

Shivaji University, Kolhapur



Accredited By NAAC with 'A' Grade

CHOICE BASED CREDIT SYSTEM

Syllabus For

B.Sc. Part –III

Pollution

SEMESTER V AND VI

(To be introduced from the academic year 2024-2025)

Programme Specific Outcomes

After completing the course the students would be able to:

1. Acquire basic, scientific concepts of many of current environmental issues and happenings.
2. Upgrade the competency and different skills necessary for environment protection.
3. Undertake the post graduate program related to environmental science.
- 4 To develop the ability in the students for the application of the acquired knowledge the fields of life so as to make our country Self-reliant and self-sufficient
- 5 TO develop specific skills amongst students for employability and for the development of their

Programme Outcomes (PO'S)

1. To create awareness about the present day's environmental issues at global and local scale.
2. To create awareness about environmental and social impacts on developmental activity.
3. To generate positive attitude to solve the environmental issues with sustainable development.
4. To spread the environmental consciousness and responsibility to solve the problems of society.
5. To develop ability for the application of the acquired knowledge in the fields of life so as to make our country Self-reliant and self-sufficient.

Structure of B. Sc. Programme: Sem V & VI
Subject: Botany & Pollution
Structure – III

Semester V				
Sr. No.	Subject Name	Code	Paper Number	Title of Paper
1.	Botany	DSE-E	IX	REPRODUCTIVE BIOLOGY OF ANGIOSPERMS
2.	Botany	DSE-E	X	PLANT METABOLISM AND STRESS BIOLOGY
3.	Pollution	DSE-E	V	Biomedical Aspects and Food Safety
4.	Pollution	DSE-E	VI	Environmental Management and Legislation
Semester VI				
1.	Botany	DSE-F	XIII	PLANT BIOCHEMISTRY AND RESEARCH METHODOLOGY
2.	Botany	DSE-F	XIV	NATURAL RESOURCE MANAGEMENT AND HERBAL TECHNOLOGY
3.	Pollution	DSE-F	VII	Industrial Monitoring and Recycling of Pollution
4.	Pollution	DSE-F	VIII	ISO and Environment safety

SEMESTER – V (Duration – 6 Months)														
		TEACHING SCHEME						EXAMINATION SCHEME						
		THEORY			PRACTICAL			THEORY			PRACTICAL			
Sr. No.	Subject Title	Credits	No. of lectures	Hours	Credits	No. of lectures	Hours	Hours	Theory	Internal	Min Marks	Hours	Max Marks	Min Marks
1	DSE-E	2	3	2.4	8	20	16	2	40	10	14+4=18	PRACTICAL EXAMINATION IS ANNUAL		
2	DSE-E	2	3	2.4				2	40	10	14+4=18			
3	DSE-E	2	3	2.4				2	40	10	14+4=18			
4	DSE-E	2	3	2.4				2	40	10	14+4=18			
5	AEEC-E	2	4	3.2	---	---	---	2	40	10	14+4=18			
TOTAL		10	16	12.8	8	20	16		200	50	---			
SEMESTER – VI (Duration – 6 Months)														
1	DSE-F	2	3	2.4	8	20	16	2	40	10	14+4=18	As per BOS Guideline	200	70
2	DSE-F	2	3	2.4				2	40	10	14+4=18			
3	DSE-F	2	3	2.4				2	40	10	14+4=18			

4	DSE-F	2	3	2.4				2	40	10	14+4=18	s		
5	AECC-F	2	4	3.2	---	---	---	2	40	10	14+4=18	---	---	---
TOTAL		10	16	12.8	8	20	16		200	50	---			
GRAND TOTAL		20	32	25.6	16	40	32		400	100	---	---	200	

Student contact hours per week : 20 Hours (Min)	Total Marks for B.Sc.-III (Including English) : 700
Theory and Practical Lectures: 48 Min. Each	Total Credits for B.Sc.-III (Semester V & VI) : 36
DSE- Discipline Specific Elective. A candidate shall select one course (subject) from the three Courses (Subjects) selected at B.Sc. – II. Select any 4 pairs of papers from DSE- E1 to DSE - E86 for Sem – V and DSE - F1 to DSE - F86 for Sem – VI	
AECC- Ability Enhancement Compulsory Course (E & F) : English	
Practical Examination will be conducted annually for 100 Marks.	
There shall be separate passing for theory, internal and practical.	
(A) Non-Credit Self Study Course : Compulsory Civic Courses (CCC) For Sem V: CCC – II : Constitution of India and Local Self Government	
(B) Non-Credit Self Study Course : Skill Development Courses (SDC) For Sem VI: SDC – II: Any one from following (vi) to (x)	
vi) Interview & Personal Presentation Skill, vii) Entrepreneurship Development Skill, viii) Travel & Tourism, ix) E-Banking & Financial Services, x) RTI & Human Right Education (HRE), IPR & Patents	

SCHEME OF EXAMINATION:-

- The examination shall be conducted at the end of each term for semester pattern.
- The Theory paper shall carry 40 marks.
- The evaluation of the performance of the students in theory papers shall be on the basis of Semester Examination of 40 + 10 marks.
- Question Paper will be set in the view of the /in accordance with the entire Syllabus and preferably covering each unit of syllabi.

STANDARD OF PASSING: - As Prescribed under rules & regulation for each degree.

NATURE OF QUESTION PAPER AND SCHEME OF MARKING:

(Unit wise weightage of marks should also be mentioned)

- Q. 1. Multiple choices questions (8-questions) 08 Marks
- Q.2. Attempt any two of the following. (Essay type/Broad answer questions) 16 Marks
- Q.3. Write short notes (any four) 16 Marks

EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS) (Introduced from the academic year June- 2024)

Old Syllabus (Semester pattern)		Revised Syllabus (Semester pattern)	
PAPE R NO.	TITLE OF THE PAPER	PAPER NO.	TITLE OF THE PAPER
Semester III		Semester III	
V	Biomedical Aspects of Pollution	V	Biomedical Aspects and Food safety
VI	Environmental Legislation	VI	Environmental Management and Legislation
Semester IV		Semester IV	
VII	Monitoring and Recycling of Pollution	VII	Industrial Monitoring and Recycling of Pollution

VIII	ISO and Environment safety	VIII	ISO and Environment safety
------	----------------------------	------	----------------------------

Course Outcomes (CO'S)

DSE E : Paper-V

1. To introduce the concepts of aerobiology.
2. To educate the students about biomedical aspects of pollution.
3. To educate the students about food safety.
4. To aware about pathogenic waterborne diseases.
5. To educate the students about water pollution indicators

DSE E : Paper-VI

1. To aware the students about Environmental Management.
2. To aware the students about Environmental Legislation act to control pollution.
3. To create awareness about NOC.
4. To educate students about role of various agencies involved in monitoring and controlling pollution.
5. To educate students about role of MPCB and CPCB.

DSE F: Paper-VII

1. To give knowledge to student about Monitoring and Recycling of Pollution.
2. To educate students about role of aquatic plants used in pollution treatment.
3. To aware students about Environmental Impact Assessment and Environmental Audit.
4. To aware the students about use of low cost pollution methods.
5. To give knowledge to student about need of EIA process.

DSE F: Paper-VIII

1. To understand of ISO standards and Environment safety measures.
2. To create awareness about role of safety management in industries.
3. To give knowledge about disaster management for students.
4. To educate the students for safety management.
5. To aware the students about environmental disasters.

SEMESTER-V

B. Sc. Part-III BOTANY

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10

PAPER IX: DSE-E 25

REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

Module No.	Module	Sub-module	Periods Allotted
1	Organization of flower	1.1: Concept of flower as a modified Shoot (stem nature of thalamus and leaf nature of floral leaves), structure of typical flower. 1.2: Structure of a typical stamen, Structure of a tetrasporangiate anther and pollen grain. 1.3: Structure of a typical carpel, Structure of a typical ovule and its types.	10

<p style="text-align: center;">2</p>	<p style="text-align: center;">Pollination and Fertilization</p>	<p>2.1: Definition, types and mechanism in Anemophily (<i>Zea mays</i>), Entomophily (<i>Calotropis</i>) and Hydrophily (<i>Vallisneria</i>)</p> <p>2.2: Microsporogenesis, pollen germination and development of male gametophyte</p> <p>2.3: Megasporogenesis, development and structure of embryo sac: Monosporic and Bisporic.</p> <p>2.4: Fertilization: Entry of pollen tube, double fertilization and triple fusion. Significance of double fertilization.</p>	<p style="text-align: center;">10</p>
<p style="text-align: center;">3</p>	<p style="text-align: center;">Embryo and Endosperm Development</p>	<p>3.1: Structure of dicot and monocot embryo in angiosperm.</p> <p>3.2 Development of endosperm and types of endosperms (Nuclear, Helobial and Cellular)</p> <p>3.3: Polyembryony: Introduction, Types of polyembryony- True polyembryony (Cleavage and Adventive), False polyembryony. Causes of polyembryony, Significance of polyembryony.</p> <p>3.4: Apomixis: Introduction, Causes of apomixes and Types: Gametophytic and Sporophytic, Significance of apomixis.</p>	<p style="text-align: center;">10</p>

SEMESTER- V

B. Sc. Part-III BOTANY

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10

PAPER X: DSE-E 26

PLANT METABOLISM AND STRESS BIOLOGY

Module No.	Module	Sub-module	Periods Allotted
1	Plant water relationship	<p>1.1: Introduction, Physiological importance of water.</p> <p>1.2: Water transport process: Mechanism of water absorption: active and passive absorption theories, water transport through xylem and tracheid.</p> <p>1.3. Translocation in the phloem: Experimental evidence showing phloem as a site of sugar translocation, Pressure flow model, Phloem loading and unloading, Source sink relationship</p> <p>1.4: Transpiration: Definition, Types of transpiration, Mechanism of stomatal movement, Starch-sugar hypothesis, Factors affecting transpiration, Significance of transpiration.</p>	10

2	Mineral nutrition	<p>2.1: Introduction, Macro and Micronutrients</p> <p>2.2: Criteria of essentiality</p> <p>2.3: Mineral nutrient uptake- Passive uptake (Diffusion), Active uptake (Carrier Concept)</p> <p>2.4: Role and Deficiency Disorders of Macronutrients (P, K, Ca, Mg) and Micronutrients (Fe, Mn) in plants and its recovery.</p>	10
3	Stress Biology	<p>3.1: Defining plant stress, Acclimation and adaptation.</p> <p>3.2: Biotic factors (Pathogenesis– related (PR)</p>	10

Syllabus for Pollution

SEMESTER-V

DSE E : Pollution V: Biomedical Aspects and Food Safety

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK- LECTURE HOURS: 2. PER WEEK, MARKS:40

1	Aerobiology:- Air Microbiology: Definition, sources of microorganisms in air, beneficial and harmful effect of air micro-organism aeroallergens, air borne diseases Enumeration method of micro-organism in air (microscopic method) microbes in air	7
2	Water Microbiology: - Sources of microorganism, significance of fecal contamination and bacteriological analysis of water, Water- borne diseases. Algae causing problems in water treatment, control measures	8
3	Pollution Indicators:- Organisms in water (bacteria, protozoans, algae, and higher organisms); Pollution indices for measurement of water pollution; Algal indicators of pollution, Toxic algae	6
4	Introduction to Food and safety: – Definition, Quality of food, Factors affecting on food safety, Importance of food safety, Food hazards and control measures	5

5	Management of Food Hazards:-Need, Control of Parameters, Food Storage, Personnel I Hygiene and Sanitation	4
---	---	---

SEMESTER-V

DSE E : Pollution VI: Environmental Management and Legislation

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK- LECTURE HOURS: 2.4 PER WEEK, MARKS: 40

1	Environmental Management:-Definitation, Objectives, Components, Principle and importance of Environmental management, Earth summit 1992 the Rio declaration on environment & development, earth agreement, monitor protocol & carbon Credits, Agenda 21	7
2	Role of various agencies in monitoring and control of pollution: Ministry of Environment and Forests, NEERI, WHO, UNEP, WWF	5
3	Environmental legislation in India: National Forest policy 2006; Wildlife Protection Act, 1972; Hazardous Waste Management and Handling Rules, 1989, Motor vehicle act 1988, The biological diversity act 2002	4
4	Environmental Clearance for Industrial Projects: Need and procedures for obtaining, Environmental Clearance from State and Govt Ministry of Environment and Forests	7
5	Functions of State and Central Pollution Board Pollution, Activities and Achievements of MPCB	4

SEMESTER- VI

B. Sc. Part-III BOTANY

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10

PAPER XIII: DSE-F 25

PLANT BIOCHEMISTRY AND RESEARCH METHODOLOGY

Module No.	Module	Sub-module	Periods Allotted
1	Carbohydrate Metabolism	1.1: Introduction, Classification of Carbohydrates; Properties of Monosaccharides - Pentose / Hexose 1.2: Properties of Oligo saccharides Sucrose / Lactose. 1.3: Properties of Polysaccharides -Starch and Cellulose 1.4: Biosynthesis and degradation of starch and Sucrose 1.5: Significance of Carbohydrates.	10
2	Lipid Metabolism	2.1: Introduction, classification of lipids; Saturated fatty acids- properties and examples-Stearic and Palmatic acid. 2.2: Unsaturated fatty acids- properties and examples- Linoleic and Linolenic acids. 2.3: General out-line of fatty acid biosynthesis. 2.4: Significance of lipids	10

3	Research methodology	<p>3.1: Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative).</p> <p>3.2: Literature-review and its consolidation; Library research; field research; laboratory research.</p> <p>3.3: Outline of Research paper writing; Power point presentation; Poster presentation; plagiarism</p> <p>3.4: Techniques of Micrometry and Photomicrography</p>	10
----------	-----------------------------	--	-----------

SEMESTER- VI

B. Sc. Part-III BOTANY

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK, MARKS: 40 + 10

PAPER XIV: DSE-F 26

NATURAL RESOURCE MANAGEMENT AND HERBAL TECHNOLOGY

Module No.	Module	Sub-module	Periods Allotted
1	Natural Resource management	<p>1.1: Natural resources: Definition and types; sustainable utilization and management of land and water.</p> <p>1.2: Biological Resources: Major and minor forest products; Depletion; Management.</p> <p>1.3: Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Carbon credit, Resource accounting (Green audit)</p>	10

<p style="text-align: center;">2</p>	<p style="text-align: center;">Herbal medicines</p>	<p>2.1: Definition, Importance of herbal medicines</p> <p>2.2: Identification, authentication, collection, processing and storage of medicinal plants.</p> <p>2.3: Introduction to general methods of extraction, isolation of phytoconstituents.</p> <p>2.4: Medicinal uses of <i>Tinospora cordifolia</i>, <i>Aloe vera</i>, <i>Withania somnifera</i>, <i>Embllica officinalis</i>.</p> <p>2.5: Adulteration of drugs of natural origin: Evaluation by morphological and Chemical methods.</p>	<p style="text-align: center;">10</p>
<p style="text-align: center;">3</p>	<p style="text-align: center;">Herbal Technology</p>	<p>3.1: Applications of herbs in cosmetics: Shampoo (<i>Sapindus laurifolius</i>, <i>Acacia concinna</i>), hair dye (<i>Lawsonia inermis</i>)</p> <p>3.2: Facemask (<i>Santalum album</i>), bath oil (<i>Rosa indica</i>), perfume (<i>Jasminum sambac</i>).</p>	<p style="text-align: center;">10</p>

SEMESTER-VI

DSE F : Pollution VII:Industrial Monitoring and Recycling of Pollution

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK- LECTURE HOURS: 2.4 PER WEEK, MARKS: 40

1	Wastewater characterization & Treatment of sewage: Elementary knowledge of flow measurement; Process of sampling and characterization of effluents in industries, Primary and secondary treatment (activated sludge and trickling filters); Organisms associated with secondary treatment; Septic tanks; Stabilization ponds; Oxidation ditch; Sludge digestion	12
2	Monitoring and Control of water pollution: Characteristics and treatment of wastewater from dairy, sugar mills and distilleries.	6
3	Low-cost treatment methods: Use of aquatic plants; land application of wastewaters for irrigation.	6
4	Air pollution control and monitoring: Method of sampling analysis with CPCB standard, Control of air pollution in thermal power plants and cement industries; Use of green belt.	7
5	Environmental Impact Assessment and Environmental Audit: Concept and Process	7

DSE F : Pollution VIII: ISO and Environment safety

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK- LECTURE HOURS: 2.4 PER WEEK, MARKS: 40

1	Definition of ISO, Overview of ISO, types of certificates, ISO 14001-2015 based EMS and EMS standards	7
2	Introduction to safety, Occupation health and safety, management system, definition, goals, need, principles and practices of Industrial safety	9
3	Industrial safety and policy formulation; concept and importance of safety audit, accidental reporting, emergency evaluation plan, principle of accidents prevention	9
4	Fire safety management; chemistry of fire, factors to towards fire, common causes of fire, prevention of fire, portable fire extinguisher (water type, CO ₂ , foam type, Chemical type)	8
5	Management information system; sources of information on safety, health & environment protection, analysis and use of modern method of programme, health & environment	7
6	Disaster management of tsunami, drought, landslide	5

Practical Course –I

1	Preparation of nutrient agar medium	1
2	Settling rate of bacteria from air	(2-3)
3	Bacterial Gram staining	4
4	Identification of bacteria from air up to colony characteristics	(5-6)
5	Enumeration of bacteria from air	(7-8)
6	Study of collection, concentration and preservation techniques of algae	(9-10)
7	Identification techniques of algae (Study of morphological characteristics of algae	11
8	Identification and significance of following algae with regard to pollution	(12-18)

I. Chlorophyceae

1. *Scenedesmus*
2. *Chlorella*
3. *Pediastrum*
4. *Eudorina*
5. *Pandorina*
6. *Cosmarium*

II. Cyanophyceae

7. *Merismopedia*
8. *Microcystis*
9. *Anabaena*
10. *Oscillatoria*
11. *Spirulina*

III. Bacillariophyceae

12. *Melosira*

13. *Synedra*

14. *Navicula*

15. *Nitzschia*

IV. Euglenophyceae

16. *Euglena*

17. *Phacus*

18. *Pediastrum*

9	Calculation of Palmer's Algal Genus Index	19
10	Calculation of Nygaard's Indices	20
11	Calculation of species diversity from the given data	21
12	Calculation of Margalef diversity index	22
13	Calculation of Kothe's species deficit index	23
14	Estimation of Standard Plate Count (SPC) from water	24-25
15	Estimation of MPN of coliforms from water	26-28

Practical Course –II

1	Determination of phosphate levels in clean and polluted waters	29
2	Determination of pH of soil	30
3	Determination of organic matter in soil	31
4	Study of process and mechanism of fire safety equipments	32-33
5	Study of personal protective equipment's	34
6	Study of treatment efficiency of water-hyacinth in removal of TDS and changes in pH	35-38
7	Study of a biogas plant	39
8	Visit to wastewater and drinking water treatment plants under short tours and long tours	40-42
9	Study of a vermicomposting plant	43
10	Calculation of SAR, % sodium and RSC values from the given data	44
11	Project work on some environmental aspect*	45-46
	* = One project can be shared maximum by two students	

Shivaji University, Kolhapur

B. Sc. III Botany (CBCS Syllabus)

Practical I

(Based on Paper IX and Paper XIV)

1. Study of primitive characters of flowers of angiosperms (As per Randalian Concept).

2. Study of T.S. of a typical tetrasporangiate anther (*Datura sp.*, *Ipomoea sp.*, *Catharanthus sp.* or any suitable material).
3. To calculate the pollen germination percentage by hanging drop method.
4. Study of pollen viability with any suitable method.
5. Study of structure of dicot/monocot embryo with the help of photograph/model/staining method.
6. Study of types of ovules in angiosperms.
7. Study of types of endosperms in angiosperms.
8. Estimation of carbonates and bicarbonates from polluted and non-polluted water samples.
9. & 10. Estimation of BOD, COD and DO from polluted and non-polluted water samples.
11. Study of morphology, source, identification characters and uses of major forest products (Tannin: *Terminalia chebula*; Vit. C: *Emblica officinalis*, Dye: *Bixa orellana*; Timber: *Tectona grandis*).
12. Study of morphology, source, identification characters and uses of minor forest products (Saponin: *Senegalia concinna* ≡ *Acacia concinna*; Gum: *Vachellia nilotica* ≡ *Acacia nilotica*; Khair: *Senegalia catechu*; Jute: *Agave sp.*).
13. Herbal Preparations of Churn (Triphala Churna) and Kadha/Decoction (Adulsa)
14. Herbal Preparations of Hair oil (Maka) and Shampoo (Ritha, Shikakai).
15. Morphological/Biochemical test for drug adulteration of:
 - a) **Biochemical:** Haladi (*Curcuma longa* + *Zea mays*); Coconut (*Cocos nucifera* + *Solanum tuberosum*).
 - b) **Morphological:** Mustard (*Brassica juncea* + *Argemone mexicana*); Saffron (*Crocus sativus* + *Syzygium cumini*)
16. Analysis of Carbon sequestration of standing trees.
17. Study of remote sensing technique with the help of satellite images.
18. & 19. Study of morphology, source and uses of *Tinospora cordifolia*, *Aloe vera*, *Withania somnifera*.
20. Visit to Herbal cosmetics industry/Pharma industry or Institute (Separate handwritten report to be submitted by student).

Shivaji University, Kolhapur

B. Sc. III Botany (CBCS Syllabus)

Practical II

(Based on Paper X and Paper XIII)

1. Demonstration of endosmosis and exosmosis.
2. Demonstration of ascent of sap in plants.
3. Study of structure of stomata of healthy and stressed plant.

4. Determination of stomatal density.
5. Study of stomatal and cuticular transpiration by Cobalt chloride paper method.
6. & 7. Study of role and deficiency symptoms of Phosphorus, Potassium, Calcium, Magnesium, Iron and Manganese.
8. Estimation of proline from plant material.
9. Estimation of polyphenols from plant material.
10. To study the effect of salinity on seed germination.
11. Determination of Fatty acid value of oil sample.
12. Qualitative test for sugar in plant material.
13. Qualitative test for Starch and cellulose in plant material.
14. Qualitative test for protein.
15. Qualitative test for Lipids.
16. Identification of Sugars by circular paper chromatography.
17. To study the writing skill of a research article (Outline of Manuscript).
18. Micrometry techniques.
19. Study of Photomicrography techniques.
20. Preparation and presentation of poster on any topic (should be presented at the time of examination).

Study Tour

A study tour of at least a week long duration should be undertaken to visit places like Industries, Research Institutions, R&D Departments, Pollution Control Boards, NEERI Laboratories, Academic Institutions, Natural and polluted areas, Mining areas, areas of environmental interest, etc.

Instructions for Practicals and Study Tours:

- A. Every candidate/student must have recorded his/her observations on the above practicals in the laboratory Journal and written report on each exercise performed. Such journal is to be checked regularly and signed by a teacher in-charge. The Head of Department has to certify the same stating that the student has completed in a satisfactory manner the practical course as recommended by the Board of Studies and the Journal has been properly maintained throughout the year.
- B. Candidates shall be required to submit the following at the time of practical examination.
 - a. Certified laboratory Journal
 - b. Tour Report
- C. The candidates shall be orally examined (Viva-voce) for tour report, project work and other knowledge they gained of the subject during theory and Practicals. Distribution of marks for practical shall be 50 marks for each practical (Total 100 for Practical-I + Practical-II) as per the following scheme.

List of Recommended Books for B.Sc (III) Pollution

1. Agarwal, A. State of India's Environment: A Citizens Report, Centre for Science and Environment, New Delhi

2. APHA, Standard Methods for Examination of Water and Wastewater. American Public Health Association, New York
3. Arceivala, S.J. Wastewater Treatment and Disposal, Marcel Dekker Inc, New York (1981)
4. Besselivere et al. The Treatment of Industrial Waters, McGraw Hill Kogakusha (1978).
5. Bhide and Sundaresan, B.R. Solid Waste Management in India, NEERI, Nagpur.
6. Bockris, J.O.M. Environmental Chemistry, Plenum Press New York, U.S.A. (1978)
7. Brock, T.D. Microbial Ecology, Prentice Hall, England (1966)
8. Darlington, A. Ecology Refuse Tips. Heinemann Educational Books Ltd., London (1968).
9. Environment and Pollution – Dr. N. Arumugm , Prof. V. Kumarresan – Saras Publication
10. Environmental education – Mahip Singh DPA publishing house Delhi
11. Environmental Science – S. C. Santra 2001 New Central Book Agency P Ltd. 12.Environmental science student Companion – Kenneth Gregroy
13. Environmental Studies – P. D. Sharma
14. Environmental Studies –D. L. Manjunath – 2006 Pearson Publisher
15. Frolien and Cigie, (ed.) Encyclopedia of Environmental Science and Ecology Part-I and II.
16. Gar, N. Irving (ed.) Industrial Pollution, Van NostrandReinhod, New York.
17. Goel, P.K. and Sharma, K.P. Environmental Guidelines and Standards in India. Technoscience Publications, Jaipur (1996).
18. Goel, P.K. Water Pollution: Causes, Effects and Control. New Age International, Publishers, New Delhi (2006)
19. Gopal B. and Sharma, K.P.: Water-hyacinth, Hindasia Publishers, Delhi (1961)
20. Industrial Waste water treatment – A. D. Patwardhan – PHI learning 2017
21. Khoshoo, T.N. Environmental Concepts and Strategies, Ashish Publishing House, New Delhi (1984).
22. Liptak, B.G. Environmental Engineers Handbook, Vol. I. Air Pollution, Chilton Book Company, Pennsylvania, USA.
23. Liptak, B.G. Environmental Engineers Handbook, Vol. II. Water Pollution, Chilton Book Company, Pennsylvania, USA.
24. Liptak, B.G. Environmental Engineers Handbook, Vol. III. Land Pollution, Chilton Book Company, Pennsylvania, USA.
25. Mahida, U.N. Water Pollution and Disposal of Wastewater on LandTata McGraw Publishing Co. Ltd., New Delhi, 1981.
26. Metcalf and Eddy, Inc. Wastewater Engineering: Treatment Disposal, Reuse, Tata McGraw Hill Edition, New Delhi.
27. Mishra, P.C. and Trivedy, R.K. (ed.) Ecology and Pollution of Indian Lakes and Reservoirs, Ashish Publishing House 1993. pp. 450
28. Nemerow, N.L. Industria Water Pollution: Origins, Characteristics and Treatment, AddisonWesley Publishing Co., Inc. Philipines, 1971.

29. Text book of Environmental Studies for undergraduate courses – ErachBharucha Universities Press, Hyderabad
30. Tilak, S.T. Aerobiology, VaijyantaPrakashan, Aurangabad.
31. Trivedy, R.K. (ed.) Advances in Environmental Pollution and Control (Vo. I & II). EnviroMedia, 1995. Pp. 300.
32. Trivedy, R.K. (ed.) River Pollution in India, Ashish Publishing House, 1990. Pp. 300
33. Trivedy, R.K. and Goel, P.K. (ed.) Current Pollution Research in India Environmental Publications, 1985. Pp. 350.
34. Trivedy, R.K. and Goel, P.K. An Introduction to Air Pollution, Technoscience Publications, Jaipur, 1995. Pp-300.
35. Trivedy, R.K. and Goel, P.K. Chemical and Biological Medhods for Water Pollution Studies. Environmental Publications, 1986. Pp. 250.
36. Trivedy, R.K. and Sinha, M.P. (ed.) Impact of Mining on Environment, Ashish Publishing House, 1991. Pp-300.
37. Trivedy, R.K. Encyclopedia of Environmental Pollution and Control (Vol. I & II). Enviro-Media, 1995, pp. 300.
38. Trivedy, R.K. Handbook of Environmental Laws, Acts. Rules, Guidelines, Compliances and Standards Vol. I & II) Environmental Media, 1997. pp-1000.
39. Venkatraman, G.S., Algae: Fonn and Function IARI, New Delhi.
40. W.H.O. Health Hazards of Human Enviornment. WHO, Geneva.
41. W.H.O. Water Pollution Control in Developing Counties, WHO, Geneva 42.Waste water treatment – M. N. Rao, S.C. Dutta – Oxford & IB Publisher
