



**Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur 440033**

**Scheme and Syllabus
Bachelor of Science (Mathematics)**

**Submitted by
Board of Studies,
Bachelor of Science (Mathematics)**

FYUGP-Scheme I-VIII Semester
Bachelor of Science (Honors/Research)
(Mathematics - Major)
Four Year (Eight Semester Degree Course)
Teaching and Examination Scheme
B.Sc. Sem-I (Mathematics - Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Mi n.
1	DSC	Algebra and Trigonometry	BMT1T01	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Algebra and Trigonometry	BMT1P01	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Differential Calculus	BMT1T02	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Differential Calculus	BMT1P02	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO1T01	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO1T02	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Sage Math software system	BVS1P01	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS1P02	-	-	4	2	-	-	-	-	50	50	50
9	AEC	English Compulsory	BAE1T01	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Environmental Sci.	BVE1T01	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Vedic Mathematics	BIK1T01	2	-	-	2	3	80	20	40	-	-	-
12	CC	Refer CC Basket	BCC1P01	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	22		530	170		125	275	

B.Sc. Sem-II (Mathematics - Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme								
				(Th)	TU	P		Theory				Practical				
								Exam Hrs.	SEE	CIE	Mi n.	SEE	CIE	Mi n.		
1	DSC	Integral Calculus and Ordinary DEq	BMT2T03	2	-	-	2	3	80	20	40	-	-	-		
2	DSC	Integral Calculus and Ordinary DEq	BMT2P03	-	-	2	1	-	-	-	-	25	25	25		
3	DSC	Vector Analysis	BMT2T04	2	-	-	2	3	80	20	40	-	-	-		
4	DSC	Vector Analysis	BMT2P04	-	-	2	1	-	-	-	-	-	50	25		
5	GE/OE	Refer GE/OE Basket	BGO2T03	2	-	-	2	3	80	20	40	-	-	-		
6	GE/OE	Refer GE/OE Basket	BGO2T04	2	-	-	2	3	80	20	40	-	-	-		
7	VSC	Maxima software system	BVS2P03	-	-	4	2	-	-	-	-	50	50	50		
8	SEC	Refer SEC Basket	BVS2P04	-	-	4	2	-	-	-	-	50	50	50		
9	AEC	Second Language	BAE2T02	2	-	-	2	3	50	50	40	-	-	-		
10	VEC	Constitution of India	BVE2T02	2	-	-	2	3	80	20	40	-	-	-		
11	IKS	Indian Astronomy	BIK2T02	2	-	-	2	3	-	-	-	50	50	50		
12	CC	Refer CC Basket	BCC2P02	-	-	4	2	-	-	-	-	-	100	50		
				14	-	16	22		530	170		125	275			

**Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR
Continue with Major and Minor**

B.Sc. Sem-III (Mathematics- Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Cred it	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exa m Hrs.	SE E	CI E	M in.	SEE	CIE	Mi n.
1	DSC	Partial Differential Equations	BMT3T05	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Partial Differential Equations	BMT3P05	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Analytical Solid Geometry	BMT3T06	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Analytical Solid Geometry	BMT3P06	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 1 (Refer Minor Basket)	BMT1T01	2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 1 (Refer Minor Basket)	BMT1P01	-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 2 (Refer Minor Basket)	BMT1T02	2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 2 (Refer Minor Basket)	BMT1P02	-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO3T05	2	-	-	2	3	80	20	40	-	-	-
10	VSC	Refer VSC Basket	BVS3P05	-	-	4	2	-	-	-	-	50	50	50
11	AEC	Second Language	BAE3T03	2	-	-	2	3	50	50	40	-	-	-
12	FP	Field Project	BFP3P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC3P03	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	22		450	150		150	350	

B.Sc. Sem-IV (Mathematics- Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Cred it	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exa m Hrs.	SE E	CI E	M in.	SEE	CIE	Mi n.
1	DSC	Mathematical Methods	BMT4T07	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Mathematical Methods	BMT4P07			2	1	-	-	-	-	25	25	25
3	DSC	Sequences and Series	BMT4T08	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Sequences and Series	BMT4P08			2	1	-	-	-	-	-	50	25
5	Minor	Minor 3 (Refer Minor Basket)	BMT2T03	2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 3 (Refer Minor Basket)	BMT2P03			2	1	-	-	-	-	25	25	25
7	Minor	Minor 4 (Refer Minor Basket)	BMT2T04	2	-		2	3	80	20	40	-	-	-
8	Minor	Minor 4 (Refer Minor Basket)	BMT2P04			2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO4T06	2	-	-	2	3	80	20	40	-	-	-
10	SEC	Refer SEC Basket	BVS4T06	-	-	4	2	-	-	-	-	50	50	50
11	AEC	English Compulsory	BAE4T03	2	-	-	2	3	50	50	40	-	-	-
12	CEP	Community Service	BCM4P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC4P04	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	22		450	150		150	350	

**Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/
Internship OR Continue with Major and Minor**

B.Sc. Sem-V (Mathematics - Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credi t	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SE E	CIE	Min	SEE	CIE	Min
1	DSC	Analysis	BMT5T09	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Analysis	BMT5P09	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Abstract Algebra	BMT5T10	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Abstract Algebra	BMT5P10	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Mechanics	BMT5T11	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Mechanics	BMT5P11	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 1	BMT5T12	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 1	BMT5P12	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 5 (Refer Minor Basket)	BMT3T05	2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 5 (Refer Minor Basket)	BMT3P05	-	-	2	1	-	-	-	-	25	25	25
11	Minor	Minor 6 (Refer Minor Basket)	BMT3T06	2	-	-	2	3	80	20	40	-	-	-
12	Minor	Minor 6 (Refer Minor Basket)	BMT3P06	-	-	2	1	-	-	-	-	-	50	25
13	VSC	Refer VSC Basket	BVS5P07	-	-	4	2	-	-	-	-	50	50	50
14	CEP	Community Service	BCM5P02	-	-	2	1	-	-	-	-	25	25	25
Total				13	-	18	22	-	520	130	--	150	300	-

B.Sc. Sem-VI (Mathematics - Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credi t	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exa m Hrs.	SE E	CI E	Mi n.	SE E	CIE	Min.
1	DSC	Complex Analysis	BMT6T13	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Complex Analysis	BMT6P13	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Linear Algebra	BMT6T14	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Linear Algebra	BMT6P14	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Graph Theory	BMT6T15	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Graph Theory	BMT6P15	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 2	BMT6T16	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 2	BMT6P16	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 7 (Refer Minor Basket)	BMT4T07	2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 7 (Refer Minor Basket)	BMT4P07	-	-	2	1	-	-	-	-	25	25	25
11	VSC	Refer VSC Basket	BVS6P08	-	-	4	2	-	-	-	-	50	50	50
12	OJT	Internship (Related to DSC)	BOJ6P01	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	22	22		440	110		225	325	

Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor

B.Sc. Sem-VII (Honors) (Mathematics - Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Algebra-1	BMT7T17	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Algebra-1	BMT7P17	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Real Analysis-1	BMT7T18	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Real Analysis-1	BMT7P18	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Topology	BMT7T19	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Topology	BMT7P19	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Ordinary Differential Equations	BMT7T20	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Ordinary Differential Equations	BMT7P20	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 3	BMT7T21	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 3	BMT7P21	-	-	2	1	-	-	-	-	25	25	25
11	RM	Research Methodology	BM7T22	2	-	-	2	3	80	20	40	-	-	-
12	RM	Research Methodology	BM7P22	-	-	4	2	-	-	-	-	50	50	50
Total				13	-	14	20		520	130		125	225	

B.Sc. Sem-VIII (Honors) (Mathematics - Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Tota l Cred it	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SE E	CI E	M in.	SEE	CI E	Min .
1	DSC	Algebra-2	BMT8T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Algebra-2	BMT8P23	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Real Analysis -2	BMT8T24	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Real Analysis -2	BMT8P24	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Differential Geometry	BMT8T25	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Differential Geometry	BMT8P25	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Integral Equations	BMT8T26	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Integral Equations	BMT8P26	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 4	BMT8T27	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 4	BMT8P27	-	-	2	1	-	-	-	-	25	25	25
11	OJT	Apprenticeship (Related to DSC)	BOJ8P02	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	18	20		440	110		175	275	

Four Year UG Honours Degree in Major and Minor with 160-176 credits

B.Sc. Sem-VII (Research) (Mathematics - Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Cred it	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SE E	CI E	M in.	SEE	CIE	Mi n.
1	DSC	Algebra-1	BMT7T17R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Algebra-1	BMT7P17R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Real Analysis-1	BMT7T18R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Real Analysis-1	BMT7P18R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Topology	BMT7T19R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Topology	BMT7P19R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 3	BMT7T20R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 3	BMT7P20R	-	-	2	1	-	-	-	-	-	50	25
9	RM	Research Methodology	BMT7T21R	2	-	-	2	3	80	20	40	-	-	-
10	RM	Research Methodology	BMT7P21R	-	-	4	2	-	-	-	-	50	50	50
11	RP	Research Project/ Dissertation (Core)	BRP7P01	-	-	6	3	-	-	-	-	75	75	75
Total				11	-	18	20		440	110		175	275	

‘R’ in the subject code indicates ‘Research’.

B.Sc. Sem-VIII (Research) (Mathematics - Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Tota l Cre dit	Examination Scheme								
				(Th)	TU	P		Theory				Practical				
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min		
1	DSC	Algebra-2	BMT8T22R	2	-	-	2	3	80	20	40	-	-	-		
2	DSC	Algebra-2	BMT8P22R	-	-	2	1	-	-	-	-	25	25	25		
3	DSC	Real Analysis-2	BMTT8T23R	2	-	-	2	3	80	20	40	-	-	-		
4	DSC	Real Analysis-2	BMTT8P23R	-	-	2	1	-	-	-	-	-	50	25		
5	DSC	Differential Geometry	BMT8T24R	2	-	-	2	3	80	20	40	-	-	-		
6	DSC	Differential Geometry	BMT8P24R	-	-	2	1	-	-	-	-	25	25	25		
7	DSE	Elective 4	BMT8T25R	3	-	-	3	3	120	30	60	-	-	-		
8	DSE	Elective 4	BMT8P25R	-	-	2	1	-	-	-	-	-	50	25		
9	RP	Research Project / Dissertation (Core)	BRP8P02	-	-	14	7 (4+2 +1)	-	-	-	-	175	175	175		
Total				09	-	22	20		360	90		225	325			

'R' in the subject code indicates 'Research'.

Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits

Total Credits:

1. Three Year UG Degree Program: 132
2. Four Year UG Degree Program: 172

Abbreviations: Generic/Open Electives: OE, Vocational Skills & Skill Enhancement Courses: VSEC, Vocational Skill Courses: VSC, Skill Enhancement Courses: SEC, Ability Enhancement Courses: AEC, Indian Knowledge Systems: IKS, Value Education Courses: VEC, On Job Training (Internship/Apprenticeship): OJT, Field Project: FP, Community Engagement & Service: CEP, Co-curricular Courses: CC, Research Methodology: RM, Research Project: RP

VSC Basket (Mathematics)

Semester	Course Category	Name of Course	BoS	Course Code
I	VSC	Sage Math software system	Mathematics	BVS1P01
II	VSC	Maxima software system	Mathematics	BVS2P03
III	VSC	Mathematical foundation for data science	Mathematics	BVS3P05
V	VSC	Scilab	Mathematics	BVS5P07
VI	VSC	Statistics with R	Mathematics	BVS6P08

Basket for ELECTIVE (DSE) Category Courses (Mathematics)

Semester	Course Category	Name of Course	Course Code
V	Elective 1	Linear Programming Problems	BMT5T12-A BMT5T12-B
		Statistics	
VI	Elective 2	Mathematical Modeling	BMT6T16-A BMT6T16-B
		Special Theory of Relativity	
VII (Honors)	Elective 3	Advanced Numerical Methods	BMT7T21-A BMT7T21-B
		Fluid Dynamics	
VIII (Honors)	Elective 4	General Theory of Relativity	BMT8T27-A BMT8T27-B
		Operations Research	
VII (Research)	Elective 3	Ordinary Differential Equations	BMT7T20R-A BMT7T20R-B
		Advanced Numerical Method	
VIII (Research)	Elective 4	Integral Equations	BMT7T25R-A BMT7T25R-B
		General Theory of Relativity	

‘R’ in the subject code indicates ‘Research’.

**RASHTRASANT TUKDOJI MAHARAJ
NAGPUR UNIVERSITY, NAGPUR**



As per National Education Policy 2020

B.Sc. Four Years (Honors/Research)

**Curriculum Framework for Eight Semester Degree
Course with Mathematics Major**

B.Sc. Part I (Semester I and II)

**With effect from
the Academic Year 2023-24
B.Sc. Part I (Semester I and II)**

PROGRAM: B. Sc. Mathematics

Program Outcome:

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Problem Solving: Solve problems from the disciplines of concern using the knowledge, skills and attitudes acquired from mathematics/ sciences/social sciences/humanities.

PO3. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO4. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in wide variety of settings.

PO5. Ethics: Understand multiple value systems including your own, the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and sustainability: Understand the impact of technology and business practices in societal and environmental contexts, and sustainable development.

PO7. Self-directed and life-long learning: Demonstrate the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PO8. Design/Development of Solutions: Design solutions for complex science problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO9. Computational Thinking: Understand data-based reasoning through translation of data into abstract concepts using computing technology-based tools.

PO10. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO11. Global Perspective: Understand the economic, social and ecological connections that link the world's nations and people.

PO12. Aesthetic Engagement: Demonstrate and master the ability to engage with the arts and draw meaning and value from artistic expression that integrates the intuitive dimensions of participation in the arts with broader social, cultural and theoretical frameworks.

Program Specific Outcome:

PSO1: **Rational Thinking:** Students be able to formulate and develop Mathematical arguments in a logical manner to unravel the gist hidden in the problem at hand.

PSO2: **Problem solving ability:** Student should be able to think in a critical manner to process the data, and develop Mathematical problem-solving ability.

PSO3: **Revisiting the question:** Students should be able to recall basic facts, important milestones, discoveries in Mathematics and inculcate habit of rational thinking by which the problem at hand can be revisited, time and again, that helps in solving it.

PSO4: **Analytical ability:** In the growing field of research, it is necessary for students to learn to use some packages like Matlab, Scilab, Mathematica, Maxima, etc, so that analytical tools be available to investigate the functions, problems through graphs, programming, etc.

PSO5: **Numerical Ability:** Using packages, students can make programs to solve some problems of which exact solutions are not available, using tools of Numerical analysis.

PSO6: **Simulation Ability:** The problems that cannot be solved directly, can at times be solved through techniques of simulation by honors/research students.

PSO7: **Research:** Students thus motivated would prepare themselves for research studies in Mathematics and related fields.

PSO8: **Application:** Student will be able to apply their skills and knowledge in Mathematics to various fields of studies including, science, engineering, commerce and management etc.

B.Sc. Semester I (MATHEMATICS)

Sem I Paper - I DSC (Core) Code: BMT1T01 For Minor: BMT1T01	Course Title: Algebra and Trigonometry Course Outcomes: CO1: Foundational Knowledge: Students will be able to update their basics of Set Theory, Matrices, Theory of equations and Complex variables and its applied aspects. CO2: Elementary Skills: Students will be able to understand the importance of hyperbolic functions and their relationships with trigonometric functions. CO3: Basic Analytic skills: The main outcome of the course is to equip students with necessary basic analytic skills for problem solving. CO4: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems in science and engineering.	Credit 2 No. of hours 30
	Syllabus for B.Sc. Semester – I Paper - I BMT1T01: Algebra and Trigonometry	No. of hours
	Unit I – Algebra: Set theory, equivalence relations, equivalence classes. Theory of Numbers: Divisibility, division algorithm, Euclidean algorithm, congruence, linear congruence.	8
	Unit II - Matrices: Hermitian and skew- Hermitian matrices, idempotent, nilpotent, involuntary, orthogonal and unitary matrices. Rank of a matrix, Equivalent matrices, Row canonical form, Normal form, System of homogeneous and non-homogeneous equations, Characteristic equation and roots, Application of Cayley-Hamilton Theorem.	7
	Unit III – Theory of Equations: Relation between the roots and the coefficients of general polynomial equation in one variable, Descartes’ rule of signs, Calculation of $f(x + h)$ by Horner’s process, Transformation of equations, Reciprocal equations. Solution of cubic Equation (Cardon’s Method) and Biquadratic equations (Ferrari’s Method)	7
	Unit IV - Trigonometry: De Moivre’s Theorem and its application, The n^{th} roots of unity, series expansions of circular, inverse circular and Hyperbolic functions, Separation of $f(z)$ into real and imaginary parts. Logarithm of a complex variable, Properties of logarithmic function.	8
	Reference Books: 1) Elementary Number Theory: David M. Burton (Seventh Edition), New Delhi. 2) Matrix and Linear Algebra: K. B. Datta, Prentice Hall of India Pvt. Ltd., New Delhi- 2000. 3) Higher Algebra: H.S. Hall and S.R. Knight, S. Chand & Co. Ltd., New Delhi, 2008.	

	<p>4) Theory and problems of Complex variables by Murray R. Spiegel, Schaum's outline series, McGraw-Hill Book Company, New York (1981)</p> <p>5) A Textbook of Matrices: Shanti Narayan, P.K. Mittal, S. Chand & Company, 2010</p> <p>6) Theory and problems of Matrices: Frank Ayres, JR., Schaum's outline series, McGraw-Hill Book Company, New York. (1974)</p> <p>7) Schaum's Outline of trigonometry: Robert Moyer, Frank Ayres, 2012</p> <p>Suggested digital platform: NPTEL/SWAYAM/MOOCs</p>	
	PRACTICAL: BMT1P01: Algebra and Trigonometry	
<p>Sem I Paper - I DSC (Core) Code: BMT1P01</p> <p>For Minor: BMT1P01</p>	<p>Course Outcomes:</p> <p>CO1: Students will be able to learn implications of equivalence relations in determining equivalence classes.</p> <p>CO2: Students will understand properties of divisibility through problem solving.</p> <p>CO3: Students will be able to perform different operations on the given congruence.</p> <p>CO4: Solution of linear congruence will be studied by students.</p> <p>CO5: Students will be able to perform matrix operations to determine invertible matrices, row canonical and normal form of the matrices.</p> <p>CO6: Students will be able to apply matrix operations to solve system of linear equations.</p> <p>CO7: Students will be able to find roots of a cubic and biquadratic equation.</p> <p>CO8: Students will be able to apply De Moivre's theorem to find n^{th} roots of a complex number find.</p>	<p>Credit 1</p> <p>No. of hours 30</p>
	<p>Syllabus for Practical BMT1P01: Algebra and Trigonometry Note: Minimum 12 topics from listed practical problems must be conducted, at least 3 from every unit.</p>	
	<p><u>List of topics for practical problems:</u></p> <p>(1) Comparing relations and functions.</p> <p>(2) Exploring implication of equivalence relations in determining equivalence classes.</p> <p>(3) Properties of divisibility through problem solving.</p> <p>(4) Application of different operations on the given congruence.</p> <p>(5) Solution of linear congruence</p> <p>(6) Matrix algebra: (i) $AB \neq BA$ in general (ii) $A \neq 0, B \neq 0$ but $AB = 0$ (iii) $(AB)' = B' A', (AB)^{-1} = B^{-1} A^{-1}$</p>	

- (7) Different methods of finding Inverse of a matrix.
- (8) Row canonical form, normal form and rank of a matrix.
- (9) Solution of system of linear equations $AX = 0$ and $AX = B$, $B \neq 0$ using row operations.
- (10) Linearly independent and dependent vectors in terms of a row.
- (11) Application of Cayley-Hamilton theorem
- (12) Solving Eigen value problems: Eigen values and eigen vectors of square matrices.
- (13) Calculation of $f(x + h)$ by Horner's method
- (14) Roots of a polynomial equation: Arithmetic, Geometric, Harmonic progression.
- (15) Reciprocal equation, their types, and their solutions.
- (16) Application of Cardano's method to find roots of a cubic equation.
- (17) Application of De Moivre's theorem to find n th roots of a complex number.
- (18) Trigonometric functions, hyperbolic functions and their relations.
- (19) Separation of real and imaginary parts of trigonometric and hyperbolic functions.
- (20) Logarithm of a real valued and complex valued functions.

Reference Books:

1. Elementary Number Theory: David M. Burton (Seventh Edition), New Delhi.
2. Matrix and Linear Algebra: K. B. Datta, Prentice Hall of India Pvt. Ltd., New Delhi- 2000.
3. Higher Algebra: H.S. Hall and S.R. Knight, S. Chand & Co. Ltd., New Delhi, 2008.
4. Theory and problems of Complex variables by Murray R. Spiegel, Schaum's outline series, McGraw-Hill Book Company, New York (1981)
5. A Textbook of Matrices: Shanti Narayan, P.K. Mittal, S. Chand & Company, 2010
6. Theory and problems of Matrices: Frank Ayres, JR., Schaum's outline series, McGraw-Hill Book Company, New York. (1974)
7. Schaum's Outline of trigonometry: Robert Moyer, Frank Ayres, 2012
Suitable computer programs can be used: SageMath/Maxima/SciLab/etc

<p>Sem I Paper - II</p> <p>DSC (Core) Code: BMT1T02</p> <p>For Minor: BMT1T02</p>	<p>Course Title: Differential Calculus</p> <p>Course Outcomes:</p> <p>CO1: Foundational Knowledge: Students will be able to update their basic knowledge of Maxima and Minima of functions of single variables and their application.</p> <p>CO2: Elementary Skills: Students will undergo problem solving training by learning Indeterminate forms and L' Hospital's Rule and their applicability.</p> <p>CO3: New Concepts learning: Students will be able to learn new concept of functions of two variables, Taylor series, and maxima and minima of such functions.</p> <p>CO4: Analytic Skills: The problem-solving skills will bring forth the importance of Jacobian in understanding the existence of inverse transformation and other aspects of independence of pair of functions.</p> <p>CO5: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems in science and engineering.</p>	<p>Credit 2</p> <p>No. of hours 30</p>
<p>Syllabus for BSc Semester – I Paper -II BMT1T02: Differential Calculus</p>		<p>No. of hours</p>
<p>Unit I – <u>Functions of Single Variable – Part 1:</u> Intermediate value theorem, Rolle's Theorem, Mean value theorems and their geometrical interpretations, Applications of mean value theorems. Maxima and Minima; cases of one variable involving second or higher degree polynomials</p>		<p>8</p>
<p>Unit II – <u>Functions of Single Variable – Part 2:</u> Successive differentiation and n^{th} differential coefficient of functions, Leibnitz's theorem, Maclaurin's and Taylor's theorems, Indeterminate forms and L' Hospital's Rule</p>		<p>7</p>
<p>Unit III - <u>Functions of Two Variables – Part 1:</u> Limit and continuity of functions of two variables, Partial derivatives, Homogeneous functions, Total differentials, Composite functions, Asymptotes.</p>		<p>7</p>
<p>Unit IV - <u>Functions of Two Variables – Part 2:</u> Jacobians and its properties, Taylor's series of function of two variables, Maxima and Minima of function of two variables, Lagrange's method of multiplier.</p>		<p>8</p>
<p><u>Reference Books:</u></p> <ol style="list-style-type: none"> 1. Differential Calculus: Shanti Narayan and Dr P. K. Mittal, S. Chand & Co. Ltd, New Delhi (2014). 2. Introduction to Real Analysis: R.G. Bartle & D.R. Sherbert, , John Wiley & Sons, 1999 3. Calculus: T.M. Apostol, Vol. I, John Wiley & Sons Inc., 1974 		

	<p>4. A Basic Course in Real Analysis: Ajit Kumar and S. Kumaresan, CRC Press, 2019</p> <p>5. Differential Calculus: S. Balachandra Rao & C. K. Shantha, New Age Publication 1992</p> <p>6. Calculus: H. Anton, I. Birens and S. Davis, John Wiley and Sons, Inc. 2007</p> <p>7. Calculus: G. B. Thomas and R.L. Finney, Pearson Education, 2010</p> <p>Suggested digital platform: NPTEL/SWAYAM/MOOCs</p>	

Sem I Paper - II	PRACTICAL: BMT1P02: Differential Calculus	
DSC (Core) Code: BMT1P02 For Minor: BMT1P02	<p>Course Outcomes:</p> <p>CO1: Students will be able to make out the maximum or minimum nature of the functions by applying different conditions on the functions.</p> <p>CO2: Working on Geometric interpretation of Mean value theorems through graphs of a function will make students grasp the subject admirably.</p> <p>CO3: Students will learn application of Leibnitz, Maclaurin's and Taylor's theorems.</p> <p>CO4: Students will be able to apply L' Hospital's Rule to solve the problems</p> <p>CO5: Solving problems when functions involved are homogeneous</p> <p>CO6: Students will able to solve Jacobians and learn properties due to Jacobian.</p> <p>CO7: Analyzing Maxima and Minima of functions of two variables</p>	Credit 1 No. of hours 30
	<p>Syllabus for Practical BMT1P02: Differential Calculus Note: Minimum 12 topics from listed practical problems must be conducted, at least 3 from every unit.</p>	
	<p><u>List of topics for practical problems:</u></p> <ol style="list-style-type: none"> (1) Application of Rolle's theorem (2) Geometric interpretation of Mean value theorems through graph of a function (3) Application of Mean Value Theorems (4) Comparing results due to Rolles' theorem and Lagrange's mean value theorem on a given function with different conditions. (5) Application of Intermediate value theorem, and analyze it through its graph (6) Determination of n^{th} differential coefficient of functions (7) Application of Leibnitz's theorem (8) Application of Maclaurin's theorem and Taylor's theorems (9) Comparing different Indeterminate forms, and their conversions if possible (10) Solution of limiting problems using L' Hospital's Rule (11) Performing iterative limits on functions of two variables (12) Solving partial derivatives for functions of two variables (13) Solving problems when functions involved are homogeneous 	

	<p>(14) Solving total differentials of scalar functions</p> <p>(15) Finding asymptotes of a function and analyze it through its graph.</p> <p>(16) Solving Jacobians of functions f & g</p> <p>(17) Analyzing independent nature of functions f & g through Jacobians</p> <p>(18) Verification of $J J' = 1$ for a given function and analyze existence of inverse transformation</p> <p>(19) Analyzing Maxima and Minima of function of two variables</p> <p>(20) Application of Lagrange's method of multiplier</p> <p><u>Reference Books:</u></p> <ol style="list-style-type: none"> 1. Differential Calculus: Shanti Narayan and Dr P. K. Mittal, S. Chand & Co. Ltd, New Delhi (2014). 2. Introduction to Real Analysis: R.G. Bartle & D.R. Sherbert, , John Wiley & Sons, 1999 3. Calculus: T.M. Apostol, Vol. I, John Wiley & Sons Inc., 1974 4. A Basic Course in Real Analysis: Ajit Kumar and S. Kumaresan, CRC Press, 2019 5. Differential Calculus: S. Balachandra Rao & C. K. Shantha, New Age Publication 1992 6. Calculus: H. Anton, I. Birens and S. Davis, John Wiley and Sons, Inc. 2007 7. Calculus: G. B. Thomas and R.L. Finney, Pearson Education, 2010 <p>Suitable computer programs can be used: SageMath/Maxima/SciLab/etc</p>	

Vocational Skill Enhancement Course (VSC)

SEMESTER - I

VSC – 01 : Sage Math Software System

Sage is free, open-source Mathematics software that supports research and teaching in algebra, geometry, number theory, cryptography, numerical computation, and related areas.

(Download from <http://www.sagemath.org/>)

SYLLABUS

	<u>PRACTICAL: Sage Math Software System</u>	
Sem- I	Course Title: SAGE MATH SOFTWARE SYSTEM	Credit 2
VSC - 01	Course Outcomes: Students will be able	No. of hours 30
Code:	1) to explore topics in Calculus, Applied Linear Algebra and Numerical Method along with several applications 2) to learn an alternative software as against the commercial products Magma, Maple, Mathematica and MATLAB 3) to learn the most recent algorithms and tools for many domains of mathematics 4) to use as wonderful scientific and graphical calculator.	
BVS1P01	Syllabus for BSc Semester – I: VSC - 01 Code BVS1P01: SAGE MATH SOFTWARE SYSTEM	No. of hours
	TOPICS: 1. Introductory Tutorial 2. Evaluating Sage Commands 3. Functions in Sage 4. Annotating with Sage 5. Basic Symbolics and Plotting 6. Basic 2D Plotting 7. Basic 3D Plotting 8. Calculus 1- Differentiation 9. Calculus 2- Integration 10. Advanced 2D Plotting 11. Graphing Functions and Plotting Curves 12. Plotting Data	30
	Reference books / materials: 1. Computational Mathematics with Sage Math, By <u>Paul Zimmermann</u> , Alexandre Casamayou, <u>Nathann Cohen</u> , <u>Guillaume Connan</u> , <u>Thierry Dumont</u> , <u>Laurent Fousse</u> , François Maltey, Matthias Meulien, <u>Marc Mezzarobba</u> , <u>Clément Pernet</u> , <u>Nicolas M. Thiéry</u> , Erik Bray, <u>John Cremona</u> , Marcelo Forets, <u>Alexandru Ghitza</u> , Hugh Thomas. 2. https://doc.sagemath.org/html/en/prep/index.html 3. https://www.ictmumbai.edu.in/Mathematics/SageMath Lecures_AjitKumar_ICT Mumbai.pdf 4. http://lamastex.org/preprints/compSageMathZimmerman120517.pdf 5. ajitmathsoft.wordpress.com/sage-math	

B.Sc. SEMESTER – I

BVE1T01: ENVIRONMENTAL SCIENCE

COURSE OUTCOMES:

At the end of the course, students shall be able to:

- Explain the basics of Environmental Science and Atmospheric Science along-with the components of Environment
- Explicate the importance of Environmental Education.
- Elucidate the fundamentals of atmospheric science including formation, depletion and effects of ozone layer and acid rain on environment.
- Describe the various physical and chemical characteristics and properties of Water and Soil
- Understand the Ecology and its allied branches
- Comprehend about Population and Community Ecology
- Study the changes in Population by understanding the concept of Population ecology

Unit-I: Basics of Environmental Science (7 Hrs)

- A. Introduction of Environmental Science: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.
- B. Environmental Education: Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness.
- C. Components of Environment: Atmosphere (Structure and composition), hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere-Boundaries of biosphere.

Unit-II: Basics of Atmospheric Science (7 Hrs)

- A. Atmospheric Chemistry: Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.
- B. Green House Effect: Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. Ozone depletion: chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.
- C. Acid Rain: Chemistry of Acid Rain, effect of acid rain on ecosystem, control measures. Precipitation – Forms of precipitation (rain, drizzle, snow, sleet, and hail), types of precipitation (conventional, orographic, and cyclonic).

Unit-III: Basics of Ecology (8 Hrs)

- A. Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.
- B. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.
- C. Biotic Factor: Inter specific relationship Positive: Mutualism (symbiosis), commensalism, proto- cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism.

Unit-IV: Ecosystems and food chain (8 Hrs)

- A. Ecosystem: Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)
- B. Food chain: Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological pyramids (number biomass and energy), energy flow in ecosystem (Y-shaped). Energy flow and the law of thermodynamics.
- C. Biogeochemical Cycles: Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

Reference Books:

1. Text Book of Environment: K M Agrawal, P.K. Sikdar, and S.C. Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C. Dash and P.C. Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C. Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K. Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S. Dara, S.Chand Publication ,New Delhi.
6. Environmental Chemistry: A.K. Dey, New Age International Publishers,2001.
7. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr P.U. Meshram, Allied Publishers, New Delhi.
8. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi,1996.
9. Animal Ecology and Distribution of Animals: Veer Bala Rastogi , Rastogi Publication, Meerut (U.P).
10. Ecology and Environment: P.D.Sharma, Rastogi Publication ,Meerut (U.P).
11. Fundamentals of Environmental Biology: S. Arora, Kalyani Publishers.
12. Environmental Biology: P.K.G. Nair, Himalaya Publication.
13. Environmental Biology: K.C. Agrawal, Agro Botanical Publisher ,Bikaner,1994

Indian Knowledge System (IKS)

SEM1: VEDIC MATHEMATICS (BIK1T01)

Course Outcomes: This course will enable the students to

1. Improve speed and accuracy in numerical calculations
2. Acquire IQ skills and high-end technical knowledge
3. gain test taking skills & creativity of calculations

UNITS	TOPICS	HOURS
Unit 1	(i) Addition - Subtraction - Combined operations - Beejank (ii) Multiplication methods: Urdhwatiryagbhayam, Nikhilam, Ekanyunen, Ekadhiken, Antyayordashakepi. (iii) Vinculum - Operations. (iv) Awareness of 1 to 5 Vedic sutras as per Shankaracharya Bharthikrishan Teerthji Swamiji's book.	8
Unit 2	(i) Division methods : Nikhilam, Paravartya Yojayet, Dhvajank(ii) GCD and LCM (iii) Expression of GCD in terms of two numbers.	8
Unit 3	(i) Divisibility tests, Osculation & Reverse osculation. (ii) Division Algorithm, Quotient & Remainder. (iii) Duplex method.	7
Unit 4	i) Squares & Square-roots for 6 digit number. (ii) Cubes & Cube-roots for 6 digit number, Contribution of Indian Mathematicians in Arithmetic.	7
	TOTAL	30 HRS

Reference Books:

1. Tirthaji B.K. (1965) Vedic Mathematics, MotilalBanarsidass
2. Bidder G.P. (1856) On Mental Calculation. Minutes of Proceedings, Institution of Civil Engineers (1855-56), 15, 251-280
3. Scripture E.W. (1891) American Journal of Psychology. Vol. IV 1-59
4. Mitchell F.D. (1907) American Journal of Psychology. Vol. XVIII 61-143
5. Aitken A.C. (1954) The Art of Mental Calculation: With Demonstrations. Transactions of the Society of Engineers. 45, 295-309
6. Dow A. (1991) A Unified Approach to Developing Intuition in Mathematics, Scientific Research on the Transcendental Meditation and TM-Sidhi Program Vol 5,3386-3398
7. Williams K.R. (1984) Discover Vedic Mathematics. Vedic Mathematics Research Group
Nicholas, Williams, Pickles (1984) Vertically and Crosswise. Inspiration Books

Sem- II Paper - I DSC (Core) Code: BMT2T03 For Minor: BMT2T03	Course Title: Integral Calculus and Ordinary Differential Equations Course Outcomes: CO1: Foundational knowledge: Students to update their knowledge of improper integrals, Beta and Gamma functions and their applicability. CO2: Basic skills: Students will be able to understand the importance of varied methods of solving differential equations of first and second order. CO3: Analytical skills: The main objective of the course is to equip students with necessary analytic skills due to integrability and solutions of differential equations. CO4: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems in science and engineering.	Credit 2 No. of hours 30
	Syllabus for BSc Semester – II Paper - I BMT2T03: Integral Calculus and Ordinary Differential Equations	No. of hours
	Unit I - <u>Reduction Formulae and Beta, Gamma Functions:</u> Reduction formulae for basic trigonometric functions, Integration of irrational functions, Beta and Gamma functions, their properties, Relation between Beta and Gamma functions, Evaluation of integrals using Beta and Gamma functions.	8
	Unit II – <u>Multiple Integrals:</u> Double integration, Application of double integrals, Change the order of integration, Change of variable, Triple integration.	7
	Unit III – <u>First Order Differential Equations:</u> Exact differential equations, Integrating factors, Linear and Bernoulli’s differential equations, First order higher degree differential equations solvable for x, y and p, Clairaut’s form, Orthogonal trajectories.	7
	Unit IV - <u>Second Order Linear Differential Equations:</u> The general solution of the homogeneous equations, Operator methods for finding particular solutions, Euler’s Equidimensional Equations, Use of a known solution to find another, The method of variation of parameters.	8
	<u>Reference Books:</u> 1) Integral Calculus: Shanti Narayan and P. K. Mittal, S. Chand & Co. Ltd, New Delhi (2005). 2) Differential Equations with Applications and Historical Notes: G. F. Simmons, McGraw-Hill Inc, New Delhi (Second Edition) 1991. 3) Calculus: T.M. Apostol, Vol. I, John Wiley & Sons Inc., 1974 4) Calculus: H. Anton, I. Birens and S. Davis, John Wiley and Sons, Inc. 2007 5) Calculus: G.B. Thomas and R.L. Finney, Pearson Education, 2010. Suggested digital platform: NPTEL/SWAYAM/MOOCs	

Sem- II Paper - I	PRACTICAL: BMT2P03: Integral Calculus and Ordinary Differential Equations	
DSC (Core) Code: BMT2P03 For Minor: BMT2P03	<p>Course Outcomes:</p> <p>CO1: Students will be able to solve problems using reduction formulae, Beta and Gamma functions.</p> <p>CO2: Application of double integration in solving problems on area of a region.</p> <p>CO3: Students will able to solve problems by changing the order of integration</p> <p>CO4: Students will learn application of triple integration</p> <p>CO5: Students will be able to apply integrating factor in solving non-exact differential equations</p> <p>CO6: Students will be able to solve Euler’s Equidimensional Eqs</p> <p>CO7: Students will able to use concept of Wronskian in solving problems by method of variation of parameters</p>	Credit 1 No. of hours 30
	<p>Syllabus for Practical BMT2P03: Integral Calculus and Ordinary Differential Equations</p> <p>Note: Minimum 12 topics from listed practical problems must be conducted, at least 3 from every unit.</p>	
	<p><u>List of topics for practical problems:</u> <u>Abbreviations: Eq- Equation, DEq – Differential Equations</u></p> <ol style="list-style-type: none"> (1) Application of Reduction formulae for basic trigonometric functions (2) Solving problems of integration of irrational functions (3) Properties of Beta and Gamma functions (4) Relationship between Beta and Gamma functions (5) Solution of integrals using Beta and Gamma functions. (6) Solution of problems involving double integration (7) Application of double integration in solving problems on area of a region (8) Solving problems by changing the order of integration (9) Solution of double integral using polar coordinates (10) Learning triple integration through examples (11) Solving exact DEqs (12) Comparing exact and non-exact DEqs, and need of integrating factor in solving non-exact DEqs 	

	<p>(13) Solution of Bernoulli's DEqs</p> <p>(14) Solutions of First order higher degree DEqs</p> <p>(15) Finding orthogonal trajectory of the given family, and then sketch both the families together to decipher the orthogonality</p> <p>(16) Application of Wronskian in understanding the independent/dependent nature of functions</p> <p>(17) Solutions of homogeneous DEqs</p> <p>(18) Solutions of Euler's Equidimensional Eqs</p> <p>(19) Determination of a solution from a known solution</p> <p>(20) Application of method of variation of parameters</p> <p><u>Reference Books:</u></p> <p>(1) Integral Calculus: Shanti Narayan and P. K. Mittal, S. Chand & Co. Ltd, New Delhi (2005).</p> <p>(2) Differential Equations with Applications and Historical Notes: G. F. Simmons, McGraw-Hill Inc, New Delhi (Second Edition) 1991.</p> <p>(3) Calculus: T.M. Apostol, Vol. I, John Wiley & Sons Inc., 1974</p> <p>(4) Calculus: H. Anton, I. Birens and S. Davis, John Wiley and Sons, Inc. 2007</p> <p>(5) Calculus: G.B. Thomas and R.L. Finney, Pearson Education, 2010.</p> <p>Suitable computer programs can be used: SageMath/Maxima/SciLab/etc</p>	

Sem- II Paper - II DSC (Core) Code: BMT2T04 For Minor: BMT2T04	Course Title: Vector Analysis	Credit 2
	Course Outcomes: CO1: Foundational knowledge: To impart foundational knowledge of vector algebra and vector differentiation. CO2: Basic skills: To inculcate in students foundational base of gradient of a scalar function, divergence and curl. CO3: Concept learning: New concept of vector integration shall be introduced and problems of work done by force shall be solved. CO4: Application of Vector Theorems: To solve variety of practical problems in science and engineering by applying Greens theorem, divergence theorem, Stokes' theorem. CO5: Application: The course curriculum is so prepared that it has wide application in physics, and in other Science and Engineering subjects.	No. of hours 30
	Syllabus for BSc Semester – II Paper -II BMT2T04: Vector Analysis	No. of hours
	Unit I – Vector Differentiation: Vector triple products, product of four vectors, ordinary derivatives of vectors, space curves, continuity and differentiability, differentiation formulae, partial derivatives of vectors, differentials of vectors.	8
	Unit II - Gradient, Divergence and Curl: The vector differential operator del, Gradient, directional derivatives, Divergence, solenoidal vector, Curl, irrotational vector field.	7
	Unit III - Vector Integration: Ordinary integrals of vectors, Line Integral, Work done by force, exact differential and scalar potential, Surface integral, Volume integral.	7
	Unit IV – Vector Theorems: Green's Theorems in the plane (statement only), Gauss divergence Theorem (statement only), Stokes' Theorem (statement only) and their applications.	8
Reference Books: 1. Theory and Problems of Vector Analysis: Murray R Spiegel, Schaum's Outline Series, McGraw-Hill Book Company, New York. (1974) 2. Introduction to Vector Analysis: N. Saran and S. N. Nigam, Pothishala Pvt. Ltd. Allahabad. 3. Vector Analysis: Shanti Narayan and P. K. Mittal, S. Chand & Co. Ltd, New Delhi (2005). Suggested digital platform: NPTEL/SWAYAM/MOOCs		

	PRACTICAL: BMT2P04: Vector Analysis	
Sem- II Paper - II DSC (Core) Code: BMT2P04 For Minor: BMT2P04	Course Outcomes: CO1: Students will be able to update themselves with foundational knowledge of vector algebra and vector differentiation by solving examples. CO2: The basic skills required in science will be ingrained in students through foundational base of gradient of a scalar function, divergence and curl by solving examples. CO3: New concept of vector integration shall be learnt by students and problems of work done by force shall be solved by them. CO4: Students will be able to solve variety of practical problems in science and engineering by applying Greens theorem, divergence theorem, Stokes' theorem. CO5: The course curriculum is so prepared that it has wide application in physics, and in other Science and Engineering subjects, and this will help students immensely in their future.	Credit 1 No. of hours 30
	Syllabus for BSc Semester – II Paper -II Practical BMT2P04: Vector Analysis Note: Minimum 12 topics from listed practical problems must be conducted, at least 3 from every unit.	
	<u>List of topics for practical problems:</u> (1) Application of product of four vectors (2) Determination of ordinary derivatives of the functions (3) Finding partial derivatives of the functions (4) Determination of differentials of vector functions (5) Solving examples involving gradient of the scalar function, and plotting its graph (6) Application of gradient of function in obtaining directional derivatives (7) Application of divergence in determination of solenoidal vector (8) Learning concept of curl of vector function (9) Application of curl in irrotational/rotational field (10) Performing gradient operation in calculating angle between the surfaces (11) Solving ordinary integrals of vectors (12) Solving line integrals along various paths (13) Application of work done by force along different paths, and to verify if it is independent of the paths (14) Application of surface integrals (15) Application of volume integrals (16) Solving problems by Green's theorem in the plane	

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|---|--|
| <p>(17) Application of Green's theorem in the plane</p> <p>(18) Determination of area by Greens's theorem in the plane</p> <p>(19) Application of Gauss theorem</p> <p>(20) Application of Stokes' theorem</p> <p><u>Reference Books:</u></p> <ol style="list-style-type: none">1. Theory and Problems of Vector Analysis: Murray R Spiegel, Schaum's Outline Series, McGraw-Hill Book Company, New York. (1974)2. Introduction to Vector Analysis: N. Saran and S. N. Nigam, Pothishala Pvt. Ltd. Allahabad.3. Vector Analysis: Shanti Narayan and P. K. Mittal, S. Chand & Co. Ltd, New Delhi (2005). <p>Suitable computer programs can be used:
SageMath/Maxima/SciLab/etc</p> | |
| | |

BSc Semester – II
Vocational Skill Enhancement Course (VSC)
SEMESTER - II
VSC -02 : Maxima Software System

Maxima is a free, open source computer algebra system, which is primarily used for symbolic computation, including differentiation, integration, Taylor series, Laplace transforms, ordinary differential equations, systems of linear equations, polynomials, sets, lists, vectors, matrices and tensors.

<u>Maxima Software System</u>		
Sem- II	PRACTICAL:	Credit
VSC - 02	<u>Course Outcomes:</u> Students will be able	2
Code:	<ol style="list-style-type: none"> 1. to develop skills to deliver practical knowledge in its application 2. to explore topics in Calculus, ordinary differential equations, systems of linear equations, polynomials, sets, lists, vectors, matrices 3. to provide algorithms and tools for many domains of mathematics 4. to use as wonderful scientific and graphical calculator 	No. of hours
BVS2P03	Syllabus for BSc Semester – II: VSC - 02 Code BVS2P03: MAXIMA SOFTWARE SYSTEM	30
	TOPICS: <ol style="list-style-type: none"> 1. Introduction to Maxima 2. Mathematical functions in Maxima 3. Plotting: 2D and 3D graphical output. 4. Polynomials: Standard forms for polynomials, and Maxima functions operating on them 5. Limits: Limits of expressions 6. Differentiation: Differential calculus 7. Integration: Integral calculus 8. Equations: Defining and solving equations 9. Differential Equations: Defining and solving differential equations 10. Numerical: Numerical integration 11. Matrices: Matrix operations 12. Number Theory: Number theory problems 	30

	<p>Reference Books:</p> <ol style="list-style-type: none">1. Computational Mathematics Using Maxima Software - Paper 3 - A Manual for SY BSc Mathematics , Dr. Kalyanrao Takale, Dr. Amjad Shaikh, Dr. Veena Kshirsagar, Dr. Shrikisan Gaikwad, Prof. S. R. Patil.2. Computational Mathematics Using Maxima Software , Dr. K Takale, Dr. S Gailwad, Dr. A Shaikh, Dr. V Kshirsagar, Dr. V Jadhav, Prof. S Patil.3. Mathematics for Engineers and Science Labs Using Maxima, 1st Edition, by <u>Seifedine Kadry, Pauly Awad</u>.4. Algebra And Calculus Using Maxima Software, <u>Dr. K. C. Takale, Dr. A. S. Shaikh, Dr. V. S. Jadhav, Dr. S. B. Gaikwad, Prof. S. R. Patil, Nirali Prakashan.</u>	

SEM 2 : CONSTITUTION OF INDIA (BVE2T02)

Syllabus

UNIT – I:

- Historical Background to the Framing of the Indian Constitution: General Idea about the Constituent Assembly of India.

UNIT – II

- Preamble – Nature and key concepts/Constitutional values, Socialism, Secularism, Democracy, Justice, Liberty, Equality and Fraternity
- Salient Features of the Constitution of India

UNIT – III

- General study about the kinds, nature and importance of; Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

UNIT –IV

Introduction of the Constitutional Institutions and Authorities;

- Central Legislature and Executive (Parliament of India, President of India and Council of Ministers)
- State Legislature and Executive (State legislative Assemblies, Governors and Council of Ministers)
- Higher Judiciary (Supreme Court of India and High Courts)

Indian Knowledge System (IKS)

SEM2: INDIAN ASTRONOMY (BIK2T02)

Course Outcomes: This course will enable the students to understand that

- 1.** It is possible to create a map of the intellectual growth of a culture using astronomy as a probe.
- 2.** The growth of Indian astronomy occurs in distinct stages analogous to phase transitions of the evolution of cultures
- 3.** Indian Astronomy therefore provides an excellent window to the past dramatic transitions.

UNITS	TOPICS	HOURS
Unit 1	Astronomy in Prehistoric Era, Astronomy in Vedic Era, Vedang Jyotish, Astronomical References In Religious Scriptures, Astronomies of the West	8
Unit 2	Arya Bhatta, Panch Siddhantika of Varahamihira, Surya Siddhanta Varahamihira to Bhaskar Acharya-II, Siddhant Shiromani of Bhaskar Acharya-II, Bhaskar Acharya-II to Jai Singh, Jai Singh and his Observatories.	8
Unit 3	After Jai Singh, Interaction with the Astronomies of the World, Modern Era Astronomy , Our Universe, Cosmology	7
Unit 4	Panchang Horoscope and Astrology , Siddhantas, Karnas and Koshtakas, Observational Instruments of Indian Astronomy	7
	TOTAL	30 HRS

Reference Books:

1. The Story Of Astronomy In India, Chander Mohan, Pothi.com
2. Indian Astronomy: An Introduction. Front Cover · S. Balachandra Rao. Universities Press, 2000
3. Astronomy in India: A Historical Perspective, Thanu Padmanabhan, Springer Science & Business Media
4. Hindu Astronomy, W. Brennand, Alpha Editions
5. Origin and Growth of Astronomy in India, <https://www.tifr.res.in/~archaeo/FOP/FOP%20pdf%20of%20ppt/Vahia%20Origin%20of%20Astronomy.pdf>

Annexure - I

Credit distribution structure for three/ four-year Honors/Research Degree Program with Multiple Entry and Exit options (GoM GR dated 20/04/2023)

Level	Sem.	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC,RP	Cum. Cr./Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	I	6	-	-	2 + 2	VSC: 2, SEC: 2	AEC: 2, VEC: 2, IKS: 2	CC: 2	22	UG Certificate 44
	II	6	-	-	2 + 2	VSC: 2, SEC: 2	AEC: 2, VEC:2 IKS: 2	CC: 2	22	
	Cum Cr.	12	-	-	8	4 + 4 = 8	4 + 4 + 4 = 12	4	44	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										
5.0	III	6		6	2	VSC:2,	AEC:2	FP:2	22	UG Diploma 88
	IV	6		6	2	SEC:2	AEC:2	CEP: 2	22	
	Cum Cr.	24		12	12	12	16	12	88	
Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										
5.5	V	9	4	6	-	VSC: 2	-	CEP: 1	22	UG Degree 132
	VI	9	4	3	-	VSC: 2	-	OJT :4	22	
	Cum Cr.	42	8	21	12	16	16	17	132	
Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor										
6.0	VII	12	4	RM:4	-	-	-	-	20	UG Honours Degree 172
	VIII	12	4	-	-	-	-	OJT: 4	20	
	Cum Cr.	66	16	25	12	16	16	21	172	
Four Year UG Honours Degree in Major and Minor with 160-176 credits										
6.0	VII	9	4	RM:4	-	-	-	RP: 3	20	UG Research Degree 172
	VIII	9	4	-	-	-	-	RP: 7	20	
	Cum Cr.	60	16	25	12	16	16	27	172	
Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits										

Annexure – II
Basket of Minor Courses

13. Basket for Minor Category Courses - INFORMATION TECHNOLOGY

Semester	Course Category	Name of Course	Course Code	
			Theory	Practical
III	Minor 1	Programming in C	BIT1T01	BIT1P01
	Minor 2	IT Support Technologies	BIT1T02	BIT1P02
IV	Minor 3	Object Oriented Programming using C++	BIT2T03	BIT2P03
	Minor 4	Operating System and Linux	BIT2T04	BIT2P04
V	Minor 5	Data Structure	BIT3T05	BIT3P05
	Minor 6	Java Programming	BIT3T06	BIT3P06
VI	Minor 7	Advanced Java Programming	BIT4T07	BIT4P07

14. Basket for Minor Category Courses – MATHEMATICS

Semester	Course Category	Name of Course	Course Code	
			Theory	Practical
III	Minor 1	Algebra and Trigonometry	BMT1T01	BMT1P01
	Minor 2	Differential Calculus	BMT1T02	BMT1P02
IV	Minor 3	Integral Calculus and Ordinary Differential Equations	BMT2T03	BMT2P03
	Minor 4	Vector Analysis	BMT2T04	BMT2P04
V	Minor 5	Partial Differential Equations	BMT3T05	BMT3P05
	Minor 6	Analytical Solid Geometry	BMT3T06	BMT3P06
VI	Minor 7	Mathematical Methods	BMT4T07	BMT4P07

Annexure – III
Basket of Open Electives (OE)

GE/OE Basket Semester I
Faculty of Science and Technology

Sem.	Course Category		Name of Course	BoS	Course code
I	GE/OE	1	Bio fertilisers, bio-pesticides and composting	Botany	BGO1T01
		2	Food Biochemistry	Biochemistry	
		3	Biotechnology and Human Welfare	Biotechnology	
		4	Computer fundamentals	Computer Science/Computer Application	
		5	Basic Electronics Components & Instruments	Electronics	
		6	Environmental Conservation Movements	Environmental Science	
		7	A. Introduction to Sports Forensics / B. Toxicology in Everyday Life / C. Optics and Optical Instruments / D. General Instruments in Forensic Biology / E. Psychology of Health & Well Being-I (Psychology)/ F. Computer Fundamentals/ G. Crime and Criminal Behaviour (Law)	Forensic Science	
		8	Topographic Map Reading	Geology	
		9	Quantitative aptitude	Mathematics	
		10	Introduction and scope of Microbiology	Microbiology	
		11	Space Science	Physics	
		12	Elementary Descriptive Statistics	Statistics	
		13	Human anatomy and physiology	Zoology	
			Indian birds	Zoology	
		14	Physical Chemistry	Cosmetic Technology	
		15	Computer Basics	Fashion Design	
		16	Computer Basics	Textile Science	
		17	Food Adulteration	Chemistry	
		18	Mathematics I	Interior Design	
19F	Engineering Mathematics I	Applied Electronics & Software Technology			

SEMESTER I

1. QUANTITATIVE APTITUDE

Course Outcomes: This course will enable the students to

1. Have a strong base in the fundamental mathematical concepts.
2. Grasp the approaches and strategies to solve problems with speed and accuracy
3. Gain appropriate skills to succeed in preliminary selection process for recruitment

UNITS	TOPICS	HOURS
Unit 1	Number System • H.C.F. and L.C.M. of Numbers • Decimal Fractions • Simplification • Square Roots and Cube Roots • Average • Problems on Numbers • Problems on Ages • Surds and Indices • Logarithms	8
Unit 2	Percentage • Profit and Loss • Ratio and Proportion • Partnership • Chain Rule • Pipes and Cisterns • Time and Work • Time and Distance • Boats and Streams • Problems on Trains • Alligation or Mixture • Simple Interest • Compound Interest	8
Unit 3	Area • Volume and Surface Area • Races and Games of Skill • Calendar • Clocks • Stocks and Shares • Permutations and Combinations • Heights and Distances	7
Unit 4	<u>Data Interpretation</u> • Tabulation • Bar Graphs • Pie Chart • Line Graphs	7
	TOTAL	30 HRS

Recommended Books:

1. R.S. Aggarwal, “Quantitative Aptitude for Competitive Examinations”, Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogitaprakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications.

GE/OE Basket Semester I
Faculty of Science and Technology

Sem.	Course Category		Name of Course	BoS	Course code
I	GE/OE	1	Indoor gardening and landscaping	Botany	BGO1T02
		2	Health & Wellness	Biochemistry	
		3	Fermented Foods	Biotechnology	
		4	Office Automation	Computer Science/ Computer Application	
		5	Communication & Broadcasting	Electronics	
		6	Environmental and Public Health	Environmental Science	
		7	A. Introduction to Forensic Journalism/ B. Basic Analytical Chemistry/ C. Basic Analog and Digital Electronics / D. Basics of Enzymology / E. Psychology of Health & Well Being-II (Psychology)/ F. Programming with C /	Forensic Science	
		8	Geo-statistics in Geology	Geology	
		9	Basic Statistics	Mathematics	
		10	Statistics for Competitive examinations	Statistics	
		11	Reproductive biology	Zoology	
			Attractive insects	Zoology	
		12	Organic Chemistry	Cosmetic Technology	
		13	Chemical Processing-I	Fashion Design	
		14	Chemical Processing-I	Textile Science	
		15	Cosmetic Chemistry	Chemistry	
		16	Introduction to Microscopy and staining	Microbiology	
		17	Cultural Anthropology I	Interior Design	
18	Social Science I	Applied Electronics & Software Technology			

SEMESTER 1: BASIC STATISTICS

Course Outcomes:

1. To discuss the interpretations of Statistics in numerical data.
2. To give overview of Statistics in various sectors & disciplines
3. To apply & use of Statistics Methods in various diverse fields

UNITS	TOPICS	HOURS
Unit 1	Concept of Sample Space - Events - Definition of Probability - Addition and Multiplication laws of Probability - Conditional Probability - Baye's Theorem - Simple Problems.	8
Unit 2	Random Variables - Distribution Function - Expectation and Moments - Moment Generating Function - Probability Generating Function - Simple Problems.	8
Unit 3	Concept of Bivariate Distribution - Correlation - Karl Pearson's Coefficient of Correlation - Rank Correlation - Linear Regression.	7
Unit 4	Standard distributions: Discrete distributions - Binomial, Poisson, Hyper Geometric and Negative Binomial Distributions - Continuous Distributions Normal, Uniform, Exponential.	7
	TOTAL	30 HRS

Recommended books:

1. S.C. Gupta & V.K. Kapoor : Fundamentals of Mathematical Statistics, Sultan & sons
2. Hoel, P.G (1971): Introduction to Mathematical Statistics, Wiley.
3. Wilks S.S. Elementary Statistical Analysis, Oxford and IBH
4. Hogg, R.V. & Craig.A.T.(1998) : Introduction to Mathematical Statistics, Macmillan
5. Statistical Methods, Gupta S. P.: Sultan Chand and Sons, New Delhi.

GE/OE Basket Semester II
Faculty of Science and Technology

Sem.	Course Category		Name of Course	BoS	Course code
II	GE/OE	1	Sustainable agriculture	Botany	BGO2T03
		2	Bioethics	Biochemistry	
		3	Applications of Biotechnology in Agriculture	Biotechnology	
		4	Programming in C	Computer Science/ Computer Application	
		5	PC Assembly & Maintenance	Electronics	
		6	Introduction to Climate Crises	Environmental Science	
		7	A. Introduction to Forensic Auditing & Fraud Assessment / B. Chemistry of Natural & Synthetic Molecules / C. Instrumentation Aids/ D. Basics of Microbial Forensics/ E. Basics of Clinical Psychology (Psychology)/ F. Office Automation/ G. Criminal Law-I (Law)	Forensic Science	
		8	Introduction to Landforms	Geology	
		9	Business statistics I	Mathematics	
		10	Microbial world	Microbiology	
		11	Energy sources	Physics	
		12	Statistical methods and psychological testing	Statistics	
		13	Industrial entomology	Zoology	
		14	Physical Chemistry	Cosmetic Technology	
		15	Computer Application in Design	Fashion Design	
		16	Computer Application in Designing	Textile Science	
		17	Kitchen and Nutrition Chemistry	Chemistry	
		18	Mathematics II	Interior Design	
		19	Engineering Mathematics II	Applied Electronics & Software Technology	

SEMESTER II

2. BUSINESS STATISTICS –I

Course Outcomes: This course will enable the students to

1. Translate the real word problems through appropriate statistical modelling.
2. Explain the concepts and use equations, formulae and statistical expression and relationship in a variety of context.
3. Analyze and demonstrate the statistical skill require in intensive areas in economics and business.

UNITS	TOPICS	HOURS
Unit 1	Permutations and combinations, Set theory, Logarithm, Binomial theorem, Compound interest, Annuities	8
Unit 2	Charts & Diagrams, Collection, Classification & Presentation of business statistical data	8
Unit 3	Frequency Distribution, Frequency Curve and Analysis of data	7
Unit 4	Measure of central tendency and Measure of dispersion	7
	TOTAL	30 HRS

Recommended Books:

1. Fundamental of Mathematical Statistics, B L Agarwal, S. Chand
2. Business mathematics of Statistics., N.G. Das, J. K. Das, Mc Graw Hill
3. Statistical Methods, Gupta S. P.: Sultan Chand and Sons, New Delhi.
4. Fundamental of Mathematical Statistics, S.C. Gupta, V. K. Kapoor, Sultan Chand & Sons

GE/OE Basket Semester II
Faculty of Science and Technology

Semester	Course Category		Name of Course	BoS	Course code
II	GE/OE	1	Hydroponics and Plant Growth Regulators	Botany	BGO2T04
		2	Antimicrobial Resistance	Biochemistry	
		3	Bioethics and Biosafety in Biotechnology	Biotechnology	
		4	Web Technologies	Computer Science/ Computer Application	
		5	Home Automation	Electronics	
		6	Environmental Disaster and Management	Environmental Science	
		7	A. Forensic Gemology / B. Chemistry of Drugs / C. Introduction to Forensic Ballistics / D. Basics of Biostatistics and Bioinformatics/ E. Basics of Psychology (Psychology)/ F. Internet & Web Development/	Forensic Science	
		8	Tools and Techniques in Geology	Geology	
		9	Business statistics II	Mathematics	
		10	Statistics for Economics	Statistics	
		11	Fish farming	Zoology	
		12	Organic Chemistry	Cosmetic Technology	
		13	Chemical Processing-II	Fashion Design	
		14	Chemical Processing-II	Textile Science	
		15	Basics of Environmental Pollution	Chemistry	
		16	Biomolecules	Microbiology	
		17	Cultural Anthropology II	Interior Design	
		18	Social Science II	Applied Electronics & Software Technology	

SEMESTER II

5. BUSINESS STATISTICS –II

Course Outcomes: This course will enable the students to

1. Integrate concept in international & national business concept with functioning of global trade.
2. Evaluate the legal, social and economic environment of business.
3. Apply decision-support tools to business decision making.
4. Will be able to apply knowledge of business concepts and functions in an integrated manner.

UNITS	TOPICS	HOURS
Unit 1	Moments- Central & Non-Central Moments, Beta & Gamma Coefficients, Skewness, Kurtosis.	8
Unit 2	Correlation and Regression, Bivariate Data, Covariance, Correlation Data, Rank Correlation.	8
Unit 3	Probability and Probability Distribution, Attributes	7
Unit 4	Interpolation, Finite Differences, Newton's Forward & Backward Interpolation Formulae, Index Numbers, Time series Analysis.	7
	TOTAL	30 HRS

Recommended Books:

1. Business mathematical Statistics., N.G. Das, J. K. Das
2. Business Mathematics and Statistics, N.G. Das &Dr. J.K. Das McGraw Hill, New Delhi.
3. Fundamentals of Business Mathematics, M. K. Bhowal, Asian Books Pvt. Ltd New Delhi
4. Fundamentals of Mathematical Statistics, Gupta S. C. and Kapoor V. K., Sultan Chand and Sons, New Delhi.
5. Statistical Methods, Gupta S. P.: Sultan Chand and Sons, New Delhi.
6. Applied Statistics, Mukhopadhyaya Parimal New Central Book Agency Pvt. Ltd., Calcutta.
7. Fundamentals of Statistics, Goon A. M., Gupta, M. K. and Dasgupta, B. World Press, Calcutta.
8. Fundamentals of Applied Statistics, S. C . Gupta and V. K. Kapoor, Sultan Chand and Sons, New Delhi.

GE/OE Basket Semester III
Faculty of Science and Technology

Semester	Course Category		Name of Course	BoS	Course code
III	GE/OE	1	Nutraceuticals	Botany	BGO3T05
		2	Sports Biochemistry	Biochemistry	
		3	Biotechnology in Forensic Science	Biotechnology	
		4	Chemistry in everyday life	Chemistry	
		5	Data Base Management System	Computer Science	
		6	Data Base Management System	Computer Application	
		7	Data Base Management System	Data Science	
		8	Basic Electronics for Life Science	Electronics	
		9	Modern Technologies for Environmental Management	Environmental Science	
		10	A. Forensic Meteorology/ B. Forensic Chemistry/ C. Forensic Physics/ D. Forensic Biology/ E. (Psychology)/ F. Digital & Cyber Forensic/ G. Criminal Law-II (Law)	Forensic Science	
		11	Paedology and Soil Testing	Geology	
		12	Data Base Management System	Information Technology	
		13	Financial mathematics	Mathematics	
		14	Digital systems	Physics	
		15	Animal husbandry	Zoology	
		16	Introductory Pharmacology & Toxicology	Cosmetic Technology	
		17	Hand Printing	Fashion Design	
		18	Textile Testing-I	Textile Science	
		19	Metabolism of Biomolecules	Microbiology	
		20	Environmental Psychology	Interior Design	
		21	Engineering Mechanics I	Applied Electronics & Software Technology	

GE/OE Basket Semester IV
Faculty of Science and Technology

Semester	Course Category		Name of Course	BoS	Course code
IV	GE/OE	1	Biofuels technology	Botany	BGO4T06
		2	Pharmacogenomics	Biochemistry	
		3	Biotechnology & Law	Biotechnology	
		4	Molecules of Life	Chemistry	
		5	Cyber security	Computer Science	
		6	Cyber security	Computer Application	
		7	Cyber security	Data Science	
		8	Mobile App development	Electronics	
		9	Biodiversity and Wildlife Conservation	Environmental Science	
		10	A. Forensic Photography/ B. Forensic Chemistry/ C. Forensic Physics/ D. Forensic Biology/ E. (Psychology)/ F. Digital & Cyber Forensic/ G. Criminal Law-III (Law)	Forensic Science	
		11	Engineering Properties of Rocks and Soil	Geology	
		12	Cyber security	Information Technology	
		13	Mathematics for Competitive Examinations	Mathematics	
		14	Applied Microbiology	Microbiology	
		15	Communication Systems	Physics	
		16	Bio-statistics	Zoology	
			Communicable diseases	Zoology	
		17	Introductory Pharmacology & Toxicology	Cosmetic Technology	
		18	Home Linen Designing	Fashion Design	
		19	Textile Testing-II	Textile Science	
		20	Green Building Technology	Interior Design	
21	Green Building Technology	Applied Electronics & Software Technology			

Annexure – IV
Basket of Skill Enhancement Courses
(SEC)

SEC Basket Semester I

Faculty of Science and Technology

Sem.	Course Category	Name of Course	BoS	Course Code
I	SEC	Communicative Skills and Personality Development 1	Languages	BVS1P02
		Soil analysis and hydrobiology	Botany	
		Beekeeping	Zoology	
		Desk Top Publishing	Computer Science/ Computer Application	
		Aptitude and Reasoning	Mathematics	
		DNA Manipulation Techniques	Biotechnology	
		Quality control testing of fermented food	Microbiology	
		Food Adulteration Analysis	Chemistry	
		Food Adulteration Analysis	Biochemistry	
		Geo-statistics in Geology	Geology	
		Simulation and Modelling of Electronic Circuits 1	Electronics	
		Environmental Sampling and Monitoring	Environmental Science	
		PPT Presentation Course	Statistics	
		A. Chemical Laboratory Techniques B. General Practices in Forensic Biology C. Physics Workshop	Forensic Science	
		A. Elements of Art B. Hybrid Extension Methods C. Digital Literacy for Home Science	Home Science	
		Hand Painting 1	Fashion Design	
		Hand Painting 1	Textile Science	
		Product workshop I	Interior Design	
		Applied Chemistry I	Applied Electronics & Software Technology	
		Electric Wiring for Domestic Applications	Physics	

B.Sc. Mathematics (Major): SEMESTER 1

SEC-Aptitude and Reasoning (BVS1P02)

Course Outcome

On successful completion of the course the students will be able to:

1. Understand the basic concepts of quantitative ability
2. Understand the basic concepts of logical reasoning Skills
3. Acquire satisfactory competency in use of reasoning
4. Solve campus placements aptitude papers covering Quantitative Ability, Logical
5. Reasoning Ability

TOPICS:

1. Logarithm
2. Permutation and Combinations
3. Profit and Loss
4. Time, Speed and Distance
5. Time & Work
6. Ratio and Proportion
7. Data Interpretation
8. Tables
9. Column Graphs
10. Bar Graphs
11. Line Charts
12. Pie Chart
13. Venn Diagrams
14. Analogy
15. Blood Relation
16. Directional Sense
17. Number and Letter Series
18. Coding – Decoding
19. Calendars
20. Clocks

Reference books:

1. A Modern Approach To Verbal & Non Verbal Reasoning By R S Agarwal
2. Analytical and Logical reasoning By Sijwali B S
3. Quantitative aptitude for Competitive examination By R S Agarwal
4. Analytical and Logical reasoning for CAT and other management entrance test By
1. Sijwali B S
5. Quantitative Aptitude by Competitive Examinations by Abhijit Guha 4th edition
6. <https://prepinsta.com/>
7. <https://www.indiabix.com/>
8. <https://www.javatpoint.com/>

SEC Basket Semester II (BVS2P04)
Faculty of Science and Technology

Sem.	Course Category	Name of Course	BoS	Course Code
II	SEC	Communicative Skills and Personality Development 2	Languages	BVS2P04
		Plant Pathology and Disease Management	Botany	
		Tally	Computer Science/ Computer Application	
		Financial Mathematics	Mathematics	
		Wine Technology	Biotechnology	
		Tools and Techniques in Geology	Geology	
		Water and wastewater analysis	Chemistry	
		Lac culture	Zoology	
		Testing of food adulteration	Microbiology	
		A. Innovative Community practices B. Food Preservation C. Cosmetic Preparation	Home Science	
		Blood Processing Techniques	Biochemistry	
		File Handling in C	Electronics	
		Entrepreneurship Development and Services by Environmental Consultancy	Environmental Science	
		Financial literacy	Statistics	
		A. Security Features of Security Documents B. General Techniques and Recombinant DNA Technology in Microbial Forensics C. Mobile App Development	Forensic Science	
		Hand Painting-II	Fashion Design	
		Hand Painting-II	Textile Science	
		Product Workshop II	Interior Design	
		Applied Chemistry II	Applied Electronics & Software Technology	
		Fundamentals of Data Analysis and Data Interpretation	Physics	

B.Sc. Mathematics (Major): SEMESTER II (SEC)

Financial Mathematics (BVS2P04)

Course Outcomes

1. Calculate variables using both simple and compound interest;
2. Calculate variables using annuities formulas, including bond market value calculations;
3. Describe the features of promissory notes, bonds, and annuities;
4. Judge if a project is viable based on a Net Present Value calculation;
5. Demonstrate the interaction between interest rates and market prices for bonds;
6. Communicate using financial terminology;
7. Solve common business problems employing mathematics of finance.

TOPICS:

1. Arbitrage and risk aversion
2. Interest (simple and compound, discrete and continuous),
3. Time value of money,
4. Inflation,
5. Net present value,
6. Internal rate of return,
7. Comparison of Net Present Value (NPV) and Internal Rate of Return (IRR)
8. Bonds, bond prices and yields. Floating-rate bonds
9. Immunization
10. Asset return
11. Short selling
12. Portfolio return, (brief introduction to expectation, variance, covariance and correlation) random returns
13. Portfolio mean return and variance
14. Diversification
15. Portfolio diagram
16. Feasible set

Reference BOOKS:

1. David G. Luenberger; Investment Science; Oxford University Press, Delhi, 1998.
2. John C. Hull; Options, Futures and Other Derivatives, 6th Ed.; Prentice-Hall India, Indian reprint, 2006.
3. Sheldon Ross; An Elementary Introduction to Mathematical Finance, 2nd Ed.; Cambridge University Press, USA, 2003.

SEC Basket
Semester IV
Faculty of Science and Technology

Sem.	Course Category	Name of Course	BoS	Course Code
IV	SEC	English for Business Communication	Languages	BVS4P06
		Medicinal plants, cultivation, practices and marketing	Botany	
		Clinical Pathology	Zoology	
		Visual Basic Programming	Computer Science/ Computer Application	
		Logic and sets	Mathematics	
		Plant Transformation Techniques	Biotechnology	
		Phytochemistry	Chemistry	
		Mushroom Cultivation	Microbiology	
		Enzyme Kinetics	Biochemistry	
		Data Interpretation and Drafting of Geological Reports	Geology	
		Troubleshooting of Electronic Gadgets	Electronics	
		Biomedical Waste Management	Environmental Science	
		A. Forensic Psychology B. Law C. Forensic Biology	Forensic Science	
		A. Fabric Ornamentation Techniques B. Psychological Testing C. Soap and Detergent Making D. Digital Agricultural Technologies	Home Science	
		Embroidery Techniques-II	Fashion Design	
		Advance Computer Aided Textile Design	Textile Science	
		Graphics IV	Interior Design	
		Workshop	Applied Electronics & Software Technology	
		Advanced Experimentation	Physics	

Annexure – V

Basket for Co-Curricular Courses

Guidelines and Standard Operating Procedures for awarding credits for Co-Curricular Courses

Preamble:

The Government of Maharashtra vide its resolution no. एनईपी-2020/प्र.क्र.09/विशि-3/शिकाना मंत्रालय मुंबई 400032 dated 20th April 2023 has provided guidelines for restructuring the undergraduate program structures for implementing National Education Policy 2020. In view of implementation of this the University has restructured all undergraduate programs incorporating Co-Curricular courses (referred as CC henceforth in this document) in all UG programs to ensure the holistic development of learners. This document prescribes the guidelines and standard operating procedures (SOPs) for students, teachers, and principals to facilitate smooth functioning of the scheme in larger interest.

Scope:

These guidelines and SOPs shall come into effect from the academic session 2024-25 and shall be applicable for all undergraduate programs having Co-Curricular Courses (CC) as a part of its scheme of examination offered by the Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.

Definition of Co-Curricular Courses:

Co-Curricular courses are meant to bring social skills, intellectual skills, moral values, and character appeal in students. It refers to activities, programs, and learning experiences that compliment, in some way, what students are learning in the classroom – i.e. experiences that are connected to or mirror the academic curriculum. Co-Curricular courses are typically, but not always, defined by their separation from academic courses. Students enrolled for any UG program of the RTM Nagpur University will be allowed to opt for any of the following activities as a Co-Curricular Course:

CC Basket:

1. National Cadet Corps (NCC)
2. Extension Projects (Sanskar, Unnati and Sahayog) offered by the Department of Lifelong Learning and Extension, RTM Nagpur University, Nagpur
3. National Service Scheme (NSS)
4. Games and Sports Activities
5. Cultural Activities

Note: A student will not be allowed opt any course outside this basket as a Co-Curricular Course

General Rules:

1. Each UG program has a component of CC in 1st, 2nd, 3rd, and 4th Semester. Each CC is a 2-credit practical and performance-based activity course and should have student engagement of minimum 60 hours (practice cum performance) in the corresponding semester.
2. Every college/institute affiliated to the RTM Nagpur University is required to designate a teacher as CC In-charge. It may also constitute a team of teachers for monitoring CC depending on the number of students.

3. A student is required to opt for any of the CC mentioned in the basket and inform the CC In-charge in the beginning of the semester (The college/institute shall devise a suitable student friendly mechanism to facilitate students to submit their choice/s).
4. A student may opt for one or more courses as CC in a semester. In this case, the credit will be awarded for the course in which the student had performed best. Moreover, a student will get 10 bonus marks for each additional CC activity he/she had opted for.
5. The CC In-charge or a team of teachers will be responsible for monitoring the attendance, participation, and performance of students in CC activity throughout the semester.
6. The CC In-charge or a team of teachers will also be responsible for objective evaluation of students based on their performance in CC activity.
7. The rubrics for objective evaluation mentioned in this document are required to be strictly followed by all the colleges/institutes and violation of the same in any manner may attract the disciplinary action against the person/s concerned.
8. Evaluation for CC is required to be completed before the commencement of the Session End Examination of the corresponding semester and the final marks (certified by the Principal) are required to be submitted to the university in a mode and manner as may be prescribed by the university from time to time.
9. The record of the CC activities and assessment shall be kept for review for 1 year and should be submitted to the University as and when called for or during the AAA review.
10. Since the NCC/NSS follows an annual calendar, the CC Marks as per below can be claimed under any ONE of the two semesters for the academic year depending upon the availability of full assessment data of the student. Thus NCC/NSS CC marks will be allotted during the CC falling in EVEN SEMESTERS. This also means that the NCC/NSS cadet must participate in any other activity from the basket i.e. from GAMES AND SPORTS or CULTURAL ACTIVITY or COURSES OFFERED BY DEPT. OF LIFELONG LEARNING AND EXTENSION simultaneously for claiming CC marks for a specific ODD semester.
11. NCC/NSS activities shall be conducted by the respective in-charges (NCC and NSS Officers) as per the activity calendar published by the respective offices.
12. The NCC/NSS officer must ensure that the students of NCC/NSS are also enrolled in other CC activities for claiming CC marks for a specific odd semester.
13. Ordinance No. 2 of 1996 is taken as base for this marking and it is modified suitably for student to get 100 Marks.
14. If a student fails to opt for a CC, his/her result for that semester shall be declared by marking 'ABSENT' against CC.
15. If a student opts a particular CC but fails to obtain minimum marks (50), he/she shall be declared 'FAIL' in CC. However, if such a student had opted for any other CC in the same semester, the provision of 'Bonus Marks' shall come into effect and the same should be taken into account.
16. If a student is declared 'FAIL' in CC, he/she can continue the same CC in the next semester to improve the performance.

Evaluation Rubrics for CC:

In order to attain objectivity and bring uniformity in evaluation of Co-Curricular Courses having different nature, the evaluation of performance of student needs to be quantified in marks having maximum 100 (Hundred) marks. The breakup of these maximum marks varies according to the CC and is elaborately explained hereunder:

1. National Cadet Corps (NCC):

This course can only be opted by the students of a college/institute having NCC unit.

Evaluation Rubrics

Criteria	MAXIMUM POSSIBLE MARKS	Rubric			
		Attendance Equal to or more than 75% = 30 Marks	Attendance 60% to 75% = 20 Marks	Attendance more than or equal to 50% = 10 Marks	Below 50% attendance = 0 Marks
Participation in NCC in an academic year	30	Attendance Equal to or more than 75% = 30 Marks	Attendance 60% to 75% = 20 Marks	Attendance more than or equal to 50% = 10 Marks	Below 50% attendance = 0 Marks
Participation in Camps at Unit, GPs Dte and DG NCC level (Eg. Annual Training Camp, National Integration Camp, Basic Leadership Camp, Advance Leadership Camp, Army Attachment Training, Hospital Attachment Training, RD selection Camps, Basic Leadership Selection Camps Delhi, Nau Sainik Camp, Vayu Sena Camp, International Youth Exchange Program etc)	30	Participation in any three Camps = 30 Marks	Participation in any two Camps = 20 Marks	Participation in any one Camp = 10 Marks	No Participation in Camps = 0 Marks
Participation in Social Activities through NCC (Eg. Tree Plantation, Adult Education, Eye Donation, Skin donation, Organ donation, Village adoption, Anti Leprosy Drive, Medical Health Camp etc)	20	Participation in any three Activities = 20 Marks	Participation in any two Activities = 10 Marks	Participation in any one Activity = 5 Marks	No Participation in Activity = 0 Marks
Participation in Adventure Activities: Army Cadets – Rock Climbing, Trekking, Mountaineering, cycling, para Sailing, Para Jumping Naval Cadets - Sailing, Kayaking, boat Pulling Air Cadet – Solo Gliding	20	Participation in any one or more Activities = 20 Marks			No Participation in Activity = 0 Marks
RD Parade Participation	100	Participation at RD Parade New Delhi = 100 Marks irrespective of status of marks above.			
Passing 'C' Certificate Exam	Additional Max. 10 marks	Marks to be allotted such that the total Marks under all heads should not be more than 100			
Holder of rank not below the rank of Sgd. or an equivalent distinction achieved by the cadet	Additional Max. 5 marks	Marks to be allotted such that the total Marks under all heads should not be more than 100			
Bonus Marks for participation in any of the other CC activities in the SAME SEMESTER i.e. even semester	Additional Max 10 marks per CC Activity	Marks to be allotted such that the total Marks under all heads should not be more than 100			

Note: Since the NCC follows an annual calendar, the CC Marks as per the above can be claimed in *even semester* only. This also means that the NCC cadet must participate in GAMES AND SPORTS or CULTURAL ACTIVITY or any other Co-curricular courses available in the basket simultaneously for claiming CC marks for a specific odd semester.

2) Extension Projects (Sanskar, Unnati and Sahyog) offered by the Department of Lifelong Learning & Extension of RTM Nagpur University

Rules for Extension Project:

- a. There are three types of extension projects viz. Sanskar, Unnati and Sahyog having 1 credit each.
- b. A student of any affiliated college can opt for a course under this category.
- c. A student opting for 'Extension Project' as CC must opt any two projects one of which mandatorily has to be 'Unnati.'
- d. Details of the scope and other guidelines about these projects can be obtained from the official website of the Department.
- e. Attendance record for each extension project needs to be maintained separately and assessment for attendance to be made accordingly.

Evaluation Rubrics

Criteria	MAXIMUM POSSIBLE MARKS	Rubric			
		Attendance Equal to or more than 75% = 20 Marks	Attendance 60% to 75% = 15 Marks	Attendance more than or equal to 50% = 10 Marks	Below 50% attendance = 5 Marks
Attendance and Participation in Sanskar, Unnati and Sahyog LLE activities	20	Attendance Equal to or more than 75% = 20 Marks	Attendance 60% to 75% = 15 Marks	Attendance more than or equal to 50% = 10 Marks	Below 50% attendance = 5 Marks
Sanskar Prkalpa Participation and submission of <i>Report on the life and works of Rashtrasant Tukadoji Maharaj</i>	40	Report evaluation in excellent grade = 40 marks	Report evaluation in satisfactory grade = 30 marks	Report evaluation in average grade = 20 marks	Report evaluation in below average grade = 10 Marks
Unnati participation and submission of case studies of the <i>beneficiaries of individual/common development schemes floated by the Central/State government.</i>	40	3 or more cases compiled = 40 marks	2 or more cases compiled = 25 marks	1 or more cases compiled = 15 marks	Participation but no case compiled = 5 marks
Sahyog participation and submission of Sahyog project report <i>related to senior citizens issues and activities</i>	40	Detailed Report containing senior citizen related 3 or more activities = 40 Marks	Detailed Report containing senior citizen related 2 or more activities = 25 Marks	Detailed Report containing senior citizen related 1 or more activities = 15 Marks	Participation but no report submission = 5 Marks
Bonus Marks for First ten Students scoring maximum marks	Additional Max. 10 marks	Marks to be allotted such that the total Marks under all heads should not be more than 100			
Bonus Marks for participation in any of the other CC activities in the SAME SEMESTER	Additional Max 10 marks per CC Activity	Marks to be allotted such that the total Marks under all heads should not be more than 100			

3. NSS:

This course can only be opted by the students of a college/institute having NSS unit.

Evaluation Rubrics

Criteria	MAXIMUM POSSIBLE MARKS	Rubric			
Participation in NSS in an academic year	30	Attendance Equal to or more than 75% = 30 Marks	Attendance 60% to 75% = 25 Marks	Attendance more than or equal to 50% = 20 Marks	Below 50% attendance = 10 Marks
Participation in NSS Camp	40	Participation in National level Camp = 40 Marks	Participation in University level Camp = 30 Marks	Participation in College level Camp = 25 Marks	No Participation in Camps = 0 Marks
Participation in Social Activities through NSS (Eg. Tree Plantation, Adult Education, Eye Donation, Skin donation, organ donation, Village adoption, Anti Leprosy Drive, Medical Health Camp etc)	30	Participation in any three Activities = 30 Marks	Participation in any two Activities = 20 Marks	Participation in any one Activity = 10 Marks	No Participation in Activity = 0 Marks
RD Parade Participation	100	Participation at RD Parade New Delhi = 100 Marks irrespective of status of marks above.			
Bonus Marks for participation in any of the other CC activities in the SAME SEMESTER	Max 10 per CC Activity	Marks to be allotted such that the total Marks under all heads should not be more than 100			

Note: Since the NSS follows an annual calendar, the CC Marks as per above can be claimed in even semester only. This also means that the NSS cadet must participate in GAMES AND SPORTS or CULTURAL ACTIVITY or any other Co-curricular courses available in the basket simultaneously for claiming CC marks for a specific odd semester.

4. GAMES & SPORTS

Rules for Games and Sports:

- This course can be opted by a student of any affiliated college.
- The student will be required produce an authentic certificate of participation/medal.
- The CC In-charge shall verify the authenticity of the certificate regarding level of the tournament, participation/prize/medal, etc.
- The CC In-charge shall also verify whether the tournament was conducted in the corresponding semester or not.
- In case of Team Sports, each team member will be evaluated independently and no assessment for team as such shall be made.

Evaluation Rubrics																			
Sr. no	Event	College Level				Inter College/University Level				Zonal/State Level				National Level				World/International Level	
1	Sports and Games	Participation	3 rd Prize	2 nd Prize	1 st Prize	Participation	3 rd Prize	2 nd Prize	1 st Prize	Participation	3 rd Prize	2 nd Prize	1 st Prize	Participation	3 rd Prize	2 nd Prize	1 st Prize	Participation	
	Any competition/tournament organize as per guidelines from DSO office and also from The Director Physical Education and Sports	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100	100
2	Undergoing any one course offered by Dept. of Sports & Physical Education and approved by Rashtrasant Tukadoji Maharaj Nagpur University Ex. : CC in Yoga Education, CC in Health and Wellness etc.	<p align="center">Maximum Possible Marks 100. As per assessment scheme approved by Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur</p>																	

5. Cultural Activities

Rules for Cultural Activities:

- This course can be opted by a student of any affiliated college.
- The student will be required produce an authentic certificate of participation/medal.
- The CC In-charge shall verify the authenticity of the certificate regarding level of the tournament, participation/prize/medal, etc.
- The CC In-charge shall also verify whether the tournament was conducted in the corresponding semester or not.
- In case of group event, each group member to be assessed independently and no assessment for team as such shall be made.

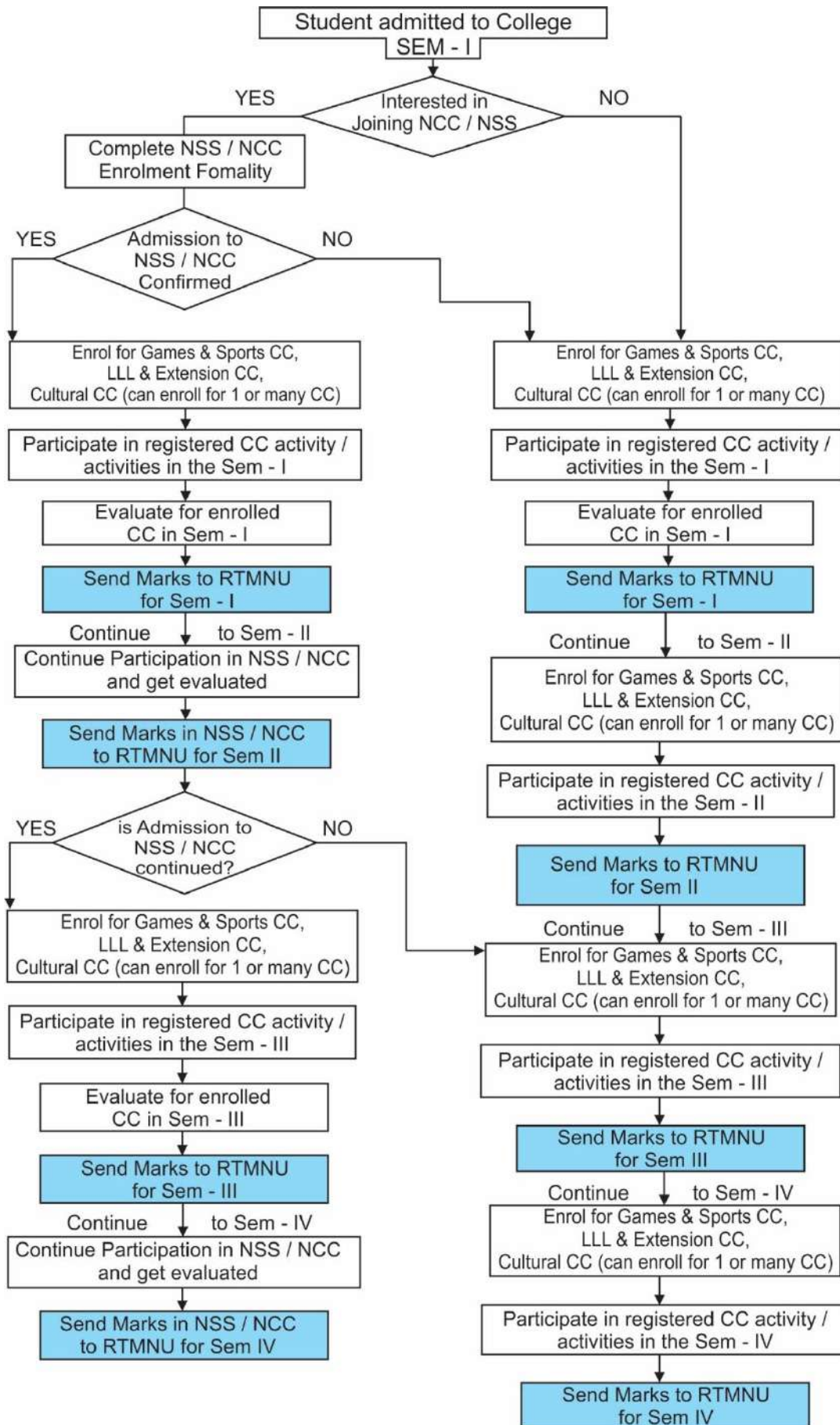
Evaluation Rubrics

Sr. no	Event	College Level				Inter College/University Level				Zonal/State Level				National Level				World/International Level
		Participation	3 rd Prize	2 nd Prize	1 st Prize	Participation	3 rd Prize	2 nd Prize	1 st Prize	Participation	3 rd Prize	2 nd Prize	1 st Prize	Participation	3 rd Prize	2 nd Prize	1 st Prize	
1	Music																	
	Indian Classical Vocal (Solo Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Indian Classical Instrumental Percussion	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Indian Classical Instrumental Non-Percussion (Swarvadya Solo Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Natyasangeet Vocal (Solo Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Indian Light Vocal (Solo Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Indian Group Song (Solo Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Folk Orchestra (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Western Vocal (Solo Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Western Instrumental (Solo Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
Western Group Song (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100	
2	Dance																	
	Indian Classical Dance (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Indian Folk Dance (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
3	Literary																	
	Elocution (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Debate (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Quiz (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
4	Theatre																	
	Mimicry (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100

Four Year Bachelor of Science & BCA (Honours/Research) Degree Examination as per NEP 2020

	One Act Play (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Skit (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Mime (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
5	<u>Fine Art</u>	Participa tion	3rd Prize	2nd Prize	1st Prize	Participa tion	3rd Prize	2nd Prize	1st Prize	Participat ion	3rd Prize	2nd Prize	1st Prize	Participat ion	3rd Prize	2nd Prize	1st Prize	Participat ion
	Painting (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Collage (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Poster Making (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Clay Modeling (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Cartooning (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Rangoli (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Spot Photography (Individual Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
	Installation (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
6	Short Film (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
7	Procession (Group Event)	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
8	Students Parliament	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100
9	Mock court	40	45	50	55	55	60	65	70	70	75	80	85	85	90	95	100	100

सुचना - AIU किंवा राजभवन द्वारा आयोजित स्पर्धा व्यतिरीक्त आंतर महाविद्यालयाच्या वरील सर्व स्पर्धा Inter College / University Level स्पर्धा म्हणुन गुणांकन करावे.



राष्ट्रसंत तुकडोजी महाराज नागपूर विद्यापीठ, नागपूर
Syllabus for Bachelor of Science / B.Sc.(IT)/B.Sc.(Data Science)/ B.Sc.(AI)/BCA
MARATHI
(To be implemented from the session 2024-25 and onwards)

विज्ञान स्नातक, सत्र २

मराठी

अभ्यासक्रमाचा उद्देश (Course Objectives) :

- मराठी भाषेच्या समृद्धीची जाणीव करून देणे
- विद्यार्थ्यांमध्ये भाषा कौशल्याचा विकास करणे.
- भाषेचा जीवनव्यवहारात आणि रोजगारात योग्य पध्दतीने वापर करण्याचा प्रयास करणे.
- मराठी भाषेचे व्याकरण व तिची उपयोजितता स्पष्ट करणे.
- व्यावहारिक मराठीच्या माध्यमातून रोजगाराच्या संधीचा शोध घेणे.
- प्राचीन अर्वाचीन साहित्याच्या आकलन, आस्वाद व चिकित्सेतून विद्यार्थ्यांची मानवी संवेदनशीलता, चारित्र्यसंपन्नता, मूल्याधिष्ठितता जागृत करणे. त्यांच्यात सामाजिक सेवेची व राष्ट्रप्रेमाची जाणीव जागृती निर्माण करणे.
- विज्ञान आणि मानवी जीवनव्यवहाराची सांगड घालून विद्यार्थ्यांना रोजगाराभिमुख बनविणे.
- स्वतंत्र चिंतन व मननातून लेखनास प्रेरित करणे.

अभ्यासक्रमाचा परिणाम (Course Outcomes) :

- मराठी भाषा, साहित्य व संस्कृतीचे ऐतिहासिक आकलन होणे.
- मराठी भाषेवर प्रभुत्व निर्माण होउन वक्तृत्वशैली विकसित होणे.
- मराठी भाषेचे संवर्धन आणि संरक्षण होण्यास मदत होणे.
- मराठी व्याकरणासंदर्भात व भाषाविज्ञानासंदर्भात भाषिक समज स्पष्ट होणे
- व्यावसायिक कौशल्याची प्रेरक वाट गवसणे.
- नैतिक मूल्याचे, सामाजिक व राष्ट्रीय उत्तरदायित्वाचे सजग भान असणारा नागरिक निर्माण होणे.
- व्यावसायिक कौशल्य विकासातून समाजाभिमुख वैज्ञानिक दृष्टिकोण विकसित होणे.
- स्वतंत्र लेखनशैली विकसित होणे.

(डॉ. कामल ठाकरे)
26/2/24

A.I. Dorekhan
(डॉ. अमृता डोर्लेकर)
26/02/2024

26/2/24

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26/2/24

26/02/2024

राष्ट्रसंत तुकडोजी महाराज नागपूर विद्यापीठ, नागपूर
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विज्ञान स्नातक सत्र दुसरे
अभ्यासक्रम

१. पाठ्यपुस्तक — सृजन
२. उपयोजित मराठी : लेखनकौशल्य, संवादकौशल्य आणि संधी

अनुक्रमणिका

Unit -1 : गद्य विभाग

- १ ससीकरण — म्हाइंभट
- २ संयम — साने गुरूजी
- ३ उषःकाल — डॉ. सुबोध जावडेकर
- ४ भारतीय संविधानाची विज्ञाननिष्ठा — यशवंत मनोहर

Unit -II : पद्य विभाग

- १ संतवाणी — ज्ञानेश्वर, तुकाराम, राष्ट्रसंत तुकडोजी महाराज
- २ विद्यार्थ्यांप्रत — केशवसुत
- ३ दीपज्योतीस — बी
- ४ सुख — बबन सराडकर

Unit -III : लेखनकौशल्य आणि संधी

- १ प्रसारमाध्यमे आणि भाषिक कौशल्ये — डॉ. संजय भक्ते
- २ जाहिरातीची लेखनकौशल्ये — प्रा. वैशाली कार्लेकर
- ३ अनुवादप्रक्रिया — डॉ. नंदकुमार मोरे
- ४ ब्लॉग लेखन — डॉ. अजय देशपांडे

Unit -IV: मराठी भाषा आणि व्याकरण

- १ मराठी भाषाविचार
- २ मराठी शुध्दलेखन

Dr. Anand
26/02/24

A.I. Darlikar
(डॉ. अमृता डोळीकर)
26/02/2024

Dr. Anand
26/2/24

Dr. Anand
26/2/24

Dr. Anand
26/2/24

Dr. Anand
26/02/2024

दुसरे सत्र (Semester -II)

विभाग एक गद्य (पहिल्या भागातील चार पाठ)	गुण १५
विभाग दोन पद्य (दुसऱ्या भागातील चार कविता)	१५
विभाग तीन उपयोजित मराठी : लेखनकौशल्य आणि संधी	१०
१ प्रसारमाध्यमे आणि भाषिक कौशल्ये — डॉ. संजय भक्ते २ जाहिरातींची लेखनकौशल्ये — प्रा. वैशाली कार्लेकर ३ अनुवादप्रक्रिया — डॉ. नंदकुमार मोरे ४ ब्लॉग लेखन — डॉ. अजय देशपांडे	
विभाग चार मराठी भाषा आणि व्याकरण	१०
१ मराठी भाषाविचार २ मराठी शुध्दलेखन	

एकूण गुण ५०

सूचना :-

अभ्यासक्रमात नेमलेल्या **सृजन** पुस्तकातील सर्व पाठ व सर्व कविता अभ्यासक्रमात समाविष्ट राहतील. प्रश्नपत्रिका ५० गुणांची राहिल. ५० गुण अंतर्गत मूल्यांकनावर (Internal Assessment) राहतील. विद्यार्थ्यांच्या सर्जनशील जाणीवा विकसित करण्यासाठी अभ्यासक्रमातील पाठ आणि कवितेवरील आपले स्वतंत्र विचार लिखित स्वरूपात मागण्यात येतील. याशिवाय विद्यार्थ्यांकडून साकार करावयाच्या व्यावसायिक कौशल्याधारित नव्या संकल्पना व प्रकल्पांतर्गत मूल्यांकनासाठीचे स्वातंत्र्य विषय शिक्षकाला असेल.


26/2/24

A. J. Dablikar
26/02/2024


26/2/24


26/2/24




26/2/24


26/2/24

प्रश्नपत्रिकेचे स्वरूप व गुण विभागणी
द्वितीय सत्र

वेळ : तास

गुण : ५०

प्रश्न १ला— खालील प्रश्न (५० शब्दांत) सोडवा.

(चारपैकी तीन प्रश्न सोडवा — पहिल्या भागातील चार पाठातून)

(विभाग एक)

१५ (५X३)

प्रश्न २ रा— खालील प्रश्न (५० शब्दांत) सोडवा.

(चारपैकी तीन प्रश्न सोडवा — दुसऱ्या भागातील चार कवितांतून)

(विभाग दोन)

१५ (५X३)

प्रश्न ३ रा — खालील प्रश्न (५० शब्दांत) सोडवा.

(चारपैकी दोन प्रश्न सोडवा— तिसऱ्या भागातील चार लेखांतून)

(विभाग तीन)

१० (५X२)

प्रश्न ४ था— खालील प्रश्न (५० शब्दांत) सोडवा.

(तीनपैकी दोन प्रश्न सोडवा— चौथ्या भागातील दोन लेखांतून)

(विभाग चार)

१० (५X२)

अंतर्गत मूल्यांकनासाठी खालील घटकांप्रमाणे गुण विभागणी असेल.

१. अभ्यासक्रमावर आधारित गृहपाठ — १० गुण
२. वर्गपातळीवर गटचर्चा — १० गुण
३. कवितेचे रसग्रहण करणे — १० गुण
४. अनुवाद करणे — १० गुण
५. सुप्रसिद्ध व्यक्तीचे चित्रण लिहिणे — १० गुण

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26/2/24

A.I. Doshi
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B. Sc. Part II (Semester III)

M-5: Partial Differential Equations & Calculus of Variations

Unit I

Simultaneous differential equations of first order and first degree in three variables, Methods of solution of $dx/P = dy/Q = dz/R$, Pfaffian differential forms and equations, Solution of Pfaffian differential equation in three variables, Partial differential equations of first order, Origins of first order partial differential equations.

Unit II

Linear equations of first order, Integral surface passing through a given curve, Compatible system of first order equations, Charpit's method, Jacobi's method.

Unit III

Partial differential equation (PDE) of second order, Linear PDE with constant coefficients and their solutions.

Unit IV

Calculus of Variations: Functionals, Classes of functions, Extremum of a functional, Variation of functional, The necessary condition for an extremum of a functional, Special cases of integrability of Euler's equation, Functional dependent on higher order derivative, Functional dependent on two functions of one independent variable, Euler-Ostrogradsky equation, Invariance of Euler's equation.

Text Book:

1. Elements of Partial Differential Equations: IAN N. Sneddon, McGraw- Hill Book Company, 1957
Scope: Chapter 1 (Articles: 2, 3, 5, 6), Chapter 2 (Articles: 1, 2, 4, 5, 9, 10, 13)
2. Mathematics for Degree Students (B.Sc. Second year): Dr P.K. Mittal, S. Chand & Co. Ltd, New Delhi, 2011 (First edition)
Scope: Chapters 10 and 11, Chapter 13 (Articles: 13.2 to 13.11, 13.13)

Reference Books:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. Ordinary and Partial Differential Equations (Theory and Applications)
Nita H. Shah, PHI, 2010,
3. Erwin Kreyzig: *Advanced Engineering Mathematics*, John Willey and Son's, Inc. New York, 1999.
4. A.R. Forsyth: *A Treatise on Differential Equations*, McGraw-Hill Book Company, 1972.
5. B. Courant and D. Hilbert: *Methods of Mathematical Physics (Vol I and II)*, Willey-interscience, 1953.
6. I.M. Gelfand and S.V. Fomin: *Calculus of Variables*, Prentice Hill, Englewood Cliffs (New Jersey), 1963.
7. A.M. Arthurs: *Complementary Variational Principles*, Clarendon Press, Oxford, 1970.
8. V. Komkav: *Variational Principles of Continuum Mechanics with Engineering Applications*, (Volume I), Reidel Pup. Dordrecht, Holland, 1985.
9. J.I. Oden and J.N Reddy: *Variational Methods in Theoretical Mechanics*, Springer-Veriag, 1976.

B. Sc. Part II (Semester III)

M-6: Modern Algebra

Unit I

Group Theory: Definition of a Group, Some examples of Group, Some preliminary lemma, Sub-group, A counting principle.

Unit II

Normal sub-group and Quotient Group, Homomorphism, Permutation groups.

Unit III

Ring Theory: Definition and examples of rings, Some special classes of rings, Homomorphisms, Ideals and Quotient rings, More ideals and Quotient rings.

Unit IV

The field of Quotients of an integral domain, Euclidean rings, A particular Euclidean ring, Polynomial rings.

Text Book:

1. Topics in Algebra: I. N. Hartstein, Wiley Eastern Ltd. (Second edition) 1992
Scope: Chapter 2 (Articles: 2.1 to 2.7, 2.10), Chapter 3 (Articles: 3.1 to 3.9)

Reference Books:

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.
4. P.B. Bhattachaya, S.K. Jain and S.R. Nagpaul: *First Course in Linear Algebra*, Willey Eastern, New Delhi, 1983.
5. P.B. Bhattachaya, S.K. Jain and S.R. Nagpaul: *Basic Abstract Algebra*, (2nd Edition) Cambridge University Press India Edition.
6. H.S. Hall and S.R. Knight: *Higher Algebra*, S. Chand & Co. Ltd., New Delhi, 2008.

B. Sc. Part II (Semester IV)

M-7: Real Analysis

Unit I

Bounded sets, Completeness, Archimedean property of \mathbb{R} , Absolute value of Real Number, Neighborhoods, Open Sets, Interior point of a set, Limit point of a set, Bolzano-Weierstrass theorem, Closed sets, Closure sets.

Unit II

Sequences: Definition and examples, Bounded sequences, Convergent sequences, Monotone sequences, Subsequences, Cauchy sequences, Divergent sequences, Limit superior and limit inferior of sequences.

Unit III

Infinite series: Convergent series, Cauchy criterion of convergence of a series, Positive term series, Geometric series test, Comparison test, Limit comparison test, Ratio comparison test, p-Test, Cauchy's root test, D'Alembert ratio test, Integral test, Alternating series, Leibnitz's test, Absolute and conditional convergence.

Unit IV

Riemann Integration: Riemann integral, Criterion for Integrability, Properties of integrable functions, Certain classes of integrable function, The Fundamental theorem of calculus. Mean value theorem.

Text Book:

1. An Introduction to Real Analysis: P K Jain and S K Kaushik, S. Chand & Co. Ltd. New Delhi, (2000)

Scope: Chapters 1, 2, 3, Chapter 4 {Articles: 1, 2 (2.1 to 2.10), 3, 4, 5}, Chapter 8 (Articles: 1, 2, 3, 5, 6, 7)

Reference Books:

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia) P. Ltd., 2000.
3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.
4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series-* Undergraduate Texts in Mathematics, Springer Verlag, 2003.
5. Principles of Mathematical Analysis (Third Edition) by Walter Rudin, McGraw-Hill International Edition, 1976.
6. I. M. Apostol: *Mathematical Analysis*, Narosa Publishing house, New Delhi, 1985
7. R. R. Goldberg: *Real Analysis*, Oxford & IBH Publishing Co., New Delhi, 1970
8. S. Lang: *Undergraduate Analysis*, Springer-Verlag, New York, 1983
9. D. Somasundaram and B. Chaudhary: *A First Course in Mathematical Analysis*, S. Chand Co. New Delhi, 2000

B. Sc. Part II (Semester IV)
M-8: Mathematical Methods

Unit I – Power Series Solution

Introduction, A review of Power series, Series solution of first order equations, Second order linear equations, Ordinary point, Singular point, Regular singular point, Irregular singular point, Legendre's and Bessel's equations.

Unit II – Special Functions

Legendre's and Bessel's functions with their properties, Generating functions, Recurrence relations, Orthogonality of functions.

Unit III – Laplace Transforms

Laplace transform of some elementary functions, Properties of Laplace transforms, Inverse Laplace transforms, Laplace transforms of derivatives and integrals, Laplace transform of $t.f(t)$, Laplace transform of $f(t)/t$, Convolution theorem, Solution of Ordinary differential equations with constant coefficients, Solution of simultaneous ordinary differential equations.

Unit IV – Fourier Series

The Fourier coefficients, The problem of convergence, Even & Odd functions, Half range cosine and sine series, Extension to arbitrary intervals.

Text Books:

1. Differential Equations with Applications and Historical Notes (Second Edition): G. F. Simmons, McGraw-Hill International Editions, 1991.
Scope: Chapter 5 (Articles: 26 to 30), Chapter 6 (Articles: 33 to 36)
2. Advanced Engineering Mathematics: H. K. Das, S. Chand and Co. Ltd, New Delhi (2009).
Scope: Chapter 8 (Articles: 8.6 to 8.21), Chapter 13 (Articles: 13.1 to 13.12, 13.18)

Reference Books:

1. Laplace Transforms: Murray R. Spiegel, Schaum's Outline Series, McGraw-Hill
2. Laplace and Fourier Transforms: Goyal & Gupta, Pragati Prakashan, Meerut
3. Applied Mathematics (Vol II): P.N. Wartikar & J.N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune

B. Sc. Final (Semester V)
M-9: Complex Analysis

Unit I

Definition of Functions of complex variable, Limit, Continuity, Differentiability, Analytic function, Necessary and sufficient conditions for $f(z)$ to be analytic, C-R equations in polar form. Orthogonal curves, Harmonic function, Method to find the conjugate function, Milne-Thomson method.

Unit II

Transformation, Conformal transformation, Transformations - Linear, Magnification, Rotation, Inversion, Reflection and their combinations, Bilinear transformation. Schwarz-Christoffel transformation.

Unit III

Complex integration, Cauchy integral theorem, Cauchy integral formula, Morera Theorem, Cauchy's inequality, Liouville Theorem.

Unit IV

Convergence of a series of complex terms, Taylor's theorem, Laurent's theorem, Singular point, Residue, Residue theorem, Evaluation of real definite integral by contour integration, Evaluation of improper indefinite integral.

Text Books:

1. Advanced Engineering Mathematics: H. K. Das, S. Chand and Co. Ltd, New Delhi (2009).
Scope: Chapter 7 (Articles: 7.1 to 7.47)

Reference Books:

1. Functions of a Complex Variable by Goyal & Gupta, Pragati Prakashan, 2010.
2. R. V. Churchill and J. W. Brown: Complex Variables and Applications (5th Edition), McGraw Hill, New York, 1990
3. Shanti Narayan: Theory of Complex Variables, S. Chand & Co. Ltd., New Delhi.
4. Mark J. Ablowitz and A. S. Fokas: Complex Variables (Introduction and Applications), Cambridge University Press, South Asian Edition, 1998

B. Sc. Final (Semester V)
M-10: Metric Space, Boolean Algebra & Graph Theory (Optional)

Unit I

Countable set, Uncountable set, Metric spaces, Interior point, Open set, Limit point, Closed set, Closure of a set, Dense set.

Unit II

Complete metric space, Compact Set, Connected set.

Unit III

Partial order relation, Partial ordered set, Lattices as Partially ordered set, Some properties of Lattices, Lattices as algebraic systems, Sub-lattices, Direct product and homomorphism, Some special lattices.

Boolean algebra, Sub-algebra, Direct product and homomorphism, Boolean functions, Boolean forms and free Boolean algebra, Values of Boolean expressions and Boolean functions.

Unit IV

Graph Theory: Basic concepts, Path, Reachability and connectedness, Matrix representation of graphs, Trees, Storage representation and manipulation of graphs.

Text Books:

1. Introduction to Topology and Modern Analysis: G. F. Simmons, McGraw-Hill International Edition (1963).
Scope: Chapter 1 (Articles: 6 & 7), Chapter 2 (Articles: 9 to 12)
2. Principles of Mathematical Analysis (Third Edition): Walter Rudin, McGraw Hill International Editions, 1976.
Scope: Chapter 2 (Articles: 2.31 to 2.42, 2.45 to 2.47)
3. Discrete Mathematical Structures with Applications to Computer Science: J. P. Tremblay, R. Manohar, Tata McGraw-Hill Pub Company, New Delhi (1997)
Scope: Chapter 2 (Articles: 2-3.8, 2-3.9), Chapter 4 (Articles: 4-1, 4-1.1 to 4-1.5, 4-2, 4-2.1, 4-2.2, 4-3, 4-3.1, 4-3.2), Chapter 5 (Articles: 5-1, 5-2)

Reference Books:

1. P. K. Jain and K. Ahmad: Metric Spaces, Narosa Publishing House, New Delhi, 1968.
2. B A. Davey and H. A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
3. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
4. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003.

B. Sc. Final (Semester V)
M-11: Mechanics (Optional)

Unit I

Forces acting at a point, Parallel forces, Moments, Couples, Coplanar forces, Reduction theorems and examples, Equilibrium under three forces, General conditions of equilibrium, Centre of gravity.

Unit II

Work and Energy, Virtual work, Flexible strings, Common catenary.

Unit III

Motion in a plane: Velocity and acceleration, Radial and transverse components of velocity and acceleration, Angular velocity and acceleration, Relation between angular and linear velocities, Tangential and normal components of velocity and acceleration, Newton's Laws of motion, Projectile.

Unit IV

Basics concept of Lagrange's Dynamics, Constraints, Generalized Coordinates, Principle of Virtual work, D' Alembert principle, Lagrange's Equations, Reduction of two body central force problem to the equivalent one body problem, Central force and motion in a plane, Differential equation of an orbit, Inverse square law of force, Virial theorem.

Text Book:

1. Text Book of Statics: R S Varma, Pothishala Private Ltd. Allahabad (1996)
Scope: Chapters 2, 3, Chapter 4 (Articles: 4.1, 4.2, 4.4), Chapter 6 (Articles: 6.1 to 6.5), Chapter 7, Chapter 9 (Articles: 9.2, 9.3, 9.5, 9.7, 9.8) Chapter 10 (Articles: 10.1, 10.2, 10.21, 10.22, 10.3, 10.4)
2. A Text Book of Dynamics: M Ray, S. Chand & Co. (2000)
Scope: Chapter 1 (Articles: 1.3 to 1.6, 1.8, 1.9), Chapter 3 (Articles: 3.1, 3.2)
3. Classical Mechanics: J C Upadhyaya, Himalaya Publishing House, New Delhi, 2006.
Scope: Chapter 2 (Articles: 2.2 to 2.9), Chapter 4: (Articles: 4.1, 4.2, 4.4, 4.5, 4.9)

Reference Books:

1. A.S. Ramsay, *Statics*, CBS Publishers and Distributors (Indian Reprint), 1998.
2. A.P. Roberts, *Statics and Dynamics with Background in Mathematics*, Cambridge University Press, 2003.
3. Classical Mechanics (Second Edition) by Herbert Goldstein , Narosa Publishing House , New Delhi , 1998.
4. S.L. Loney: *Statics*, Macmillan and Company, London.
5. S.L. Loney: *An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies*, Cambridge University Press, 1956.

B. Sc. Final (Semester VI)

M-12: Linear Algebra

Unit I

Vector Spaces: Definition and examples of vector spaces, Sub-spaces, Span of a set, More about sub-spaces, Linear dependence, Linear independence, Dimensions and Basis.

Unit II

Linear Transformations: Definition and examples, Range and kernel of linear map, Rank-Nullity, Inverse of a linear transformation, Consequences of Rank-Nullity Theorem.

Unit III

The space $L(U, V)$, Composition of linear maps, Operator equations, Applications to the theory of ordinary linear differential equations, Matrix associated to linear map, Linear map associated with matrix.

Unit IV

Linear Operations in Matrices, Matrix multiplication, Rank and Nullity of a matrix, Inner product spaces, Normed linear space, Orthogonal and orthonormal vectors, Gram-Schmidt orthogonalization process, Orthogonal and Unitary matrices, Application to reduction of quadrics.

Text Books:

1. An Introduction to Linear Algebra: V Krishnamurthy, V P Mainra and J L Arora, Affiliated East West Press Pvt. Ltd (1976).
Scope: Chapters 3, 4, Chapter 5 (Articles: 5.1 to 5.5), Chapter 7 (Articles: 7.2 to 7.4)

Reference Books:

1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra*, 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
2. David C. Lay, *Linear Algebra and its Applications*, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
3. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005.
4. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.
5. S. Kumaresan: *Linear Algebra (A Geometrical Approach)*, Prentice Hall of India, 2000
6. S. K. Jain, A. Gunawardena and P. B. Bhattacharya: *Basic Linear Algebra with MATLAB*, Key College Publishing (Springer-Verlag) 2001.
7. K. Hoffman and R. Kunze: *Linear Algebra (2nd Edition)*, Prentice-Hall, Englewood Cliffs (New Jersey), 1971.
8. K. B. Datta: *Matrix and Linear Algebra*, Prentice Hall of India Pvt., New Delhi, 2000
9. Shanti Narayan: *A Text Book of Modern Abstract Algebra*, S. Chand & Co.Ltd., New Delhi.

B. Sc. Final (Semester VI)
M-13: Numerical Methods (Optional)

Unit I

Solution of Algebraic and Transcendental Equations: The Bisection Method, The method of False position, The iteration method, Newton-Raphson method, Ramanujan's method, The Secant method, Muller's method, Solution to systems of non-linear equations.

Unit II

Interpolation: Finite differences, Differences of a polynomial, Newton's formulae for interpolation, Central difference interpolation formulae, Interpolation with unevenly spaced points, Divide differences and their properties, Inverse interpolation.

Unit III

Numerical Differentiation and Integration: Numerical differentiation, Maximum and minimum values of a tabulated function, Numerical integration, Euler-Maclaurin formula.

Unit IV

Numerical Solution of Ordinary Differential Equation: Solution by Taylor's series, Picard's method of successive approximation, Euler's method, Runge-Kutta method, Predictor-Corrector method, The cubic spline method, Simultaneous and higher order equations.

Text Books:

1. Introductory Methods of Numerical Analysis: S. S. Sastry, Prentice Hall of India (4th Edition) (2008).
Scope: Chapter 2 (Articles: 2.2 to 2.8, 2.12), Chapter 3 (Articles: 3.3, 3.5 to 3.7, 3.9 to 3.11), Chapter 5 (Articles: 5.2 to 5.5), Chapter 7 (Articles: 7.2 to 7.8)

Reference Books:

1. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, 2007.

B. Sc. Final (Semester VI)
M-14: Special Theory of Relativity (Optional)

Unit I

Review of Newtonian Mechanics: Inertial frames, Speed of light and Galilean relativity, Relative character of space and time, Postulates of Special theory of relativity, Lorentz transformation equations and its geometrical interpretation, Group properties of Lorentz transformations.

Unit II

Relativistic Kinematics: Composition of parallel velocities, Relativistic addition law for velocities, Transformation equation for components of velocities and acceleration of a particle , Transformation of Lorentz contraction factor, length contraction and time dilation.

Unit III

Geometrical representation of Space-Time: Four dimensional Minkowskian space-time of relativity, Space like and time like intervals, Proper time, Light cone or null cone World line of a particle, Four vector and tensors in Minkowskian space-time.

Unit IV

Relativistic Mechanics and Electromagnetism: Variation of mass with velocity. Equivalence of mass and energy i.e., $E = m c^2$, Transformation equations for mass, momentum and energy. Relativistic force and transformation equations for its components. Relativistic Lagrangian and Hamiltonian.

Maxwell's equation in vacuum, Propagation of electric and magnetic field strengths, Four potential, Transformation equations for electromagnetic four potential vector. Transformation equations for electric and magnetic field strengths.

Text Books:

C. Molar, The Theory of Relativity, Oxford Clarendon Press, 1952

Reference Books:

1. J.K. Gupta, K.P. Gupta, Theory of Relativity, Krishna Prakashan Media (P) Ltd.
2. T. M. Karade, K.S. Adhav, M.S. Bendre, Lectures on Special Relativity, Sonu Nilu
3. P.G. Bergman, Introduction to The Theory of Relativity, Prentice Hall of India Pvt. Ltd., 1969
3. J.L. Anderson, Principles of Relativity Physics, Academic Press, 1967
4. V.A. Ugarov, Special Theory of Relativity, Mir Publishers, 1979
5. R. Resnick, Introduction to Special Relativity Wiley Eastern, Pvt.Ltd.1972