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)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
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)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
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)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
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)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
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 ORContinue with Major and Minor

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

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	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)

SN	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	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)

SN	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-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)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
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)

SN	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-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
		Statistics	BMT5T12-B
VI	Elective 2	Mathematical Modeling	BMT6T16-A
		Special Theory of Relativity	BMT6T16-B
VII (Honors)	Elective 3	Advanced Numerical Methods	BMT7T21-A
		Fluid Dynamics	BMT7T21-B
VIII (Honors)	Elective 4	General Theory of Relativity	BMT8T27-A
		Operations Research	BMT8T27-B
VII (Research)	Elective 3	Ordinary Differential Equations	BMT7T20R-A
		Advanced Numerical Method	BMT7T20R-B
VIII (Research)	Elective 4	Integral Equations	BMT7T25R-A
		General Theory of Relativity	BMT7T25R-B

'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 – <u>Algebra</u>: Set theory, equivalence relations, equivalence classes. Theory of Numbers: Divisibility, division algorithm, Euclidean algorithm, congruence, linear congruence.	**8**
	Unit II - <u>Matrices</u>: 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 – <u>Theory of Equations</u>: 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 - <u>Trigonometry</u>: 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**
	<u>Reference Books:</u> 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 Suggested digital platform: NPTEL/SWAYAM/MOOCs	
	PRACTICAL: BMT1P01: Algebra and Trigonometry	
Sem I **Paper - I** **DSC (Core) Code: BMT1P01** **For Minor: BMT1P01**	**Course Outcomes:** CO1: Students will be able to learn implications of equivalence relations in determining equivalence classes. CO2: Students will understand properties of divisibility through problem solving. CO3: Students will be able to perform different operations on the given congruence. CO4: Solution of linear congruence will be studied by students. CO5: Students will be able to perform matrix operations to determine invertible matrices, row canonical and normal form of the matrices. CO6: Students will be able to apply matrix operations to solve system of linear equations. CO7: Students will be able to find roots of a cubic and biquadratic equation. CO8: Students will be able to apply De Moivre's theorem to find n^{th} roots of a complex number find.	**Credit 1** **No. of hours** 30
	Syllabus for Practical BMT1P01: Algebra and Trigonometry 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) Comparing relations and functions. (2) Exploring implication of equivalence relations in determining equivalence classes. (3) Properties of divisibility through problem solving. (4) Application of different operations on the given congruence. (5) Solution of linear congruence (6) Matrix algebra: (i) $AB \neq BA$ in general (ii) $A \neq 0, B \neq 0$ but $AB = 0$ (iii) $(AB)' = B'A', (AB)^{-1} = B^{-1}A^{-1}$	

(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 nth 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

Sem I **Paper - II** **DSC (Core) Code: BMT1T02** **For Minor: BMT1T02**	Course Title: **Differential Calculus** **Course Outcomes:** CO1: **Foundational Knowledge**: Students will be able to update their basic knowledge of Maxima and Minima of functions of single variables and their application. CO2: **Elementary Skills**: Students will undergo problem solving training by learning Indeterminate forms and L' Hospital's Rule and their applicability. 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. 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. 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.	**Credit 2** **No. of hours 30**
	Syllabus for BSc Semester – I Paper -II **BMT1T02: Differential Calculus**	**No. of hours**
	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	**8**
	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	**7**
	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.	**7**
	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.	**8**
	<u>Reference Books:</u> 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. Apostal, 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 Suggested digital platform: NPTEL/SWAYAM/MOOCs	

Sem I Paper - II **DSC (Core) Code: BMT1P02** **For Minor: BMT1P02**	**PRACTICAL: BMT1P02: Differential Calculus**	
	Course Outcomes: CO1: Students will be able to make out the maximum or minimum nature of the functions by applying different conditions on the functions. CO2: Working on Geometric interpretation of Mean value theorems through graphs of a function will make students grasp the subject admirably. CO3: Students will learn application of Leibnitz, Maclaurin's and Taylor's theorems. CO4: Students will be able to apply L' Hospital's Rule to solve the problems CO5: Solving problems when functions involved are homogeneous CO6: Students will able to solve Jacobians and learn properties due to Jacobian. CO7: Analyzing Maxima and Minima of functions of two variables	**Credit 1** **No. of hours** 30
	Syllabus for Practical BMT1P02: Differential Calculus Note: **Minimum 12** topics from listed practical problems must be conducted, at least 3 from every unit.	
	List of topics for practical problems: (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	

	(14) Solving total differentials of scalar functions (15) Finding asymptotes of a function and analyze it through its graph. (16) Solving Jacobians of functions f & g (17) Analyzing independent nature of functions f & g through Jacobians (18) Verification of $J J' = 1$ for a given function and analyze existence of inverse transformation (19) Analyzing Maxima and Minima of function of two variables (20) Application of Lagrange's method of multiplier **Reference Books:** 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. Apostal, 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 **Suitable computer programs can be used:** SageMath/Maxima/SciLab/etc	

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

	PRACTICAL: Sage Math Software System	
Sem- I **VSC - 01** **Code:** **BVS1P01**	Course Title: **SAGE MATH SOFTWARE SYSTEM** Course Outcomes: **Students will be able** 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.	**Credit 2** **No. of hours** 30
	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 Paul Zimmermann, Alexandre Casamayou, Nathann Cohen, Guillaume Connan, Thierry Dumont, Laurent Fousse, François Maltey, Matthias Meulien, Marc Mezzarobba, Clément Pernet, Nicolas M. Thiéry, Erik Bray, John Cremona, Marcelo Forets, Alexandru Ghitza, 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, Dhwajank(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. Apostal, 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**	**Course Outcomes**: CO1: Students will be able to solve problems using reduction formulae, Beta and Gamma functions. CO2: Application of double integration in solving problems on area of a region. CO3: Students will able to solve problems by changing the order of integration CO4: Students will learn application of triple integration CO5: Students will be able to apply integrating factor in solving non-exact differential equations CO6: Students will be able to solve Euler's Equidimensional Eqs CO7: Students will able to use concept of Wronskian in solving problems by method of variation of parameters	**Credit 1** **No. of hours** 30
	Syllabus for Practical BMT2P03: Integral Calculus and Ordinary Differential Equations Note: **Minimum 12** topics from listed practical problems must be conducted, at least 3 from every unit.	
	List of topics for practical problems: **Abbreviations: Eq- Equation, DEq – Differential Equations** (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	

	(13) Solution of Bernoulli's DEqs (14) Solutions of First order higher degree DEqs (15) Finding orthogonal trajectory of the given family, and then sketch both the families together to decipher the orthogonality (16) Application of Wronskian in understanding the independent/dependent nature of functions (17) Solutions of homogeneous DEqs (18) Solutions of Euler's Equidimensional Eqs (19) Determination of a solution from a known solution (20) Application of method of variation of parameters **Reference Books:** (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. Apostal, 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. **Suitable computer programs can be used:** SageMath/Maxima/SciLab/etc	

Sem- II **Paper - II** **DSC (Core) Code: BMT2T04** **For Minor: BMT2T04**	Course Title: **Vector Analysis** **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.	**Credit 2** **No. of hours** 30
	Syllabus for BSc Semester – II Paper -II **BMT2T04: Vector Analysis**	**No. of hours**
	Unit I – <u>Vector Differentiation:</u> 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 - <u>Gradient, Divergence and Curl:</u> The vector differential operator del, Gradient, directional derivatives, Divergence, solenoidal vector, Curl, irrotational vector field.	**7**
	Unit III - <u>Vector Integration:</u> Ordinary integrals of vectors, Line Integral, Work done by force, exact differential and scalar potential, Surface integral, Volume integral.	**7**
	Unit IV – <u>Vector Theorems:</u> Green's Theorems in the plane (statement only), Gauss divergence Theorem (statement only), Stokes' Theorem (statement only) and their applications.	**8**
	<u>Reference Books:</u> 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.	
	List of topics for practical problems: (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	

	(17) Application of Green's theorem in the plane (18) Determination of area by Greens's theorem in the plane (19) Application of Gauss theorem (20) Application of Stokes' theorem **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). **Suitable computer programs can be used:** SageMath/Maxima/SciLab/etc	

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.

	Maxima Software System	
Sem- II **VSC - 02** **Code:** **BVS2P03**	**PRACTICAL:** **Course Outcomes**: **Students will be able** 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	**Credit** **2** **No. of hours** 30
	Syllabus for BSc Semester – II: VSC - 02 **Code BVS2P03: MAXIMA SOFTWARE SYSTEM**	**No. of hours**
	TOPICS: 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**

	Reference Books: 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 Seifedine Kadry, Pauly Awad. 4. Algebra And Calculus Using Maxima Software, Dr. K. C. Takale, Dr. A. S. Shaikh, Dr. V. S. Jadhav, Dr. S. B. Gaikwad, Prof. S. R. Patil, Nirali Prakashan.	

SEM 2 : CONSTITUION 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 usingastronomy as a probe.
2. The growth of Indian astronomy occurs in distinct stages analogous to phasetransitions of the evolution of cultures
3. Indian Astronomy therefore provides an excellent window to the pastdramatic 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