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# UNIVERSITY OF MYSORE

Estd. 1916

**VishwavidyanilayaKaryasoudha**
**Crawford Hall, Mysuru- 570 005**

No.AC2(S)/151/2020-21 Dated: 01.09.2023

## Notification

**Sub:-** Syllabus and Scheme of Examinations of Environmental Science (UG) (V & VI Semester) with effect from the Academic year 2023-24.

**Ref:-** 1. This office letter No: AC6/303/2022-23 dated: 28-07-2023.

2. Decision of BOS in Environmental Science (UG) meeting held on 29-08-2023.

*****

The Board of Studies in Environmental Science (UG) which met on 29-08-2023 has resolved to recommended and approved the syllabus and scheme of Examinations of Environmental Science programme (V & VI Semester) with effect from the Academic year 2023-24.

Pending approval of the Faculty of Science & Technology and Academic Council meetings the above said syllabus and scheme of examinations are hereby notified.

The syllabus and scheme of Examinations contents may be downloaded from the University website i.e., www.uni-mysore.ac.in.

Registrar
University of Mysore
Mysore

**Registrar**

**To:-**

1. All the Principal of affiliated Colleges of University of Mysore, Mysore.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS, in Environmental Science, Manasagangothri, Mysore.
4. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
5. The Director, PMEB, Manasagangothri, Mysore.
6. Director, College Development Council , Manasagangothri, Mysore.
7. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
8. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
9. Office Copy.

**GOVERNMENT OF KARNATAKA**

# Report on

## Proposed Curricular Framework for Under graduate Programme in Universities of Karnataka State in

# ENVIRONMENTALSCIENCE

*Submitted to*

**Karnataka State Higher Education Council Government of Karnataka**
**Bengaluru**

**June2023**

# GOVERNMENTOFKARNATAKA

## Reporton

# Proposed Curricular Framework for Undergraduate Programme in Universities of Karnataka State

# in

# ENVIRONMENTALSCIENCE

**Submittedby**


| | |
|---|---|
| **Dr.N.Nandini**<br>**Chairperson, Subject ExpertCommittee - Environmental Science,**Professor, Dept. of Environmental Science,Bangalore University,Bengaluru. | **Smt. Akshatha Chandra, G. M**<br>**Member Convenor,**<br>**Subject Expert Committee-Environmental Science**<br>Special Officer, Karnataka State Higher Education Council Bengaluru and Coordinator, Environmental Science Committee |

**and**

**Members of Subject Expert Committee-Environmental Science**

1. **Dr.N.S.Raju**, Professor, Department of Studies in Environmental Science, University of Mysore, Mysuru.
2. **Dr. K. L. Prakash**, Professor, Department of Environmental Science, Bangalore University, Bengaluru.
3. **Dr. S. Suresha**, Professor, Department of Environmental Science, Yuvaraja's College(Autonomous), University of Mysore,Mysuru.
4. **Dr.B.S.Prabhakar,**Associate Professor, Department of Environmental Science, St.Joseph's University, Bengaluru.


**June2023**

# PREFACE

Education empowers life and life systems. A holistic education paradigm will effectively focus on developing knowledge, employable skill sets, appropriate attitudes and an overall personality. A graduate is the one who acquires the following attributes and employs them to benefit societies.

- Skills of identifying a problem and factors responsible for the problem
- Acquires and appreciates problem solving skills
- Logically employs problem solving tools, spatially and temporally
- Identifies timely needs of the community and contributes to them
- Works towards creating employment opportunities and work domains for different skill sets and knowledge disciplines
- Blends with various social and economic situations making life happier for the self and of the communities
- Envisages and employs various attitudes and skill sets for the betterment of the Nation, blending local and regional variations

Environmental Science is adomain which seamlessly connects the sciences withday-to-day societal demands. Proposing and developing a curriculum for the subject of Environmental Science is unique in many ways.Mank in disfacing serious environmental issues like climate change,desertification, deforestation, pollution, solid waste generation, natural and man-made disasters.

Improving the quality of life is a process of development which includes teaching, training and instruction. A competent subject expert committeewasconstitutedbyKarnatakaStateHigherEducationCouncil,Government of Karnataka to achieve these objectives. The assigned task of this committee was to design curriculum structure for both

- ✓ Under-Graduate and Post-Graduate programmes of Environmental Science
- ✓ Environmental Studies–SEC for all Under-Graduate courses

The proposed curricular framework designed by this committee was headed by me with Eminent Educationalists in the field of Environmental Science.

| SUBJECTEXPERTCOMMITTEE–ENVIRONMENTALSCIENCE | | |
|---|---|---|
| **Name** | **Designation and address** | **Position** |
| **Dr.N.Nandini** | Professor<br>Department of Environmental Science,<br>Bangalore University,Bengaluru | Chairperson |
| **Dr.N.S.Raju** | Professor<br>Department of Studies in Environmental Science, University of Mysore, Mysuru | Member |
| **Dr.K.L.Prakash** | Professor<br>Department of Environmental Science,<br>Bangalore University, Bengaluru | Member |
| **Dr.S.Suresha** | Professor and Head<br>Department of Environmental Science,<br>Yuvaraja's College (Autonomous)<br>University of Mysore, Mysuru | Member |
| **Dr.B.S.Prabhakar** | Associate Professor<br>Department of Environmental Science,<br>St.Joseph'sUniversity,Bengaluru | Member |
| **Smt. AkshathaChandra, G.R.** | Special Officer<br>Karnataka State Higher Education Council, Government of Karnataka | Member Convenor |

The Chairpersons of Board of Studies, Board of Examiners (Environmental Science) and Subject experts teaching under-graduate and post-graduate courses of various Universities in the State of Karnataka, who have participated active lyin this process are-**Dr.N.S.Raju**,Professor,Department of Studies in Environmental Science, University of Mysore, Mysuru; **Dr. B. S. Prabhakar**, Associate Professor, St.Joseph's University, Bengaluru; **Dr.J.Narayana**, Professor, Department of Environmental Science, Kuvempu University, Shankaraghatta; **Dr.K.L.Prakash**, Professor, Department of Environmental Science, Bengaluru University, Bengaluru; **Dr. G. V. Venkataramana**, Professor, Department of

Studies in Environmental Sciences, University of Mysore, Mysuru;**Dr. S. SrikantaSwamy**,Professor,DepartmentofEnvironmentalScience,UniversityofMysore,Mysuru;**Dr. Yogendra, K.,** Associate Professor, Department of Environmental Science, Kuvempu University, Shankaraghatta; **Dr.Prakash Kariajjanavar**, Assistant Professor, Department of Environmental Science, Gulbarga University, Kalaburagi; **Dr. B.C.Nagaraja**,Professor, Department of Environmental Science, Bengaluru University, Bengaluru; **Dr. J. S.Chandrashekar**, Assistant Professor, Department of Environmental Science, Karnataka State Open University, Mysuru; **Dr. T. S. Harsha**, Assistant Professor, Department of Environmental Science, Karnataka State Open University, Mysuru; **Dr. Basavarajappa,S.H.,** Assistant Professor, Department of Environmental Science, Kuvempu University, Shankaraghatta; **Dr.M.R.EbenezerWilson**, Associate Professor, St. Joseph's College (Autonomous), Bengaluru; **Dr. HelenRoselene**,AssociateProfessor,DepartmentofEnvironmentalScience,MountCarmel College (Autonomous), Bengaluru; and **Dr. K. Harish Kumar**, Assistant Professor, Department of Environmental Science, Government First Grade College, Hosakote; **Dr.Kumar,M**., Faculty, Department of Environmental Science, Bangalore University, Bengaluru; **Dr.AlaknandaJ.Adur**, Assistant Professor, St. Joseph's University, Bengaluru, Bengaluru; **Dr. M. Raghavendra, Sri.S.NiranjanKumar, Smt. NeethiNair** and **Sri.Vishnu,H.V.,** from Department of Environmental Science, Bangalore University, Bengaluru. This work progressed under the guidance of **Shri. L. S. Ramesh and Dr. Jayappa, M.,** Special Officers, Karnataka State Higher Education Council, Government of Karnataka, initially and later steered by **Smt. Akshatha Chandra, G. R.,** Special Officer,Karnataka State Higher Education Council, Government of Karnataka.

The valuable support from subject experts **Dr. B. S. Prabhakar**, Associate Professor and Head, Department of Environmental Science, St.Joseph's University, Bengaluru and **Dr.Kumar,M**.,Faculty, Department of Environmental Science, Bangalore University, Bengaluru, in compiling there port and overall editing is appreciated.

I take this opportunity to express my gratitude to the authorities of

Karnataka State Higher Education Council, Government of Karnataka for giving us an opportunity to be a part of curriculum framework design.

**Prof.N.Nandini**

Chairperson
Subject Expert Committee – Environmental Science
Karnataka State Higher Education Council
Government of Karnataka

# MODELCURRICULUM

Name of the Degree Programme: **B.Sc.(Basic/Hons.)**

Discipline Core: **Environmental Science**

Total Credits for the Programme: **193**

Startingyearofimplementation:**2021-22**

ProgrammeOutcomes:

By the End of the Programme the students will be able to develop:

1. Disciplinary knowledge in fields related to Environmental Science
2. Systemic and critical thinking with reference to environment-people-economic-development attributes
3. Problem identification skills and sustainable solution provisioning
4. Analytical reasoning and appropriate interpretation skills
5. Self-directed learning efficiencies leading to a productive lifelong learning process
6. Research-related skills such as review of literature, design of experiments, statistical competence, report writing and prepare target specific communication packages
7. Cooperation/Teamwork
8. Reflective thinking
9. Multidisciplinarycompetencecateringtoenvironmentalsustainability

Assessment:

Weightageforassessments(inpercentage)

| TypeofCourse | FormativeAssessment/IA | SummativeAssessment |
|---|---|---|
| Theory | **40** | **60** |
| Practical | **25** | **25** |
| Project/Experiential Learning (Internshipetc.) | **Report=50**<br>- Relevance of the topic=05<br>- Robustness of literature review = 10<br>- Appropriateness of Methodology=10<br>- Results, Discussion and Interpretation=20<br>- Referencing and citation=05 | **Viva-voce=50**<br>- Presentation skills= 25<br>- Question answer=25 |

## PROPOSEDCURRICULUMSTRUCTUREFORUNDERGRADUATEENVIRONMENTALSCIENCEDEGREEPROGRAMME

B2.Curriculum and Credit Frame work for Under graduate Programme with two cores ubjects with practicals (SayA&B) in the first two years, and two theory and two practical's papers in each core subjects in 3rdyear.

| Sem. | Discipline Specific-Core(DSC),Elective(DSE) Courses (Credits)(L+T+P) | Minor/Multidisciplinary/ Open Elective (OE)Courses(Credits)(L+T+P) | Ability Enhancement Courses (AEC)(Credits) (L+T+P)(Languages) | Skills Enhancement Courses (SEC) (Credits) (L+T+P)/Value Added Courses(Credits)(L+T+P)(common for all UG Programs)/Summer Internship. | | Total Credits |
|---|---|---|---|---|---|---|
| I | DSCEnv.Science -A1(4),A2(2) Other Core-B1(4),B2(2) | OE-1 (3) | L1-1(3),L2-1(3) (4hrseach) | **SEC-1**: Digital Fluency(2)(1+0+2)/ Env. Studies (3) | Health,Wellness&Yoga(2)(1+0+2) | 25/26 |
| II | DSCEnv.Science -A3(4),A4(2), Other Core-B3(4),B4(2) | OE-2 (3) | L1-2(3),L2-2(3) (4hrseach) | Env.Studies(3)/SEC-1: Digital Fluency(2)(1+0+2) | Sports/NCC/NSS/R&R(S&G)/Cultural(2)(0+0+4)/SEC(2) | 26/25 |
| Students exiting the programme after securing 46 credits will be awarded UG Certificate in Disciplines A and B provided they secure 4 credits in work based vocational courses during summer term or internship/Apprenticeship in addition to 6 credits fromskill-basedcoursesearnedduringthefirstyear. | | | | | | |
| III | DSCEnv.Science -A5(4),A6(2), Other Core-B5(4),B6(2) | OE-3 (3)/ India andIndianConstitution(3) | L1-3(3),L2-3(3) (4hrs. each) | **SEC-2**: AI/FinancialEdu. & Inv. Aw. (2)(1+0+2) | Sports/NCC/NSS/R&R(S&G)/Cultural(2)(0+0+4)/SEC(2) | 25 |
| IV | DSCEnv.Science -A7(4),A8(2), Other Core-B7(4),B8(2) | IndiaandIndian Constitution (3) / OE-3(3) | L1-4(3),L2-4(3) (4hrs. each) | **SEC-3**: Financial Edu. &Inv.Aw./AI(2)(1+0+2) | Sports/NCC/NSS/R&R(S&G)/Cultural(2)(0+0+4)/SEC(2) | 25 |

| |
|---|
| Studentsexitingtheprogrammeaftersecuring92creditswillbeawardedUGDiplomainDisciplinesAandBprovidedtheysecureadditional4creditsinskillbasedvocationalcoursesofferedduringthefirst- orsecond-yearsummerterm. |

| | | | | | | |
|---|---|---|---|---|---|---|
| V | DSCEnv.Science-<br>A9(4),A10(2),<br>A11(4),A12(2), | | | **Employability skill**<br><br>SEC-4: Integrated Solid Waste Management (2+2) | | 24 |
| VI | DSC Env. Science<br>A13(4),A14(2),<br>A15(4),A16(2), | | | Internship(2) | | 24 |
| Students exiting the programme after 3-years will be awarded UG Degree in Discipline A with Discipline B as Minor upon securing 136 credits and satisfying the minimum Credit requirements under each category of courses prescribed. | | | | | | |

Note:*L+T+P=Lecturing in Theory+Tutorial+Practicals.

*Inlieuoftheresearchproject,twoadditionalelectivepapers/Internshipmaybeoffered

Numbers in the parenthes is refer to credits.

**CURRICULUMSTRUCTUREFORTHEUNDERGRADUATEDEGREEPROGRAMME-B.Sc.INENVIRONMENTALSCIENCE**

Total Credits for the Programme:**193**

Starting year of implementation:**2021-2022**

Name of the Degree Programme: **B.Sc.(Basic/Hons.)**

Discipline/Subject: **Environmental Science**

## ProgrammeArticulationMatrix

**PROPOSED CURRICULUM STRUCTURE FOR UNDER GRADUATE IN ENVIRONMENTAL SCIENCE DEGREE PROGRAMME**

**B2.CurriculumandCreditFrameworkforUndergraduateProgrammewithtwocoresubjectswithpracticals(SayA&B)inthefirsttwoyears,andtwo theory and two practicals papers in each core subjects in 3rdyear.**

| Semester | Title/Name ofthecourse&Credits | Programmeoutcomesthatthecourseaddresses(notmorethan3percourse) | Pre-requisite course(s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 1 | **DSCENVC1-T-DIVISIONSOFENVIRONMENT(4)** | Have developed knowledge and understanding of the Divisions of the Environment and able to appreciate the holistic relationship between them. | PUCorequivalentinSciencesubjects | Theoryand courseprojects | Continuous InternalAssessment (Formativeassessment)-40%.End SemesterExamination(Summative assessment)-60% |
| | **DSCENVC2-P-WATERQUALITYANALYSIS(2)** | Be able to analyse the vital physicochemicalparametersofwater,interpretandsuggestsuitabletreatmentmethods. | | Hands-on-training | |

| | | | | | |
|---|---|---|---|---|---|
| | **ES OE1-T-ENVIRONMENTALCONSERVATION MOVEMENTS(3)**<br>**OR**<br>**ES OE1-T-ENVIRONMENTALPOLLUTION(3)** | Be able to get an introductory account of the Chosen open elective paper and use the acquired knowledge in decision making and hence add to quality of life. | | Theory,case studies andself-study | |
| **Semester** | **Title /Nameofthe course** | **Programmeoutcomesthatthecourseaddresses(notmorethan3percourse)** | **Pre-requisite course(s)** | **Pedagogy** | **Assessment** |
| **2** | **DSC ENV C3-T- ECOLOGY – THEORYANDPRACTICE(4)** | Have developed sound knowledge of Basic and Applied Ecology. | **-** | Theory, case studies and Course projects | Continuous Internal Assessment (Formative assessment)-40%.<br>End Semester Examination (Summative assessment)-60% |
| | **DSCENVC4-P-ECOLOGICALANALYSIS(2)** | Be able to Identify and Enumerate Planktons, Estimate the Primary Productivity of an Aquatic Ecosystem, study the characteristics of a Biotic Community; Be able to Compute Carbon Sequestration of trees. | | Hands-on-training | |
| | **ES OE2-T-CLIMATE CHANGEANDITS IMPLICATIONS(3)**<br>**OR**<br>**ES OE2-T-ENVIRONMENT ANDPUBLIC HEALTH INCONTEMPORARYSOCIETY(3)** | Be able to get an introductory account of the Chosen open elective paper and use the acquired knowledge in decision making and hence add to quality of life. | | Theory,Case studies andSelf-study | |
| **Exitoption with Certificate in Science(51credits)** | | | | | |
| **Job opportunities for the Exit option with Certificate** | | | | | |

- Sampling Assistantinwastewatertreatmentplants
- AnalyticalAssistant/Internanalystinwatertestinglaboratories
- Laboratoryinstructorinineducationalinstitutions
- FieldTechnicianinmobileenvironmentallaboratories

- FieldTechnicianinResearchinstitutions/NGOsinvolvedinenvironmentalmonitoring/carboncreditestablishment/productivitystudies.
- Samplingandexecutionassistantinenvironmentalauditing
- Garden/nurserySupervisor/Entrepreneurship
- NGOs/Consultancyfirms
- Self-employment

| Semester | Title /Nameofthe course | Programme outcomes that the course addresses(notmorethan3percourse) | Pre-requisite course(s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 3 | **DSCENVC5-T-NATURAL RESOURCESANDMANAGEMENT(4)** | Have developed a sound knowledge and understanding of Natural Resources and Application of various management practices. | Certificate in Science with EnvironmentalScienceasasubjectandatotalcreditscoreof50 | Theory, case studies and problem solving methods | Continuous Internal Assessment (Formative assessment)-40%. End Semester Examination (Summative assessment)-60% |
| | **DSCENVC6-P-MINERALOGY, PETROLOGY, ENERGY RESOURCESANDMEDICINALPLANTS(2)** | Be able to Identify Major Rock Forming Minerals and Rocks. Learn basic skills of mapping and cartography. | | Hands-on-training and field studies | |
| | **ESOE3-T-WOMENANDENVIRONMENT(3)** **OR** **ES OE3-T-ENVIRONMENTALDISASTERS AND MANAGEMENT(3)** | Be able to get an introductory account of the Chosen open elective paper and use the acquired knowledge in decision making and hence add to quality of life. | | Theory, Case studies and Self-study | |

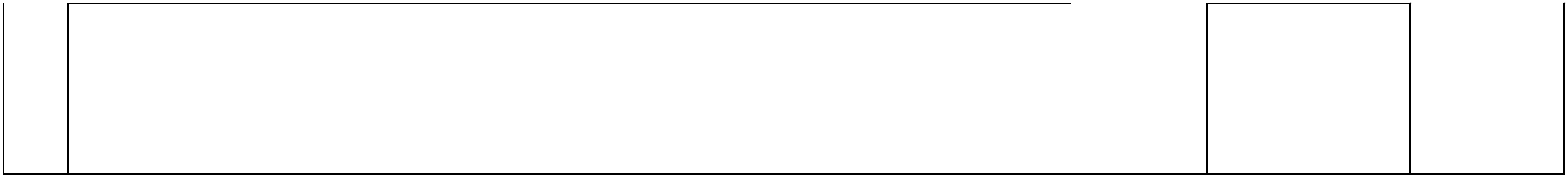
| | |
|---|---|
| | ***Note: Universities are free to opt for one of the papers among OE3OR India and Indian Constitution in third semester.**<br><br>**Universities which have chosen OE3 in third semester will offer India and Indian Constitution in the fourth semester and visa-versa.** |

| Semester | Title /Nameofthe course | Programme outcomes that the course addresses(notmorethan3percourse) | Pre-requisite course(s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 4 | **DSC ENV C7-T-BIODIVERSITY,WILDLIFEANDCONSERVATION(4)** | Have developed an understanding of the Biodiversity resources, status of wildlife, the Pressures faced by wildlife areas and cultivate an insight into the conservation practices. | ' | Theory, case studies and field studies | Continuous Internal Assessment (Formative assessment)-40%.<br>End Semester Examination (Summative assessment)-60% |
| | **DSC ENV C8-P-BIODIVERSITYASSESSMENTANDECOSYSTEMSERVICES(2)** | Be able to analyse the behaviour of local weather patterns by monitoring meteorological parameters. Develop wind and pollution roses; analyze climate maps and make interpretations.<br>Be able to execute sampling and data collection skills with reference to biodiversity and wildlife.<br>Will have an exposure to wildlife monitoring technique such as quadrats, line transects and mark-release-re capture methods. | | Data handling and Hands-on-training | |
| | **ESOE4-T- Environment and sustainable Agriculture(3)**<br>**OR** | Be able to get an introductory account of the Chosen open elective paper and use the acquired | | Theory, Case studies and Self-study | |

| | | | | | |
|---|---|---|---|---|---|
| | **ES OE4-T- INITIATIVE FOR ENVIRONMENTALMANGEMENT(3 )** | Knowledge in decision making and hence add to quality of life. | | | |
| | ***Note: Universities that have opted for one of the OE3 in the third semester will offer India and Indian Constitution in the fourth semester.**<br><br>**Universities which have chosen Indi and Indian Constitution in the third semester will offer one of the OE3 in the fourth semester.** | | | | |
| **ExitoptionwithDiplomainScience(101credits)ORChooseanyoneofthecoresubjectsasMajorandotherasMinor** | | | | | |
| **Job opportunities for the Exit option with Diploma in Science** | | | | | |
| • Procurement,processing,valueadditionandMarketingofNTFPs-Executive/Entrepreneurship<br>• ProcurementofMedicinalPlants–Marketing/Entrepreneurship<br>• Labassistantineducationalinstitutions<br>• WildlifeandEcotourismguides<br>• PublicHealth/WasteManagementAssistantsinMunicipalities<br>• Incineratoroperatorsinsmallestablishments<br>• NGOs/Consultancyfirms<br>• Self-employment | | | | | |

| Semester | Title /Name of thecourse | Programme outcomes that the course addresses(notmorethan3percourse) | Pre-requisite course(s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 5 | **DSCENVC9-T-AIRPOLLUTION,WATERPOLLUTIONANDENVIRONMENTAL ENGINEERING(4)** | Havedevelopedknowledgeandunderstandingo fAir,WaterandLand Pollutionand Application of control measures. | Diploma in Science with Environmental Science as a subject and a total credits core of 100 | Theory, Self-studyandCasestudies | Continuous internal assessment (Formative assessment)-40%. End Semester Examination(Summative assessment)-60% |
| | **DSCENVC10-P-AIRANDWASTEWATERANALYSIS(2)** | Be able to analyse vital parameters of Wastewater, interpret and suggest suitable Treatment methods, analyse vital air pollutants, interpret and suggest suitable control methods. | | Hands-on-training | |
| | **DSCENVC11-T-ENVIRONMENTAL CHEMISTRYANDINSTRUMENTATION(4)** | Havedevelopedknowledgeandskillsonch emistryofenvironmentalpollution, Principles ofchemistryemployedintreatmentandmitigati onmechanisms. Beableto understandthegoverningprinciplesofanalytical procedureslikeTitrimetry, Gravimetry,Spectrophotometry,Flame PhotometryandAtomic Absorption Spectroscopy. | | Theory, Self-studyandCasestudies | |
| | **DSCENVC12-P-SOIL ANALYSIS, NOISE MEASUREMENT AND SOLID WASTE ANALYSIS(2)** | Beabletoanalysenoiselevels,identifyandcat egorieslandpollutionandbecapableof developingasolidwastemanagementplanforur banareas. | | Hands-on-training | |
| | | | | | |

| Semester | Title /Nameofthecourse | Programme out comes that the course addresses (not more than 3 percourse) | Pre-requisite course(s) | Pedagogy | Assessment |
|---|---|---|---|---|---|
| 6 | **DSCENVC13-TENVIRONMENTALMICROBIOLOGY and BIOTECHNOLOGY (4)** | Have developed knowledge and understanding of Environmental Microbiology. | | Theory andpractices | Continuousinternalassessment(Formativeassessment)-40%. EndSemesterExamination(Summativeassessment)-60% |
| | **DSCENVC14-PENVIRONMENTALMICROBIOLOGY and biotechnology(2)** | Be able to culture and identify Bacteria and Fungi; be able to detect the faecal contamination of drinking water. | | Hands-on-trainingand practices | |
| | **DSC ENV C15-T-ENVIRONMENTALIMPACT ASSESSMENT AND RISKASSESSMENT(4)** | Have developed knowledge and understanding of various process involved in Environmental Impact Assessment, be able to employassessmenttechniquesandanalysetherepo rts.Havedevelopedknowledgetoenable Identification of risk perception and implement assessment protocols. | | Theory,Self-studyandCasestudies | |
| | **DSCENVC16-P-METHODSOFENVIRONMENTAL IMPACTASSESSMENTAND RISK ASSESSMENT(2)** | Be able to make appropriate choices of impact identification methodologies such as checklist and matrices. Be able to compile the collected data, suggest suitable amelioration measures and develop monitoring protocols. | | Hands-on-training | |
| | | | | | |



**ExitoptionwithBachelorofScience,B.Sc.DegreeinEnvironmentalScience(149credits)o**

**Job opportunities for the Exit option with Bachelor of Science Degree**

- Assistants in Central and State Pollution Control Boards
- EnvironmentalHealthandSafetyAssistantinindustries
- OccupationalHealthandSafetyAssistantinindustries/themeparks
- PublicHealth/WasteManagementOfficersinMunicipalities
- WastewaterTreatmentPlantManagers
- Environmental/ProductionQualityAssuranceExecutive-Junior
- EnvironmentalAnalyst(Validation)
- ResearchAssistant/Staff
- R&DLabAssistant
- Watertestinglabsor chemicalsuppliers/Entrepreneurship
- LiaisonOfficer
- WatershedManagementAssistant
- Mineral/EnergyResourceExplorationAssistant
- Solarenergy/alternateenergyExecutives
- MicroirrigationExecutives
- OrganicFarmingExecutives/Entrepreneurship
- NGOs/Consultancyfirms

- TeachersinSchools
- Self-employment

**SYLLABUS – Theory and Practical's for Bachelor of Science degree in Environmental Science**

**B.Sc.(Basic/Hons.) Semester5**

Title of the Course: **DSCENVC9-T-AIRPOLLUTION,WATER POLLUTION AND ENVIRONMENTAL ENGINEERING**

| Number of Theory Credits | Number of lecture hours/semester | Number of practical Credits | Number of practical hours/semester |
|---|---|---|---|
| **4** | **60** | **2** | **60** |

| **Programme Specific Objectives** | |
|---|---|
| PSO1 | To develop competency in understanding the concepts of pollution and pollutants. |
| PSO2 | To instill an introductory knowledge of engineering concepts for controlling the pollution. |
| PSO3 | To motivate and inspire to acquire contemporary understanding and skills leading to issue identification. |
| PSO4 | To develop knowledge on act and rules related to pollution. |

| **Programme Outcomes** | |
|---|---|
| PO1 | Demonstrate an entry level competence in understanding the environmental pollutants and their impacts. |
| PO2 | Demonstrate the ability to carry out air and water quality analysis in the laboratory and interpret the results. |
| PO3 | Ability to understand the harmful impact of pollutants on environment and human health. |
| PO4 | Be able to understand the existing treatment technologies and scope of developing these methods. |

| Content of Theory Course | 60 Hours |
|---|---|
| **Unit-1** | **15** |
| **Meteorology**: Definition, Significance of meteorology. Meteorological parameters:Solarradiation,Temperature,Humidity(Absolute,Specific&Relative),Windspeed&direction,Pressure and Precipitation.<br><br>**Air pollution**: Definition. Sources of air pollution (Point and non-point).Classification of air pollutants –Particulates, gaseous and aerosols.<br><br>Meteorology of air pollution: Air shed – Concept and Scope. Atmospheric stability, Temperature inversions. Plume Behavior.<br><br>Effects of air pollution on humans, plants and materials($CO$,$CO_2$,SOx, NOx, PAN, Ground level Ozone, $PM_{<10\mu m}$, $PM_{<2.5\mu m}$, $PM_{<1\mu m}$, Acid rain and Photochemical reactions-$O_3$&Smog)in atmosphere.<br><br>Respiratory and cardiovascular diseases, neuro psychiatric complications, the eyes irritation, skin diseases and long-term chronic diseases. Pneumoconiosis.<br><br>**Automobile pollution**: Definition. Sources–Petrol, Diesel, LPG, CNG, Biodiesel, Ethanol, Hydrogen and Fuel cells. Emerging fuels – Biobutanol, Dimethyl ether, Methanol and Renewable hydrocarbon biofuels.<br><br>Internal Combustion Engines (Two stroke and Four stroke: Carburettor and Fuel Injection systems) – Exhaust emissions, Evaporative emissions and Crank case blow-by.<br><br>Effects and control of automobile pollution. | |
| **Unit–2** | **13** |

| | |
|---|---|
| **Air Pollution Control Engineering;**<br>Definition; Sources, Types of emission, Control of emissions from engines<br>Monitoring and Control of Air Pollution: Scope and significance.<br>Air Sampling: Ambient, Indoor and Stack-Gaseous and particulates.<br>National Ambient Air Quality Monitoring Programme (NAQMP)–Introduction, Guidelines for Sampling and Measurement o f notified Ambient Air Quality Parameters (NAAQS), National Ambient Air Quality Standards.<br>Bharat Stage Emission Standards (BSES)–Introduction, Timeline of Implementation of BSES in India. Current Emissions norms.<br>Air Quality Indices.<br>Concept of Air Pollution Tolerance Index and Industrial<br>Greenbelts. Gaseous–Absorption, Adsorption and Condensation.<br>Particulate–Settling Chambers, Inertial Separators, Cyclones, Filters (Baghouse), Electrostatic Precipitators and Scrubbers.<br>Salient features of Air Pollution (Prevention and Control) Act, 1981 and latest amendments; NationalCleanAirProgramme2019andlatestamendments. | |
| **Unit–3** | **12** |
| Waterpollution: Definition,Sources(Pointandnon-point).ClassificationofWaterPollutants.<br>Heavymetalpollution: Sources/Causes, EffectsandControlMeasureswithreferencetoLead and Mercury.<br>Fertilizer pollution: Sources/Causes, Effects and Control Measures with reference to Nitrogen, Phosphorus and Potassium. Agriculture runoff and detergents as pollutants. Eutrophication.<br>Pesticide pollution: Sources/Causes, Effects and Control Measures with reference to Organo-chlorine and Organo-phosphatepesticides.<br>Thermalpollution:Sources/Causes,EffectsandControlMeasures.Oilpo<br>llution:Sources/Causes,EffectsandControlMeasures.<br>Ground water pollution: Sources/Causes, Effects and Control Measures with reference to Nitrate, Fluoride and Arsenic.<br>Coliform contamination of water. | |
| **Unit–4** | **20** |
| Water and Wastewater Engineering:<br>Characteristics of potable water: Physical, Chemical and Biological. | |

| | |
|---|---|
| Characteristics of domestic and industrial wastewater: *Physical* – Color, Odour, Turbidity, Temperature and Solids(Dissolved, Suspended, Settleable, Volatile; MLSS & MLVSS); *Chemical* – Organic, Inorganic andVolatile Organic compounds ;and *Biological*–Coliforms and other organisms.<br>Treatment of water for potable purposes: Intake, screening, aeration, pre-chlorination, coagulation, flocculation, sedimentation, filtration (SSF and RSF),disinfection and distribution.<br><br>Preliminary and Primary treatment: Screening (fine, medium and coarse – stationary, moving and movable – disposal of screenings), pumping, gritremoval (sedimentation tank and detritustan k–types;disposal of detritus)and skimming.<br><br>Secondary treatment: Activated Sludge Process and Tricking filters. Sludge management.<br><br>Tertiary treatment: Chlorination; Reverse Osmosis, Activated Carbon.<br><br>Advanced treatment methods: Filtration, ion exchange, activated carbon adsorption, electro dialysis, nitrification, de-nitrification and Phosphorous removal.<br><br>Other treatment methods: Oxidationponds;oxidationditches;septictanksAnaerobiclagoons,Anaerobic filterreactorsandUp-flowanaerobicdigesters. Disposal of sewage on land; disposal of sewage by dilution.<br><br>Salient features of Water Pollution (Prevention and Control) Act,<br><br>1974;and its characteristics | |

**References**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Crites,R.andGeorge,T.1998).*SmallandDecentralisedWastewaterManagementEnvironmentalNoise Pollutionand itsControl*.AnmolPublications.

Garg,S.K.(1990).*EnvironmentalEngineeringVolI&IISewageDisposalandAirPollutionEngineering*,KhannaPubl.Delhi.

J.PaulGuyer.(2021).*AnIntroductiontoAirPollutionControlEngineering*.UNICORNPublishin gGroup.1-182.

Perkins,H.C.(1974).*AirPollution*.McGraw–HillKogakushaLtd.

Phiri,N.B.(2021).*FactorsAffectingTutoringEffectivenessinFinance-RelatedModules*.University ofJohannesburg(SouthAfrica).

Rao,M.N.andRao,H.V.N.(1988).*AirPollution*.TataMcGraw–HillPublishingCo. Ltd.

Santra,C.S.(2001).*EnvironmentalScience*.(1stEd.),NewCentralBookAgency

Stern,A.C.(1986).*Airpollution*Vol.I–VIII.AcademicPressInc.

**ContentofPracticalCourse5:ListofExperimentstobeconductedDSCEN**

**VC10-P-AIRANDWASTEWATERANALYSIS**

**(Total Teaching Hours=60;TotalCredits=2)**

***13 experiments can be chosen from the list below and incorporated into thesyllabusdeliveredindifferentInstitutionsbasedontheavailabilityofresources.***

1. Study of meteorological parameters– Light, Temperature, Pressure and Rain fall
2. Study of meteorological parameters–Relative Humidity, Wind Speed and Direction
3. Construction of a Windrose
4. Sampling techniques of air
5. Determination of Particulate Matter
6. Determination of Sulphur- di -oxideinambientair
7. Determination of Nitrogen-di-oxidein ambient air
8. Determination of Carbon-di-oxideinambient air
9. Calculate Air Quality Indices from secondary data sources
10. Sampling techniques of wastewater
11. Determination of totalsolids in wastewater
12. Determination of Chromiumin liquid effluents
13. Determination of Copper in liquid effluents
14. Determination of Iron in liquid effluents
15. Determination of BOD
16. Determination of COD

**References**


Donn,W.L.1975. Meteorology. McGraw–Hill Book Co.

Harrison,R.M.andPerry,R.1986.HandbookofAirPollutionAnalysis.ChapmanandHall.

Kazt,M.1969.MeasurementofAirPollutants.WHO.

NEERIManual.1982.AirQualityMonitoring.NEERIPublications.

Sawyer,C.N.andMcCarty,P.L.1978.ChemistryforEnvironmentalEngineering. McGraw–Hill International.

Stern,A.C.1986.AirpollutionVol.I–VIII.AcademicPressInc.

StandardMethodsforExaminationofWaterandWastewater.2012.APHA–WEF.

**B.Sc.Semester:5**

**Title of the course: DSCENVC13-T-ENVIRONMENTAL CHEMISTRY AND INSTRUMENTATION**

| Number of theory credits | Number of lecture hours/semester |
|---|---|
| **4** | **60** |

| **Programme Specific Objectives** | |
|---|---|
| PSO1 | Todevelopcompetencyinunderstandingthechemistryandtheprocessesin environment. |
| PSO2 | To instill knowledge about the chemistry of soil and water. |
| PSO3 | To develop competency in understanding the instruments used for analysis and the principles for developing the instruments. |
| PSO4 | To be able to employ the developed skills in real-time situations. |

| **Programme Outcomes** | |
|---|---|
| PO1 | Demonstrate competence in understanding the concepts and chemistry of elements interacting in the environment. |
| PO2 | Demonstrate the ability to carry out data collection procedures and analysis in field conditions/laboratories and make appropriate interpretations. |
| PO 3 | Be able to develop competence and academic skills in handling advance instruments. |
| PO4 | To be able to apply skills in accordance with guidelines/standards prescribed by statutory authorities. |

| **Content of Theory course** | **60 Hours** |
|---|---|
| **Unit–1** | **15** |
| Fundamentals of Environmental Chemistry: Concept and scope and of Environmental chemistry, Environmental segments, Structure of atoms, Gibbs energy ,chemical potential, acid-base reactions, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radio isotopes in the environment.<br>Water chemistry- Water molecules and unique properties of water -specific heat, latent heat, thermal conductivity, expansion and freezing of water. Chemical reaction-acid base reactions in water. | |
| **Unit–2** | **15** |

| | |
|---|---|
| Atmospheric chemistry: Composition of elements in the atmosphere. Classification of elements, Definition, sources and types – gaseous pollutants and particulate matter; chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matters. Thermo chemical and photochemical reactions in the atmosphere. CFCs-types naming of CFCs and Ozone chemistry,<br><br>Chemistry of air pollutants (Primary and secondary) and aerosols, Photochemical smog, London Smog and other case studies. Chemistry of acid rain formation and mechanism, ozone depletion mechanism. | |
| **Unit–3** Water and Soil chemistry: | **15** |
| **Physico-Chemical Characteristics of Water Quality: Physical Parameters-** Colour, temperature, taste and odour, turbidity, conductivity, hydrogen ion concentration (pH), total solids, suspended and dissolved solids. **Chemical Parameters-** Acidity, alkalinity, hardness, chlorides, fluorides, dissolved oxygen, Heavy metals and metalloids. Concept of DO, BOD, COD and measurements.<br><br>**Chemical Properties of soil ;** Chemical composition of soil. Soil colloids, properties of soil colloids, ion exchange of soil- factors affecting cation and anion exchange capacity of soil. Soil solution, soil reaction pH, factors affecting soil reaction pH. Formation of acid soils, characteristics of acidic soils harmful for plant growth. Control measure of soil acidity. Characteristics and formation of saline and alkaline soil, effect of soil salinity & alkalinity on plant growth. Control measures of soil salinity**.** . | |
| **Unit–4** | **15** |
| Advanced instrumentation: Various ranges of electromagnetic radiation, Interaction of electromagnetic radiation with matter, Introduction to UV and X-ray spectroscopy and its applications in Environmental Science, Nephelometry, Atomic Absorption Spectroscopy and Atomic emission spectroscopy and Flame emission spectroscopy-Principle, instrumentation and applications in Environmental sample analysis, Concept of Solvent extraction, Thin Layer Chromatography and Ion Exchange Chromatography, Basic concept to HPLC and Gas Chromatography. | |

**References**

AjayKumarBhagiandChatwal,G.R.TextbookofEnvironmentalChemistry.Bhatia,S.

C.2011.EnvironmentalChemistry, CBS Publishers.

Day,A.K.1984.EnvironmentalChemistry,WilleyEastern,IIIEd.Faust,S.

D.andDly,O.M.1983.Chemistryofwatertreatment.

Manahan, S.E. 2000. Environmental Chemistry, 7thEd., Lewis Publications, Florida,U.S.A.

Sharma,B.K.andKaur.1995.EnvironmentalChemistry,GoelPublishingHouse,Meerut.

Sawyer,C.N.,McMarty,P.L.andPerkinG.F.1994.ChemistryforEnvironmentalEngineering,II Ed.,McGraw Hill.

Tyagi,O.D.andMehra,M.1990.EnvironmentalChemistry,AnmolPublications

## Content of Practical Course 5: List of Experiments to be conducted

### DSCENVC12-P–SOIL ANALYSIS, NOIS EMEASUREMENT AND SOLIDWASTEANALYSIS
### (Total Teaching Hours=60;TotalCredits=2)

***13 experiments can be chosen from the list below and incorporated into thesyllabusdeliveredindifferentInstitutionsbasedontheavailabilityofresources.***

1. Sampling techniques of Soil
2. Determination of Soil Moisture and Texture
3. Determination of Specific Gravity of Soil
4. Determination of Particle Density of Soil
5. Determination of Water Holding Capacity of Soil
6. Characterization of Solid Wastes
7. Determination of pH and Electrical Conductivity in Soil/Refuse matter
8. Determination of Calcium and Magnesium in Soil/Refuse matter
9. Determination of Lime Content in Soil/Refuse matter
10. Determination of Organic Carbon in Soil/Refuse matter
11. Determination of available Nitrogen in Soil/Refuse matter
12. Determination of available Phosphorus in Soil/Refuse matter

13. Determination of available Potassium in Soil/Refuse matter

14. Determination of C/N ratio in Soil/Refuse matter

## References


Baruah, T. C. and Barthakur, H. P. 1997.*Textbook of Soil Analysis*.Vikas PublishingHousePvt.Ltd.

Daji, J.A. 1988. *Textbook of Soil Science*.Media Promoters and

Publishers.Firman,E.B.1964. *ChemistryofSoils*.OxfordIBHPublishingCo.

Jackson,M.L.1973.*Soil–ChemicalAnalysis*.PrenticeHallPublications.

Miller, R. W. and Donahue, R. L. 1992.*Soils – Introduction to Soils and PlantGrowth*.Prentice Hallof India.

Rowell, T. L. 1994. *Soil Sciences – Methods and Applications*.Longman ScientificandTechnical.


**SEC4: Environmental Employability 4 Credits**

**SEMESTER – V**

**Title of the course SEC-4: Integrated Solid Waste Management**

CREDITS – 02

**Course objectives: This course will enable students to**

- Gain insight into the collection, transfer, and transport of municipal solid waste.
- Understand the design and operation of a municipal solid waste landfill.
- Understand the design and operation of a resource recovery facility.
- Understand the design and operation of a waste-to-energy facility.

**Unit -1 Introduction:** Day-day solid waste management and social issues, scope and importance of solid waste management, classification and magnitude of the problem, functional elements. Solid Waste: Sources of generation, classifications, characterization and quantification, municipal industrial and bio-medical waste, estimation of moisture content and density of a solid waste.**10 Hours**

**Unit -2 Transfer and Transport:** Collection services and collections systems, collection equipment, transfer stations, collection route optimization. Processing Techniques: Processing methodologies and waste minimization, recovery, recycle and reuse (3R) of materials from solid waste, volume and size reduction, biological processing. **10 Hours**

**Unit- 3 Treatment Methodologies :** Composting- aerobic and aerobic process, incineration, pyrolysis and energy recovery. Ultimate Disposal: Significance of refuse disposal and management, impact of open land dumping site selection, sanitary land, filing, design criteria and design examples. Leachate and gas collection system leachate treatment.

Hazardous waste: Identification of Hazardous waste, classification, treatment and disposal techniques – biomedical, radioactive and chemical industries**10 Hours**

**Course outcomes: During this course, students will be trained** :

- Apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges.
- Adopt the role on policy driver's play in stakeholders' response to the waste and resource management challenge within a circular economy.
- Know the principles of existing and emerging technologies for the treatment of waste and recovery of value from wastes. Question paper pattern:

Reference:


1. Tchobanoglous G., Theissen H., and EIiassen R.(1991), “Solid Waste Engineering Principles and Management Issues”, McGraw Hill, New York.
2. Peavy, Rowe and Tchobanoglous (1985), “Environmental Engineering”, McGraw Hill Co. 4th Edition • CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000. Reference Books:
3. Waste Treatment and Disposal 2nd edition Paul T Williams, Wiley, 2005
4. Integrated Solid Waste Management - Engineering Principles and Management Issues, Tchobanoglous/Theisen/Vigil, McGraw Hill (1993)
5. Mantell C.L., (1975), “Solid Waste Management”, John Wiley.


**Laboratory: (CREDITS – 02)**

1. Study and sampling techniques of Industrial solid waste
2. Determination of Solids in wastewater: Total Solids, Suspended Solidsinlechate
3. determationDissolved Solids, Volatile Solids, Fixed Solids, Settleable Solids in leachate samples
4. Identification bacteria in aerobic and anaerobic digestion.
5. Determination of pH of the solid waste.
6. Study of land filling methods.
7. Study of composting, incineration methods

**B.Sc.Semester6**

Title of the Course: **DSCENVC14-T-ENVIRONMENTALMICROBIOLOGY and Biotechnology**

| Number of Theory Credits | Number of lecture hours/semester | Number of practical Credits | Number of practical hours/semester |
|---|---|---|---|
| **4** | **60** | **2** | **60** |

| **Programme Specific Objectives** | |
|---|---|
| PSO1 | To develop competency in understanding the microbes of Environment. |
| PSO2 | To instill a knowledge about roles of microbes in the Environment. |
| PSO3 | Tomotivateandinspiretoacquirecontemporaryunderstandingandusingthe knowledge for remediation. |
| PSO4 | To inculcate creativity and innovative spirit in identifying appropriate measures for recycling and conservation. |

| **ProgrammeOutcomes** | |
|---|---|
| PO1 | Demonstrate competence in understanding the microbes of Environment. |
| PO2 | Demonstrate competence in understanding the microbes in water and their impact on human health. |
| PO3 | Ability to understand and appreciate the role of microbes in enhancing the quality of life of human. |
| PO4 | Demonstrate the ability to carryout data collection procedures and analysis in field conditions/laboratories and make appropriate Interpretations using the microbes. |

| **Content of Theory Course** | **60 Hours** |
|---|---|
| **Unit-1** | **15** |
| Environmental Microbiology: Definition, scope and significance. History of microbiology. Structure, Characters and Classification of Microorganisms – Bacteria, Archaea, Protozoa, Algae, Fungi, Viruses and Parasites.<br>**Microbial Environment:** The physical and Chemical environmental parameters of Microorganisms : Physical factors(Temperature, Visible radiation & Ultraviolet radiation) Chemical factors (Water activity, pH, Inorganic nutrients, gases and organic nutrients). Microbial habitats: Terrestrial Environment: soil microflora, symbiotic and non-symbiotic nitrogen fixation, mycorrhiza-Ectomorphic, Endomorphic and its significance | |

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| **Unit–2** | **15** |
| Aquatic Microbiology: Definition. Water related diseases-Bradley's classification - *water-borne diseases, water-washed diseases, water-based diseases and water-related diseases*. Infection, pathogens, symptoms. Treatment and preventive measures – Disinfection of water for potablepurposes.Coliforms– *Citrobacter*,*Enterobacter*,*Escherichia*and*Klebsiella*.TotalandFaecal coliforms.water borne (Poliomyelitis, Viral hepatitis, Cholera, and amoebic dysentery) and COVID-19<br>Air Microbiology: Definition. Airborne infections – Causative microbes – Control measures; Droplet infection; Sick Building Syndrome. as specific pathogens with examples of air borne (Swine flu, Influenza, tuberculosis) | |
| **Unit–3** | **15** |
| Soil Microbiology: Definition. Rhizosphere and Rhizoplane Microflora – Biodegradation of DDT, PCBs and Plastics; Bioleaching of Heavy Metals – Copper, Iron and Uranium; Role of microbes in Biogeochemical Cycles: Nitrogen and Phosphorus.<br>**Gaseous fuel**: introduction, Biogas and Hydrogen – Biogas production. anaerobic digestion - solubilisation, acidogenesis and methanogenesis - methanogens. Mechanism of methane production, advantage and disadvantage. Hydrogen production – photo biological process, hydrogenese and hydrogen production.<br>**Bio-fuels**: introduction, production of bio-ethanol, ethanol recovery**.** Advantages of ethanol over petrol, disadvantages of ethanol, Biodiesel: lipids as a source of biodiesel, biodiesel from hydrocarbon. Biodiesel production from jetropa. | |
| **Unit–4** | **15** |
| **Biotechnology and application of microbes in Environment:**<br>**Bio fertilizers and biopesticide:** Introduction, scope and importance of biotechnology. Biofertilizer- *Rhizobium, azotobactor, azospirilium,* Blue green algae, *azoll*a, *mycorrhizae*. Phosphate solubilizing microorganisms, large scale production, vermicomposting, advantage and disadvantages. Bio-control agents- Bio insecticide, bio herbicide, disease control, advantage and disadvantages<br>**Restoration of Degraded Lands:** Reforestation through micro propagation; casuarinas for tropical reforestation on adverse sites; development of stress tolerant plants; use of mycorrhizae in reforestation: use of microbes for improving soil fertility – nitrogen fixing actinomycetes; reforestation of soils contaminated with | |

| | |
|---|---|
| heavy metals.<br><br>**Role of microbes inorganic solid waste management**: Composting– anaerobic and aerobic (Windrows method, accelerated composting, Bio-mechanical composting machines). Role of inoculum in composting. Vermi composting. | |

**References**


Atlas,R.M.andBartha,R.1998.MicrobialEcology– FundamentalsandApplications.Benjamin/CummingsSciencePublishing.

Bitton, G. 1994. Wastewater Microbiology. Wiley-Liss Inc.McGraw HillInternationalEditions.

Hurst,C.J.(Ed.).(2017).Modelingthetransmissionandpreventionofinfectiousdisease.Springer InternationalPublishing.

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Southey,C.,Kaushik,N.andTrivedi,R.K.(Eds).2001.DetergentsandtheEnvironment.Tata McGraw-HillPublishingCo.Ltd.

Waites,M.J.,Morgan,N.L.,Rockey,J.S.,&Higton,G.(2009).Industrialmicrobiology:anintroduction.JohnWiley& Sons.

Prescott L.M. Harley,J.P and Klein,D.A 1999. Microbiology. IV edn,WBC/ McGraw Hill companies USA.

Cassida – Industrial Microbiology

Atlas- Environmental Microbiology

R C Dubay- A Text book of Biotechnology

P K Gupta - Elements of Biotechnology by

Vinita Kale and Kishore Bhusari - Applied Microbiology

7Pelzer J.M Chan, E.C.S. and Kreig, N.R. 1993. Microbiology. V edn, Tata McGraw Hill Publishing Co. Ltd. New Delhi.

SubbaRao, N.S.1986. Soil Microorganisms and plant growth. III edn, Oxford and IBH Publishing Co., New Delhi.

Power and Daginawala 1996. General Microbiology Vol I&II, Himalaya Publishing House , Bombay.

Industrial Microbiology by Prescott and Dunn

Industrial Microbiology- by Cassida

Agriculture Biotechnology by Purohith
Environmental Microbiology by Atlas
Biotechnology by B D Singh
A text book of Biotechonology by R C Dubay
Elements of Biotechonology by P K Gupta
Applied Microbiology by VinitaKale and Kishore Bhusari
Food Microbiolgy by M R Adams and Moss

## Content of Practical Course 6: List of Experiments to be conducted
## DSC ENVC15-P-ENVIRONMENTAL MICROBIOLOGY

**(Total Teaching Hours=60;TotalCredits=2)**

1. Best practices for microbiology laboratories
2. Microscopy–Study of Simple and Compound microscopes
3. Sterilization techniques and preparation of culturemedia–Broth and Solid media
4. Isolation of Bacteria from Water/Wastewater–Serial dilution technique
5. Identification of Bacteria–Colony characteristics
6. Identification of Bacteria by gram staining technique
7. Isolation of Fungi from Soils–Pour plate method
8. Identification of Fungi –Lacto phenol cotton blue staining
9. Study of Root Nodule Bacteria–Gram staining
10. Study of Endomycorrhiza(VAM)
11. Estimation of Coliform Group of Bacteria–MPN Technique
12. Estimation of Coliform Group of Bacteria–MF Technique
13. Estimation of Faecal Coliform in water
14. Construction of bacterial growth curves–pH–Broth culture
15. Minimum Inhibitory Concentrations(MICs)of heavy metals on bacteria

### References

Aneja,K.R.1996.ExperimentsinMicrobiology,PlantPathology,TissueCultureandMushroomCultivation.WishwaPrakashan.

Benson,H.J.1998.MicrobiologicalApplications–LaboratoryManualinGeneralMicrobiology.McGraw-HillPublications.

Bhattacharyya,B.N.1993.ExperimentswithMicroorganisms.EmkayPublications.Standard

MethodforExaminationofWaterandWastewater.2017.APHA–WEF.

**B.Sc.Semester6**

Title of the Course:**DSC ENVC16–T–ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL RISK ASSESSMENT**

| Number of Theory Credits | Number of lecture hours/semester | Number of practical Credits | Number of practical hours/semester |
|---|---|---|---|
| **4** | **60** | **2** | **60** |

| **Programme Specific Objectives** | |
|---|---|
| PSO1 | To develop competency in understanding the process of assessing the EnvironmentalImpact. |
| PSO2 | To instill a knowledge on methodologies used for assessing Environmental Impact. |
| PSO3 | Tomotivateandinspiretoacquirecontemporaryunderstandingandskillsleadingtoissueidentificationandconservation. |
| PSO4 | Toinculcatecreativityandinnovativespiritinidentifyingappropriateassessmenttools. |

| **ProgrammeOutcomes** | |
|---|---|
| PO1 | DemonstratecompetenceinunderstandingthereportsofEnvironmentalImpactassessment ofa project. |
| PO2 | Demonstratetheabilitytocarryoutdatacollectionproceduresandanalysisinfieldconditions/laboratoriesandmakeappropriate interpretationsrequiredforEIA. |
| PO3 | Abilitytounderstandtheproceduretoconductanaudit. |
| PO4 | Demonstrate the ability to carry out risk analys is adhering to the laws. |

| **Content of Theory Course** | **60 Hours** |
|---|---|
| **Unit-1** | **15** |
| Environmental Impact Assessment (EIA): Definition, principle, process and importance of an EIA. Salient features of EIA. Utilities of EIA. EIANotification,2006 and subsequent amendments.<br>Components of EIA – Air, Water, Noise, Land, Biological environment, Socio- economic and Health Environment. Participants of an EIA. | |

| | |
|---|---|
| Steps in an EIA–Screening, Scoping & consideration of alternatives, Baseline data collection, Impact prediction, Assessment of alternatives, Delineation of mitigation measures, preparation of environmental impact statement, Public hearing, Environment Management Plan, Decision making and Monitoring the clearance conditions. | |
| **Unit–2** | **15** |
| EIA Methodologies: Rapid and Comprehensive EIA. Characteristics of methods of Impact Identification. Criteria for the selection of EIA methodology–General, impact identification, impact measurement, impact interpretation and evaluation and impact communication.<br>Methods of Impact Identification - Adhoc methods, Checklist methods, Matrices methods, Networks methods and Overlay methods. Environmental index using factor analysis, Cost-benefit analysis, Predictive or Simulation methods.<br>Case Studies: Industry, Housing and Multi purpose Dams. | |
| **Unit–3** | **15** |
| Environmental Audit: Concept, Aims and Objectives; Elements of Environmental audit- Internal and External audit.<br>Types of Environmental Audit: Environmental Compliance Audits, Environmental Management Audits and Functional Environmental Audits.<br>Water audit, Energy audit, Health & Safety audit and Waste & Waste Minimisation audit.<br>Audit procedure: Pre-audit activities, On-site activities and Post-audit activities.<br>Evaluation of Audit data and Preparation of audit report. | |
| **Unit–4** | **15** |
| Environmental Risk Assessment<br>Hazard identification and risk assessment-Quantitative and Qualitative risk assessment.<br>Quantitative-Hazard Identification and Risk Analysis(HIRA). | |

| | |
|---|---|
| Qualitative-Hazard and Operability Analysis(HAZOP),Job Safety Analysis(JSA),Fault Tree Analysis(FTA) and Event Tree Analysis(ETA).<br>Disaster management plan-Off-site emergency plan and On-site emergency plan<br>Occupation, Health and Safety Management Plan, PPEs, Fire Safety,<br>Chemical and Biological Hazards. Safety Management and Laws-Factories Act; Manufacture, Storage and Import Hazardous Chemical Rules. | |

**References**


Anjaneyalu,Y.andValliManickam.2014.EnvironmentalImpactAssessmentMethodologies. BS Publications,Hyderabad.

Baldwin,J.H.1988.EnvironmentalPlanningand Management.International BookDistributors.

Barthwal, R.R.2009. Environmental Impact Assessment.New Age Internationalpublication.

Canter,L.W.1996.EnvironmentalImpactAssessment.McGrawHillInc.

Rao, P. S. B. and Rao, P. M. (Eds). 2001. Environment Management and Audit. DeepandDeepPublicationsPvt.Ltd.

Rau,J.G.andWooten,D.C.1980.EnvironmentalImpactAnalysisHandbook. McGrawHill.

Santra, S. C. 2001. Environmental Science, New Central Book Agency (P)

Ltd.Shrivastava,A.K.2003.EnvironmentImpactAssessment.APHPublishing Corporation.

Trivedi,P.R.2004.EnvironmentalImpactAssessment.APHPublishingCorporation.

## Content of Practical Course6: List of Experiments to be conducted

## DSCENVC17–P–METHODS OFENVIRONMENTAL IMPACTASSESSMENT AND ENVIRONMENTAL AUDIT

## (Total Teaching Hours=60;TotalCredits=2)

1. Study of recent EIA notification and guidelines
2. Baseline data collection and analysis
3. Study of impact identification methods -Checklists
4. Study of impact identification methods-Matrices
5. Study of impact identification methods-Networks
6. Study of cost-benefit analysis of development project
7. Study of socio-economic impacts-Questionnaire method
8. Study of health impacts-Questionnaire method
9. Study of Environmental Risk Assessment–Data sheet method
10. Study of Environmental audit methods-Water audit
11. Study of Environmental audit methods –Waste water audit
12. Study of Environmental audit methods-Energy audit–Electricity
13. Study of Environmental audit methods –Energy audit –fossil fuels
14. Study of Environmental audit methods–Solid Waste audit

### References


Arts,J.,&Morrison-Saunders,A.(Eds.).(2012).*Assessingimpact:handbookofEIAandSEA follow-up*.Routledge.

Barton,H.,&Bruder,N.(2014).*Aguidetolocalenvironmentalauditing*.Routledge.

Carroll,B.,&Turpin,T.(2002).*Environmentalimpactassessmenthandbook:Apracticalguideforplanners,developersandcommunities*.ThomasTelford.

Erickson,P.A.(1994).*Apracticalguidetoenvironmentalimpactassessment*. AcademicPressInc..

Munier,N.(2004).*Multicriteriaenvironmentalassessment:apracticalguide*. SpringerScience&BusinessMedia.

Nelson, D. D. (1998). *International environmental auditing*.Government

Institutes.Rathi,A.K.A.(2021). *Handbook of*

*EnvironmentalImpactAssessment:Conceptsand*


**INTERNSHIP -2 CREDITS**

**Subject Expert Committee Members** actively participated in the preparation of proposed curriculum for four years B.Sc. (Basic/Hons.) degree in Environmental Science.

Severalmeetingswereconductedvirtuallyandphysicallywith Environmental Science subject committee experts; and the proposed curriculumwas approved by the Chairpersons - Board of Studies and Board of Examiners ofvarious Universities and Colleges of Karnataka State.

| SUBJECTEXPERTCOMMITTEE–ENVIRONMENTALSCIENCE | | | |
|---|---|---|---|
| **Name** | **Designation and address** | **Position** | **Signature** |
| **Members Present** | | | |
| **Dr. N. Nandini** | Professor, Department of Environmental Science, Bangalore University, Bengaluru | Chairperson |  |
| **Dr. N. S. Raju** | Professor, Department of Studies in Environmental Science, University of Mysore, Mysuru | Member |  |
| **Dr. S. Suresha** | Associate Professor, Department of Environmental Science, Yuvaraja's College (Autonomous),University of Mysore,Mysuru | Member |  |
| **Dr. B. S. Prabhakar** | Associate Professor, Department of Environmental Science, St.Joseph's University, Bengaluru | Member |  |
| **Dr. K. L. Prakash** | Professor, Department of Environmental Science, Bangalore University, Bengaluru | Member |  |
| **Smt. Akshatha Chandra,G.R.,** | Special Officer, Karnataka State Higher Education Council, Government of Karnataka | Member Convenor |  |