Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur 440033

Scheme and Syllabus
Bachelor of Science (Environmental Science)

Submitted by

Board of Studies,
Bachelor of Science (Environmental Science)

FYUGP-Scheme I-VIII Semester

Bachelor of Science (Honors/Research)
(Environmental Science - Major)
Four Year (Eight Semester Degree Course)
Teaching and Examination Scheme

B.Sc. Sem-I (Environmental Science - 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	Fundamentals of Environmental Science	BES1T01	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Fundamentals of Environmental Science	BES1P01	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Environmental Biology	BES1T02	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Environmental Biology	BES1P02	-	-	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	Environmental Chemistry and Instrumentation	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	Home Science/ Computer Application	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 (Environmental Science- 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	Basics of Environmental Pollution	BES2T03	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Basics of Environmental Pollution	BES2P03	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Forest, Wildlife and Biodiversity and it's conservation	BES2T04	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Forest, Wildlife and Biodiversity and it's conservation	BES2P04	-	-	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	Operation and Maintenance of Water and Wastewater Treatment Plant	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
Total				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 ORContinue with Major and Minor

B.Sc. Sem-III (Environmental Science - 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	Atmospheric Science, Meteorology and Climatology	BES3T05	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Atmospheric Science, Meteorology and Climatology	BES3P05	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Natural Resources and Management	BES3T06	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Natural Resources and Management	BES3P06	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 1 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 1 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 2 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 2 (Refer Minor Basket)		-	-	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 (Environmental Science - 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	Solid and Hazardous Waste Management	BES4T07	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Solid and Hazardous Waste Management	BES4P07			2	1	-	-	-	-	25	25	25
3	DSC	Water and Waste water Quality Monitoring	BES4T08	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Water and Waste water Quality Monitoring	BES4P08			2	1	-	-	-	-	-	50	25
5	Minor	Minor 3 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 3 (Refer Minor Basket)				2	1	-	-	-	-	25	25	25
7	Minor	Minor 4 (Refer Minor Basket)		2	-		2	3	80	20	40	-	-	-
8	Minor	Minor 4 (Refer Minor Basket)				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 (Environmental Science - 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	Air and Noise Pollution Control Technology	BES5T09	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Air and Noise Pollution Control Technology	BES5P09	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Water and Wastewater Treatment Technology	BES5T10	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Water and Wastewater Treatment Technology	BES5P10	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Green Chemistry and Technologies for sustainable Development.	BES5T11	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Green Chemistry and Technologies for sustainable Development.	BES5P11	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 1	BES5T12	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 1	BES5P12	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 5 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 5 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	Minor	Minor 6 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
12	Minor	Minor 6 (Refer Minor Basket)		-	-	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 (Environmental Science - 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	Soil Pollution and Environmental Toxicology	BES6T13	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Soil Pollution and Environmental Toxicology	BES6P13	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Remote Sensing and Geographical Information System (GIS) and its application	BES6T14	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Remote Sensing and Geographical Information System (GIS) and its application	BES6P14	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Environmental Toxicology and Environmental Remediation	BES6T15	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Environmental Toxicology and Environmental Remediation	BES6P15	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 2	BES6T16	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 2	BES6P16	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 7 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 7 (Refer Minor Basket)		-	-	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) (Environmental Science - 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	Environmental Microbiology, Environmental Biotechnology and Environmental Statistics	BES7T17	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Environmental Microbiology, Environmental Biotechnology and Environmental Statistics	BES7P17	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Introduction to Environmental Impact Assessment (EIA) and Environmental Audit (EA)	BES7T18	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Introduction to Environmental Impact Assessment (EIA) and Environmental Audit (EA)	BES7P18	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Environmental Legislation and Policies	BES7T19	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Environmental Legislation and Policies	BES7P19	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Biostatistics and Environmental Modelling	BES7T20	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Biostatistics and Environmental Modelling.	BES7P20	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 3	BES7T21	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 3	BES7P21	-	-	2	1	-	-	-	-	25	25	25
11	RM	Research Methodology	BES7T22	2	-	-	2	3	80	20	40	-	-	-
12	RM	Research Methodology	BES7P22	-	-	4	2	-	-	-	-	50	50	50
Total				13	-	14	**20**		**520**	**130**		**125**	**225**	

B.Sc. Sem-VIII (Honors) (Environmental Science - 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	Sustainable and Environmental Management System	BES8T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Sustainable and Environmental Management System	BES8P23	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Climate Change its consequences and Mitigation.	BES8T24	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Climate Change its consequences and Mitigation.	BES8P24	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Environmental Instruments and Techniques	BES8T25	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Environmental Instruments and Techniques	BES8P25	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Environmental Geo-Science	BES8T26	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Environmental Geo-Science	BES8P26	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 4	BES8T27	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 4	BES8P27	-	-	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 Honors Degree in Major and Minor with 160-176 Credits

B.Sc. Sem-VII (Research) (Environmental Science 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	Environmental Microbiology, Environmental Biotechnology and Environmental Statistics	BES7T17R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Environmental Microbiology, Environmental Biotechnology and Environmental Statistics	BES7P17R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Introduction to Environmental Impact Assessment (EIA) and Environmental Audit (EA)	BES7T18R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Introduction to Environmental Impact Assessment (EIA) and Environmental Audit (EA)	BES7P18R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Environmental Legislation and Policies	BES7T19R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Environmental Legislation and Policies.	BES7P19R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 3	BES7T20R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 3	BES7P20R	-	-	2	1	-	-	-	-	-	50	25
9	RM	Research Methodology	BES7T21R	2	-	-	2	3	80	20	40	-	-	-
10	RM	Research Methodology	BES7P21R	-	-	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) (Environmental Science - 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	Sustainable and Environmental Management System	BES8T22R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Sustainable and Environmental Management System	BES8P22R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Climate Change its consequences and Mitigation.	BES8T23R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Climate Change its consequences and Mitigation.	BES8P23R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Environmental Instrumentation & Techniques	BES8T24R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Environmental Instrumentation & Techniques.	BES8P24R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 4	BES8T25R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 4	BES8P25R	-	-	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: /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 (Environmental Science)

Semester	Course Category	Name of Course	BoS	Course Code
I	**VSC**	Environmental Chemistry and Instrumentation	Environmental Science	**BVS1P01**
II	**VSC**	Operation and Maintenance of Water and Wastewater Treatment Plant	Environmental Science	**BVS2P03**
III	**VSC**	Sanitary Engineering	Environmental Science	**BVS3P05**
V	**VSC**	Watershed Management	Environmental Science	**BVS5P07**
VI	**VSC**	Organic Farming	Environmental Science	**BVS6P08**

Basket for <u>ELECTIVE</u> (DSE) Category Courses (Environmental Science)

Semester	Course Category	Name of Course	Course Code
V	Elective 1	A. Environmental and Society B. Urban Planning and Development	BES5T12
VI	Elective 2	A. Circular Economy B. Wetland Conservation and Management.	BES6T16
VII (Honors)	Elective 3	A. Green Technologies B. Eco-restoration and Development	BES7T21
VIII (Honors)	Elective 4	A. Industrial Waste Treatment Technology B. Environmental Entrepreneurship	BES8T27
VII (Research)	Elective 3	A. Green Technologies B. Eco-restoration and development	BES7T20R
VIII (Research)	Elective 4	A. Industrial Waste Treatment Technology B. Environmental Entrepreneurship	BES7T25R

R' in the subject code indicates 'Research'.

The examination shall comprise two theory papers of 3 hours duration of 80 marks.
Theory paper is divided into four units. Each Unit shall be covered in 7.5 hours

B.Sc Semester 1

Paper - I

Fundamentals of Environmental Science

Unit–I: Basics of Environmental Science

A) Introduction to Environmental Science: Definition, Types, Classification, Characteristics, Components and Principle of Environment, Multidisciplinary Nature of environmental science.

B) Components of Environment: Atmosphere- Definition, structure and composition. **Hydrosphere -** Definition, distribution of water, hydrological cycle and global water balance. **Lithosphere-** definition, internal structure of earth. Rocks –types and their formation. **Biosphere –** definition, boundaries of biosphere. **(7 Periods)**

Unit –II: Aquatic Chemistry

A) Physical parameters of water: Solvency, colour, temperature, turbidity, taste, conductivity, odour, viscosity, Transparency, Density, pH, Forms of precipitation.

B) Chemical parameters of water: Salinity, CO_2, O_2, Alkalinity, Acidity, Hardness, Chlorides, Dissolved oxygen. Principle and method of estimation, prescribed limit of potable water as per WHO guidelines. **(7 Periods)**

Unit –III: Soil Chemistry

A) **Soil:** Definition, Composition of soil, Type of soil, soil formation, soil profile, soil structure, soil organism.

B) Properties of Soil –Physical- soil density, Soil texture, soil colour, porosity, soil temperature, soil air, soil water. **Chemical –** soil components (Inorganic and organic), soil pH , soil humus, NPK in soil. **(8 Periods)**

Unit – IV: Environmental Education and Awareness

A) Environmental Education: Goals, objectives and principles of Environmental Education, Formal and Non-formal Education, Importance of Environmental Education.

B) Environmental Awareness: Environmental awareness programs , Celebration of Environmental Days, **Global environmental issues –** Acid rain ,Ozone depletion , Greenhouse effect , Global warming, El-Nino,La-Nino. **(8 Periods)**

Practical-I

1. Study of laboratory Instruments and Glasswares.
2. Water sampling for ground and surface water and its storage techniques.
3. Determination of odor and conductivity.
4. Estimation of Chloride in water sample by Argentometric method
5. Estimation of Alkalinity in water sample.
6. Estimation of Acidity in water sample.
7. Determination of pH in soil sample
8. Determination of moisture content of soil
9. Determination of bulk density of soil

Visit:

- Visit to water body to study Pond as an ecosystem.
- Visit to Nearby Forest to study the flora and fauna in its Natural Environment.

All students shall undertake field visits, soon after their visit, students shall submit study tour report which is certified by the HOD is to be submitted at the time of Annual practical examination.

Field Diary:

The students shall prepare their field diary under the following heads:

- Issue on Regional problems of Environmental interest (Case study).
- Issue on National interest (Case study).
- Famous personalities in Environmental Movements

Distribution of Marks:

1.	Long experiment (Any one)	:	08 Marks
2.	Short experiment (Any two)	:	08 Marks
3.	Viva – voce	:	03 Marks
4.	Tour report / field diary	:	03 Marks
5.	Practical Record	:	03 Marks

	Total Marks	**:**	**25 Marks**

Books for Reference (Practical)

1. A Manual of Water and Wastewater Analysis: Dr D.S.Ramteke and Dr C.A.Moghe,Published by NEERI,Nagpur,1996.
2. Laboratory Manual of Environmental Chemistry: Dr Snita Hooda and Dr Sumanjeet Kaur,S.Chand and Co.Ltd.New Delhi.1997.
3. Physico-chemical Examination of Water Industrial Effluents: N.Manivaskaram, Pragti Prakashan, Meerut (U.P) 1996.
4. Chemical and Biological Methods of Water Pollution Studies: R.K.Trevedi and P.K.Goel, Enviro Media Publication.

Book for Reference:

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: B.K.Sharma, Goel Publication,Meerut.
7. Environmental Chemistry: A.K.Dey,New Age International Publishers,2001.
8. Man and Environment: P.R.Trivedi and Gurdeep Raj,Akashdeep Publishing House,New Delhi.
9. Fundamentals Concepts in Environmental Studies: Dr.D.D.Mishra, S.Chand Publication,New Delhi.
10. Climatology: D.S.Lal,Sharda Pustak Bhavan,Allahabad,2003.
11. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr P.U.Meshram,Allied Publishers, New Delhi.

B.Sc Semester 1
Paper II

ENVIRONMENTAL BIOLOGY

Unit -I : Ecology and Environmental factors

A) Ecology: Introduction of Ecology (Definition, sub-division branches and scope), application and significance of ecology to human being.

B) Abiotic factors: Temperature, light, fire, soil, Shelford law of tolerance, Liebig's law of minimum. **Biotic factor:** Mutualism, commensalism, parasitism, neutralism, predation, competition. **(7 Periods)**

Unit – II : Population and Community ecology

A) Population Ecology: Characteristics of population - Natality, Mortality, Population Density, Population dispersal, Population Fluctuation, Population dispersion, Population Growth Curves (S & J Shaped), Biotic potential, Environmental resistance

B) Community Ecology: Definition, characteristic of community, community structure, Ecological indicators, Ecotone and edge effect, Ecological Niche , Ecological succession. **(7 Periods)**

Unit -III : Ecosystem

A) Ecosystem: Components, structure and function of ecosystem; Major ecosystems (terrestrial and aquatic). Major biome of the world.

B) Food Chain: food chain and food webs; energy flow in ecosystem, ecological pyramids, pollutants and trophic level (Bio-magnification and Bio-accumulation) **(8 Periods)**

Unit- IV: Biogeochemical cycles

A) Biogeochemical Cycles: Hydrological, gaseous (carbon, oxygen, nitrogen) sedimentary cycle (phosphorus and sulphur).

B) Productivity: Definition and types, measurement of productivity (Light and dark bottle method) factors affecting primary productivity. **(8 Periods)**

Practical-II

1) To determine the primary productivity in a water body by Light and Dark bottle method.

2) To determine the chlorophyll content of the given plant material.
3) Determination of species diversity indices by Simpson and Shannon's Wiener index
4) To measure color and temperature of different water bodies.
5) Determination of turbidity of given water sample
6) Determination of pH of given water sample
7) Determination of carbon dioxide (CO_2) in polluted and unpolluted water bodies.
8) To study biotic and abiotic components of a pond and forest ecosystem.
9) Observation and monitoring of different inter-specific relationship from different local habitat.
10) Identification of ecological indicators

Visit:

- Visit to water body to study Pond as an ecosystem.
- Visit to Nearby Forest to study the flora and fauna in its Natural Environment.

All students shall undertake field visits, soon after their visit, students shall submit study tour report which is certified by the HOD is to be submitted at the time of Annual practical examination.

Field Diary:

The students shall prepare their field diary under the following heads:

- Issue on Regional problems of Environmental interest (Case study).
- Issue on National interest (Case study).
- Famous personalities in Environmental Movements

Distribution of Marks:

1.	Long experiment (Any one)	:	08Marks
2.	Short experiment (Any two)	:	08Marks
3.	Viva – voce	:	03 Marks
4.	Tour report / field diary	:	03 Marks
5.	Practical Record	:	03 Marks

	Total Marks	**:**	**25 Marks**

Books for Reference (Practical)

1. A Manual of Water and Wastewater Analysis: Dr D.S.Ramteke and Dr C.A.Moghe,Published by NEERI,Nagpur,1996.
2. Laboratory Manual of Environmental Chemistry: Dr Snita Hooda and Dr Sumanjeet Kaur,S.Chand and Co.Ltd.New Delhi.1997.
3. Physico-chemical Examination of Water Industrial Effluents: N.Manivaskaram, Pragti Prakashan, Meerut (U.P) 1996.
4. Chemical and Biological Methods of Water Pollution Studies: R.K.Trevedi and P.K.Goel, Enviro Media Publication.

Books for Reference:

1) Environmental Biology:Biswarup Mukherjee,Tata McGraw-Hill Publishing Company Ltd,New Delhi,1996
2. Animal Ecology and Distribution of Animals:Veer Bala Rastogi, Rastogi Publication,Meerut (U.P).
3. Ecology and Environment: P.D.Sharma, Rastogi Publication,Meerut (U.P).
4. Fundamentals of Environmental Biology: S.Arora,Kalyani Publishers.
5. Plant Ecology and Soil Science:R.S.Shukla and P.S.Chandel, S.Chand Publication,New Delhi.
6. Animal Ecology and Environmental Biology: H.R Singh,Vishal Publication.
7. Environmental Biology:P.S.Verma and V.K.Agrawal, S.Chand Publication,New Delhi.
8. Environmental Biology:P.K.G.Nair,Himalaya Publication.
9. Environmental Biology:K.C.Agrawal,Agro Botanical Publisher,Bikaner,1994.

VSC (BVS1P01)

Environmental Chemistry and Instrumentation

Unit 1

A. Types pollutants in the environment and their sources, general classifications of pollutants and their chemical structures, properties, concept of toxicity, units of measurement; Impacts of pollutants on human health,
B. Errors in quantitative analysis, precision and accuracy in measurement, accuracy, selectivity, sensitivity, role of r^2, sample preparation procedure for water, air, soil samples.

Unit 2

A. Titrimetric and colorimetric procedures, pH meter, conductivity meter, Nephelometer/Turbidity, working and applications.
B. Potentiometry and Voltammetry: Theory, instrumentation and applications of Colorimetry and Voltammetry. Electro-chemical techniques: Types, principle and working. Beer- Lambert's law, Flame photometry.

Unit 3

A. Absorption Spectrophotometry**:** Principle, working and applications of variousinstruments like UV-Visible Spectrophotometer, Infra-red (IR) Spectrophotometer, Nuclear Magnetic Resonance (NMR), Atomic Absorption Spectrophotometer (AAS), Flame Photometer
B. Chromatography: Introduction, Definition, theory of chromatographic separation, stationary and mobile phases, classification of chromatographic separations, Rf value**.** Types of Chromatography- Gas Chromatography (GC). High Performance Liquid Chromatography (HPLC)

Unit 4

A. Interpretation of mass spectra, basic GC/MS instrumentation, ion detectors, quantification, liquid-liquid extraction, solid phase extraction, ultrasonic extraction, supercritical fluid extraction; sample clean-up methods, ICP-MS, basic principle and its applications

B. Basic principle of High Volume Sampler its components, anemometer, weather station, adsorbent tubes, and canisters, solvent and thermal desorption techniques; Basic principle and applications of Total Organic Cabon analyser, X-Ray Fluorescence, X-Ray Diffraction.

Reference Books

1. A Technical Manual for Water and Wastewater Analysis, Sunil P Pande and Dr. LeenaDeshpande, Himalaya Publishing house 2012
2. Instrumental Methods of Environmental Analysis: Karan Sareen, (Sarup and SonsPublishers, New Delhi), 2001
3. Instrumental Methods of Chemical Analysis: B. K. Sharma, Goel Publishing House,Meerut (1996).
4. Standard Methods for the Examination of Water and Waste Water: (APHA, AWWA &WPCF), 1985
5. Willard. H., Merritt, L., Dean, D.A. and Settle F.A., 'Instrumental Methods ofAnalysis',7th edition, Wordsworth, New York, 1998.
6. Galen. W. Ewing, 'Instrumental Methods of Chemical Analysis 5th edition,McGraw Hill,New York., 1995.
7. Roger Reeve, Introduction to Environmental Analysis, John Wiley & SonsLtd,2002
8. Fundamentals of Analytical chemistry, D.A. Skoog, D.M. West and F.J.Holler,
9. Harcourt Asia PTE. Ltd., 7th edition, New Delhi,2001.
10. Manual of Water and Wastewater Analysis by Dr. D.S. Ramteke, C.A. Moghe &R.Sarin,NEERI, Nagpur
11. Our Environment Pollution Control and Future Strategies by M.P. Mishra, S.Chand&Company Ltd. New Delhi, 2000.
12. Principals of Environmental Science by H.V. Jadhav, Himalaya Publishing House, NewDelhi, 1994

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 (7.5 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 (7.5 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 (7.5 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 (7.5 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 ofCivil 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
8. Nicholas, Williams, Pickles (1984) Vertically and Crosswise. Inspiration Books

The examination shall comprise two theory papers of 3 hours duration of 80 marks. Theory paper is divided into four units. Each Unit shall be covered in 7.5 hours

B.Sc Semester-II
Paper - I
Basics of Environmental Pollution

Unit-I: Environmental Pollution:

A) **Environmental Pollution:** Definition, types, Classification of Pollutants- on the basis of physical properties and forms of their existence, Primary and secondary pollutants, degradable and non-degradable pollutants.

B) **Air Pollution:** Sources, Effects (Human health, vegetation and animals, Building material and structures), Indoor pollution, vehicular pollution, Bhopal gas tragedy, Air Quality Standards- NAAQS, AQI, Air pollution control measures.

(7.5 Periods)

Unit-II: Water Pollution:

A) **Water Pollution:** sources, effect of water pollution on flora and fauna, human beings and materials, Eutrophicaton, Heavy metal pollution- Minamata episode, water, pollution control measures, water quality indices.

B) **Thermal Pollution**: Causes, effects and control measures. **Marine Pollution:** sources, causes and mitigation of marine pollution. **(7.5 Periods)**

Unit-III-Soil and Solid Pollution:

A) **Soil Pollution:** Sources and types, soil pollutants- metals, inorganic ion and salts, organic substances, effects of soil pollution on soil health and productivity, effects of pesticides, soil pollution control measures,

B) **Solid Waste Pollution:** sources, Classification and characteristics of solid waste, segregation, collection and transportation and disposal of solid waste, Solid Waste management, **Biomedical Waste**: Categories of biomedical waste, types of container used for the disposal of biomedical waste, biomedical waste management.

(7.5 Periods)

Unit-IV: Noise and Radiation Pollution:

A) Noise Pollution: Sources and effects, Decibel scale, control measures of noise pollution. Ambient noise level of monitoring.

B) Radioactive Pollution: Types and sources of radiations, biological effects and control measures of radiations, E-waste (sources and its health effect), recycling and disposal methods. **(7.5 Periods)**

Practical-I

1. Determination of total solids in polluted water sample.
2. Determination of free chlorine in water sample.
3. Estimation of Hardness in water sample
4. Determination of Dissolved Oxygen (DO) in polluted water sample.
5. To estimate the amount of dust (particulate matter) deposition on the leaves of roadside plants.
6. To measure settealable particles by dust fall jar.
7. Determination of Total Organic Carbon (TOC) and % organic matter in the soil sample.
8. Determination of noise levels of residential, institutional and industrial area.
9. Determination of moisture content municipal solid waste,
10. To segregate domestic solid waste into bio-degradable and non bio-degradable components.

All students shall undertake field visits, soon after their visit, students shall submit study tour report which is certified by the HOD is to be submitted at the time of Annual practical examination.

Field Diary:

The students shall prepare their field diary under the following heads:

- Issue on Regional problems of Environmental interest (Case study).
- Issue on National interest (Case study).
- Famous personalities in Environmental Movements

Distribution of Marks:

1.	Long experiment (Any one)	:	08 Marks
2.	Short experiment (Any two)	:	08 Marks
3.	Viva – voce	:	03 Marks
4.	Tour report / field diary	:	03 Marks
5.	Practical Record	:	03 Marks

	Total Marks	**:**	**25 Marks**

Book for Reference:

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.A Text book of Environmental Chemistry and Pollution Control: S.S.Dara, S.Chand and Company Ltd,New Delhi.
6.Environmental Chemistry: B.K.Sharma, Goel Publication,Meerut.
10. Environmental Chemistry: A.K.Dey,New Age International Publishers,2001.
11. Man and Environment: P.R.Trivedi and Gurdeep Raj,Akashdeep Publishing House,New Delhi.

12. Fundamentals Concepts in Environmental Studies: Dr.D.D.Mishra, S.Chand Publication,New Delhi.
13. Environmental Pollution: Khitoliya,R.K**.** S.Chand Publication,New Delhi.
14. Air pollution and it's Control: Rao,M.N and Rao, H.V.N., Tata McGraw-Hill Publishing Company ,New Delhi.
15. Principles of Environmental Chemistry,3rd edition, J.E.Girard, Jones and Bartlett Learning Company, Burlington
16. The Science of Environmental Pollution,3rd edition, Frank.R.Spellman, CRC Press, Taylor and Francis Group.

B.Sc Semester II
Paper IV
Forest, Wildlife & Bio-diversity Conservation

Unit -I: Forest Conservation

A) Forest: Types of forest in India, Minor forest products, Significance of forest, Deforestation (causes, effects and control measures), forest fires.

B) Forest Conservation: Social forestry, National Forest Policy, Chipko Movenment, Afforestation, Forest Conservation Act,1988,Sustainable Forest Management (SFM), Joint Forest Management (JFM) **(7 Periods)**

Unit – II: Wildlife Conservation

A) **Wildlife:** Importance of wildlife, Rare, endangered, vulnerable and extinct species of wildlife, causes of wildlife depletion, wildlife management, man-animal conflicts,

B) Wildlife conservation: Necessity and mode of conservation of wildlife, Project Tiger, Wildlife Protection Act,1972, Role of IUCN, UNEP and WWF in wildlife conservation.

(7 Periods)

Unit -III: Biodiversity

A) Biodiversity: types, causes for the loss of biodiversity, preservation strategies for biodiversity, benefits of biodiversity, Hotspots of biodiversity, Measurement of biodiversity.

B) India as mega diversity nation, Biogeography zones of the country, Community Biodiversity Register (CBD), Biodiversity Act' 2002, Red Data Book. **(8 Periods)**

Unit- IV: Biodiversity Conservation

A) Biodiversity: Conservation: Approaches for Conservation of Biological Diversity, "In-situ' (Biosphere Reserves, National Park and Sanctuaries) conservation, "Ex-situ" conservation (Botanical and Zoological gardens, gene banks, seed and seedling bank).

B) Role of local communities and traditional knowledge in conservation; Biodiversity convention; International and national efforts to conserve biodiversity (CITES and WCU)

(8 Periods)

Practical-II

1. To determine the frequency of a species (plant) by Quadrate method.
2. To determine the density of a species (plant) by Quadrate method.
3. To determine the Abundance of a species (plant) by Quadrate method.
4. To study the water holding capacity of soil.
5. Identification of Zoo-planktons and Phyto-planktons.
6. Preparation of field report based on the survey of local flora (herbarium sheet).
7. To determine the Humidity by Psychrometer.
8. Identification of endangered species of flora and fauna
9. Preparation of Social Forestry Proposal
10. Study of adaptive features of hydrophytes and xerophytes.

All students shall undertake field visits, soon after their visit, students shall submit study tour report which is certified by the HOD is to be submitted at the time of Annual practical examination.

Field Diary:

The students shall prepare their field diary under the following heads:

- Issue on Regional problems of Environmental interest (Case study).
- Visit to Bio-Diversity Park.
- Famous personalities in Environmental Movements

Distribution of Marks:

1.	Long experiment (Any one)	:	08 Marks
2.	Short experiment (Any two)	:	08 Marks
3.	Viva – voce	:	03 Marks
4.	Tour report / field diary	:	03 Marks
5.	Practical Record	:	03 Marks

	Total Marks	**:**	**25 Marks**

Book for Reference:

1. Biodiversity – Strategies for Conservation – Dadhich.L.K. and A.P.Sharma, APH publishing corporation. New Delhi, 2002
2. Global Biodiversity Conservation measures – Khan. T.I and Dhari. N Al-Ajmi, pointer Publishers, Jaipur (1999)
3. An Advanced Text book on Biodiversity – Principles and Practice – Krishnamurthy. K.V, Oxford and IBH publishing, New Delhi (2003)
4. A Text Book of Ecology and Environment-P.C.Joshi and Namita Joshi, Himalaya Publihng House, First Edition (2005)
5. Environment and Ecology-S.N.Pandey and S,P.Mishra, Ane Books Pvt. Ltd. (2011).
6. A Text of Environmental Studies- Shashi Chawla, McGraw Hill Education (India) Private Ltd, New Delhi.(2012)
7. Environment and Ecology-Majid Husain, Access Publishing(India) Private Ltd, New Delhi.(2014)

Vocational and Skilled Based Education (VSE) (Environmental Science)

VSE-2: OPERATION & MAINTENANCE OF WATER & WASTE WATER TREATMENT PLANTS

Unit -1 : Introduction to Water Treatment Plant (WTP) & Waste Water Treatment Plants (WWTP) :

Objectives of WTP and WWTP. Role & duties of WTP / WWTP operator and Plant Incharge. Various units involved in WTP & WWTP. Operation of Pumps, Blowers, Agitators, Flow meters, valves, gear box, motors, MCC Panel

Sludge generation & Sludge handling system - Filter Press, Decanter, Screw Press, Belt Press. Handlingof filtrate and cakes

Layout , Hydraulic Profile and Piping &Instrumentation diagram of water and waste water treatment plant. Importance of spare list. Capital cost & Operational cost. Power (HP/kw) calculation of running plant.

Unit – 2 : Operation & Maintenance of Water Treatment Plant :

Water scarcity – Indian scenario. Depleting water resources. Per capita water supply, water supply schemes, Importance of water treatment plant and reuse.

Operation & Maintenance of intake well, check well, jack well, rising main, cascade aeration, flocculation and sedimentation, filters, Mass Balancing Reservoirs , Ground Storage Reservoirs, Elevated Service Reservoirs.

Advanced Water Treatment Technologies and it's operation & maintenance. Membrane filtration technology – Low & high pressure membrane, advanced oxidation, ultraviolet treatment, water softening.desalination plants, packaged drinking water and mineral water plants. Statutory guidelines for drinking water, Demineralization – cation exchangematerials – removal of ion, manganese, odour, colour taste – fluoridation, reverse osmosis

Unit – 3 : Operation & Maintenance of Primary & Biological Waste Water Treatment Plant :

Unit operations involved in Primary & Biological Treatment. Discharge norms. Zero liquid discharge (ZLD), treatment schemebased on discharge norms. Operation &maintenance of mechanical and manual screen , vibro separator, oil skimmer, plate heat exchanger, primary clarifier, agitator, coagulation &flocculation, dissolved air floatation unit, clarifloccculator, tube settler, gear box and motors.

Unit operation involved in Biological Treatment. Operation &maintenance of aerators, diffusers, blowers, pumps, secondary clarifier, lamella clarifier, aeration tank, anaerobic digesters – Media based, Upflow Anaerobic Sludge Blanket (UASB), Continuous Stirred Tank Reactors (CSTR).

Operation and maintenance of sludge dewatering units – Sludge thickener, filter press, decanters, screw press, belt press.

Unit -4 : Operation & Maintenance of Tertiary and Advanced Waste Water Treatment Plant:

Basics of advanced waste water treatment technologies – Dual Media Filters, Membrane Bio Reactor, HRSCC, Multi Effect Evaporators. Membrane based treatment technologies. Instrumentations and it's O & M – pressure gauge, hi and low Laval switch, DO meter, PH meter, flow meter, various types of valves. Cleaning of filters, backwashing.

Operation & Maintenance of Reverse Osmosis Plant, High Rate Solid Contact Clarifier (HRSCC), Membrane Bio Reactor (MBR), Moving Bed Biofilm Reactor (MBBR), Multi Effect Evaporators, Skid mounted STPs

Documentation, Interpretation and Commissioning: Preparation of operation and maintenance manual, record keeping, report preparation& documentation, Log-sheet, Routine analysis of various parameters. commissioning of waste water treatment plants. Preparation of quality assurance plan. Environment audit.

Reference Books:

1. Waste Water Engineering: Metcalf and Eddy, Tata McGraw Hill Publishing Company,New Delhi.
2. Waste Water Treatment for Pollution Control : Soli J. Arceivala (Tata Mc- GrewHill Publishing Company, New Delhi)
3. Water Supply and Sanitary Engineering : R. C. Rangwala and S. C. Rangwala (Charotal publishing house, Anand)
4. Waste Water Engineering By Parker R (2018).
5. Waste water treatments by S.S Jahagirdar, R.K Lad,V.S Rajamanya.
6. Water and Waste Water Systems – Poonam Ahluwalia
7. Waste Water Treatment : M. N. Rao, A. K. Datta (Oxford and IBH Publishing company, New Delhi)
8. Introduction to Environmental Engineering: Mackenzie L. Davis & David A. Cornwell, McGrew Hill Publishing Company, New Delhi.
9. Fundamentals of Water Treatment Unit Processes - Physical, Chemical, and Biological David Hendricks, CRC Press, ISBN: 978-1-4200-6191-8 (Hardback), 2011 Edition [DWH]
10. Industrial Waste Water Treatment by A.D Patwardhan
11. Water-Wastewater Engineering - Fair G.M., Geyer J.G and Okun.
12. Waste Water treatment and Water Management – Anamika Srivastava
13. Sewage Treatment & Disposal & Waste Water Engineering- P N Modi

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, VedangJyotish, 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 BhaskarAcharya-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