BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM

(as per NEP 2024)

Syllabus for I & II Semester
Mathematics

2024-25

Board of Studies in Mathematics for UG

(No. BCU/BoS/Mathematics-UG/88/2024-25 dated: 03-07-2024)

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11.	Prof A Haritha	Member
12.	Prof M Ashok Kumar	Member
13.	Prof KL Sharma	Member
14.	Prof Chandrashekarappa	Member

Name of the Degree Program	**:**	**Bachelor of Science- BSc**
Discipline Course	**:**	**Mathematics**
Starting Year of Implementation	**:**	**2024-25 (I & II Semesters)** **2025-26 (III & IV Semesters)** **2026-27 (V & VI Semesters)**

Programme Outcomes (PO): By the end of the program the students will be able to:

PO 1	**Disciplinary Knowledge:** Bachelor degree with Mathematics as one of subjects in chosen combination is the culmination of in-depth knowledge of Algebra, Calculus, Geometry, differential equations and several other branches of pure and applied mathematics. This also leads to study the related areas such as computer science and other allied subjects
PO 2	**Communication Skills**: Ability to communicate various mathematical concepts effectively using examples and their geometrical visualization. The skills and knowledge gained in this program will lead to the proficiency in analytical reasoning which can be used for modeling and solving of real life problems.
PO 3	**Critical thinking and analytical reasoning:** The students undergoing this programme acquire ability of critical thinking and logical reasoning and capability of recognizing and distinguishing the various aspects of real life problems.
PO 4	**Problem Solving**: The Mathematical knowledge gained by the students through this programme develop an ability to analyze the problems, identify and define appropriate computing requirements for its solutions. This programme enhances students overall development and also equip them with mathematical modelling ability, problem solving skills.
PO 5	**Research related skills:** The completing this programme develop the capability of inquiring about appropriate questions relating to the Mathematical concepts in different areas of Mathematics.
PO 6	**Information/digital Literacy**: The completion of this programme will enable the learner to use appropriate software's to solve system of algebraic equation and differential equations.
PO 7	**Self – directed learning**: The student completing this program will develop ability of working independently and to make an in-depth study of various notions of Mathematics.
PO 8	**Moral and ethical awareness/reasoning:** : The student completing this program will develop an ability to identify unethical behavior such as fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life in general and Mathematical studies in particular.

PO 9	**Lifelong learning**: This programme provides self-directed learning and lifelong learning skills. This programme helps the learner to think independently and develop algorithms and computational skills for solving real word problems.
PO 10	Ability to peruse advanced studies and research in pure and applied Mathematical sciences.

ASSESSMENT

Weightage for the Assessments (in percentage)

Type of Course	Formative Assessment/ I.A.	Summative Assessment (S.A.)
Theory	20%	80 %
Practical	20%	80 %

BSc Degree with Mathematics as one of the Major Subjects

Semester	Course Code	Paper Title	Teaching Hours / Week	Marks		Duration of Exam in Hours	Credits
				Exam	IA		
I	Theory	Algebra-I, Calculus-I & Geometry	04	80	20	03	03
	Practical	Algebra-I, Calculus-I & Geometry	04	40	10	03	02
II	Theory	Algebra-II, Calculus-II & Polar Coordinates	04	80	20	03	03
	Practical	Algebra II, Calculus II & Polar Coordinates	04	40	10	03	02
III	Theory		04	80	20	03	03
	Practical		04	40	10	03	02
	Elective-I	Linear Programming	03	80	20	03	02
IV	Theory		04	80	20	03	03
	Practical		04	40	10	03	02
	Elective-II	Mathematical Logic	03	80	20	03	02
	SEC-I	Mathematical Statistics	03	80	20	03	02
V	Theory		04	80	20	03	03
	Theory		04	80	20	03	03
	Practical		04	40	10	03	02
	Practical		04	40	10	03	02
	SEC-II	Machine Learning	03	80	20	03	02
VI	Theory		04	80	20	03	03
	Theory		04	80	20	03	03
	Practical		04	40	10	03	02
	Practical		04	40	10	03	02

	SEC-III	Internship/Project	--	--	--	--	02

Draft Structure for BSc Mathematics Course

Syllabus for B.Sc. with Mathematics as one of the Major Subjects

SEMESTER – I

Theory	Algebra-I Calculus-I Geometry
Teaching Hours : 04 Hours/Week	**Credits: 03**
Duration of Exam: 03 Hours	**Maximum Marks:100 (Exam 80 + IA 20)**

Course Learning Outcomes:

The overall expectation from this course is that the student builds a basic understanding on Algebra, Calculus and Geometry. The broader course outcomes are listed as follows. At the end of this course, the student will be able to:

- solve the system of homogeneous and non-homogeneous linear system of *'m'* equations in' *n*' variables by using concept of rank of matrix.
- find eigenvalues and eigenvectors.
- find n^{th} derivatives of some standard functions.
- solve problems on partial differentiation, Jacobians and related properties.
- find the reduction formulae and apply Leibnitz Rule.
- identify geometrical aspects of planes and sphere in 3D.

Algebra-I

Unit I Matrices 14 Hours

Recapitulation of matrices, Elementary row and column transformations (operations). equivalent matrices, theorems on it. Row reduced echelon form. Normal forms of a matrix, Rank of a matrix, problems. Homogenous and non-homogenous systems of linear equations in unknowns, Consistency Criterion - Criterion for uniqueness of solutions. Eigenvalues and Eigenvectors of a square matrix of order 2 and 3, standard properties. Cayley-Hamilton theorem with proof, Finding A^{-1}, A^{-2} *and* $A^2, A^3,\ A^4$.

Calculus -I

Unit II Differential Calculus 14 Hours

Successive differentiation: An n^{th} derivative of the function $e^{ax+b}, (ax+b)^n$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$ $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$ and problems, Leibnitz theorem with proof and its applications. Partial differentiation- function of two and three variables- first and higher order derivatives. Homogeneous function- Euler's theorem and its extension with proof, Total derivative and differentiation of implicit function and composite function problems Jacobian properties and problems.

Integral Calculus

Unit III Integral Calculus 14 Hours

Recapitulation of integration, reduction formulas for $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \cot^n x dx$, $\int \sec^n x dx$, $\int \cos ec^n x dx$, $\int \sin^m x \cos^n x dx$ with definite limit problems, Differentiation under integral sign by Leibnitz rule and problems.

Analytical Geometry

Unit IV Analytical Geometry 14 Hours

Analytical geometry of three-dimensional, recapitulations of elements of three-dimensional geometry. Planes (intercept form , normal form and passing through three points with proof) distance from a point to a plane, angle between two planes, bisectors of angle between two planes and problems, standard equation of sphere and orthogonal spheres, standard equation of right circular cone and right circular cylinder and problems.

Reference Books:

1. University Algebra -N.S. Gopala Krishnan, New Age International (P) Limited
2. Theory of Matrices - B S Vatsa, New Age International Publishers.
3. Matrices - A R Vasista, Krishna Prakashana Mandir.
4. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
5. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd.,2019.
6. Calculus – Lipman Bers, Holt, Rinehart &Winston.
7. Calculus - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt.Ltd., vol. I &II.
8. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th edition USA: Mc.Graw

Web links:

1. httiii//www.cs.columbib.edu/-zeph/32$s0allectures.html
2. httir://horne.scarlet.be/math/matr.html
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.html
8. http://mathworld.wolfram.com/Calculus.html
9. http://ocw.mit.edu/courses/mathematics/
10. http ://www.univie.ac.at/future' media/more/galerie.html
11. http ://mathwortd.wolfram.com/AnalyticGeometry.html
12. http ://www.nptelvideos.in I 2072 / t1lmathematics.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

Practical	Algebra-I Calculus-I Geometry(DCMP1)
Teaching Hours : 04 Hours/Week	**Credits: 02**
Duration of Exam: 03 Hours	**Maximum Marks: 50 (Exam 40 + IA 10)**

Course Learning Outcomes: This course will enable the students to Learn, fundamentals and implement the python programming language, and will enable to:

1. learn fundamentals of python
2. solve problem on algebra and calculus
3. acquire knowledge of applications of algebra and calculus
4. solve problems related to analytical geometry

Practical/lab work to be performed in computer lab using Python

Suggested Programs

1. Introduction to Python
2. Basics of software with simple examples.
3. Basics of software with simple examples.
   a. compare two numbers using if statements
   b. sum of natural numbers using while loop
   c. finding the factors of a number using for loop
   d. to check the given number is prime or not (use if.....else statement)
   e. find the factorial of a number(use... if...if...else)
   f. simple programmes to illustrate logical operators (and or not)
4. Computation of a rank of matrix by row reduced and normal forms
5. Solving the system of homogeneous and non-homogeneous linear equations
6. Computation of inverse of a matrix by using Cayley-Hamilton theorem
7. Finding the nth derivative of a function without Leibnitz theorem
8. Finding the nth derivative of a function with Leibnitz theorem
9. Partial differentiation of some standard functions.
10. Verification of Eulers theorems with examples
11. Program to find Jacobians
12. Program to find reduction formula with or without limits
13. Program to find angle between the two planes
14. Program to find equation and plot sphere
15. Program to find equation and plot cones
16. Program to find equation and plot cylinders

Note: To implement the above programs, there should be not more than 15 students per batch.

SEMESTER II

Theory	Algebra-II, Calculus-II & Polar Coordinates
Teaching Hours : 4 Hours/Week	Credits: 03
Duration of Exam: 03 Hours	Maximum Marks: 100 (Exam 80 + IA 20)

Course Learning Outcomes:

The overall expectation from this course is that the student builds a basic understanding on Algebra, Calculus and Polar Coordinates. The broader course outcomes are listed as follows. At the end of this course, the student will be able to understand:

- the mathematical structure called Groups.
- the fundamental concepts of limits, continuity and differentiability
- identify and apply the intermediate value theorem and L' Hospital's rule.
- interpret the geometric and physical meaning of derivatives.
- problems related to angle between radius vector and tangent, angle between two curves.
- express the curves in pedal form, derivative of an arc in different forms.
- center of curvature, asymptotes, evolutes and envelops of the given curve.
- length of an arc, area of plane curves and surface area, volume of revolution.

Algebra II

Unit I Groups 14 Hours

Binary operations algebraic structure- problems on finding identity and inverse definition of semi group and group, abelian group, problems on finite and infinite groups, properties of groups with proof- standard problems on groups-finite semi group with both the cancellation laws in a group- any group of orders less than five is abelian, subgroups theorems on subgroups with proof problems.

Calculus II

Unit II Differential Calculus 14 Hours

Limits and continuity, differentiability and properties of continuous functions. Intermediate value theorem, mean value theorem, Rolle 's Theorem, Lagrange's mean value theorem, Cauchy mean value theorem and examples. Indeterminate forms and evaluation of limits using L'Hospital rule.

Polar Coordinates

Unit III Polar Coordinates 14 Hours

Polar coordinates, angle between the radius vector and tangent, angle of intersection of two curves (polar forms), length of perpendicular form pole to the tangent, pedal equation, derivative of an arc in Cartesian parametric and polar forms, curvature of plane curve, radius of curvature formula in Cartesian, parametric polar and pedal forms, center of curvature evolutes, asymptotes, singular points and double points.

Integral calculus

Unit IV Integral calculus 14 Hours

Application of integral calculus computation of length of arc, plane area and surface area and volume of solids of evaluations for standard curves in Cartesian and polar forms.
Improper integrals of first, second and third kinds with examples , improper integral has the limit of proper integral.

Reference Books:

1. Elements of Number Theory; I. M. Vinogradov. Courier Dover Publications, 2016
2. Differential Calculus, Shanti Narayan, S. Chand & Company, New Delhi. 2005
3. Integral Calculus, Shanti Narayan and PK Mittal, S. Chand and Co. Pvt. Ltd., 2005
4. Schaum's Outline of Calculus, Frank Ayres and Elliott Mendleson, The McGraw-Hill Companies, 2013
5. Mathematical Analysis, S C Malik, Wiley Eastern, 6 Edition, 2017.
6. A Course in Abstract Algebra, Vijay K Khanna and S K Bhambri, Vikas Publications. 5 Edition, 2022

Web Links

1. http://www.themathPage.com/
2. http://www.abstractmath'org/
3. http://ocw.mit.edu/courses/mathematics/
4. http://pla netmath.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.mediaImoreIgalerie.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' i n/2012/77/mathematics.html
13. https://www. my-m ooc.com/en/categorie/mathematics
14. www,python.org
15. www.rosettacode.olg
16. http://faculty,msmary.edu/heinold/python.html
17. https:/ lkitchingroup.cheme.com ued/pycse/pycse.html

Practical	Algebra-II, Calculus-II and Polar Coordinate
Teaching Hours : 04 Hours/Week	**Credits: 02**
Duration of Exam: 03 Hours	**Maximum Marks: 50 (Exam 40 + IA 10)**

Course Learning Outcomes: This course will enable the students to write python code to:

1. solve problems on algebra and calculus.
2. acquire knowledge of applications of algebra and calculus
3. plot the curves in different forms
4. find surface area and volume of revolution

Practical/lab work to be performed in computer lab using Python

Suggested Programs

1. Verifying whether given operator is binary or not.
2. To find identity and inverse element of a group
3. Program to illustrate continuity of a function
4. Program to illustrate differentiability of a function
5. Program to verify Rolle's Theorem
6. Program to verify Lagrange's theorem
7. Evaluation of limits by L'Hospital rules.
8. Finding the angle between the radius vector and tangent
9. Finding the angle between two curves
10. Finding the radius of curvature of the given curve
11. Plotting of standard Cartesian curves (part I)
12. Plotting of standard Cartesian curves (part II)
13. Plotting of standard polar curves
14. Plotting of standard parametric curves
15. Program to compute surface area of revolution.
16. Program to compute volume of revolution.

Note: To implement the above programs, there should be not more than 15 students per batch.

BLUEPRINT FOR QUESTION PAPER

Marks	Unit I	Unit II	Unit III	Unit IV	Number of questions to be answered	Total
2	3	3	3	3	Any 10	20
5	5	5	5	5	Any 3 questions from each Unit	60
					Total	80