with equations independent of y
	III Numerical Analysis
8	Newton's Forward interpolation formula
9	Newton's Backward interpolation formula
10	Trapezoidal rule

11	Simpsons $1/3^{rd}$ rule
12	Simpsons $3/8^{th}$ rule

FIFTH SEMESTER
MATHEMATICS – VI

(3 lecture hours per week+ 3 hours of practicals/week per batch of not more than 15 students) (42 HOURS)

THEORY

1. CALCULUS - IV

Differential Calculus of Scalar and Vector Fields

Scalar field – gradient of a scalar field, geometrical meaning – directional derivative – Maximum directional derivative – Angle between two surfaces - vector field – divergence and curl of a vector field – solenoidal and irrotational fields – scalar and vector potentials – Laplacian of a scalar field – vector identities. Standard properties, Harmonic functions, Problems. Applications (14 hours)

2. CALCULUS – V

Line and Multiple Integrals

Definition of line integral and basic properties examples evaluation of line integrals.

Definition of double integral – its conversion to iterated integrals .Evaluation of double integrals by change of order of integration and by change of variables– computation of plane and surface areas, volume underneath a surface and volume of revolution using double integrals.

Definition of triple integral and evaluation – change of variables – volume as a triple integral. Applications. (18 hours)

3. INTEGRAL THEOREMS

Green's theorem (with proof) - Direct consequences of the theorem. The Divergence theorem (with proof) - Direct consequences of the theorem. The Stokes' theorem (with proof) - Direct consequences of the theorem. (10 hours)

Suggested distribution of lecture hours

1. Differential Calculus Of Scalar And Vector Fields: 1 hour /week.
2. Calculus VI (Line and Multiple Integrals and Integral theorems): 2 hours/week

Text Books/open source materials

1. R. Weinstock, *Calculus of Variation*, Dover, 1970.
2. M. D. Raisinghania, *Vector Calculus,* S Chand Co. Pvt. Ltd., 2013.
3. www.scilab.org
4. **wxmaxima**.sourceforge.net
5. www.geogebra.org

Reference Books

1. F B Hildebrand, *Methods in Applied Mathematics,*
2. B Spain,*Vector Analysis* , ELBS, 1994.
3. D E Bournesand, P C Kendall, *Vector Analysis,* ELBS, 1996.

Useful web links:

1. http://ocw.mit.edu/courses/mathematics/
2. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
3. http://mathworld.wolfram.com/Calculus.html
4. http://www.univie.ac.at/future.media/moe/galerie.html
5. http://www.math.gatech.edu/~harrell/calc/

PRACTICALS –VI

Mathematics practicals with F*ree and* O*pen* S*ource* S*oftware* (FOSS)tools for computer programs

(3 hours/ week per batch of not more than 10 students)

Sl. No.	Title
	I. Vector Differential Calculus
1	Gradient and Laplacian of a scalar field ϕ
2	Curl of a vector field f
3	Divergence of a vector field f
	II. Line and Multiple integrals
4	Evaluation of line integrals with constant limits
5	Evaluation of line integrals with variable limits
6	Evaluation of double integral with constant limits
7	Evaluation of double integral with variable limits
8	Evaluation of triple integral with constant limits
9	Evaluation of triple integral with variable limits
	III. Integral Theorems
10	Verification of Green's theorem
11	Verification of Gauss divergence theorem
12	Verification of Stokes theorem

SIXTH SEMESTER

MATHEMATICS - VII

(3 lecture hours per week+ 3 hours of practicals/week per batch of not more than 15 students) (42 HOURS)

THEORY

1. ALGEBRA –V

Linear Algebra

Vector space – Examples – Properties – Subspaces – criterion for a subset to be a subspace –linear span of a set - linear combination – linear independent and dependent subsets – Basis and dimensions– Standard properties – Examples illustrating concepts and results.

Linear transformations – properties – matrix of a linear transformation – change of basis – range and kernel – rank and nullity – Rank – Nullity theorem –Eigenvalues and eigenvectors of linear transformation - Application Problems. (14 hours)

2. DIFFERENTIAL EQUATIONS III

a). Orthogonal Curvilinear Coordinates

Definition of orthogonal curvilinear coordinates. Fundamental vectors or base vectors, Scale factors or material factors - Quadratic differential form. Spherical, Cartesian, Cylindrical co-ordinate systems- Theorem: the Spherical and cylindrical coordinate systems are orthogonal curvilinear coordinate system- problems on conversion of one system to another. (10 hours)

b). Partial Differential Equations

Total differential equations-Necessary condition for the equation $Pdx+ Qdy +Rdz = 0$ to be integrable - Simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

Formation of partial differential equation - Equations of First order Lagrange's linear equation – Charpit's method, Standard types of first order non-linear partial differential equation (By known substitution).

Solution of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral

Solution of one – dimensional heat equations, Solution of one – dimensional wave equations using Fourier series- Application Problems. (18 hours)

Suggested distribution of lecture hours:

1. Algebra-V (Linear Algebra) : 1 hours / week.
2. Differential Equations III: 2 hours / week

Text Books/open source materials

1. Krishnamoorty V K and Mainra V P and Arora J L, *An Introduction to Linear Algebra*, Reprint. New Delhi, India: Affiliated East West Press Pvt. Ltd., 2003.
2. M. D. Raisinghania, *Vector Calculus,* S Chand Co. Pvt. Ltd., 2013.
3. M D Raisinghania, Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd., 2014.
4. www.scilab.org
5. wxmaxima.sourceforge.net
6. www.geogebra.org

Reference Books

1. G Strang, MIT open courseware (http://ocw.mit.edu/courses).
2. B Spain, *Vector Analysis* , ELBS, 1994.
3. D E Bournes and, P C Kendall, *Vector Analysis,* ELBS, 1996.
4. Frank Ayres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 1972.
5. GF Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.
6. S Narayanan & T K Manicavachogam Pillay, *Differential Equations*.: S V Publishers Private Ltd., 1981.
7. I N Sneddon, *Elements of Partial Differential Equations*, 3rd ed.: Mc. Graw Hill., 1980.

Useful web links:

1. http://ocw.mit.edu/courses/mathematics/
2. http://mathworld.wolfram.com/Calculus.html
3. http://www.math.gatech.edu/~harrell/calc/
4. http://tutorial.math.lamar.edu/classes/de/de.aspx
5. http://www.sosmath.com/diffeq/diffeq.html
6. http://www.analyzemath.com/calculus/Differential_Equations/applications.html

PRACTICALS –VII(Mathematics practicals with F*ree and* O*pen* S*ource* S*oftware* (FOSS) tools for computer programs

(3 hours/ week per batch of not more than 15 students)

Sl. No.	Title
	I Linear Algebra
1	Expressing a vector as a linear combination of given set of vectors.
2	Examples on linear dependence and independence of vectors.
3	Expressing a vector as a linear combination of given set of vectors.
4	Examples on linear dependence and independence of vectors.
5	Verifying whether a given transformation is linear or not.
6	Finding matrix of a linear transformation.
7	Verification of rank and nullity theorem.
	II Total Differential and Partial Differential Equations
8	Solutions to the problems on total and simultaneous differential equations.
9	Solutions to the problems on different types of partial differential equations.
10	Solving second order linear partial differential equations in two variables with constant coefficients.
11	Solution of one dimensional heat equation
12	Solution of one dimensional wave equation

SIXTH SEMESTER

MATHEMATICS - VIII

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 15 students) (42 HOURS)

THEORY

1. ANALYSIS - III

Complex Analysis

Complex numbers-Cartesian and polar form-geometrical representation-complex-Plane-Euler's formula. Functions of a complex variable- limit, continuity and differentiability of a complex function. Analytic function- Cauchy-Riemann equations in Cartesian and polar forms-Sufficiency conditions for analyticity (Cartesian form only)-Harmonic function-standard properties of analytic functions-construction of analytic function when real or imaginary part is given- Milne Thomson method.

Complex integration- properties and problems. Cauchy's integral theorem-proof using Green's theorem- Direct consequences. Cauchy's integral formula with proof-Cauchy's generalized formula for the derivatives with proof and applications for evaluation of simple line integrals - Cauchy's inequality with proof – Liouville's theorem with proof. Fundamental theorem of algebra with proof.

Transformations – conformal transformation – some elementary transformations namely Translation, Rotation, Magnification and Inversion - examples.

The bilinear transformation (B.T.)-cross ratio-invariant points of B.T.-properties-

(i) B.T. sets up a one to one correspondence between the extended z-plane and the extended w-plane.
(ii) Preservation of cross ratio under a B.T.
(iii) B.T. transforms circles onto circles or straight lines.

Problems on finding a B.T., and finding images under a B.T.and invariant points of a B.T. Discussion of transformations $w = z^2$, $w = \sin z$, $w = \cos z$, $w = \sinh z$, $w = \cosh z$, $w = \frac{1}{2}\left(z + \frac{1}{z}\right)$ and $w = e^z$. Applications. (28 hours)

2. NUMERICAL METHODS – II

Numerical solutions of equations – method of successive bisection- method of false position – Newton-Raphson method.

Numerical solutions of non-homogeneous system of linear algebraic equations in three variables by Jacobi's method and Gauss-Seidel method. Computation of the largest eigenvalue of a square matrix by power method.

Solutions of first order linear ordinary differential equations by Taylor's series, Euler's and Euler's modified method and Runge-Kutta 4^{th} order method. Applications

(14 hours)

Suggested distribution of lecture hours:

1. Analysis-III (Complex Analysis): 2 hours / week.
2. Numerical Methods-II: 1 hour / week

Text Books/open source materials

1. S Shanthinarayan, *Complex Analysis*, S Chand Co. Pvt. Ltd., 2012.
2. M K Jain, S R K Iyengar, and R K Jain, *Numerical Methods for Scientific and Engineering Computation*, 4th ed. New Delhi, India: New Age International, 2012.
3. www.scilab.org
4. **wxmaxima**.sourceforge.net
5. www.geogebra.org

Reference Books

1. R V Churchil & J W Brown, *Complex Variables and Applications*, 5th ed.: McGraw Hill Companies., 1989.
2. L V Ahlfors, *Complex Analysis*, 3rd ed.: Mc Graw Hill. , 1979.
3. A R Vashista, *Complex Analysis*, Krishna Prakashana Mandir, 2012.
4. S S Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall of India, 2012.

Useful web links:

1. http://www.mathcs.org/analysis/reals/index.html
2. http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm
3. http://math.fullerton.edu/mathews/numerical.html
4. http://www.onesmartclick.com/engineering/numerical-methods.html

PRACTICALS –VIII

Mathematics practicals with F*ree and* O*pen* S*ource* S*oftware* (FOSS) tools for computer programs

(3 hours/ week per batch of not more than 10 students)

Sl. No.	Title
	I Complex Analysis
1	Verifying the given complex function (Cartesian and polar) is analytic.
2	Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.
3	Verifying real and imaginary parts of an analytic function being harmonic
4	Construction of analytic functions by Milne-Thomson method.
5	Examples connected with Cauchy's integral theorem and Cauchy's integral formula.
	II Numerical Analysis
6	Solution of an equation using bisection and Regula-Falsi methods
7	Solution of an equation by Newton-Raphson method.
8	Solution of system of equations by Gauss-Jacobi method.
9	Solution of system of equations by Gauss-Seidel method.
10	Finding the largest eigenvalue by Power method.
11	Solving ordinary differential equation by modified Euler's method.
12	Solving ordinary differential equation by Runge-Kutta method of 4^{th} order.

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)	$2x\ 5 = 10$ Marks
V	Answer any TWO of the following (03 questions are given)	$2x\ 5 = 10$ Marks
VI	Answer any TWO of the following (03 questions are given). Questions to be taken only from Application part	$2x\ 5 = 10$ Marks

PATTERN OF THE QUESTION PAPER

FOR 5th and 6th SEMESTER B.Sc

I	Answer any FIVE of the following (EIGHT questions are given)	$5 \times 2 = 10$ Marks
II	Answer any THREE of the following (FIVE questions are given)	$3 \times 5 = 15$ Marks
III	Answer any THREE of the following (FIVE questions are given)	$3 \times 5 = 15$ Marks
IV	Answer any THREE of the following (FIVE questions are given)	$3\times\ 5 = 15$ Marks
V	Answer any THREE of the following (FIVE questions are given). Questions to be chosen only from Application part	$3\times 5 = 15$ Marks