
Proposed Syllabus
for B.Sc.
Mathematics
paper for 6
semesters under
Choice Based
Credit Scheme
(CBCS)

Effective from the academic
year 2014-2015

Department of Mathematics
Bangalore University

3.GEOMETRY

Analytical Geometry Of Three Dimensions

Recapitulation of elements of three dimensional geometry - Different forms of equations of straight line and plane.

Angle between two planes - Line of intersection of two planes - Plane coaxial with given planes - Planes bisecting the angle between two planes - Angle between a line and a plane - Coplanarity of two lines - Shortest distance between two lines.

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.

(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/open source materials

1. Shanti Narayan and P K Mittal , Text book of *Matrices*, 5th edition, 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. www.scilab.org.
6. wxmaxima.sourceforge.net
7. www.geogebra.org

Reference Books

1. B S Vatssa, *Theory of Matrices*, New Delhi: New Age International Publishers, 2005.
2. A R Vashista, *Matrices*, Krishna Prakashana Mandir, 2003.
3. G B Thomasand 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. S.P.Mahajan & Ajay Aggarwal, *Comprehensive Solid Geometry* , 1st ed.: Anmol Publications , 2000.

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>

PRACTICALS – I

**Mathematics practicals with Free and OpenSource Software (FOSS) tools for computer programs
(3 hours/ weekper batch of not more than 10 students)**

LIST OF PROBLEMS

1. Introduction to Scilab and commands connected with matrices.
2. Computations with matrices.
3. Row reduced echelon form and normal form.
4. Establishing consistency or otherwise and solving system of linear equations.
5. Introduction to Maxima and commands for derivatives and n^{th} derivatives.
6. Scilab and Maxima commands for plotting functions.
7. n^{th} derivative without Leibnitz rule.
8. n^{th} derivative with Leibnitz rule.
9. Obtaining partial derivative of some standard functions
10. Verification of Euler's theorem, its extension and Jacobian.
11. Maxima commands for reduction formula with or without limits.

12. Implementing vector form of line.
13. Implementing vector form of plane.

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 10 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 semigroup 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.

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

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.

(28 lecture hours)

4. DIFFERENTIAL EQUATIONS – I

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

- (i) Linear equations, Bernoulli equation and those reducible to these.
- (ii) Exact equations (excluding reducible to Exact)

Equations of first order and higher degree – non linear first order, higher degree – (Mention) solvable for p - solvable for y - solvable for x - Clairaut's equation -

singular solution - Geometric meaning. Orthogonal trajectories in Cartesian and polar forms.

(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/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: 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. M D Raisinghania, *Ordinary and Partial Differential Equations*, S Chand and Co. Pvt. Ltd., 2014.
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 Balakrishnan and N. Ramabadrana, *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 examples*, 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 Private Ltd., 1981.
14. G F Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.

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

PRACTICALS –II

**Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)**

LIST OF PROBLEMS

1. Creating a Scilab program (simple examples).
2. Creating a Maxima program (simple examples).
3. i. Verifying whether given operator is binary or not.
ii. To find identity element of a group.
iii. To find inverse element of a group.
4. Finding all possible subgroups of a finite group.
5. Plotting of standard Cartesian curves using Scilab/Maxima.
6. Plotting of standard Cartesian curves using Scilab/Maxima.

7. Plotting of standard Polar curves using Scilab/Maxima.
8. Plotting of standard parametric curves using Scilab/Maxima.
9. Scilab/Maxima programs for area and volume.
10. Solution of Differential equation using Scilab/Maxima and plotting the solution-I.
11. Solution of Differential equation using Scilab/Maxima and plotting the solution-II.
12. Solution of Differential equation using Scilab/Maxima and plotting the solution-III.
13. Solution of Differential equation using Scilab/Maxima and plotting the solution-IV.

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THIRD SEMESTER MATHEMATICS-III

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 10 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 –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.

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.(28 lecture hours)

3. CALCULUS - III

Differential Calculus

Recapitulation of Equivalence Class and partition of a set. 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 –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
(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. Calculus - III(differential calculus): 1 hour / 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. 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. Shanthi Narayan and P K Mittal, *Differential Calculus*, Reprint. New Delhi: SChand and Co. Pvt. Ltd., 2014.
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 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. G B Thomas and R L Finney, *Calculus and analytical geometry*, Addison Wesley, 1995.
7. J Edwards, *An elementary treatise on the differential calculus: with applications and numerous example*, Reprint. Charleston, USA: BiblioBazaar, 2010.
8. N P Bali, *Differential Calculus*, New ed. New Delhi, India: Laxmi Publications (P) Ltd., 2010.
9. S Narayanan & T. K. Manicavachogam Pillay, *Calculus.*: S. Viswanathan Pvt. Ltd., vol. I & III 1996.
10. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th ed. USA: Mc. Graw Hill., 2008.
11. E Spiegel, *Schaum's Outline of Advanced Calculus*, 5th ed. USA: Mc. Graw Hill., 2009.

Useful web 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/>

PRACTICALS –III

**Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)**

LIST OF PROBLEMS

1. Examples to verify Lagrange's theorem.
2. Examples for finding left and right coset and finding the index of a group.
3. Illustration of convergent, divergent and oscillatory sequences using Scilab/Maxima.
4. Illustration of convergent, divergent and oscillatory series using Scilab/Maxima.
5. Scilab/Maxima programs to find the sum of the series and its radius of convergence.
6. Using Cauchy's criterion to determine convergence of a sequence (simple examples).
7. Using Cauchy's criterion on the sequence of partial sums of the series to determine convergence of a series.

8. Testing the convergence of binomial, exponential and logarithmic series and finding the sum.
9. Scilab/Maxima programs to illustrate continuity of a function.
10. Scilab/Maxima programs to illustrate differentiability of a function and unequal left hand and right hand limits for discontinuous functions.
11. Scilab/Maxima programs to verify Rolle's theorem and Lagrange's theorem.
12. Scilab/Maxima programs to verify Cauchy's mean value theorem and finding Taylor's theorem for a given function.
13. Evaluation of limits by L'Hospital's rule using Scilab/Maxima.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

FOURTH SEMESTER

MATHEMATICS - IV

(4 lecture hours per week+ 3 hours of practicals /week per batch of not more than 10 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.

(14 lecture hours)

2. ANALYSIS -II

Fourier Series

Trigonometric Fourier series of functions with period 2π and period $2L$ – Half range Cosine and sine series.

(9 lecture hours)

3. CALCULUS - IV

Differential Calculus

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. (9 lecture hours)

4. 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.
(10 lecture hours)

5. 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 (Rings ,Fields and Integral domains): 1 hour / week
2. Analysis – II (Fourier series), Calculus-IV (Differential Calculus) and Mathematical methods-I (Laplace transform): 2 hours / week.
3. Differential Equations II: 1 hour / 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. 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: S Chand and Co. Pvt. Ltd., 2014.
5. M D Raisinghania, *Ordinary and Partial Differential Equations*, S Chand and Co. Pvt. Ltd., 2014.
6. www.scilab.org.
7. wxmaxima.sourceforge.net
8. 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 Balakrishnan 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 & III 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. Raisinghania M.D., *Laplace and Fourier Transforms*. New Delhi, India: S. Chand and Co. Ltd. , 1995.
12. M D Raisinghania, *Advanced Differential Equations*, S Chand and Co. Pvt. Ltd., 2013.
13. F Ayres, *Schaum's outline of theory and problems of Differential Equations*, 1st ed. USA: McGraw-Hill, 2010.
14. S Narayanan and T K Manicavachogam Pillay, *Differential Equations.*: S V Publishers Private Ltd., 1981.
15. G F Simmons, *Differential equation with Applications and historical notes*, 2nd ed.: McGraw-Hill Publishing Company, Oct 1991.

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.anlyzemath.com/calculus/Differential_Equations/applications.html

PRACTICALS –IV
Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)

LIST OF PROBLEMS

1. Illustrating homomorphism and isomorphism of groups.
2. Verification of Normality of a given subgroup.
3. Verifying Cayley's theorem and isomorphism theorems.
4. To plot periodic functions with period 2π and $2L$.
5. To find full range trigonometric Fourier series of some simple functions with period 2π and $2L$.
6. Plotting of functions in half-range and including their even and odd extensions.
7. To find the half-range sine and cosine series of simple functions.
8. Finding maxima/minima of functions of two variables.
9. Finding the Laplace transforms of some standard functions.
10. Finding the inverse Laplace transform of simple functions.
11. Implementing Laplace transform method of solving ordinary linear differential equations of first and second order with constant coefficient.
12. Finding complementary function and particular integral of constant coefficient second and higher order ordinary differential equations.
13. Finding complementary function and particular integral of constant coefficient second and higher order ordinary differential equations.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

FIFTH SEMESTER

MATHEMATICS V

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

THEORY(42 hours)

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 lecture hours)

2. CALCULUS - V

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.

(14 lecture 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 -Simpson's 1/3 and 3/8 rule(without proofs) and problems.

(14 lecture hours)

Suggested distribution of lecture hours.

1. Algebra IV: 1 hour /week.
2. Calculus-V (Differential calculus of scalar and vector fields): 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: S Chand 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 Balakrishnan and N.Ramabadrnan, *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.

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://www.univie.ac.at/future.media/moe/galerie.html>
8. <http://www.math.gatech.edu/~harrell/calc/>
9. <http://www.amtp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm>
10. <http://math.fullerton.edu/mathews/numerical.html>
11. <http://www.onesmartclick.com/engineering/numerical-methods.html>

PRACTICALS –V

**Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)**

LIST OF PROBLEMS

1. Examples on different types of rings.
2. Examples on integral domains and fields.
3. Examples on subrings, ideals and subrings which are not ideals.
4. Homomorphism and isomorphism of rings- illustrative examples.
5. To demonstrate the physical interpretation of gradient, divergence and curl.
6. Writing gradient, divergence, curl and Laplacian in cylindrical coordinates.
7. Writing gradient, divergence, curl and Laplacian in spherical coordinates.
8. Using cyclic notations to derive different vector identities.
9. Using cyclic notations to derive some more vector identities.
10. Scilab/Maxima programs on Interpolations with equal intervals.
11. Scilab/Maxima programs on Interpolations with unequal intervals.

12. Scilab/Maxima programs to evaluate integrals using Simpson's $\frac{1}{3}$ rd rule.

13. Scilab/Maxima programs to evaluate integrals using Simpson's $\frac{3}{8}$ th rule.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

FIFTH SEMESTER MATHEMATICS – VI

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

(42 HOURS)

THEORY

1. MATHEMATICAL METHODS - II

Calculus Of Variation

Variation of a function $t = f(x, y, y')$ – 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.

(14 Lecture hours)

2. CALCULUS – VI

a). 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 .

(18lecture hours)

b). 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 lecture hours)

Suggested distribution of lecture hours

1. Mathematical Methods II (Calculus of variation): 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 FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)**

LIST OF PROBLEMS

1. Example on Euler's equation in full form.
2. Example on particular forms of Euler's equation.
3. Examples on minimum surface of revolution and Brachistochrone problem.
4. Examples on Isoperimetric problems.
5. Evaluation of the line integral with constant limits.
6. Evaluation of the double integral with constant limits.
7. Evaluation of the triple integral with constant limits.
8. Evaluation of the line integral with variable limits.
9. Evaluation of the double integral with variable limits.
10. Evaluation of the triple integral with variable limits.
11. Verifying Green's theorem.
12. Verifying Gauss divergence theorem.
13. Verifying Stokes' theorem

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

SIXTH SEMESTER MATHEMATICS - VII

(3 lecture hours per week+ 3 hours of practicals /week per batch of not more than 10 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 – Non-singular and singular linear transformations - Standard properties – Examples.

(14 lecture 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 curvilinear system : Cartesian, Cylindrical – conversion of Cylindrical to orthogonal Spherical polar coordinates. Theorem: The Spherical coordinate system is orthogonal curvilinear coordinate system. (without proof) No problems on conversions of one system to another.

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.

(28 lecture 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. Krishnamoorthy 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.anlyzemath.com/calculus/Differential_Equations/applications.html

PRACTICALS –VII

**Mathematics practicals with FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)**

LIST OF PROBLEMS

1. i. Vector space, subspace – illustrative examples.
ii. Expressing a vector as a linear combination of given set of vectors.
iii. Examples on linear dependence and independence of vectors.
2. i. Basis and Dimension – illustrative examples.
ii. Verifying whether a given transformation is linear.

3. i. Finding matrix of a linear transformation.
ii. Problems on rank and nullity.
4. Plotting of cylinder and cone using orthogonal curvilinear coordinates.
5. Plotting of sphere using orthogonal curvilinear coordinates.
6. Solutions to the problems on total and simultaneous differential equations.
7. Solutions to the problems on different types of Partial differential equations.
8. Solving second order linear partial differential equations in two variables with constant coefficient.
9. Solving some more second order linear partial differential equations in two variables with constant coefficient.
10. Solution of one dimensional heat equation using Fourier series with Dirichlet condition.
11. Solution of one dimensional heat equation using Fourier series with Neumann condition.
12. Solution of one dimensional wave equation using Fourier series with Dirichlet condition.
13. Solution of one dimensional wave equation using Fourier series with Neumann condition.

Note:The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

SIXTH SEMESTER MATHEMATICS - VIII

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

(42 HOURS)

THEORY

1. ANALYSIS - III

Complex Analysis

Complex numbers-Cartesian and polar form-geometrical representation-complex-Plane-Euler's formula- $e^{i\theta} = \cos \theta + i \sin \theta$. 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-the complex integration –properties-problems.Cauchy's Integral theorem-proof using Green's theorem- direct consequences.Cauchy's Integral formula with proof-Cauchy's generalised 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 a 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) A 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 $w = z^2$, $w = \sin z$, $w = \cosh z$ and $w = e^z$.

(28 lecture hours)

2. NUMERICAL METHODS – II

Numerical solutions of algebraic and Transcendental 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 largest Eigen value of a square matrix by power method.

Solutions of initial value problems for ordinary linear first order differential equations by Taylor's series, Euler's and Euler's modified method and Runge-Kutta 4th ordered method.

(14 lecture 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 Churchill & 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 FOSS tools for computer programs
(3 hours/ week per batch of not more than 10 students)**

LIST OF PROBLEMS

1. Some problems on Cauchy-Riemann equations (polar form).
2. Implementation of Milne-Thomson method of constructing analytic functions (simple examples).
3. Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.
4. Verifying real and imaginary parts of an analytic function being harmonic (in polar coordinates).
5. Illustrating the angle preserving property in a transformation.
6. Illustrating that circles are transformed to circles by a bilinear transformation.
7. Examples connected with Cauchy's integral theorem.
8. Solving algebraic equation (Bisection method).
9. Solving algebraic equation (Regula-Falsi and Newton-Raphson methods).
10. Solving system of equations (Jacobi and Gauss-Seidel methods).
11. Solving for largest eigenvalue by Power method.
12. Solving ordinary differential equation by modified Euler's method.
13. Solving ordinary differential equation by Runge-Kutta method of 4th order.

Note: The above list may be changed annually with the approval of the BOS in UG (Mathematics). Geogebra/Octave may also be used in place of scilab/maxima.

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BENGALURU
CENTRAL UNIVERSITY

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BE BOUNDLESS



Proposed Syllabus for B.Sc.

Mathematics paper for first 4 semesters under Choice Based Credit Scheme (CBCS)

**Effective from the
academic year
2020 - 21**

**Department of
Mathematics
Bengaluru Central
University**

Structure of B.Sc.Mathematics papers

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

Note: The structure of the syllabus of mathematics paper of B. Sc. is included in the structure of M.Sc. (Mathematics) syllabus.

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: 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 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 Petter Langtangen 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 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. 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*, 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.msmmary.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 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 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/real/index.html>
7. <http://www.mathcs.org/analysis/real/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 Balakrishnan and N.Ramabadrnan, *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.	Theory	4 hrs	3 hrs	30	70	100	150

	I	Practical	3 hrs	3 hrs	15	35	50	
2	B.Sc.	Theory	4hrs	3 hrs	30	70	100	150
	II	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.	Theory	4 hrs	3 hrs	30	70	100	150
	IV	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 × 2 = 10 Marks
II	Answer any THREE of the following (05 questions are given)	3 × 5 = 15 Marks
III	Answer any THREE of the following (05 questions are given)	3 × 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

BCA-Syllabus.pdf

BCA105T: DISCRETE MATHEMATICS

Total Teaching Hours: 65

No of Hours / Week: 05

Unit-I

13 Hrs

Sets, Relations and Functions: Sets, Subsets, Equal Sets, Universal Sets, Finite and Infinite Sets, Operation on Sets, Union, Intersection and Complements of Sets, Cartesian Product, Cardinality of Set, De-morgan's law, Simple Applications. Relations, Properties of Relations, Equivalence Relation, Function: Domain and Range, Onto, Into, One to One, one to many Functions, Composite and Inverse Functions. Mathematical Logic: Proposition and truth values, Logical Connectives and their truth tables, Converse, Inverse and Contrapositive, Tautology and Contradiction, Logical Equivalence – Standard Theorems, Switching Circuits.

Unit-II

13 Hrs

Matrices: Review of fundamentals: Definition of matrix, order, Types of matrices: zero, row, column, square, diagonal, scalar, unit, symmetric, skew-symmetric. Determinant: Value of determinant of order 2×2 , 3×3 , minors, cofactors, adjoint, inverse of a matrix. Solutions of linear equations: Cramers rule and matrix method involving two and three variables. Eigen values and Eigenvectors: Characteristic equation, characteristic roots, characteristic vectors (without any theorems) only 2×2 order. Cayley Hamilton theorem. (Only statement), verification of Cayley Hamilton theorem (only 2×2 matrices), using the same finding the powers of A (A^4 , A^5 , A^{-1} , A^{-2}), Inverse of a Matrix using Cayley-Hamilton theorem.

Unit-III

13 Hrs

Logarithms: Definition of Logarithm, Indices leading to Logarithms and vice versa, Laws of Logarithms with proofs, Problems, Common Logarithm: Characteristic and Mantissa, Use of Logarithmic Tables, Problems. Permutation and Combination: Fundamental Principle of Counting, Factorial n, Permutations: Definition, Examples, Derivation of Formula nPr , Permutation when all the objects are not distinct, Problems, Combinations: Definition, examples, Proving $nCr = nPr / r!$, $nCr = nC_{n-r}$, $nCr + nCr-1 = n+1Cr$, Problems based on above formulae.

Unit-IV**13 Hrs**

Groups: Binary operation, Define of group, properties (only statement), problems (both finite and infinite groups), subgroup, theorems (no proof), problems. Vectors: Definition of vector and scalar, vector addition, dot and cross product, projection of a vector on the other (no geometrical meaning), area of parallelogram, area of a triangle, scalar triple product, volume of parallelepiped, co planarity of three vectors, vector triple product.

Unit-V**13 Hrs**

Analytical Geometry in Two Dimensions: Coordinates, Distance formula, Section Formula, Area of the Triangle formula (no derivation), Locus of point. Straight Line: Slope of a line and angle between two lines, Various forms of equations of lines – Derivation and Problems. Equation of family of lines passing through the point of intersection of two lines, Distance of a point from line (only problems)

BCA205: NUMERICAL AND STATISCAL METHODS

Total Teaching Hours: 65

No of Hours / Week : 05

Unit - I

13 Hours

Floating-point representation and errors-Normalized floating-point forms, Errors in representing numbers, Floating point machine number and machine epsilon, Loss of significance and its avoidance. Roots of equations-locating roots of $f(x)=0$ Bisection method, Newton's method, Secant method.

Unit - II

13 Hours

Interpolation and numerical differentiation-polynomial interpolation, Lagrange and Newton form of interpolating Polynomial, Divided difference and recursive property, Inverse interpolation, First and Second derivative formulae via interpolation Polynomials. Numerical integration-Trapezoidal, Simpson's and adaptive Simpson rules.

Unit - III

13 Hours

System of linear equations-Gaussian elimination and back substitution-partial and complete pivoting, Doolittle, Cholesky and Crout LU decomposition methods, Jacobi and Gauss – Seidel iterative methods. Power (and inverse power) method of obtaining largest (smallest) eigenvalue and corresponding eigenvector. Ordinary differential equations-initial value problem, Picard's, Taylor series, Runge-Kutta first, second and fourth order methods.

Unit – IV

13 Hours

Basics concepts and definition of statistics. Mean, Standard deviation, coefficient of Variation, skewness & kurtosis, Carl Pearson Correlation, Rank correlation and illustrated examples. Probability: Basic concept and definition of probability, probability axioms, Laws of Probability, Conditional probability, Bayes theorem , Problems and application.

Unit - V

13 Hours

Random variable and Expectation: Discrete and continuous random variables, expectation of random variables, theorems on expectation, illustrative examples. Probability Distribution: Probability function, Probability mass/density function, Discrete Distribution – Bernoulli, Binomial Distribution, Continuous distribution – Normal Distribution, applications and problems.

B.Com Mathematics syllabus

2.6: METHODS AND TECHNIQUES FOR BUSINESS DATA ANALYSIS

56 hrs

OBJECTIVE: The objective of this course is to provide basic knowledge of mathematics and their application in business

- Unit 1: NUMBER SYSTEM** 04 Hrs
Introduction – Natural numbers - Even numbers – Odd numbers – Integers – Prime numbers – Rational & Irrational numbers, Real numbers, HCF & LCM (Simple problems)
- Unit 2: THEORY OF EQUATIONS** 10 Hrs
Introduction – Meaning - Types of Equations – Simple/ Linear Equations and Simultaneous Equations (only two variables). Elimination and Substitution Methods only. Quadratic Equation - Factorization and Formula Method ($ax^2 + bx + c = 0$ form only). Simple problems
- Unit 3: MATRICES, INDICES AND LOGARITHMS** 16 Hrs
Meaning – types – operation on matrices – additions – subtractions and multiplication of two matrices – transpose – determinants – minor of an element – co-factor of an element – inverse – crammers rule in two variables – problems.
Indices and Logarithms: Meaning- Basic Laws of Indices and their application for simplification. Laws of Logarithms – Common Logarithm, Application of Log Table for Simplification
- Unit 4: COMMERCIAL ARITHMETIC** 16 Hrs
Simple Interest, Compound Interest including yearly and half yearly calculations, Annuities, Percentages, Bills Discounting, Ratios and proportions, duplicate-triplicate and sub-duplicate of a ratio. Proportions: third, fourth and inverse proportion – problems.
- Unit 5: PROGRESSIONS** 10 Hrs
PROGRESSIONS: Arithmetic Progression – Finding the ' n^{th} ' term of AP and Sum to ' n^{th} ' term of AP. Insertion of Arithmetic Mean, Geometric Progression – Finding the ' n^{th} ' term of GP and sum to ' n^{th} ' term of GP and insertion of Geometric Mean

BOOKS FOR REFERENCE:

- Saha: Mathematics for Cost Accountants, Central Publishers
- R.G. Saha & Others – Methods & Techniques for Business Decisions, VBII
- Dr. Sancheti & Kapoor: Business Mathematics and Statistics, Sultan Chand
- Zamarudeen: Business Mathematics, Vikas
- R.S. Bhardwaj : Mathematics for Economics & Business
- Madappa, mahadi Hassan, M. Iqbal Taiyab – Business Mathematics, Subhash
- G.R. Veena and Seema : Business Mathematics and Statistics I.K. Intl Publishers

BBA Mathematics Syllabus

2.4 BUSINESS ANALYTICS - I

OBJECTIVE

To provide basic knowledge of mathematics and their application to commercial situations.

Unit 1: NUMBER SYSTEM

04 Hrs

Introduction – Natural Numbers - Even Numbers – Odd Numbers – Integers – Prime Numbers – Rational and Irrational numbers, Real Numbers, HCF and LCM (Simple problems).

Unit 2: THEORY OF EQUATIONS

10 Hrs

Introduction – Meaning - Types of Equations – Simple/ Linear Equations and Simultaneous Equations (only two variables), Elimination and Substitution Methods only. Quadratic Equation - Factorization and Formula Method ($ax^2 + bx + c = 0$ form only). Simple problems

Unit 3: INDICES, MATRICES AND LOGRITHEMS

16 Hrs

Meaning – types – operation on matrices – additions – subtractions and multiplication of two matrices – transpose – determinants – minor of an element – co-factor of an element –inverse – crammers rule in two variables – problems.

Indices and Logarithms: Meaning- Basic Laws of Indices and their application for simplification. Laws of Logarithms –Common Logarithm, Application of Log Table for Simplification.

Unit 4: COMMERCIAL ARITHMETIC

16 Hrs

Simple Interest, Compound Interest including yearly and half yearly calculations, Annuities, Percentages, Bills Discounting, Ratios and proportions, duplicate-triplicate and sub-duplicate of a ratio. Proportions: third, fourth and inverse proportion - problems.

Unit 5: PROGRESSIONS

10 Hrs

PROGRESSIONS: Arithmetic Progression - Finding the ' n^{th} ' term of AP and Sum to n^{th} term of AP. Insertion of Arithmetic Mean Geometric Progression – Finding the ' n^{th} ' term of GP and sum to ' n^{th} ' term of GP and insertion of Geometric Mean

SKILL DEVELOPMENT:

- Develop an Amortization Table for Loan Amount – EMI Calculation.
- Secondary overhead distribution summary using Simultaneous Equations Method.
- Preparation of Bank Statement.
- Application of Matrix In Business Problems

BOOKS FOR REFERENCE:

- Saha: Mathematics for Cost Accountants, Central Publishers
- R.G. Saha and Others – Methods and Techniques for Business Decisions, VBII
- Dr. Sancheti and Kapoor: Business Mathematics and Statistics, Sultan Chand
- Zamarudeen: Business Mathematics, Vikas
- R.S Bhardwaj :Mathematics for Economics and Business
- Madappa, mahadi Hassan, M. Iqbal Taiyab – Business Mathematics, Subhash
- G.R. Veena and Seema : Business Mathematics and Statistics I.K. Intl Publishers