SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A++' Grade

Choice Based Credit System with Multiple Entry and Multiple Exit Option

(NEP-2020)

CHOICE BASED CREDIT SYSTEM

Syllabus for

B.Sc. Part – I

MATHEMATICS

SEMESTER I AND II

(Syllabus to be implemented from Academic Year 2022-23)

Choice Based Credit System with Multiple Entry and Multiple Exit Options

To be implemented from the Academic Year 2022-23

First Year Bachelor of Science (Level-5) Programme Structure (NEP-2020 PATTERN)

Courses	Sr. No.	Course Code	TEACHING SCHEME						EXAMINATION SCHEME						
			THEORY			PRACTICAL			THEORY				PRACTICAL		
			Credits	No. of lectures	Hours	Credits	No. of lectures	Hours	Hours	Max	Total Marks	Min	Hours	Max	Min
S E M E S T E R – I (Duration – 6 Months)															
CGPA COURSES	1	DSC-A	2	5	4	2	4	3.2	2	50	100	35	PRACTICAL EXAMINATION IS ANNUAL		
	2	DSC-A	2						2	50					
	3	DSC-A	2	5	4	2	4	3.2	2	50	100	35			
	4	DSC-A	2						2	50					
	5	DSC-A	2	5	4	2	4	3.2	2	50	100	35			
	6	DSC-A	2						2	50					
	7	DSC-A	2	5	4	2	4	3.2	2	50	100	35			
	8	DSC-A	2						2	50					
	9	AECC- A	2	4	3.2	-	-	-	2	50	50	18			
		TOTAL (A)	18			8	16				450				
Non CGPA	10	SEC-1	-	-	-	2	4	4							
	11	VBC-1				1	2	2							
S E M E S T E R – II (Duration – 6 Months)															
CGPA COURSES	1	DSC-B	2	5	4	2	4	3.2	2	50	100	35	As per BOS Guide-lines	50	18
	2	DSC-B	2						2	50					
	3	DSC-B	2	5	4	2	4	3.2	2	50	100	35		50	18
	4	DSC-B	2						2	50					
	5	DSC-B	2	5	4	2	4	3.2	2	50	100	35		50	18
	6	DSC-B	2						2	50					
	7	DSC-B	2	5	4	2	4	3.2	2	50	100	35		50	18
	8	DSC-B	2						2	50					
	9	AECC- B	2	4	3.2	--	--	--	2	50	50	18		200	18
		TOTAL (B)	18			8					450				
		TOTAL (A+B)	36			16					900				
Non CGPA	10	SEC-2	-	-	-	2	4	4							
	11	VBC-2				1	2	2							

- Student contact hours per week : 32 Hrs (Minimum)
- Total Marks for B.Sc.- I : 1100
- Theory and Practical Lecture Duration: 48 min each
- Total Credits for B.Sc.-I (Sem I & II) : 52
- Practical Examination will be conducted annually for 50 marks per course.
- **AECC:** Ability Enhancement Compulsory Course (A & B) : English for communication
- **SEC:** Skill Enhancement Course (Vocational Studies): Field Projects/ Internship/ Apprentiship/ Community Engagement and Service. Any one from pool of courses. For SEC courses there shall be only practical examination of 50 marks. **VBC:** Value Based Course (NSS/NCC/Sports/Cultural, etc.)
- Except English, there shall be combined passing for two theory courses of 50 marks each. i.e. minimum 35 marks are required for passing out of 100. There shall be separate passing for theory and practical.
- ***Exit option after Level 5: Students can exit with Certificate Course in Science (with the completion of courses equal to minimum of 52 credits).***

B. Sc. Part – I: Sem. – I: List of Courses

Discipline Specific Core (DSC) Courses

Course code	Name of the Course	Course code	Name of the Course
B. Sc. Part-I: Sem-I DSC : A1 to A38			
DSC A1	Physics I	**DSC A21**	Geology I
DSC A2	Physics II	**DSC A22**	Geology II
DSC A3	Chemistry I	**DSC A23**	Seed Technology I
DSC A4	Chemistry II	**DSC A24**	Seed Technology II
DSC A5	Mathematics I	**DSC A25**	Microbiology I
DSC A6	Mathematics II	**DSC A26**	Microbiology II
DSC A7	Statistics I	**DSC A27**	Industrial Microbiology I
DSC A8	Statistics II	**DSC A28**	Industrial Microbiology II
DSC A9	Electronics I	**DSC A29**	Biochemistry I
DSC A10	Electronics II	**DSC A30**	Biochemistry II
DSC A11	Computer Science I	**DSC A31**	Psychology I
DSC A12	Computer Science II	**DSC A32**	Psychology II
DSC A13	Botany I	**DSC A33**	Food Science & Quality control-I
DSC A14	Botany II	**DSC A34**	Food Science & Quality control-II
DSC A15	Zoology I	**DSC A35**	Astrophysics I
DSC A16	Zoology II	**DSC A36**	Astrophysics II
DSC A17	Biotechnology (Opt) I	**DSC A37**	Nanotechnology (opt) I
DSC A18	Biotechnology (Opt) II	**DSC A38**	Nanotechnology (opt) II
DSC A19	Geography I		
DSC A20	Geography II	**AECC – A**	English Paper – I

DSC: Discipline Specific Core Course

AECC – Ability Enhancement Compulsory Course

AECC – A – English Paper– I

Link for the pool of SEC courses from National Skills Qualification Framework (NSQF)

(You may add or delete any courses as per available facilities)

https://drive.google.com/file/d/176Vwvx4SC2ONrt69XADruzI2qnfBPI_o/view?usp=sharing

B. Sc. Part – I: Sem. – I: List of Courses

Discipline Specific Core (DSC) Courses

Course code	Name of the Course	Course code	Name of the Course
B. Sc. Part-I: Sem-II DSC : B1 to B38			
DSC B1	Physics III	**DSC B21**	Geology III
DSC B2	Physics IV	**DSC B22**	Geology IV
DSC B3	Chemistry III	**DSC B23**	Seed Technology III
DSC B4	Chemistry IV	**DSC B24**	Seed Technology IV
DSC B5	Mathematics III	**DSC B25**	Microbiology III
DSC B6	Mathematics IV	**DSC B26**	Microbiology IV
DSC B7	Statistics III	**DSC B27**	Industrial Microbiology III
DSC B8	Statistics IV	**DSC B28**	Industrial Microbiology IV
DSC B9	Electronics III	**DSC B29**	Biochemistry III
DSC B10	Electronics IV	**DSC B30**	Biochemistry IV
DSC B11	Computer Science III	**DSC B31**	Psychology III
DSC B12	Computer Science IV	**DSC B32**	Psychology IV
DSC B13	Botany III	**DSC B33**	Food Science & Quality control II
DSC B14	Botany IV	**DSC B34**	Food Science & Quality control IV
DSC B15	Zoology III	**DSC B35**	Astrophysics III
DSC B16	Zoology IV	**DSC B36**	Astrophysics IV
DSC B17	Biotechnology (Opt) III	**DSC B37**	Nanotechnology (opt) III
DSC B18	Biotechnology (Opt) IV	**DSC B38**	Nanotechnology (opt) IV
DSC B19	Geography III		
DSC B20	Geography IV	**AECC – B**	English Paper – II

B.Sc. Part I (Mathematics), Semester-I & II

Choice Based Credit System with Multiple Entry and Multiple Exit Option
(NEP-2020)

Syllabus to be implemented from Academic Year 2022-23

1. **TITLE: Mathematics**
2. **YEAR OF IMPLEMENTATION:** Revised Syllabus will be implemented from June 2022 onwards.
3. **DURATION:** B.Sc. in Mathematics Part- I. The duration of course shall be one year and two semesters.
4. **PATTERN:** Pattern of examination will be semester.
5. **STRUCTURE OF COURSE:**

STRUCTURE OF COURSE

Sr. No.	Paper	Name of Paper	Marks
Mathematics (Semester I)			
1	DSC-A5	Calculus	50 (Theory)
2	DSC-A6	Ordinary Differential Equations	50 (Theory)
Mathematics (Semester II)			
3	DSC-B5	Multivariable Calculus	50 (Theory)
4	DSC-B6	Basic Algebra	50 (Theory)
Practical (Annual)			
5	CCPM-I	Core Course Practical in Mathematics - I	50 (Practical)

B.Sc. (Mathematics) (Part I) (Semester – I)
Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
Syllabus to be implemented from Academic Year 2022-23

Course code: **DSC – A5**
Title of course: **Calculus**
Theory: **32 Hrs. (40 lecturers)**
Marks: **50 (Credit: 02)**

Course Learning Outcomes: Upon successful completion of the course students will able to:

1. Evaluate the limit and examine the continuity of a function at a point.
2. Understand the consequences of mean value theorems for differentiable functions.
3. Apply Leibnitz theorem to obtain higher derivatives of product of two differentiable functions.

Unit – 1: Limit, Continuity and Differentiability **(20 lect.)**

1.1 Limits: ε – δ definition, infinite limit ($f \to \infty$ as $x \to c$), limit at infinity ($f \to l$ as $x \to \infty$ and $f \to \infty$ as $x \to \infty$) .

1.2 Left hand and Right hand limits: definition and examples.

1.3 Properties of limits:

Theorem: If f and g are two functions defined on some neighbourhood of c such that $\lim_{x \to c} f(x) = l$, $\lim_{x \to c} g(x) = m$ then

(i) $\lim_{x \to c}(f+g)(x) = l + m$

(ii) $\lim_{x \to c}(f-g)(x) = l - m$

(iii) $\lim_{x \to c}(f \cdot g)(x) = lm$

(iv) $\lim_{x \to c}(f/g)(x) = l/m \ \ if\ m \neq 0$ (without proof)

1.4 Evaluation of limit: Examples (using techniques like factorization, rationalization, Left hand and Right hand limits etc.).

1.5 Continuous functions: definition of Continuity at a point, definition of continuity in an interval.

1.6 Properties of continuous functions:

1.6.1 Theorem: Let f and g be two functions continuous at a point c, then the functions $f+g$, $f-g$, fg are also continuous at c and if $g(c) \neq 0$, then f/g is also continuous at c.

Functions continuous on closed intervals:

1.6.2 Definition of bounded function

1.6.3 Theorem (Statement only): If a function f is continuous in a closed interval, then it is bounded therein.

1.6.4 Theorem: If a function f is continuous on a closed interval $[a,\ b]$, then it attains its bounds at least once in $[a,\ b]$.

1.6.5 Theorem: If a function f is continuous at an interior point c of an interval $[a,\ b]$ and $f(c) \neq 0$, then $\exists$ a $\delta > 0$ such that $f(x)$ has the same sign as $f(c)$, for every $x \in]c-\delta,\ c+\delta[$.

1.6.6 Corollary (Statement only): If f is continuous at the end point b of $[a,\ b]$ and $f(b) \neq 0$, then there exists an interval $]b-\delta,\ b[$ such that $f(x)$ has the sign of $f(b)$ for all x in $]b-\delta,\ b]$.

1.6.7 Corollary (Statement only): If f is continuous at the end point a of $[a,\ b]$ and $f(a) \neq 0$, then there exists an interval $[a,\ a+\delta[$ such that $f(x)$ has the sign of $f(a)$ for all x in $[a,\ a+\delta[$.

1.6.8 Theorem: If a function f is continuous on a closed interval $[a,\ b]$ and $f(a)$ and $f(b)$ are of opposite signs ($f(a) \cdot f(b) < 0$), then there exists at least one point $\alpha \in]a,\ b[$ such that $f(\alpha) = 0$.

1.6.9 Intermediate Value Theorem.

1.6.10 Corollary (Statement only): A function f, which is continuous on a closed interval $[a, b]$, assumes every value between its bounds.

1.7 Discontinuous functions: Definition, Types of discontinuities – (i) removable discontinuity (ii) discontinuity of first kind (iii) discontinuity of second kind.

1.8 Examples on 1.5 and 1.7

1.9 Uniform continuity: definition and simple examples

1.10 Theorem: A function which is uniformly continuous on an interval is continuous on that interval.

1.11 Differentiability at a point and Differentiability in an interval: definitions.

1.12 Examples on 1.11

1.13 (Differentiability and continuity) Theorem: A function which is derivable at a point is necessarily continuous at that point

Unit – 2: Mean Value Theorems, Successive Differentiation, Expansions of functions

(20 lect.)

2.1 Mean Value Theorems

2.1.1 Rolle's Mean Value Theorem, Geometrical interpretation.

2.1.2 Lagrange's Mean Value Theorem, Geometrical interpretation.

2.1.3 Cauchy's Mean Value Theorem.

2.1.4 Examples on 2.1.1, 2.1.2, 2.1.3.

2.2 Successive Differentiation

2.2.1 Higher order derivatives: notations.

2.2.2 Calculation of n^{th} derivative: Standard results

$(ax+b)^m$, $1/(ax+b)$, $\log(ax+b)$, a^{mx}, e^{mx}, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$.

2.2.3 Determination of n^{th} derivative: examples.

2.2.4 Leibnitz's Theorem.

2.2.5 Examples on 2.2.4.

2.3 Expansion of functions

2.3.1 Maclaurin's theorem (Statement only), examples using Maclaurin's theorem.

2.3.2 Taylor's theorems (Statement only), examples using Taylor's theorem.

Recommended Books:

1. **Mathematical Analysis**, S. C. Malik and Savita Arora, New Age International Publishers, 4^{th} Edition (2012) – For Unit 1
2. **Differential Calculus,** Shanti Narayan and P.K. Mittal, S. Chand publishing, 15^{th} edition (2016) – For Unit 2.

Reference Books:

1. **Differential Calculus**, Gorakh Prasad, Pothishala Pvt. Ltd., 19th edition (2016).
2. **Aspects of Calculus**, Gabriel Klambauer, Springer-Verlag.(1986)
3. **Calculus with Maple Labs**, Wieslaw Krawcewicz & Bindhyachal Rai, Narosa (2003).
4. **Calculus**, George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir Pearson Education, 14th edition (2018).

B.Sc. (Mathematics) (Part I) (Semester – I)
Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
Syllabus to be implemented from Academic Year 2022-23

Course code: **DSC – A6**
Title of course: **Differential Equations**
Theory: **32 Hrs. (40 lecturers)**
Marks: **50 (Credit: 02)**

Course Learning Outcomes: Upon successful completion of the course students will able to:

1. Understand types of differential equations.
2. Solve different types of ordinary differential equations.
3. Understand applications of differential equations.

Unit – 1: Ordinary differential equations of first order and first degree (22 lect.)

Definition, Order and Degree, Exact differential equations, Necessary and sufficient condition for exactness, Differential equations reducible to exact, Integrating factors with rules, Linear differential equations, Differential equations reducible to linear differential equation, Bernoulli's differential equations.

Orthogonal trajectories, orthogonal trajectories to Cartesian and polar curves. Differential equations of first order but not of first degree: Equations that can be factorized, Equations solvable for p, Equations that cannot be factorized, Equations solvable for x, Equations solvable for y and Clairaut's form.

Unit – 2: Linear differential equations with constant coefficients (18 lect.)

Definition, General solution, Auxiliary equation, Complementary function, Types of complementary function: real and distinct roots, real and repeated roots , complex roots, complex and repeated roots, mixed roots, Examples on different types of complementary function, Particular integral, Particular integrals of the functions: e^{ax}, sin ax, cos ax, x^m, $e^{ax}\,V$, x.V and general method.

Recommended Books:

1. **Ordinary and partial differential equations**, M. D. Raisinghania, S. Chand and Company Pvt. Ltd, New Delhi, 18th Revised Edition (2016).

Reference Books:

1. **Introductory course in differential equations**, D. A. Murray, Khosala Publishing House, Delhi.
2. **An Introduction to Differential Equations**, R. K. Ghosh and K. C. Maity. Book and Allied (P) Ltd., Seventh Edition (2000).
3. **Differential Equations and Their Applications**, Zafar Ahasan, PHI, Second Edition (2004).

B.Sc. (Mathematics) (Part I) (Semester – II)
Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
Syllabus to be implemented from Academic Year 2022-23

Course code: **DSC – B5**
Title of course: **Multivariable Calculus**
Theory: **32 Hrs. (40 lecturers)**
Marks: **50 (Credit: 02)**

Course Learning Outcomes: Upon successful completion of the course students will able to:

1. Learn conceptual variations while advancing from one variable to several variables in calculus.
2. Set up and solve optimization problems involving several variables.
3. Learn the concept of Jacobian of a transformation.

Unit – 1: Partial differentiation **(20 lect.)**

Functions of two variables: domain, Neighbourhood of a point, Continuity of functions of two variables (at a point), Limit of functions of two variables, Partial derivatives: first order partial derivatives, partial derivatives of higher order, Geometrical interpretation of partial derivatives, examples,

Homogeneous functions: definition, Euler's theorem on homogeneous functions (Case of two and three variables), examples using Euler's theorem. Total Differentials, Differentiation of composite functions, examples, Implicit function: first and second order derivative of implicit functions and its examples. Taylor's theorem for a function of two variables, its examples.

Unit – 2: Extreme values and Jacobian **(20 lect.)**

Maxima and minima of functions of two variables: Condition for existence of maxima or minima, stationary and extreme points, Sign of quadratic expression, Lagrange's condition for maximum and minimum values of a function of two variables, examples, Lagrange's method of undetermined multipliers, examples using Lagrange's method.

Jacobian: Definition, examples. Jacobian of function of function (for the case of two and three variables and proof of the corollary $J.J' = 1$ is expected), Jacobian of implicit functions, examples using these properties.

Recommended Books:

1. **Differential Calculus**, Shanti Narayan and P.K. Mittal, S. Chand publishing, 15th edition (2016).

Reference Books:

1. **Basic Multivariable Calculus**, J. E. Marsden , A. J Tromba & A. Weinstein; Springer Verlag, New New York, 1993.
2. **Calculus, Early Transcendental**, H. Anton, I. Birens and Davis, John Wiley and Sons, 11th Edition (2015).
3. **Differential Calculus,** Maity and Ghosh, New Central Book Agency (P) limited, Kolkata, India. 2007.
4. **Calculus: Early transcendental,** James Stewart, Brooks/ Cole Cengage Learning, 7th edition (2012).

B.Sc. (Mathematics) (Part I) (Semester – II)
Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
Syllabus to be implemented from Academic Year 2022-23

Course code: **DSC – B6**
Title of course: **Basic Algebra**
Theory: **32 Hrs. (40 lecturers)**
Marks: **50 (Credit: 02)**

Course Learning Outcomes: Upon successful completion of the course students will able to:

1. Use fundamental concepts in Mathematics like sets, relations and functions.
2. Use fundamental concepts in Number theory.
3. Solve examples on congruence.
4. Determine n^{th} roots of unity.
5. Understand various properties of hyperbolic functions.

Unit – 1: Functions, divisibility and congruence **(20 lect.)**

1.1 Set, Relations on sets, type of relations, equivalence relations, Equivalence classes and partitions of a set.

1.2 Functions: One-one, onto functions and bijections, composition of functions (Definitions and examples).

1.3 The induction principle and strong induction principle.

1.4 Divisibility and congruence:

1.4.1 The division algorithm: Theorem and its applications.

1.4.2 Definitions of Greatest common divisor least common multiple.

1.4.3 Euclidean Algorithm.

1.4.4 Fundamental Theorem of Arithmetic.

1.4.5 The theory of Congruence: Basic Properties of congruence.

Unit – 2: Complex numbers **(20 lect.)**

2.1 Complex numbers (Revision): Sums and Products, Basic Algebraic Properties, Moduli, complex conjugates and polar representation of complex numbers.

2.2 Theorem: De Moivre's theorem.

2.2.1 n^{th} roots of unity.

2.2.2 Examples.

2.3 Complex logarithm and complex power.

2.4 Hyperbolic functions and identities.

2.5 Relation between hyperbolic and trigonometric functions.

2.6 Identities of hyperbolic functions.

2.7 Hyperbolic equations.

2.8 Inverses of hyperbolic functions.

2.9 Derivative of hyperbolic and inverse hyperbolic functions

Recommended books:

1 **A Foundation Course in Mathematics**, Ajit Kumar, S. Kumeresan and Bhaba Kumar Sarma, Narosa Publication House.
Unit 1 (1.1): Chapter 4: 4.1 to 4.4, (1.2): Chapter 3: 3.1 to 3.3, (1.3): Chapter 5: 5.1 to 5.2.

2 **Elementary Number Theory**, Seventh edition: David M. Burton, McGraw-Hill.
Unit 1 (1.4): Chapter 2: 2.2 to 2.4, Chapter 3: 3.1, Chapter 4: 4.2.

3 **Foundation Mathematics for the Physical Sciences**, Riley and Hobson, Cambridge University press, 2011.
Unit 2 (2.1 to 2.9): Chapter 5: 5.1 to 5.7.

Reference Books:

1 **Foundations of Complex Analysis**, S. Ponnusamy, Narosa Publishing House, India, Second Edition Reprint 2019.

2 **Introduction to Real Analysis**, R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.

Core Course Practicals in Mathematics (CCPM - I)

Marks – 50, Credits – 4

Pr. No	Title
1.	Properties of Tracing of Cartesian Curves
2.	Tracing of Cartesian Curves – I
3.	Tracing of Cartesian Curves – II
4.	Properties of Tracing of Polar Curves
5.	Tracing of Polar Curves – I
6.	Tracing of Polar Curves – II
7.	Examples on Leibnitz's theorem
8.	Extreme values of functions of two variables
9.	Lagrange's method of undetermined multipliers
10.	Jacobian
11.	Euclidean Algorithm
12.	Examples on Fermat's theorem
13.	Law of growth
14.	Law of decay
15.	Newton's law of cooling
16.	Electrical circuits
17.	Plotting 2D curves (Use any open source software).
18.	Plotting 3D graphs (Use any open source software).