

**MINUTES OF THE MEETING OF BOARD OF STUDIES IN GEOGRAPHY HELD  
ON 24<sup>th</sup> APRIL 2016 AT 10.30 A.M. IN THE CONFERENCE ROOM, BHOO  
MANDIR, BANASTHALI VIDYAPITH, RAJASTHAN**

**PRESENT**

1. Dr. Rashmi Sharma	-	Convener
2. Prof. H.S.Sharma,	-	External Member
3. Prof. S.K. Shukla	-	External Member
4. Dr. M.G. Thakkar	-	External Member
4. Dr. Ashutosh	-	Internal Member
5. Dr. Vipin Kumar	-	Internal Member
6. Dr. Kh. Moirangleima	-	Internal Member
7. Dr. Salahuddin Mohd.	-	Internal Member
8. Dr. Dipjyoti Chakraborty	-	Invitee
9. Dr. Sudesh Kumar	-	Invitee
10. Dr. Saral Kumar Gupta	-	Invitee
11. Mr.Ashutosh Kumar Srivastava	-	Invitee
12. Dr. K.F. Rahman	-	Invitee

**Note:** Dr. M.G. Thakkar (External Member), Dr. Ashutosh and Mr. Ashutosh Kumar Srivastava (Internal members) could not attend the meeting.

1. The Board **confirmed the minutes** of its last meeting held on 11<sup>th</sup> March' 2012.
2. The Board scrutinized the existing **panel of examiners** in the subject of Geography and Environmental Science with the Bye –laws of the University and **updated**. The panel of examiners was submitted in a sealed envelope to the secrecy section in hard and soft copy both.
3. The Board considered the courses of study and scheme of examination for the following examinations.
  - I. **B.A./B.Sc. Geography Examination:**
    - i. First Semester Examination, December, 2016
    - ii. Second Semester Examination, April/May, 2017
    - iii. Third Semester Examination, December, 2017
    - iv. Fourth Semester Examination, April/May, 2018
    - v. Fifth Semester Examination, December, 2018
    - vi. Sixth Semester Examination, April/May, 2019

**Resolved to recommend** that the existing course of study be continued **with some modifications and updations in all the papers (Enclosure 1 pp. 1- 36).**

**2 M.A./M.Sc. Geography Examination:**

- i. First Semester Examination, December, 2016
- ii. Second Semester Examination, April/May, 2017
- iii. Third Semester Examination, December, 2017
- iv. Fourth Semester Examination, April/May, 2018

**Resolved to recommend** that the existing course of study be continued with modification and updation in all papers of all the semesters and is given in **(Enclosure 2 pp. 1-79)**. The changes will be effective from the **upcoming new batches**.

### 3 M. Phil. (Geography) Examination

- (i) First Semester Examination, December, 2016
- (ii) Second Semester Examination, April/May, 2017
- (iii) Third Semester Examination, December, 2017

The Board **accepted** the course structure, scheme and syllabi of the new course M. Phil (Geography) after incorporating the suggestions which is going to be introduced from the coming session 2016-17 (**Enclosure 3, pp. 1-23**).

### 4 M.Sc. (Environmental Sciences) Examination:

- i. First Semester Examination, December, 2016
- ii. Second Semester Examination, April/May, 2017
- iii. Third Semester Examination, December, 2017
- iv. Fourth Semester Examination, April/May, 2018

The Board **accepted** the course structure, scheme and syllabi of the new course M. Sc. (Environmental Sciences) after incorporating the suggestions which is going to be introduced from the coming session 2016-17 (**Enclosure 4, pp. 1-26**).

5. **No new courses** will be proposed as M. Sc. Environmental Science is being introduced from the coming session.

6. The Board considered the **reports of the examiners** in the subject of Geography of various examinations 2013-2014 and 2014-2015.

It was noted that the examiners have generally reported 'to the point' answers and have found expression/method of representation satisfactory/good. Few examiners suggested to give more emphasis on maps & charts to support their answers.

7. The **Board** has thoroughly analyzed the quality of **question papers** of final university examination conducted during the academic year 2013-14 and 2014-15 for UG and PG examination.

The **Board** concluded that the quality of question papers is good but sometimes the **some questions are out of syllabus**, so, the board recommended for moderations of the question papers immediately started in order to overcome the prevailing discrepancies in the question.

8. (i) The Board Co - opt **external members** of the Board of Studies (**Geography**) for a fresh term of three years commencing from 1<sup>st</sup> January, 2017 under bye-law 9.2.03.

The following shall be the members of the Board of Studies:-

(a) Prof. H.S. Sharma

A 3 Shanti Niketan colony  
Kisan Marg Tonk Road, Jaipur  
Mobile: 9983349022  
Email: pachhora1@yahoo.com

(b) Prof. Santosh Kumar Shukla

29, Shanti Residency, Neha Nagar, Makronia, Sagar (MP) – 470004  
Mobile: 9425495826  
Email: sshukla.sgr@gmail.com

- (ii) The Board Co - opt **external members** of the Board of Studies (**Environmental Science**) for a fresh term of three years commencing from 1<sup>st</sup> January, 2017 under bye-law 9.2.03.

The following shall be the members of the Board of Studies:-

- (a) Prof. H.S. Sharma  
A 3 Shanti Niketan colony  
Kisan Marg Tonk Road, Jaipur  
Mobile: 9983349022  
Email:pachhora1@yahoo.com
- (b) Dr. M. G. Thakkar  
(Head)  
Department of Earth and Environmental Science  
K.S.K.V. Kachchh University,  
Bhuj Kachchh-370001

### **M.Sc. ENVIRONMENTAL SCIENCE SCHEME OF EXAMINATION**

1. The Eligibility criteria for M.Sc. Environmental Science are those candidates who have passed B.Sc (Hons.)/B.Sc. (10+ 2+3) or B.E/B.Tech with a minimum of 50% marks aggregate in bachelor degree.
2. M.Sc. Environmental Science course shall be imparted to students for two academic sessions consisting of four semesters as given below. Candidates will be examined and evaluated on marks basis at the end of each semester in the different courses of theory and practical as per marks given against each course.
3. First and Third semester examinations will be normally held in the month of December and Second and Fourth semester examinations will be normally held in the month of April/May every year.
4. The M. Sc. Environmental Science will consist of (a) Core Papers (b) Electives (c) Project Dissertation. The Core papers will be compulsory for all the students and students can opt one elective in third semester. In fourth semester, Project Dissertation is compulsory for all students which have to be conducted in any related company/laboratory/industry etc.
5. It will be necessary for a candidate to pass in the theory and practical part separately.
6. Question papers of semester examinations will be divided into three sections. Each section will contain three questions. Students will be required to attempt five questions in all, selecting not more than two questions from each section.
7. The dissertation will be evaluated by internal and external members separately. The three committee member will be chaired by the Head and having two other internal members for evaluating the seminar and dissertation work in which the students have to make a presentation of their dissertation as a part of defense of their work conducted. Viva voice examination will be conducted by the external examiner. The marks of the continuous assessment will be sent by the respective company/laboratory/industry etc.

## M.Sc. Environmental Science, 2016-2018

### FIRST SEMESTER (DECEMBER, 2016)

Course No.	Paper	Name of Paper	Duration of Exam	Contact Hrs/Week	Max Marks	Conti. Ass. Marks	Sem. Ass Marks	Min Pass Marks
1	2	3	4	5	6	7	8	9
MES 1.1	Paper – I	Ecology and Environment	3 Hrs	4	60	20	40	22
MES 1.2	Paper – II	Geography of Environment	3 Hrs	4	60	20	40	22
MES 1.3	Paper – III	Environmental Chemistry	3 Hrs	4	60	20	40	22
MES 1.4	Paper – IV	Introduction to Computer for Environmental Science	3 Hrs	4	60	20	40	22
MES 1.5	Paper – V	Fundamentals of Remote Sensing and GIS	3 Hrs	4	60	20	40	22
MES 1.6	Paper – VI	Practical	12 Hrs	12	90	30	60	32
			<b>Total</b>		<b>390</b>	<b>130</b>	<b>260</b>	<b>140</b>

### SECOND SEMESTER (APRIL/MAY, 2017)

Course No.	Paper	Name of Paper	Duration of Exam	Contact Hrs/Week	Max Marks	Conti. Ass. Marks	Sem. Ass Marks	Min Pass Marks
1	2	3	4	5	6	7	8	9
MES 2.1	Paper – I	Biostatistics & Research Methodology	3 Hrs	4	60	20	40	22
MES 2.2	Paper – II	Environmental Biology and Toxicology	3 Hrs	4	60	20	40	22
MES 2.3	Paper – III	Environmental Physics	3 Hrs	4	60	20	40	22
MES 2.4	Paper – IV	Applications of Remote Sensing for Natural Resource Management	3 Hrs	4	60	20	40	22
MES 2.5	Paper – V	Environmental Legislation	3 Hrs	4	60	20	40	22
MES 2.6	Paper – VI	Practical	12 Hrs	12	90	30	60	32
			<b>Total</b>		<b>390</b>	<b>130</b>	<b>260</b>	<b>140</b>

### THIRD SEMESTER (DECEMBER, 2017)

Course No.	Paper	Name of Paper	Duration of Exam	Contact Hrs/ Week	Max Marks	Conti. Ass. Marks	Sem. Ass Marks	Min Pass Marks
1	2	3	4	5	6	7	8	9
MES 3.1	Paper – I	Environmental Safety & Impact Assessment	3 Hrs	4	60	20	40	22
MES 3.2	Paper – II	Energy Auditing and Conservation	3 Hrs	4	60	20	40	22
MES 3.3	Paper – III	Disaster Management and Mitigation Strategies	3 Hrs	4	60	20	40	22
MES 3.4	Paper – IV	Solid Waste Management	3 Hrs	4	60	20	40	22
MES 3.5	Paper – V	Elective	3 Hrs	4	60	20	40	22
MES 3.6	Paper – VI	Practical	12 Hrs	12	90	30	60	32
			<b>Total</b>		<b>390</b>	<b>130</b>	<b>260</b>	<b>140</b>

Notes: 1 Contact Hour = 1 Credit (Theory), 1 Contact Hour = 15 Marks,  
2 Contact Hour in Practical = 1 Contact Hours Workload.

#### Electives

MESEE. 1 Environmental Biotechnology

MESEE. 2 Biodiversity and Conservation

MESEE. 3 Environmental Health Management

MESEE. 4 Air Pollution Monitoring, Control Technology and Management

MESEE. 5 Water Pollution Monitoring, Control Technology and Management

### FOURTH SEMESTER (APRIL/MAY, 2018)

Sections	Max. Marks
I. Project Dissertation	140
II. Seminar	110
III. Continuous Assessment	90
IV. Viva – Voce	50
<b>Total</b>	<b>390</b>
<b>Grand Total</b>	<b>1,560</b>

8. A candidate who has failed at First/Second semester examination but has passed in at least 50% of the papers prescribed for the examination be admitted to the next semester course, subject to the condition that along with the paper prescribed for the Third/Fourth semester examination, she will also reappear and pass in the paper(s) of the First/Second semester examination in which she failed.
9. (a) Where a candidate fails to secure the requisite minimum percentage of marks prescribed for a pass in the aggregate of all the papers, she shall be deemed to be have passed in each such paper in which she has secured the marks prescribed for a pass in the aggregate.
  - (b) For reckoning 50% of the papers at the semester examination, prescribed will be included and one practical will be counted as one paper.
  - (c) If the number of papers prescribed at the semester examination is an odd number, it shall be increased by one for the purpose of reckoning 50% of the papers.
10. A candidate who does not pass even in 50% of the papers prescribed for the semester examination in accordance with the above rule shall not be eligible for admission to the next semester course and she will be required to appear at the previous semester examination in all the prescribed papers and practicals.
11. A candidate who pass in 50% or more papers in any semester examination and thereby becomes eligible for admission to the next semester examination but chooses not to do so and desires to appear in the remaining papers of that semester only or to reappear in all the prescribed papers and practicals will be permitted to do so on the condition that in the latter case her previous performance will be treated as cancelled.
12. Candidates reappearing at an examination in a subsequent semester shall be examined in accordance with the scheme and syllabus in force.
13. Candidates shall be entitled to the award of the degree in the year in which the last failing paper(s) are cleared by them.
14. The division of the candidates shall be worked out at the end of the final Semester Examination on the basis of the aggregate marks obtained by them at all the semester examination taken together.
15. Classification of Division will be as under :-

Distinction	75%	
First Division	60%	of the aggregate marks obtained at
Second Division	48%	the all semesters taken together.
Pass	36%	

## SEMESTER – I

### M.Sc. Environmental Science MES 1.1 Ecology and Environment

#### Section A

##### Introduction to Environment

- Concept of Environment
- Factors of the environment: Physiographic, Climatic, Edaphic, Biotic and Anthropogenic.
- Bio Geochemical Cycles: The Carbon cycle, the Oxygen cycle, the Nitrogen cycle.
- The Hydrological cycle.

#### Section B

##### Concept of Ecology, Ecosystem and Biomes

- Concept of Ecosystem: With special reference to desert, forest and aquatic ecosystem.
- Food chain, Food web & succession.
- Ecological Pyramids and their types.
- Energy flow in ecosystem.
- Concepts of Biomes. Major biomes of the world: Tropical forest, Temperate forest, Grassland and Tundra.

#### Section C

##### Environmental Pollution and its Effect

- Environmental pollution-Pollutants and sources:
  - Water pollution,
  - Soil pollution,
  - Air pollution and,
  - Noise pollution.
- Global warming
- Global climatic changes: Indicators and Theories
- Biodiversity: Threats and Conservation

##### Books Recommended:

- Atkinson & Raw, Michael (2007): Biogeography. Philip Allan Updates.
- Gautam, A (2007): Environmental Geography, Sharda Pustak Bhawan, Allahabad.
- Gautam, A. (2005): Resource and Environment (in Hindi), Sharda Pushtak Bhawan, Allahabad.
- Huggett, R. J (1998): Fundamental of Biogeography. Routledge, London.
- Kayastha, S.L. and Kumra V.K. (1986): Environmental Studies. Tara Book Agency, Varanasi.
- Mathur, H.S.(1998) : Essentials of Biogeography, Pointer Publishers, Jaipur.
- Mehtani, S. & Sinha, A. (2010): Biogeography. Commonwealth Publisher.
- New begin : Plant and Animal Geography.
- Odum, E. P. (1975): Ecology. Rowman and Littlefield, Lanham USA.
- Odum, E.P.(1968) : Fundamentals of Ecology, W.B. Sanders. Company, Philadelphia and London.
- Saxena, H. M. (1999): Environmental Geography. Rawat Publications., Jaipur and New Delhi.
- Saxena, H. M. (2000): Environmental Management. Rawat Publications., Jaipur and New Delhi.
- बाकरे, बाकरे, वाधवा (2005 - 2006) : पर्यावरणीय अध्ययन, रस्तोगी पब्लिकेशन्स, गंगोत्री, शिवाजी रोड मेरठ।
- भाटिया, डॉ. ए. एल, कोहली, डॉ. के. एस : जन्तु परिस्थितिकी एवं जन्तु वितरण
- डॉ. अरुण रघुवंशी, पर्यावरण तथा प्रदूषण, मध्य प्रदेश हिन्दी ग्रन्थ अकादमी।
- डॉ. नरेन्द्र मोहन अवस्थी, एवं डॉ. आर के तिवारी, पर्यावरण भूगोल, मध्य प्रदेश हिन्दी ग्रन्थ अकादमी।
- डॉ. गायत्री प्रसाद एवंम डॉ. नोटियाल, पर्यावरण भूगोल, शांता पब्लिशर्स।
- एच. एम. सक्सेना पर्यावरण भूगोल, राजस्थान, हिन्दी ग्रन्थ अकादमी।



## MES 1.2 Geography of Environment Section A

### Physical Dimensions

- Endogenetic Process: Concept of Plate Tectonics, Earthquakes and Volcanoes
- Exogenetic process: Weathering and Mass wasting
- Geomorphic processes and resulting landforms : Fluvial, Arid and Coastal
- Composition and Stratification of Atmosphere, Insolation and Heat Budget, Temperature
- Bottom Relief of Ocean, Oceanic Temperature and Salinity

### Section B

### Human Dimensions

- Human Population: Growth and Distribution
- Population Growth and Environmental Deterioration
- Man Induced Environmental Changes
- Types of Human Activities
- Impact of Human Activities: Deforestation, Mining and Industrialization

### Section C

### Environmental Awareness and Policies

- Environmental Awareness- Need and Role in Amelioration of Environment
- Concept and Significance of Environmental Movements, Environmental Movements in India with special reference to The Chipko Movement, Narmada Bachao Andolan
- Environmental Protection Efforts in India
- International Environmental Policy with special reference to THE AGENDA 21 EARTH SUMMIT
- National Environmental Policy of India

### Books Recommended:

- Bal Anand S. (2005) An Introduction to Environmental Management, Himalaya Publishing House Mumbai
- Bloom, A. L. (1998/ 2001): Geomorphology. 3<sup>rd</sup> edition. Prentice Hall of India, New Delhi.
- Chandana, R. C (2008): A Geography of population, Kalyani Publishers, New Delhi.
- Chopra, Girish (2006): Population Geography. Commonwealth Publishers
- Chorley, R.J., Schumm S A and Sugden D E. (1984). Geomorphology. Methuen and Company Ltd., London.
- Dayal, P. (1994): A Text Book of Geomorphology. Kalyani Publishers, New Delhi.
- Husain Majid (2002), Fundamentals of Physical Geography, 2<sup>nd</sup> Ed. Rawat Pub. Jaipur and New Delhi.
- Jadhav H.V. and Purohit S.H. (2011): Environmental Studies, Himalaya Publishing House, Mumbai
- Kale, V. and Gupta, A. (2001): Introduction to Geomorphology. Orient Longman, Hyderabad.
- King, C.A.M. (1966): Techniques in Geomorphology. Edward Arnold, London.
- Kumar Satish (2011): Protecting Environmental Issues- A Quest for NGO's, AVON Publication, New Delhi
- Levag & Goh Cherry (1982), Human & Economic Geography, Oxford University, Press Oxford London
- Rajagopalan R. (2014): Environmental Studies- 2<sup>nd</sup> Ed. Oxford University Press, Delhi
- Singh, S. (2004): Geomorphology. Prayag Pustak Bhawan, Allahabad.
- Singh, S. [1993]: Physical Geography. Prayag Pustak Bhawan, Allahabad.
- Singh, S. [1993]: Environmental Geography. Prayag Pustak Bhawan, Allahabad
- Strahler, A.N. (1988) Earth Science, Harper and Row Publishers, New Delhi (India reprint).
- Strahler, A.N. and Strahler, A.H. (1996), Introducing Physical Geography. John Wiley and Sons, New York.
- Thornbury, W.D. (2005): Principles of Geomorphology. John Wiley and Sons, New Delhi (India Reprint).
- उपाध्याय एल. एन. : भौतिक भूगोल राजस्थान हिन्दी ग्रन्थ अकादमी, जयपुर।
- चतुर्भुज मामोरिया एवं जैन (1961) : भौतिक भूगोल एवं जीव मण्डल, सहित्य भवन, आगरा।
- तिक्खा, रामनाथ : भौतिक भूगोल, केदारनाथ रामनाथ, मेरठ।
- पी. दयाल : भूआकृतिक विज्ञान, शुक्ला बुक डिपो।

24. शर्मा एच. एस., शर्मा एम.एल. और मिश्रा आर.एल. : "भौतिक भूगोल" पंचशील प्रकाशन जयपुर।
25. सविन्द्र सिंह : भूआकृतिविज्ञान, प्रयाग पुस्तक भवन, इलाहाबाद।
26. सविन्द्र सिंह (1971) : भौतिक भूगोल, वसुन्धरा प्रकाशन, गोरखपुर।

### MES 1.3 Environmental Chemistry

#### Section A

- a) Concept and Scope of Environmental Chemistry: Definition and explanation for various terms, segments of environment. Principles and cyclic pathways in the environment: Sulphur, Oxygen, Nitrogen, Phosphorous cycle.
- b) Chemistry of Water: Unusual physical properties, unusual solvent properties, changes in water properties by addition of solute.
- c) Soil Chemistry: Formation, constituents and properties of soils, adsorption of contaminants in soil, soil fertility, surface exchange reaction, soil redox potential and adsorption-desorption.

#### Section B

Chemistry of various organic, inorganic, carcinogenic compounds and their effects.

- a) Hydrocarbons: Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms. Surfactants: Cationic, anionic and nonionic detergents, modified detergents.
- b) Pesticides: Classification, degradation, analysis, pollution due to pesticides and DDT problems.
- c) Synthetic Polymers: Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives.
- d) Lead and its compounds: Physical and chemical properties, behavior, human exposure, absorption, influence. Aflatoxin occurrence, chemical composition and properties metabolism, acute toxicity, carcinogenicity.
- e) Destruction of some hazardous substances: Acid halides and anhydrides, alkali metals, cyanides and cyanogens bromides, chromium, aflotoxins, halogenated compounds.

#### Section C

- a) Physico-Chemical methods for analysis of environmental samples: Physico-chemical parameters; Definition and determination of conductivity, pH, COD, BOD.
- b) Estimation of various elements at major, minor trace, ultra traces level concentrations; Choice of a technique.
- c) Principle, merits and demerits of the techniques: colorimetry, atomic absorption spectroscopy, gas chromatography, HPLC, ion exchange chromatography.

#### **Books Recommended:**

1. Bhatia S. C, Environmental Chemistry, Cbs Publisher.
2. De, A. K. & De, A. K., Environmental Chemistry, New Age International Publishers.
3. Gary W.V, Stephen J. D., Environmental Chemistry, A global perspective (Third Edition), Oxford University Press.
4. Rao P. Venugopala, Principles Of Environmental Science And Engineering, PHI Learning Pvt. Ltd.
5. Séamus P. J. H., 2003, Analytical Chemistry, Oxford University Press, UK.
6. Stanley Manahan & Stanley E. Manahan, Environmental Chemistry, Ninth Edition, CRC Press.

## MES 1.4 Introduction to Computer for Environmental Science

### Section A

#### Introduction to Computers

- a) Elements of a Computer System, Block diagram of Computer System and functions of its components,
- b) Evolution of computers and classification, concept of hardware and software.
- c) Introduction to Operating Systems (DOS, Windows and UNIX).

### Section B

#### PC Software

- a) Word Processing: Creating and Saving documents, formatting, Inserting Tables and Pictures, and Mail Merge.
- b) Spread sheet: Creating worksheet, Use of functions and Creating Charts.
- c) Introduction to Presentation Packages, Graphics and Animation packages.

#### Introduction to Computing

- a) Programming languages, system and application software, compiler and interpreters,
- b) Concept of a program, program design & development, algorithms and flowchart development.

### Section C

#### Internet & Web

Introduction to popular packages on concept of computer communication, computer network (LAN, WAN, MAN), Internet, Internet Services-www, email etc.

#### Introduction to Computer Applications in Environmental Science

Data Base Management Systems,  
Statistical Packages,  
Expert Systems,  
Multilingual Applications.

#### Books Recommended:

1. Sinha, P.K., Computer Fundamentals., BPB Publication, New Delhi.
2. Taxali, R.K., PC Software for window - made simple, Tata Macgraw Hill Publication.

## MES 1.5 Fundamentals of Remote Sensing and GIS

### Section A

#### Aerial Photograph

- a) Aerial Photographs: Definition, Basic Terms and Scale
- b) Classification of aerial photographs
- c) Overlapping in aerial photographs and aerial photo mosaics
- d) Elements of aerial photo interpretation

### Section B

#### Remote Sensing

- a) Remote sensing: Definition, Process and Stages
- b) Remote sensing platforms
- c) Electromagnetic Radiation (EMR) - Properties, Interaction of EMR with the earth's surface and atmosphere
- d) Basic Principles and Applications of Thermal and Microwave Remote Sensing

### Section C

#### GIS and GPS

- a) GIS: Concept, Components and Application of GIS
- b) Data Base Management System (DBMS) in GIS
- c) Spatial analysis in GIS
- d) Basic Principles, Segments and Application of GPS

#### **Books Recommended:**

1. Abbasi, S. A. (2005) : 'Application of GIS & Remote Sensing in Environment Managements' Discovery Publishing House, New Delhi.
2. American Society of Photogrammetry (1993) : 'Manual of Remote Sensing Publishers', Falls Church Virginia.
3. Avery, T. E. & Berlin, G. L. (1985): Interpretation of Aerial photographs, Burgess, Minneapolis.
4. Bhatta B. (2014): Remote Sensing and GIS, Oxford University Press
5. Burrough, P.A. and Rachael A. McDonnell (2010) : 'Principles of Geographic Information Systems', 2nd Ed.
6. Ciciarelli John A (1991) : A Practical Guide to Aerial Photography- with an introduction to surveying, Van Nostrand
7. Curran P. J. (1985) : 'Principles of Remote Sensing, Longman, London.
8. Fazal S., (2008) : GIS Basics, New Age International Publishers
9. Ganesh A and Narayanakumat R. (2006) : GPS Principles and Applications, Satish Serial Publishing House
10. George Joseph (2008): Fundamentals of Remote Sensing, Universities Press (India) Pvt Ltd. Hyderabad
11. Heywood I, Cornelius S, Carver S. (2000) : Introduction to GIS, Addison Wesley Longman, New York
12. Kumar S. (2014) : Basics of Remote Sensing and GIS, University Science Press
13. Lillesand T.M., Kiefer, R.W. and Chipman J.W., (2011) : Remote Sensing and Image interpretation, Wiley and Sons
14. Lo CP & Yeung AKW(2004) : Concepts and Techniques of GIS, Prentice-Hall of India, New Delhi
15. Paine David P. and Kiser James D (2012) : Aerial Photograph and Image interpretation, John Wiley and Sons
16. Palet, A.N, (1992) : Remote Sensing-Principles & Application, Scientific Publishers, Jodhpur.
17. चौनियाल देवी दत्त (2010) : सुदूर सर्वेदन एवं भौगोलिक सूचना प्रणाली, शाखा पुस्तक भवन

## MES 1.6 : PRACTICAL

1. Working with Windows.
2. Working with MS office Package (MS-Word, Excel, Power Point).
3. Working with CorelDraw
4. Using Internet services
5. Using subject specific application packages.
6. Determination of conductivity of water/soil samples.
7. Determination of pH for water/soil samples.
8. Determination of TSS and TDS in water samples.
9. Determination of turbidity in water/soil samples.
10. Determination of COD in water samples.
11. Determination of BOD in water samples.
12. Determination of Dissolved Oxygen (DO) in water samples.
13. Determination of Alkalinity in water/soil samples.
14. Determination of Acidity in water/soil samples.
15. Determination of Nitrate in water/soil samples.
16. Determination of Nitrogen, Phosphorus and Potassium (N, P, K) in soil samples.
17. Determination of water, CaCO<sub>3</sub> and Carbon contents in soil samples.
18. Determination of Grain size of soil samples.
19. Determination of micronutrients (Cu, Fe, Mn and Zn) in soil samples.
20. Identify the products of combustion of hydrocarbons.
21. Test the effect of green house on the temperature.
22. Introduction to Satellite Images, TCC, FCC
23. Visual Interpretation
24. Stereoscopic Vision
25. Object Identification with Aerial Photograph
26. Introduction to GIS Software
27. Georeferencing
28. Creation of spatial data
29. Joining Non spatial with spatial data
30. Buffering
31. Map layout

## SEMESTER – II

### MES 2.1 Biostatistics And Research Methodology

#### Section A

- a) Scope of Biostatistics, variables in biology, collection, classification, tabulation of data.
- b) Frequency distribution, Diagrammatic and graphical presentation of statistical data, Sampling techniques.
- c) Measures of central location and dispersion, Simple measure of skewness and Kurtosis.
- d) Probability, conditional probability.

#### Section B

- a) Binomial, Poisson and Normal Distribution.
- b) Correlation and Regression : Least Square method of fitting, Standard error of estimate, Correlation and regression coefficient.
- c) Basic idea of significance testing, level of significance, students 't' test,  $\chi^2$  (chi-square) test and F-test, Analysis of variance.

#### Section C

- a) Introduction of Research Methodology : Meaning and importance, Nature and areas of research in Biological Sciences.
- b) Formulation of a research problem (Hypothesis).
- c) Elements in Research Methodology; Research Designs (CRD, RBD, LSD).
- d) Ethical, Legal and Social Issues in Biological Research.
- e) Writing of Research Report/Research Paper : Various components and their organization.

#### **Books Recommended :**

1. Basotia, G.R. & K.K. Sharma, Research Methodology :.
2. Chaudhary, C.H., Research Methodology, RBSA Publication.
3. Daniell, W., Elements of Biostatistical in Health Science –
4. Enhance, D.N., Fundamentals of Statistics .
5. Gupta, S.P., Statistical Methods S. Chand Publications.
6. Khan and Khanam , Fundamentals of Biostatistics , Ukaz Publications.
7. Singh, S., et. al. (1988), Statistical methods for Research Central Publishing, Ludhiana.
8. Zerold Jar, 2008, Biostatistical Analysis (3<sup>rd</sup> edition) Pearson Dorling Kindersley (India), Pvt ltd.

## MES 2.2 Environmental Biology And Toxicology

### Section A

- a) Concept of energy, conventional & non-conventional energy sources. Fossil fuels, hydro, wind and nuclear power, geothermal, solar and bioenergy.
- b) Energy flow in organisms, energy pathways & models, energy efficiencies, conservation of energy.
- c) Classification & characteristics of resources: water, soil, forest, wild life, land use.
- d) Conservation of natural resources: water, soil, forest and wild life.

### Section B

- a) Origin of pollutants: industrial, agricultural, domestic and vehicular sources.
- b) Pollutant & their toxicology: Heavy metals and trace elements. agrochemicals (Pesticides, herbicides, rodenticides & fungicides, detergents) & particulate matter.
- c) Types of radiations including ionizing & non-ionizing radiations & their interaction with matter.
- d) Radiations as environmental pollutants.
- e) Effects of radiations at cellular, molecular & genetic level.

### Section C

- a) Mutagenicity, carcinogenicity.
- b) Green house effect, acid rains.
- c) Ozone layer depletion, photochemical smog.
- d) Types of solid wastes, transport, reuse & recycling.

### **Books Recommended:**

1. Clark, Bissel & Watham , Environmental Impact Assessment.
2. Encyclopedia of pollution & its control : Vol. I-VI
3. Eugene P. Odum., Fundamentals of Ecology
4. R.L. Smith, Field Biology
5. Timberell J.A, Introduction to Toxicology

## MES 2.3 Environmental Physics

### Section-A

- a) The scope of environmental physics
- b) Laws of thermodynamics, reversible and irreversible thermodynamical process and entropy, Specific heats, Gas Laws for isothermal and adiabatic processes, Lapse rate
- c) Water and Water Vapour: vapour pressure, dew point, saturation vapour pressure defect, specific and relative humidity
- d) Transport laws: General transfer equation, molecular transfer process, diffusion coefficients
- e) Radiation Laws: black body radiations, Wien's law, Stefan's law, Planck's law, Cosine law for emission and absorption, reflectivity, radiance and irradiance, Wind chill, Hypothermia

### Section-B

- a) Radiation Environment- Solar Radiation: solar constant, sun-earth geometry, attenuation in the atmosphere, solar radiation at the ground; Terrestrial Radiation; Cloudless skies, Cloudy skies
- b) Microclimatology of radiations (interception): Direct and diffused solar radiations, Shape factors, canopies of black leaves
- c) Microclimatology of radiations (absorption and reflection): radiative properties of natural materials

### Section-C

- a) Laser applications, Laser light transmission through the atmosphere, molecular absorption and particle scattering techniques for detection of molecules of pollutants by absorption of laser,
- b) Remote monitoring capabilities of laser systems, LIDAR technique and its applications
- c) Microwaves; Environmental aspects of microwave radiations, Microwave decomposition of toxic vapour stimulants.

### Reference/Text Books:

1. Garg S. C., Bansal R. M., Ghosh C. K., Thermal Physics;; Publisher: McGraw Hill Education (India).
2. John, Monteith L. and Unsworth M.H., Principles of Environmental Physics; Publisher: Eastern Book Linkers, London (2<sup>nd</sup> Edition)
3. Orazio S., Principles of Laser, Publisher: Springer.
4. Wei G., Schmoldt D., Slusser J.R., UV Radiation in Global Climate Change: Measurements, Modeling and Effects on Ecosystem; Publisher: Springer (2010).



## MES 2.4 Applications of Remote Sensing for Natural Resource Management

### Section A

#### INTRODUCTION

- a) Emergence of Remote Sensing technology in application areas,
- b) Understanding potentials of Remote Sensing in allied sectors,
- c) Indian satellite missions with focused applications,
- d) Recent trends in Remote Sensing applications.

### Section B

#### APPLICATION IN LAND AND WATER RESOURCE

- a) Remote sensing in mapping Land use / land cover classification and monitoring,
- b) Crop forecasting, Forest resources management, soil taxonomy and degradation, geomorphology and surface mining on land resources, groundwater modelling,
- c) Water quality Monitoring, Reservoir sedimentation,
- d) Snow covers mapping and modelling approaches

### Section C

#### APPLICATION IN CLIMATE CHANGE AND DISASTER MANAGEMENT

- a) Concept of climate and weather, Climatic classification, paleo-climate
- b) Adaptation and vulnerability
- c) Mapping of landslide, Floods, Cyclones, Forest fire and Drought.

#### APPLICATION IN ENVIRONMENTAL MANAGEMENT

- a) Selection of disposal sites for industrial and municipal wastes,
- b) Solid waste management,
- c) Environmental Impact Assessment (EIA)

#### **Books Recommended:**

1. Jenson, J.R. 2000. Remote Sensing of the environment-An Earth Resource Perspective, Prentice Hall Inc.
2. Kumar P., Rani M, Pandey P (2012) "Conservation areas to beat the heat", Lambert Publication, Germani.
3. Lillisand, T. M. and Keifer, R. W. 1994. Remote Sensing and Image interpretation', John Willey and Sons, New York, Third Edition.
4. P. S. Roy (2000). Natural Disaster and their mitigation. Published by Indian Institute of Remote Sensing (IIRS), 2000.
5. P.K. Joshi and T.P. Singh (2011). Geoinformatics for Climate Change Studies, TERI Press, New Delhi.
6. P.K. Joshi, P. Pani, S. N. Mohapatra and T.P. Singh, Ed 2010 "Geoinformatics for Natural Resource Management", Nova Publishers, India
7. Schultz, G. A. and Engman, E. T. 2000. Remote Sensing in Hydrology and Water Management, Springer -Verlag, Berlin, German.
8. Spatial Technologies for Natural Hazard Management. Proceedings of ISRS National Symposium, Nov. 21-22 2000, IIT, Kharagpur.

## MES 2.5 Environmental Legislation

### Section A

#### Fundamental Principles of Domestic and International Environmental Law

- a) State sovereignty, co-operation, Indian Constitutional provision (Fundamental rights, Directive principal of State Policy and Fundamental duties ) role of courts
- b) Key elements of some International Declarations (Stockholm, Rio declaration, Agenda 21, Kyoto protocol on Climate Change)
- c) Sustainable development: Polluter Pay Principle, Precautionary Principle, Preventive Principle, Intergenerational Equity

### Section B

#### Domestic Laws on Environment

- a) The Environmental Protection Act 1986, Definition of pollution and pollutant
- b) Power of Central government, The water (Prevention and Control of Pollution) Act 1974 – Definitions, Construction Power and functions of Boards
- c) The Air (Prevention and control of Pollution) Act, 1981 – Definitions, Constitution Power and functions of Boards, National environmental Tribunal Act 1995
- d) The national Environmental Appellate Authority Act 1997

### Section C

#### Environment Related Other Laws and Policies

- a) The Forest conservation Act 1980,
- b) The Wildlife Act 1972, the Cruelty against Animal Act 1961
- c) Environmental Impact Assessment Rules 2006,
- d) Bio-Medical waste (management & handling) rules 1998,
- e) Hazardous waste (Management and Handling ) Rules 1989 and 2000

#### Books Recommended:

1. Diwan, Shyam and Rosencranz, Armin (2002) : Environmental Law and Policy in India, New Delhi, Oxford University Press.
2. Krishna, Leela. Environmental Law in India, Delhi, Lexis Nexis, Butterworth wadhwa ,
3. S.Santakumar's Introduction to Environmental Law, Nagpur, Lexis Nexis, Butterworth wadhwa
4. Sahasranaman, (2009) : P.B.Handbook of Environmental Law in India , New Delhi , Oxford University Press.

## MES 2.6 : PRACTICAL

1. Measurement of size of particles by laser technique
2. Measurement of thermal conductivity of different materials
3. Measurement of speed of electromagnetic radiations of different frequencies
4. Measurement of nuclear radiations in environment
5. Study of heat transfer by radiations and convections
6. To Determine the Hydraulic Conductivity
7. To verify Stefan's law
8. To verify Planck's law
9. Estimation of total hardness.
10. Estimation of Calcium content.
11. Estimation of Magnesium content.
12. Estimation of Chloride content.
13. Estimation of Sulphate content.
14. Estimation of Alkalinity.
15. Estimation of dissolved Oxygen.
16. Estimation of Fluoride.
17. Effect of toxicants on insects.
18. Experiment based on food preferences in insects.
19. Land Use/ Land Cover mapping
20. Crop area estimation using remote sensing
21. Forest cover and density mapping
22. Water quality modelling using remote sensing and GIS
23. Flood hazard analysis using multi- temporal imagery
24. Site suitability for solid waste management

### III SEMESTER

#### MES 3.1 Environmental Safety & Impact Assessment

##### Section A

###### Introduction:

- a) Historical development of Environmental Impact Assessment (EIA)
- b) Definition and scope of EIA
- c) Objectives of EIA
- d) Basic EIA principles.

###### Impact study:

- a) Approach for environmental impact studies
- b) EIA as planning tool
- c) EIA methodology
- d) Predictive model of impact assessment.

##### Section B

###### Impact Prediction and assessment for air, water and noise: Air:

- a) Knowledge of air quality, Air quality standards, Sources of pollutants, Effects of pollutions
- b) Conceptual approach for air impacts prediction.

###### Water:

- a) Information on water quality (Surface water and ground water), water quality standards
- b) Identification and prediction of impact and assessment.

###### Noise:

- a) Information on noise legislation and guidelines
- b) Methodology for noise-impacts prediction
- c) Assessment of impact significance.

##### Section C

###### Environmental Risk Assessment (ERA) and Management in EIA:

Environmental risk assessment, treatment of uncertainty, key steps.

###### Management Plan:

- a) Impact prediction, evaluation and mitigation
- b) Preparation of EIA plan for industrial project and functions
- c) Factors for consideration, managing the EIA process, Monitoring and auditing.

###### Books Recommended:

1. Attri S. D., Tyagi A., "Climate Profile Of India", Ministry of Earth Sciences, New Delhi.
2. Glasson J., Therivel R., Chadwick A., "Introduction to Environmental Impact Assessment", Routledge- Taylor & Francis Group.
3. Lawrence, D.P., (2003) : Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey.
4. Petts, J., (1999) : Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London.
5. Y. Anjaneyulu, (2003) : Environmental Impact Assessment, B.S Publications.

## MES 3.2 Energy Auditing and Conservation

### Section A

- a) Barriers to energy conservation, Key energy issues to 2025, Carbon dioxide emission, Energy Audits for building (Background, Energy Audit Procedures, Energy Management Programs & Energy Conservation Measures).
- b) Electrical Energy Management in Buildings (Principal Electricity Uses in Building, Strategies for Electricity End-Use Management), Heating, Ventilating and Air-Conditioning Control Systems (Modes of Feedback Control, Basic Control Hardware, Basic Control Systems Design Considerations & Example of HVAC Control Systems).
- c) Energy Efficient Lighting Technologies and Their Applications in the Commercial And Residential Sectors (Design of Energy-Efficient Lighting Systems, Lighting Technologies, Efficient Lighting Operation, Current Lighting Markets and Trends)

### Section B

- a) Energy Efficient Technologies: Major Appliances and Space Conditioning Equipment (Description of Major Appliances and Space Conditioning Equipment, Current Production & Efficient Designs), Heat Pumps (Basic Principles, Solar-Assisted Heat Pump Systems & Geothermal Heat Pumps).
- b) Industrial Energy Efficiency and Energy Management (Energy Efficiency and Energy Management Improvement, Improving Energy Audits, Electricity End Uses and Electrical Energy Management).

### Section C

- a) Electric Motor System Efficiency (Motor System Efficiency & Energy Saving Applications).
- b) Energy Storage Technologies (Overview of Storage Technologies, Principal Forms of Stored Energy, Applications of Energy Storage, Specifying Energy Storage Devices, Specifying Fuels, Energy Storage: Direct Electric, Electrochemical, Mechanical, Direct Thermal & Thermochemical).

### **Books Recommended:**

1. Abbi YP and Jain S., (2006) : Handbook on Energy Audit and Environment Management,(TERI Press).
2. Goswami D. Y., & Frank K., (2007) : Energy Management and Conservation Handbook (edited) (CRC Press (Taylor & Francis Group).
3. Goswami D. Y., & Frank K., (2015) : Energy Efficiency & Renewable Energy Handbook, (edited) Second Edition, CRC Press (Taylor & Francis Group).
4. Polimeros G., (1981) : Energy Cogeneration Handbook, (Industrial Press, Inc., New York.
5. Threlkeld J.L ., (1970) : Thermal Environmental Engineering, Second Edition (Prentice Hall).
6. Trinks, W ., Mawhinney, M.H., Shannon, R.A. Reed RJ., Garvey J.R. (2003): Industrial Furnaces, SixthEdition, (John Wiley & Sons).
7. Turner WC (2007) : Energy Management Handbook, Seventh Edition, (Fairmont Press Inc.).
8. Witte, LC., Schmidt PS and Brown D.R., (1998) : Industrial Energy Management and Utilization (Hemisphere Publishing Corporation, Washington).

### **Websites:**

1. National Productivity Council (<http://www.npcindia.org/>)
2. EA/EM Guide Books (<http://www.bee-india.nic.in/index.php?module=tri&id=4>)

## Mes 3.3 Disaster Management and Mitigation Strategies

### Section A

#### Introduction to Disaster and Hazards

- a) Hazards and Disaster: Definition and Difference; Types of Hazards and Disaster; causes and consequences
- b) Prediction and Indicators of Natural Disasters
- c) Natural Disasters – Earthquakes, Cyclones, Floods, Drought and Landslides
- d) Man Made Disaster – Nuclear and Chemical

### Section B

#### Impact of Disaster and Case Studies

- a) Social, Economic and Health impacts of Disaster
- b) Floods - one case study with special reference to Brahmaputra Basin
- c) Drought – one case study with special reference to Vidarbha and Telangana region
- d) Earthquake – one case study with special reference to Himalayan region
- e) Nuclear – Hiroshima and Nagashakhi

### Section C

#### Natural Disaster Management and Preparedness

- a) Disaster Management: Prevention, Preparedness and Mitigation
- b) Planning and control of Natural Disaster
- c) National and State level planning for Hazard Mitigation
- d) Role of Natural Disaster Management Authority

#### **Books Recommended:**

1. BMTPC & CDMM (2003) : Landslide Hazard Zonation of India, New Delhi.
2. Bolt, B.A. (1988) : Earthquakes WH Freeman & Company, New York.
3. Decker, R.W. & BB Decker (1998): Volcanoes, 3<sup>rd</sup> Edition WH Freeman & Company, New York.
4. Dowrick, D. (2003) : Earthquake Risk Reduction Zone Wiley & Sons Ltd, Sussex England.
5. Drake, F. (2000) : Global Warming the Science of Climate Change, Oxford University Press, New York.
6. Gere, J.M., Shah., H.C. (1984) : Terra Non Firme Understanding and Preparing for Earthquakes, WH Fremman & Company, New York.
7. Govt. of India, (2002), Drought 2002 a Report (part I), Ministry of Agriculture, Dept. of Agriculture and Cooperation , New Delhi.
8. Govt. of India, (2002), Drought 2002 States Report (part II), Ministry of Agriculture, Dept. of Agriculture and Cooperation , New Delhi.
9. Govt. of India, (2004), Annual Reports, Ministry of Agriculture, Dept. of Agriculture and Cooperation, 1999-2000, 2002-2003, 2003-2004, New Delhi.
10. IGNOU (2005) : Understanding Natural Disasters, Shagun Offset Press, Noida.
11. IMD (1972) : Cyclone and safeguards, New Delhi.
12. Inca., M. (1990) : The Rising Seas, Earthscan, London.
13. IPCC (2001) : Climate Change, University of Cambridge.
14. Prakash, I. (1994) : Disaster Management – Rastriya Prahari Prakashan, Ghaziabad.
15. Roy., S. (2004) : Natural Disaster Management – a case study of Tornado, Abhijit Publications, New Delhi.
16. Savindra S. (2015) : Environmental Geography, Pravika Publications, Allahabad.
17. Sharma, V.K. (1995) : Disaster Management (ed.), IIPA, New Delhi.
18. Singh, Tej (2006) : Disaster Management Approaches and Strategies, Akanksha Publishing House, New Delhi
19. Sinha, D.K. (2006) : Towards Basics of Natural Disaster Reduction, Reasearchco, Book Centre, New Delhi.
20. Thomas, B. (1993) : disaster response: A Handbook for Emergencies, CASA, New Delhi.
21. Ward, R. (1978) : Floods A Geographical perspective, Mac. Millan press Ltd.

## MES 3.4 Solid Waste Management

### Section A

- a) Concept of solid waste, Types, composition and classification of solid waste,
- b) Effects of solid waste generation on quality of air, water and public health.
- c) Need of Solid Waste Management.
- d) Principal of Solid Waste Management, Technical approach for solid waste management: collection, transportation, Disposal, Recovery and recycling of organic waste.
- e) 3R Principle (Reduce, Reuse and Recycle).

### Section B

- a) Solid waste disposal and Management methods – Recycling, Vermi-composting and incineration, pyrolysis, biogas generation, solid waste as a source of raw material (light weight bricks from fly ash, composting)
- b) Landfill Planning and designing, Act and rules for Solid waste management.
- c) Case studies on solid wastes (Jaipur city and Vishakhapatnam city)

### Section C

- a) Hazardous waste, types of hazardous waste and its classification, Management of hazardous wastes.
- b) Biomedical waste and its management
- c) Radioactive waste and pollution – concept, sources, types and possible hazardous of radioactive substances, measurement of radiation intensity.
- d) Monitoring and control of radiation pollution, Effects of radioactive waste.

### **Books Recommended:**

1. A.D., and Sundaresan, B.B. Bhide (1987) : Solid Waste Management in Developing countries, INSDOC, New Delhi.
2. C.J. Barrow (1993) : Developing the Environment Problems and Management
3. David Alexander (1993) : National Disaster, UCL Press London, U.K.
4. Dhamija, U. (2006) : Sustainable Solid Waste Management-Issues Policies and Structures, Academic Foundation Publication, New Delhi.
5. Hosetti B.B. and Kumar Darya (1998) : Environmental Impact Assessment and Management, Pub. House New Delhi.
6. Manual on Municipal Solid Waste Management (2005, 2011) : Prepared by the Expert Committee constituted by the Government of India, Ministry of Urban Development, Published by the controller of Publication
7. Peter Calow (1998) : Handbook of Environmental risk Assessment and Management, Blackwell Science Ltd.
8. Rasure, K. A. (2007) : Solid Waste Management, Environment and Sustainable Development, Serials Publications, New Delhi.
9. S.K.Agarwal (1997) : Environmental Issues and Threats, APH Publishing Corporation.
10. Walter H. (1990) : The Global Ecology handbook - Corson Beacon Press Boston.
11. Wim Salomons & S.LIForstner (1990) : Environmental Management of Solid waste.

## MES 3.5 ELECTIVES

### MES EE.1 Environmental Biotechnology

#### Section A

- a) Definition and Scope of Environmental Biotechnology; Environmental Pollution; Types, Causes and Effects of Soil, air, water, oil and heavy metal.
- b) Pollution, control measures. Social Issues- Green House Gases, Global Warming, Acid Rain, Ozone depletion, nuclear accidents and holocaust.
- c) Purification of waste water; Aerobic and anaerobic treatments; Laboratory methods for the detection of coli form organisms in water; Water recycling methods; Management of radioactive pollutants in water, VOC, COD BOD and BOD sensors.

#### Section B

- a) Molecular biology tools for Environmental management, rDNA technology in waste treatment, Genetically modified organisms in Waste management, Genetic Sensors, Metagenomics, Bioprospecting, Nanoscience in Environmental management, Phytoremediation for heavy metal pollution, Biosensor development to monitor pollution.
- b) Biomass waste as renewable source of energy, Cellulose and Hemi cellulose as source of energy Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biofuels, Biomineralization, Bioethanol and Biohydrogen,

#### Section C

- a) Bioelectricity through microbial fuel cell, Conversion of Solid Waste to Methane; Biogas production, Management of Sludge and Solid waste treatment- Land filling, lagooning, Ecofriendly agriculture.
- b) Definition, Types- Ex situ and In situ Bioremediation; genetically Engineered Microbes for Bioremediation; Bioremediation of Ground Water; Biodegradation of Hydrocarbons, Pesticides, Herbicides, Insecticides and Xenobiotics.

#### **Books Recommended:**

1. Chakraborty K.D. Omen G.S. (1989) : Biotechnology and Bio degradation, Advances in Applied Biotechnology series, Vol. I, Gulf Publications Co. London.
2. Foster C.F; Lohnware D.A. (1987) : Environmental Biotechnology.Ellis Harwood Ltd.
3. Sharma DL., Organic farming
4. Thakur, I.S., (2006) : Environmental Biotechnology- Basic concepts and Applications.



## MES EE.2 Biodiversity & Conservation

### Section A

- a) Introduction to biodiversity concepts, significance, magnitude and distribution.
- b) Biodiversity trends, diversity gradients and related hypotheses methods for monitoring biodiversity trends.
- c) Threats to biodiversity, major causes, extinction's, vulnerability of species to extinction, IUCN threat categories, Red data book.

### Section B

- a) Principles of biodiversity conservation Ex situ and In situ methods of conservation, Genetical and evolutionary principles in conservation.
- b) Conservation of biological diversity and its significance- source of food, medicine, raw material, aesthetic, cultural and ecosystem services.
- c) Concepts, distribution and importance of Hot spots.
- d) Strategies for sustainable exploitation of biodiversity.

### Section C

- a) Conservation – efforts in India, Endangered flora & fauna of India.
- b) Ethan botany in India & selected medicinal plants.
- c) Wildlife conservation in India- Project Tiger, Project crocodile, silent valley controversy.
- d) Conservation of Himalayan, Gangetic ecosystems.

### **Books Recommended:**

1. Global biodiversity status of the earth's living resources. Published by Crapman and Hall, 2-6 Boundary Row, London SE1 8HN. Compiled by World Conservation Monitoring Centre.
2. Kovacs, M. (1995) : Pollution Control and Conservation, Ellis Horwood Ltd., Chichester. 398p
3. Kumar A., Biodiversity and environment. Published by A.P.M. Publishing Corporation, New Delhi.
4. Kumar and Asija. Biodiversity – Principles and conservation. Published by UpdeshPurohit for Agrobios, Jodhpur, India.
5. Mishra, R. (1968) : Ecology Work Book Oxford and IBH Publishing Co, Calcutta, pp. 244.
6. Odum, E.P. (1983) : Basic Ecology. Saunders College Publishing, Holt Saunders, Japan, 613.
7. Odum, E.P. Fundamentals of Ecology, Natraj Publisher, Dehradun
8. Singh, Vishwakarma. Forest environment and biodiversity. Daya Publishing House, Delhi.
9. Sinha, B.N. (1990) : Eco-system Degradation in India. Ashish Publishing House, New Delhi.
10. Tewari, D.N. Biodiversity and forest genetic resources. Published by InternationalBook Distributions, Dehra Dun.

## MES EE.3 Environmental Health Management

### Section A

- a) Meaning of health: Physical, Mental and Social
- b) Environmental factors influencing health: Urbanization & congestion, pollution.
- c) Environmental health criteria, Concept of environmental health management

### Section B

- a) WHO classification of diseases and their distribution: Water borne diseases; Prevention and protection of community health from water borne diseases.
- b) Air borne bio-allergens; present in the ambient air, seasonal changes, mode of dispersal, disease intensity and control.

### Section C

- a) Effects of Physical Environment on Accidents, Crime, Suicide and Diseases of Man
- b) Effects of temperature, humidity, ionization, ultra violet radiation and acidity of air on skin, lungs, throat, nose, eye, nervous system.
- c) Effects of weather and climate on diseases, mental processes, working efficiency, traffic and industrial accidents, behaviour, suicide and suicide attempts, effect of thermal stress and altitude on the action of drug.

### **Books Recommended:**

1. Abdul, M., et.al. (2014) : Environmental Deterioration and Human Health, Springer Dordrecht Heidelberg London.
2. Ahluwalia, V.K. (2015) : Environmental Pollution and Health, TERI, New Delhi.
3. Annalee, Y., et.al. (2001) : Basic Environmental Health, Oxford University Press, New York.
4. Kathryn, H. (2006) : Environmental Health Ecological Perspective, Jones & Bartlett Learning, Sudbury, Massachussetts.
5. Robert, H.F., Essentials of Environmental Health, 2<sup>nd</sup> Edition, Jones & Bartlett Learning, Sudbury, Massachussetts.
6. Singh, A.L. (2010) : Environment and Health, B.R. Publishers, New Delhi.

## MES EE.4 Air Pollution Monitoring, Control Technology and Management

### Section A

- a) Air pollution: Definition, sources and effects.
- b) Air pollutants; Classification and properties, emission sources, major emissions from global sources and importance of Anthropogenic sources.
- c) Effects of air pollution on health, vegetation and materials damages. Photochemical smog.

### Section B

- a) Control techniques and equipments for air pollution, particulate emission control: Gravitational settling chambers, cyclone separators, fabric filters, electrostatic precipitator, wet scrubbers.
- b) Control of specific gaseous pollutants; control of SO<sub>x</sub>, control of NO<sub>x</sub>, control of hydrocarbons, and control of carbon mono-oxide

### Section C

Air pollution sampling and measurement: Types of pollutant sampling and measurement, ambient air sampling, collection of gaseous air pollutants, collection of particulate pollutants, stack sampling, analysis of air pollutants

### **Books Recommended:**

1. Alan Andrews (2014), The Clean Air A Practical Guide To EU Air Quality Law, Clientearth274 Richmond Road London
2. Arthur C Stern (1976.), AIR POLLUTION. Volume III Measuring, monitoring and surveillance of air pollution. THIRD EDITION.. Academic Press.
3. Arthur C Stern (1986), AIR POLLUTION. Volume VII. Supplement to measuring, monitoring and surveillance and engineering control of air pollution. THIRD EDITION.. Academic Press.
4. Buonicore A, Wayne T. Davis (1992). Air Pollution Engineering Manual. Van Nostrand Reinhold, New York, USA.
5. Buonicore A., Theodore L. (1994). Air Pollution Control Equipment: Selection, Design, Operation and Maintenance. Springer-Verlag, New York, USA.
6. Burke G, Singh B R and Theodore L (2000). *Handbook of Environmental Management and Technology*, 2nd edition. John Wiley & Sons, Inc. New York.
7. Burke G.H., Singh B.R., and Theodore L. (2000). *Handbook of Environmental Management and Technology (Second Edition)*. John Wiley & Sons, Inc., New York, USA.
8. Cavaseno V. (1980). *Industrial Air Pollution Engineering*. McGraw-Hill Publications Co., New York, N.Y., USA.
9. Cheremisinoff P.N. (1993). *Air Pollution Control and Design for Industry*. Marcel Dekker, Inc., New York, USA.
10. De Nevers N.(2000). *Air Pollution Control Engineering (second edition)*. McGraw-Hill Companies, USA.
11. Franek, William and DeRose, (2004) *Principles and Practices of Air Pollution Control*, United States Air Pollution Training Institute (APTI)
12. Heinsohn R.J. and Kabel R.L.(1999). *Sources and Control of Air Pollution*. Prentice, New Jersey, USA.
13. James P Lodge(1988.), *Methods of Air Sampling and Analysis*. Third Edition. Lewis Publishers.
14. Kovacs, M. 1995. *Pollution Control and Conservation*. Ellis Horwood Ltd., Chichester.398p
15. Kumar S. and Kumar R. (2012) *Air Quality – Monitoring and Modeling* Published by InTech Janeza Trdine 9, 51000 Rijeka, C
16. Metcalf & Eddy, Inc. (1991). *Wastewater Engineering-Treatment, Disposal, and Reuse*, 3rd edition, McGraw-Hill, New York.
17. Nicholas p. Cheremisinoff, (2002) *handbook of Air pollution prevention and control*, butterworth-heinemann of elsevier science. Printed in the United States of America

## MES EE.5 Water Pollution Monitoring, Control Technology and Management

### Section A

- a) Water pollution- Causes and Pollutants
- b) Categories of waste water, generation of waste water
- c) Water resource management.

### Section B

- a) Waste water sampling and monitoring
- b) Methods of analysis, determination of organic matter, inorganic substances
- c) Physical characteristics of bacterial measurements.

### Section C

- a) Waste water treatment, Basic processes of primary treatments; Pre treatment, sedimentation and floatation.
- b) Secondary treatments; Activated sludge process, Trickling filter, sludge treatment and disposal.
- c) Advanced waste water treatment, N-removal, P-removal, Advanced Biological Systems, Chemical oxidation, Removal of suspended solids, Dissolved solids.

### **Books Recommended:**

1. Burke G, Singh B R and Theodore L (2000) : *Handbook of Environmental Management and Technology*, 2nd edition. John Wiley & Sons, Inc. New York.
2. Daniel P. Loucks and Eelco van Beek (2005) : *Water Resources Systems Planning and Management An Introduction to Methods, Models and Applications*, Studies and Reports in Hydrology UNESCO PUBLISHING
3. Eilbeck W J and Mattock G (1987). *Chemical Processes in Waste Water Treatment*, Ellis Horwood Limited.
4. Gray N F (1990). *Activated Sludge, Theory and Practice*, Oxford University Press, Oxford.
5. Jamie Bartram and Richard Balance (2007) *Water Quality Monitoring. A practical guide to the design and implementation of freshwater quality studies and monitoring programmes* Published on behalf of United Nations Environment Programme Published by E&FN Spon, an imprint of Chapman & Hall, 2-6 Boundary Row, London UK
6. Kostas Voudouris and Dimitra Voutsas, (2012) *Water Quality Monitoring and Assessment* Published by InTech Janeza Trdine 9, 51000 Rijeka, Croatia
7. Metcalf & Eddy, Inc. (1991). *Wastewater Engineering-Treatment, Disposal, and Reuse*, 3rd edition, McGraw-Hill, New York.
8. Richard Helmer and Ivanildo Hespanhol (1997) *Water Pollution Control - A Guide to the Use of Water Quality Management Principles Edited by*, United Nations Environment Programme, First edition 1997 © WHO/UNEP Printed in Great Britain by St Edmundsbury Press, Bury St Edmunds, Suffolk
9. UNEP, *Water Quality for Ecosystem and Human Health*, 2nd Edition Prepared and published by the United Nations Environment Programme Global Environment Monitoring System (GEMS)/Water Programme. Burlington, Ontario, CANADA
10. UNICEF (2008) : *Handbook on Water Quality*, United Nations Children's Fund (UNICEF), New York.

### MES 3.6 : PRACTICAL

1. Impact of land use patterns on biodiversity over a period of time (**Field Survey**).
2. List of Impacts at the stage of construction and operation (**Field Survey**).
3. To collect and interpret various water sample data.
4. To conduct survey of microorganisms of water and soil.
5. To measure sound from different sources.
6. To record and analysis of climate trends by taking meteorological data of rainfall and temperature.
7. Physical composition of solid waste / refuse
8. Physical characterization of solid waste / refuse.
9. Construct the composting pit.
10. Construct the pit for vermiculture.
11. Planning and design of landfill sites.
12. EIA methods in Solid waste disposal- Leopold matrix and overlay.
13. Study of biogas plant.
14. Determination of soluble and insoluble fraction in community solid waste.
15. Measurement of intensity of solar radiation.
16. Estimation of efficiency of solar photovoltaic panels
17. Effect of Shadow & tilt angle on solar photo voltaic panel
18. Study on solar photo voltaic panel in series and parallel combination
19. Study on charging characteristics of a lead acid battery using solar photo voltaic
20. Study on green house effect on solar flat plate collector
21. Estimation of instantaneous efficiency of a solar liquid flat plate collector
22. Study on solar flat plate collector in series and parallel combination
23. Estimation of efficiency of solar air heaters
24. Performance evaluation of concentrating solar collector
25. Performance evaluation of solar cooker

Verified



Offg. Secretary  
Banasthali Vidyapith  
P.O. Banasthali Vidyapith  
Distt. Tonk (Raj.)-304022

**MINUTES OF THE MEETING OF BOARD OF STUDIES IN SCHOOL OF EARTH SCIENCES HELD ON 29<sup>th</sup> DECEMBER, 2018 AT 3.00 P.M. IN THE CONFERENCE ROOM, BHU MANDIR, BANASTHALI VIDYAPITH, RAJASTHAN.**

**PRESENT**

1. Mr. Amit Kumar Mishra	-	Internal Member
2. Dr. Anju Patel	-	Internal Member
3. Mrs. ArpanaChaudhary	-	Internal Member
4. Ms. ArushiRana	-	Internal Member
5. Dr. Ashima Sharma	-	Internal Member
6. Dr. Ashutosh	-	Internal Member
7. Dr. Ashutosh Kumar Pandey	-	Internal Member
8. Ms. ChetnaSoni	-	Internal Member
9. Dr. Chilka Sharma	-	Internal Member
10. Dr. Kartar Singh	-	Internal Member
11. Dr. Kh. Moirangleima	-	Internal Member
12. Dr. MamtaChauhan	-	Internal Member
13. Dr. Ng. Mamata Devi	-	Internal Member
14. Mrs. PradeepikaKaushik	-	Internal Member
15. Dr. Rashmi Sharma	-	Convener
16. Dr. Resmi M.R.	-	Internal Member
17. Dr. SalahuddinMohd.	-	Internal Member
18. Dr. Sarika Singh	-	Internal Member
19. Dr. Subhashree Mishra	-	Internal Member
20. Dr. Vipin Kumar	-	Internal Member
21. Mr. Vivek Deep	-	Internal Member
22. Ms. NishaChoudhary	-	Special Invitee
23. Ms. Rinku Singh	-	Special Invitee
24. Prof. H.S.Sharma	-	External Member
25. Prof. M.G. Thakkar	-	External Member
26. Prof.P.K. Joshi	-	External Member

**Note:** Prof. H.S.Sharma, Prof. P.K. Joshi, Prof. M.G. Thakkar, Dr. Ng. Mamata Devi and Mrs. PradeepikaKaushik could not attend the meeting.

The meeting started with a welcome of the members by the convener of Board of Studies for School of Earth Sciences, Dr. Rashmi Sharma, Dean, School of Earth Sciences, Banasthali Vidyapith, Rajasthan.

1. The board took up the minutes of its last meeting held on April, 24, 2016.

The Board resolved that the minutes to be confirmed.

2. The board reviewed the existing panel of examiners and suggested to update the address and phone numbers of the existing examiners for each examination of Geography, Geology, Remote Sensing, Environmental Science and Environment Studies of UG, PG,

and M.Phil. examination keeping in view the by-law 15.03.02 of the Vidyapith. Updated panel is sent to the examination and secrecy section.

3. The board reviewed the Study/Curricula, scheme of examination and proposed revisions in various courses of study as follows:

**B.A./B.Sc.**

i.	First Semester	Minor change <sup>a</sup>
ii.	Second Semester	Minor change <sup>b</sup>
iii.	Third Semester	Minor change <sup>c</sup>
iv.	Fourth Semester	Minor change <sup>d</sup>
v.	Fifth Semester	Major change <sup>e</sup>
vi.	Sixth Semester	Major change <sup>f</sup>

The Board reviewed the objectives, syllabi, learning outcomes of the B.A./B.Sc. (Geography).

(a) In B.A./B.Sc. (Geography) I Semester, revision in the syllabus of *Fundamentals of Cartography Lab* (Course Code: GEOG 101L) was proposed. Board discussed the revision proposed and agreed upon the suggested syllabus. Board also recommended implementing the proposed revision in syllabus of *Fundamentals of Cartography lab* Semester Examination, December, 2019.

(b) In B.A./B.Sc. (Geography) II Semester, revision in the syllabus of *Statistical Techniques and Data Representation lab* (Course Code: GEOG 104L) & *Human Geography* (Course Code: GEOG 102) were proposed. Board discussed the revision proposed and agreed upon the suggested syllabus. Board also recommended implementing the proposed revision in syllabi of *Statistical Techniques and Data Representation lab, Human Geography* Semester Examination, April/May, 2020.

(c) In B.A./B.Sc. (Geography) III Semester, revision in the syllabus of *Introduction to Geography of India* (Course Code: GEOG 202) was proposed. Board discussed the revision proposed and agreed upon the suggested syllabus. Board also recommended implementing the proposed revision in syllabus of *Introduction to Geography of India* Semester Examination, December, 2020.

(d) In B.A./B.Sc. (Geography) IV Semester, revision in the syllabus of *Relief Representation and Topographical Maps lab* (Course Code: GEOG 204L) & *Economic Geography* (Course Code: GEOG 201) were proposed. Board discussed the revision proposed and agreed upon the suggested syllabus. Board also recommended implementing the proposed revision in syllabi of *Relief Representation and Topographical Maps lab, Economic Geography* Semester Examination, April/May, 2021.

(e) In B.A./B.Sc. (Geography) V Semester, revision in the syllabus of *Map Projection lab* (Course Code: 5.2) was proposed. Board discussed the revision proposed and agreed upon the suggested syllabus. Board also recommended implementing the proposed revision in syllabus of *Map Projection lab* Semester Examination, December, 2021. The Board proposed introduction of pool of Discipline Elective courses and agreed upon it. The courses *Geographical Thought* (Course Code: GEOG 302) and *World Regional Geography* (Course Code: GEOG 304) has been shifted in the pool as courses *Geographical Thought* (Course Code: GEOG\_to be generated) and *World Regional Geography* (Course Code: GEOG\_to be generated) of Discipline electives and another two new courses has also been added.

(f) In B.A./B.Sc. (Geography) VI Semester, revision in the syllabus of *Geographical Thought* (Course Code: GEOG 6.1) was proposed. Board discussed the revision proposed and agreed upon the suggested syllabus.

The Board proposed introduction of pool of Discipline Electives in Semester V and VI also and agreed upon it.

**List of Discipline Electives:**

*Environment and Disaster Management* (Course Code: GEOG\_to be generated)

*Geographical Thought* (Course Code: GEOG\_to be generated)

*Settlement Geography* (Course Code: GEOG\_to be generated)

*World Regional Geography* (Course Code: GEOG\_to be generated)

Board proposed to introduce Open (Generic) audit/credit Elective and agreed to implement as per Vidyapith policy.

Board also recommended implementing the proposed changes in syllabus from Semester Examination, April/May, 2022.

**Board recommended implementation of reviewed Recommended Books and e-learning materials from session 2019-20 in all semesters respectively.**

Programme educational objectives, outcomes and the list of courses of the B.A./B.Sc. (Geography) programme is attached and marked as **Annexure –1 (PP. 1-4)**.

The revised syllabus, learning outcomes, list of recommended books and e-learning materials of the B.A./B.Sc. (Geography) programme is attached and marked as **Annexure –2 (PP. 1-37)**.

**I. B.Sc. (Geology):**

i.	First Semester	Major change <sup>a</sup>
ii.	Second Semester	Major change <sup>b</sup>
iii.	Third Semester	Major change <sup>c</sup>



iv.	Fourth Semester	Major change <sup>d</sup>
v.	Fifth Semester	Major change <sup>e</sup>
vi.	Sixth Semester	Major change <sup>f</sup>

The Board reviewed the objectives, syllabi, learning outcomes of the **B.Sc. (Geology)**.

- a) In B.Sc. Geology I Semester, the courses *Physical Geology and Plate Tectonics* (Course Code: GEOL 102) & *Physical Geology and Plate Tectonics Lab* (Course Code: GEOL 102 L) have been proposed to be replaced by new course *Physical Geology* (Course Code: *to be generated*) containing both theory and practical. Board discussed the changes proposed and agreed upon suggested changes. Board also recommended implementing the proposed replacement in the syllabus of new course in Semester Examination, December, 2019.
- b) In B.Sc. Geology II Semester, the courses *Mineralogy, Crystallography and Economic Geology* (Course Code: GEOL 101) & *Mineralogy, Crystallography and Economic Geology Lab* (Course Code: GEOL 101L) have been proposed to be replaced by new course *Structural Geology and Plate Tectonics* (Course Code: *to be generated*) containing both theory and practical. Board discussed the changes proposed and agreed upon suggested changes. Board also recommended implementing the proposed replacement in the syllabus of new courses in Semester Examination, April/May, 2020.
- c) In B.Sc. Geology III Semester, the courses *Petrology and Structural Geology* (Course Code: GEOL 202) & *Petrology and Structural Geology Lab* (Course Code: GEOL 202L) have been proposed to be replaced by new course *Mineralogy, Crystallography and Geochemistry* (Course Code: *to be generated*) containing both theory and practical. Board discussed the changes proposed and agreed upon suggested changes. Board also recommended implementing the proposed replacement in the syllabus of new courses in Semester Examination, December, 2020.
- d) In B.Sc. Geology IV Semester, the courses *Palaeontology and Stratigraphy* (Course Code: GEOL 201) & *Palaeontology and Stratigraphy Lab* (Course Code: GEOL 201L) have been proposed to be replaced by new course *Petrology and Economic Geology* (Course Code: *to be generated*) containing both theory and practical. Board discussed the proposed changes and shifting of the courses and agreed upon suggested changes. Board also recommended implementing the proposed changes in the syllabus of new courses in Semester Examination, April/May, 2021.
- e) In B.Sc. Geology V Semester, the courses *Geochemistry, Geomorphology, Photogeology and Remote Sensing* (Course Code: 5.1) & *Geochemistry, Geomorphology, Photogeology and Remote Sensing Lab* (Course Code: 5.2) have been proposed to be replaced by newly introduced pool of Discipline Electives containing both theory and practical. Board discussed the changes proposed and agreed upon the suggested changes. Board also

recommended implementing the proposed replacement in the syllabus of new courses in Semester Examination, December, 2021.

- f) In B.Sc. Geology VI Semester, the courses *Hydrogeology, Environmental and Engineering Geology* (Course Code: 6.1) & *Hydrogeology, Environmental and Engineering Geology Lab* (Course Code: 6.2) have been replaced by newly introduced pool of Discipline Electives containing both theory and practical. Board discussed the changes proposed and agreed upon suggested changes. Board also recommended implementing the proposed replacement in the syllabus of new courses in Semester Examination, April/May, 2022.

The Board proposed introduction of pool of Discipline Electives containing both theory and respective practicals and agreed upon it.

**List of Discipline Electives:**

*Applied Geology* (Course Code: GEOL\_*to be generated*)

*Field Geology: Tools and Techniques* (Course Code: GEOL\_*to be generated*)

*Geology of Rajasthan* (Course Code: GEOL\_*to be generated*)

*Palaeontology and Stratigraphy* (Course Code: GEOL\_*to be generated*)

Board proposed to introduce Open (Generic) audit/credit Elective and agreed to implement as per Vidyapith policy.

Board recommended implementation of reviewed Recommended Books and e-learning materials from session 2019-20 in all semesters respectively.

Programme educational objectives, outcomes and the list of courses of the B.Sc. (Geology) programme is attached and marked as **Annexure –3 (PP. 1-5)**.

The revised syllabus, learning outcomes, list of recommended books and e-learning materials of the B.Sc. (Geology) programme is attached and marked as **Annexure -4 (PP. 1-55)**.

**III. M.A./M.Sc. (Geography):**

i.	First Semester	Minor Change <sup>a</sup>
ii.	Second Semester	Minor Change <sup>b</sup>
iii.	Third Semester	Major Change <sup>c</sup>
iv.	Fourth Semester	Major Change <sup>d</sup>

The Board reviewed the objectives, syllabi, learning outcomes of the M.A./M.Sc. (Geography).

The Board discussed the recent trends in Geography at postgraduate level and found that the knowledge of computational software is the necessity of today's research environment. In addition to this, board suggested to give more weightage to self-learning and independent research activities.

(a) In M.A./M.Sc. (Geography) I Semester, the board reviewed the syllabi of *Cartographic Techniques Lab* (Course Code: GEOG 402L). It was found that students had already studied the diagrammatic representation of data manually in their graduation. It was suggested to introduce advanced techniques of this diagrammatic representation using Microsoft Excel at post graduate level. Board also recommended implementing the proposed revision in syllabus of *Cartographic Techniques Lab* Semester Examination, December, 2019.

(b) In M.A./M.Sc. (Geography) II Semester, the board reviewed the syllabi of *Geography of India* (Course Code: GEOG 406) & *Oceanography* (Course Code: GEOG 409) and recommended to add some topics for enrichment and specification. Board also recommended implementing the proposed revision in syllabi of *Geography of India* and *Oceanography* Semester Examination, April/May, 2020.

(c) In M.A./M.Sc. (Geography) III Semester, the board reviewed the syllabi of *Political Geography* (Course Code: GEOG 504), *Research Methodology and Quantitative Techniques* (Course Code: GEOG 507), *Systematic Agricultural Geography* (Course Code: GEOG 510) and *Surveying Lab* (Course Code: GEOG 509L) and recommended to add some topics for enrichment and specification. Board also recommended implementing the proposed revision in syllabi of *Political Geography*, *Research Methodology and Quantitative Techniques*, *Systematic Agricultural Geography* and *Surveying Lab* Semester Examination, December, 2020.

The Board proposed introduction of pool of Discipline Electives and courses of Elective I *Population Geography* (Course Code: GEOG 505) and *Social Geography* (Course Code: GEOG 508) to be shifted in pool of Discipline Electives and agreed upon it.

Board recommended the introduction of Reading Elective I which has to be opted from common pool of Reading Electives in PG courses of School of Earth Sciences (Environmental Science, Geology & Geography).

The Board also recommended implementing the Reading Elective by III Semester Examination, December, 2020.

(d) In M.A./M.Sc. (Geography) IV Semester, the board reviewed the syllabi of *Environmental Geography* (Course Code: GEOG 501), *Remote Sensing and GIS* (Course Code: GEOG 506), *Remote Sensing and GIS Lab* (Course Code: GEOG 506 L), *Geography of Rural Settlements* (Course Code: GEOG 502) and *Urban Geography* (Course Code: GEOG 512) and recommended to add some topics for enrichment and specification. Board also recommended implementing the proposed revision in syllabi of *Environmental Geography*, *Remote Sensing and GIS*, *Remote Sensing and GIS Lab*, *Geography of Rural Settlements* and *Urban Geography* Semester Examination, April/May, 2021.

The Board proposed introduction of pool of Discipline Electives and courses of Elective II *Geography of Rural Settlements*(Course Code: GEOG 502)and *Tourism Geography*(Course Code: GEOG 511) and courses of Elective III *Medical Geography*(Course Code: GEOG 503) and *Urban Geography*(Course Code: GEOG 512) to be shifted in pool of Discipline Electives and agreed upon it.

**List of Discipline Electives:**

- *Geography of Rural Settlements* (Course Code: GEOG 502)
- *Medical Geography* (Course Code: GEOG 503)
- *Population Geography* (Course Code: GEOG 505)
- *Social Geography* (Course Code: GEOG 508)
- *Tourism Geography* (Course Code: GEOG 511)
- *Urban Geography* (Course Code: GEOG 512)

Board recommended the introduction of Reading Elective II which has to be opted from common pool of Reading Electives in PG courses of School of Earth Sciences (Environmental Science, Geology & Geography).

The Board has proposed the following List of Reading Electives in the curricula:

- *Agroforestry* (Course Code :ENVS\_R to be generated)
- *Energy Resources and Conservation* (Course Code: ENVS\_R to be generated)
- *Man and Environment* (Course Code :ENVS\_R to be generated)
- *Water and Sustainable Development* (Course Code : ENVS\_R to be generated)
- *Environmental Challenges and Disaster Management* (Course Code :GEOG\_R to be generated)
- *India: Socio-Political and Environmental Scenario* (Course Code: GEOG\_R to be generated)
- *Rajasthan: Challenges and Prospects*(Course Code :GEOG\_R to be generated)
- *Transforming India* (Course Code: GEOG\_R to be generated)
- *Geo Tourism* (Course Code: GEOL\_R to be generated)
- *Indian Mineral Deposits, Economics and Mining Ethics* (Course Code: GEOL\_R to be generated)
- *Innovation and Entrepreneurship in Earth Sciences* (Course Code: GEOL\_R to be generated)
- *Natural Hazards and Disasters* (Course Code: GEOL\_R to be generated)

Board proposed to introduce open elective course in Semester IV.

Board recommended implementation of reviewed recommended books and e-learning materials from session 2019-20 in all semesters respectively.

Programme educational objectives, outcomes and the list of courses of the M.A./M.Sc. (Geography) programme is attached and marked as **Annexure –5 (PP. 1-6)**.

The revised syllabus, learning outcomes, list of recommended books and suggested e-learning materials of the M.A./M.Sc. (Geography) programme is attached and marked as **Annexure -6 (PP. 1-80)**.

#### IV. M.Sc. (Geology):

i.	First Semester	Major change <sup>a</sup>
ii.	Second Semester	Major change <sup>b</sup>
iii.	Third Semester	Major change <sup>c</sup>
iv.	Fourth Semester	Major change <sup>d</sup>

The Board reviewed the objectives, syllabi, learning outcomes of the **M.Sc. (Geology)**.

The course scheme has been changed as earlier there were five credits for lectures and in proposed the credits are four. The credits for Lab are remaining same.

- a) In M.Sc. Geology I Semester, the course *Fuel Geology* (Course Code: GEOL 401) has been proposed to shift to semester III as a pool of discipline elective course and is replaced by modified course *Geochemistry and Isotope Geology* (Course Code: GEOL\_\_ to be generated) from semester III.

*Geomorphology* (Course Code: GEOL\_\_ to be generated) is suggested to introduce in place of *Ore Genesis and Economic Geology* (Course Code: GEOL 409). Earlier it was present in semester IV.

The courses *Geotectonics and Structural Geology* (Course Code: GEOL 405) & *Mineralogy and Analytical Techniques* (Course Code: GEOL 408) were proposed to be retained with modifications in the same semester as *Geotectonics and Structural Geology* (Course Code: GEOL\_\_ to be generated) & *Mineralogy and Analytical Techniques* (Course Code: GEOL\_\_ to be generated) respectively under revised scheme.

The course *Sedimentary Petrology* (Course Code: GEOL\_\_ to be generated) is proposed to introduce as a modified course under revised scheme. Earlier it was in Semester II as *Sedimentary Petrology* (Course Code: GEOL 410).

The course *Geology Lab-I* (Course Code: GEOL 402L) has been suggested to be replaced with the updated course *Geology Lab-I with Field work* (Course Code: GEOL\_\_L to be generated). Board discussed all the changes proposed in the new syllabus and agreed with the suggested changes. Board also recommended implementing the proposed changes in the syllabus of new courses in Semester Examination, December, 2019.

b) In M.Sc. Geology II Semester, the courses *Geophysics and Exploration Method* (Course Code: GEOL 404), *Igneous Petrology* (Course Code: GEOL 406) & *Metamorphic Petrology* (Course Code: GEOL 407) are proposed to retain in the same semester with minor modifications under revised scheme as *Geophysics and Exploration Method* (Course Code: GEOL\_\_ to be generated), *Igneous Petrology* (Course Code:GEOL\_\_ to be generated) & *Metamorphic Petrology*(Course Code:GEOL\_\_ to be generated). *Sedimentary Petrology* (Course Code: GEOL 410) has been proposed to replace by *Ore Genesis and Economic Geology* (Course Code:GEOL\_\_ to be generated), earlier was in semester I.

The course *Stratigraphy*(Course Code:GEOL 510) was earlier in semester III, suggested to shift to semester II with minor modifications under revised course scheme as *Stratigraphy*(Course Code:GEOL\_\_ to be generated).

The course *Geology Lab-II with Field work* (Course Code: GEOL 403L) has been proposed to replace by new course *Geology Lab-II* (Course Code: GEOL\_\_L to be generated).

Board discussed the changes proposed and agreed upon suggested changes. Board also recommended implementing the proposed replacement in the syllabus of new courses in Semester Examination, April/May, 2020.

c) In M.Sc. Geology III Semester, the course *Geochemistry and Isotope Geology* (Course Code: GEOL 504) have been shifted to semester I and replaced by new course *Hydrogeology*(Course Code: GEOL\_\_to be generated).

*Mining and Engineering Geology*(Course Code: GEOL 508) has been shifted to pool of discipline electives under new course scheme with minor modifications as *Mining and Engineering Geology*(Course Code: GEOL\_\_to be generated).

*Palaeontology* (Course Code: GEOL 509) is retained in the same semester under new course scheme with minor modifications *Palaeontology*(Course Code: GEOL\_\_to be generated).

*Stratigraphy*(Course Code: GEOL 510) is replaced by new course *Remote Sensing and GIS in Geology* (Course Code: GEOL\_\_ to be generated).

*Geology Lab-III with Field work*(Course Code: GEOL 505L) is retained as *Geology Lab-III with Field work*(Course Code: GEOL\_\_L to be generated) in the same semester with significant modifications.

Board discussed the changes proposed and agreed upon suggested changes. Board also recommended implementing the proposed replacement in the syllabus of new courses in Semester Examination, December, 2020.

Board discussed and recommended to introduce pool of discipline electives in III semester

The complete list of pool of discipline electives is as follows:

- *Environmental Geology* (Course Code: GEOL\_ to be generated)
- *Fuel Geology* (Course Code: GEOL\_ to be generated)
- *Marine Geology* (Course Code: GEOL\_ to be generated)
- *Mining and Engineering Geology* (Course Code: GEOL\_ to be generated)

Board recommended the introduction of Reading Elective I which has to be opted from common pool of Reading Electives in PG courses of School of Earth Sciences (Environmental Science, Geology & Geography).

The Board also recommended implementing the Reading Elective by III Semester Examination, December, 2020.

Board proposed to introduce open elective course in Semester III.

- d) In M.Sc. Geology IV Semester, the courses *Concepts of Remote sensing and GIS* (Course Code: GEOL 501) & *Environmental Geology and Hydrogeology* (Course Code: GEOL 503) have been removed and *Geomorphology* (Course Code: GEOL 507) has been shifted to Semester I under revised course scheme.

Geology Lab-IV (Course Code: GEOL 506L) has been removed from the semester. *Dissertation* (Course Code: GEOL 502 D) has been retained as *Dissertation* (Course Code: GEOL\_D to be generated) and now being introduced for the **entire semester** under revised scheme.

Board discussed the changes proposed and agreed upon suggested changes. Board also recommended implementing the proposed replacement in the syllabus of new courses in Semester Examination, April/May, 2021.

Board recommended the introduction of Reading Elective II which has to be opted from common pool of Reading Electives in PG courses of School of Earth Sciences (Environmental Science, Geology & Geography).

The Board has proposed the following Reading Electives in the curricula:

- *Agroforestry* (Course Code :ENVS\_R to be generated)
- *Energy Resources and Conservation* (Course Code: ENVS\_R to be generated)
- *Man and Environment* (Course Code :ENVS\_R to be generated)
- *Water and Sustainable Development* (Course Code : ENVS\_R to be generated)
- *Environmental Challenges and Disaster Management* (Course Code :GEOG\_R to be generated)
- *India: Socio-Political and Environmental Scenario* (Course Code: GEOG\_R to be generated)
- *Rajasthan: Challenges and Prospects*(Course Code :GEOG\_R to be generated)
- *Transforming India* (Course Code: GEOG\_R to be generated)
- *Geo Tourism* (Course Code: GEOL\_R to be generated)
- *Indian Mineral Deposits, Economics and Mining Ethics* (Course Code: GEOL\_R to be generated)
- *Innovation and Entrepreneurship in Earth Sciences* (Course Code: GEOL\_R to be generated)
- *Natural Hazards and Disasters* (Course Code: GEOL\_R to be generated)

Board recommended implementation of reviewed recommended books and e-learning materials from session 2019-20 in all semesters respectively.

Programme educational objectives, outcomes and the list of courses of the M.Sc. (Geology) programme is attached and marked as **Annexure –7 (PP. 1-8)**.

The revised syllabus, learning outcomes, list of recommended books and suggested e-learning materials of the M.Sc. (Geology) programme is attached and marked as **Annexure - 8 (PP. 1-67)**.

Board reviewed the process of Dissertation and recommended formal guidelines for it. The proposed guidelines with evaluation scheme are attached and marked as **Annexure-9 (PP.1)**. Board also recommended implementing the proposed guidelines by IV Semester Examination, April/May, 2021.

#### IV. M.Sc. (Environmental Science)

i.	First Semester	Major Change <sup>a</sup>
ii.	Second Semester	Major Change <sup>b</sup>
iii.	Third Semester	Major Change <sup>c</sup>
iv.	Fourth Semester	Major Change <sup>d</sup>

The Board reviewed the objectives, syllabi, learning outcomes of the M.Sc. (Environmental Science).

The Board discussed the recent trends in Environmental Science at postgraduate level and found that the knowledge of computational software is the necessity of today's research environment. In addition to this, board suggested to give more weightage to self-learning and independent research activities.

(a) In M.Sc. (Environmental Science I Semester), revision in the syllabi of *Ecology and Environment* (Course Code: ENVS 402), *Environmental Chemistry* (Course Code: ENVS 405) and *Environment Lab - I* (Course Code: ENVS 403 L) were proposed. Board discussed the revision proposed and agreed upon the suggested syllabi. Board recommended implementing the proposed revision in the syllabi of *Ecology and Environment*, *Environmental Chemistry* and *Environment Lab - I* by I Semester Examination, December, 2019.

Board agreed to replace the course *Geography of Environment* (Course Code: ENVS 410) by *Climate Change and Environment* (Course Code: ENVS\_to be generated). Board found that proposed syllabus is more elaborated and well arranged. Board recommended implementing the proposed revision in the syllabus of *Climate change and Environment* by I Semester Examination, December, 2019.

(b) In M.Sc. (Environmental Science II Semester), Board reviewed the syllabi of *Biostatistics and Research Methodology* (Course Code: BIO 406) and *Environmental Biology and Toxicology* (Course Code: BIO 408), discussed and agreed that these course should be



replaced by new courses *Environmental Statistics and Research Methodology* (Course Code:ENVS\_to be generated) & *Environmental Toxicology* (Course Code:ENVS\_to be generated) respectively. Board recommended implementing the proposed changes by II Semester Examination, April, 2020.

Board reviewed the revision in the syllabi of *Environmental Legislation* (Course Code: ENVS 406) & *Environment Lab - II* (Course Code: ENVS 404 L) and agreed upon the suggested syllabi. Board recommended implementing the proposed revision in the syllabi of *Environmental Legislation* along with *Environment Lab - II* respectively by II Semester Examination, April, 2020.

Board suggested replacement of *Environmental Physics* (Course Code: ENVS 407) by *Biodiversity & conservation* (Course Code: ENVS 502), which was an elective course of III semester as *Biodiversity & conservation* (Course Code: ENVS\_to be generated ) and Board recommended *Environmental Physics* (Course Code: ENVS\_to be generated) to be placed in discipline elective pool of III semester. Board discussed the change and agreed upon the suggested syllabus. Board recommended implementing the proposed changes by II Semester Examination, April, 2020.

(c) In M.Sc. (Environmental Science III Semester), Board reviewed the course of *Disaster Management and Mitigation Strategies*(Course Code: ENVS 504) and *Energy Auditing and Conservation*(Course Code: ENVS 505) and suggested that these courses have been replaced by *Air Pollution Monitoring, Control Technology and Management* (Course Code: ENVS 501) & *Water Pollution Monitoring, Control Technology and Management* (Course Code: ENVS 511) as *Air Pollution Monitoring, Control Technology and Management* (Course Code: ENVS\_to be generated) & *Water Pollution Monitoring, Control Technology and Management* (Course Code: ENVS\_to be generated), which was part of an elective in III semester. Board suggested inclusion of air and water courses should be part of core subjects of Environmental Science. Board recommended *Disaster Management and Mitigation Strategies* (Course Code: ENVS\_to be generated) and *Energy Auditing and Conservation* (Course Code: ENVS\_to be generated) to be placed in discipline elective pool of III semester.

Board reviewed the revision in the syllabi of *Environment Lab -III* (Course Code: ENVS 506L) agreed upon the suggested syllabi.

Board suggested to shift *Biodiversity and Conservation* (Course Code: ENVS 502) from the pool of Elective to core course in Semester II. *Environmental Impact Assessment and Management* (Course Code: ENVS 508) to be shifted as *Environmental Impact Assessment and Management* (Course Code: ENVS\_to be generated) in the Pool of Discipline Elective Semester III from core course of same semester.

Board recommended implementing the proposed changes by III Semester Examination, December, 2020.

Board discussed and recommended to introduce pool of discipline electives in III semester

The complete list of Discipline Electives is as follows:

- *Biotechnology Application to Environmental Science* (Course Code: ENVS to be generated)
- *Disaster Management and Mitigation Strategies* (Course Code: ENVS to be generated)
- *Energy Auditing and Conservation* (Course Code: ENVS to be generated)
- *Environmental Health Management* (Course Code: ENVS to be generated)
- *Environmental Impact Assessment and Management* (Course Code: ENVS to be generated)
- *Environmental Physics* (Course Code: ENVS to be generated)

Board recommended the introduction of Reading Elective I which has to be opted from common pool of Reading Electives in PG courses of School of Earth Sciences (Environmental Science, Geology & Geography).

Board proposed to introduce open elective course in Semester III.

(d) In M.Sc. (Environmental Science IV Semester), Board discussed and agreed modification in credits of *Project* (Course Code: ENVS 509P) and proposed implementation as *Project* (Course Code: ENVS\_P to be generated), also proposed the Reading Elective-II in IV semester.

Board recommended the introduction of Reading Elective II which has to be opted from common pool of Reading Electives in PG courses of School of Earth Sciences (Environmental Science, Geology & Geography).

The Board has proposed the following Reading Electives in the curricula:

- *Agroforestry* (Course Code :ENVS\_R to be generated)
- *Energy Resources and Conservation* (Course Code: ENVS\_R to be generated)
- *Man and Environment* (Course Code : ENVS\_R to be generated)
- *Water and Sustainable Development* (Course Code : ENVS\_R to be generated)
- *Environmental Challenges and Disaster Management* (Course Code :GEOG\_R to be generated)
- *India: Socio-Political and Environmental Scenario* (Course Code: GEOG\_R to be generated)
- *Rajasthan: Challenges and Prospects*(Course Code : GEOG\_R to be generated)
- *Transforming India* (Course Code: GEOG\_R to be generated)
- *Geo Tourism* (Course Code: GEOL\_R to be generated)
- *Indian Mineral Deposits, Economics and Mining Ethics* (Course Code: GEOL\_R to be generated)
- *Innovation and Entrepreneurship in Earth Sciences* (Course Code: GEOL\_R to be generated)

- *Natural Hazards and Disasters* (Course Code: GEOL\_R to be generated)

Board recommended implementing the proposed revision in the scheme of *Project* by IV Semester Examination, April, 2021.

Programme educational objectives, outcomes and the list of courses of the M.Sc. (Environmental Science) programme is attached and marked as **Annexure –10 (PP. 1-6)**.

Board recommended implementation of reviewed recommended books and e-learning materials from session 2019-20 in all semesters respectively.

The revised syllabus, learning outcomes, list of recommended books and suggested e-learning materials of the M.Sc. (Environmental Science) programme is attached and marked as **Annexure -11 (PP. 1-88)**.

Board reviewed the process of *Project* and recommended formal guidelines for it. The proposed guidelines with evaluation scheme is attached and marked as **Annexure-12 (PP. 1)**.

Board also recommended implementing the proposed guidelines by IV Semester Examination, April/May, 2021.

#### **V. M. Phil. (Geography):**

Board discussed the curriculum structure of M.Phil. (Geography) and proposed further discussion in Faculty meeting. ( Annexure I)

Board recommended implementation of reviewed Recommended Books and e-learning materials from session 2019-20 in all semesters respectively.

#### **VI. M.Tech. (Remote Sensing):**

i.	First Semester	Major Change <sup>a</sup>
ii.	Second Semester	Major Change <sup>b</sup>
iii.	Third Semester	Major Change <sup>c</sup>
iv.	Fourth Semester	Major Change <sup>d</sup>

Board reviewed the scheme of M.Tech. and recommended to introduce discipline electives and Term paper/Minor project/Seminar in semester I & II with modified credit. Board also recommended introduction of open elective in semester II. Board suggested to replace existing lab with restructured labs.

- (a) In M.Tech. (Remote Sensing) I Semester, Board reviewed the syllabi of *Fundamentals of Geographic Information Sciences and Digital Cartography*(Course Code: RS 504), *GIS Programming and Scripting* (Course Code: RS 505), *Microwave, Thermal and Hyperspectral Remote Sensing* (Course Code: RS 506), *Principles of Remote Sensing* (Course Code: RS 508), *Fundamentals of Geographic Information Sciences and Digital Cartography Lab* (Course Code: RS 504L), *GIS Programming and Scripting Lab* (Course Code: RS 505L), and *Microwave, Thermal and Hyperspectral Remote Sensing Lab* (Course Code: RS 506L) and found that few topics need to be reordered, modified and detailed for adequate and systematic approach. It was suggested to introduce recent technologies and essential application following the modified national security policies and advanced data, tools and techniques for underpinning the essential component for further research. It was suggested to introduce discipline elective I and discipline elective II and shift courses *GIS Programming and Scripting* (Course Code: RS\_\_to be generated), *Microwave, Thermal and Hyperspectral Remote Sensing*(Course Code: RS\_\_to be generated), *Applied Statistics and Research Methodology* (Course Code: RS\_\_to be generated) to pool of discipline electives. Introduction of Term paper-I /Minor project-I/Seminar-I was suggested. *Fundamentals of Geographic Information Sciences and Digital Cartography Lab* (Course Code: RS 504L) and *GIS Programming and Scripting Lab* (Course Code: RS 505L) was combined as new Remote Sensing Lab-II (Course Code: RS\_L to be generated) and *Microwave, Thermal and Hyperspectral Remote Sensing Lab* (Course Code: RS506L) and *Principles of Remote Sensing Lab* (Course Code: RS 508L) was combined as new Remote Sensing Lab-I (Course Code: RS\_L to be generated). *Applied Statistics and Research Methodology Lab* (Course Code: RS 502L) was proposed to remove. Board proposed and agreed to implement the revision in syllabi and introduction of new components of above mentioned courses by I Semester Examination, December, 2019.
- (b) In M.Tech. (Remote Sensing)II Semester,Board reviewed the syllabi of *Applications of Remote Sensing*(Course Code: RS 501), *Digital Image Processing* (Course Code: RS 503), *Photogrammetry, Global Positioning Systems and Mobile Mapping* (Course Code: RS 507), *Spatial Database Systems, Analysis and Modeling* (Course Code: RS 509), *Spatial Decision Supports Systems* (Course Code: RS 510), *Applications of Remote Sensing Lab* (Course Code: RS 501L), *Digital Image Processing Lab* (Course Code: RS 503L) and *Photogrammetry, Global Positioning Systems and Mobile Mapping Lab* (Course Code: RS 507L) and found that few topics need to be reordered, modified and detailed for adequate and systematic approach. It was suggested to introduce recent technologies and essential application following the modified national security policies and advanced data, tools and techniques for underpinning the essential component for further research. It was suggested to introduce discipline elective III and open elective and shift courses *Applications of Remote Sensing* (Course Code: RS\_\_to be generated), *Spatial Database Systems, Analysis and Modeling* (Course Code: RS\_\_to be generated), *Spatial Decision Supports Systems* (Course Code: RS\_\_to be generated) to pool of discipline electives. Introduction of Term paper-II /Minor project-II/Seminar-II was suggested. *Digital Image Processing Lab* (Course Code: RS 503L) and *Applications of Remote Sensing Lab* (Course Code: RS 501L) was combined as new Remote Sensing Lab-III (Course Code: RS\_L to be generated) and *Photogrammetry, Global Positioning Systems and Mobile Mapping* (Course Code: RS 507) and *Spatial Database Systems, Analysis and Modeling Lab* (Course Code: RS 509L), was combined as new Remote Sensing Lab-IV (Course Code: RS\_L to be generated). Board proposed and agreed to implement the revision in syllabi and introduction of new components of above mentioned courses by II Semester Examination, April/May, 2020.

List of Discipline Electives:

*Applications of Remote Sensing*(Course Code: RS\_to be generated)

*Applied Statistics and Research Methodology*(Course Code: RS\_to be generated)

*Geospatial Entrepreneurship* (Course Code: RS\_to be generated)

*Geospatial Intelligence*(Course Code: RS\_to be generated)

*GIS Programming and Scripting*(Course Code: RS\_to be generated)

*Microwave, Thermal and Hyperspectral Remote Sensing*(Course Code: RS\_to be generated)

*Spatial Database Systems, Analysis and Modeling*(Course Code: RS\_to be generated)

*Spatial Decision Supports Systems*(Course Code: RS\_to be generated)

(c) In M.Tech. (Remote Sensing) III Semester, Board reviewed the list of reading electives and found that the course *Geoinformatics in Human Settlement Analysis*(Course Code: RS 601R) should be replaced by *Spatial Planning and Urban Development* (Course Code: RS \_ R to be generated), the course *Pattern Recognition and Processing* (Course Code: RS 602R) should be replaced by *Geospatial BigData: Challenges and Opportunities* (Course Code: RS \_ R to be generated) and the course *Remote Sensing in Environment Studies* (Course Code: RS 605R) should be replaced by *Environmental Remote Sensing and Modeling* (Course Code: RS \_ R to be generated) and shifted to the pool of reading electives. Board also suggested that some more emerging technologies and national programmes should be added. Board proposed and agreed to implement the syllabus by III Semester Examination, December, 2020.

(d) In M.Tech. (Remote Sensing) IV Semester, Board reviewed the list of reading electives and found that the course *Remote Sensing in hydrology and water resources*(Course Code: RS \_R to be generated), should be modified, as there are significant changes in syllabi and few topics need to be reordered and detailed for adequate and systematic approach. The board also found that the course *Remote Sensing in Resource Management* (Course Code: RS 607R) should be replaced by *Geo-informatics for Resource Management* (Course Code: RS \_ R to be generated) and the course *Spatial Modeling and Resource Model* (Course Code: RS 608R) should be replaced by *Open Source Software, Services and Utility Application* (Course Code: RS \_ R to be generated) and shifted to the pool of reading electives. Board also suggested that some more emerging technologies and national programmes should be added. Board proposed and agreed to implement the syllabus by IV Semester Examination, April/May, 2021.

The Board also recommended implementing the reading electives by Session 2020-2021.

Board recommended implementation of reviewed Recommended Books and e-learning materials from session 2019-20 in all semesters respectively.

Programme educational objectives, Programme specific outcomes and the list of courses of the M.Tech. (Remote Sensing) programme is attached and marked as **Annexure –13 (PP. 1-5)**.

The revised syllabus, learning outcomes, list of recommended books and e-learning materials of the M.Tech. (Remote Sensing) programme is attached and marked as **Annexure -14 (PP. 1-74)**.

In M.Tech. (Remote Sensing) III Semester, Board reviewed the process of *Project (Part I)* (Course Code: RS 603P) and recommended formal guidelines for it. The proposed guidelines with evaluation scheme is attached and marked as **Annexure-15 (PP. 1)**. Board also recommended implementing the proposed guidelines by III Semester Examination, December, 2020.

In M.Tech. (Remote Sensing) IV Semester, Board suggested that similar guidelines **Annexure-15(PP. 1)**.as suggested for *Project (Part I)* (Course Code: RS 603P), should be followed for *Project (Part II)* (Course Code: RS 604P). Board also recommended implementing the proposed guidelines by IV Semester Examination, April/May, 2021.

4. Board reviewed the curriculum for the courses running in the other programs of the Vidyapith. Following suggestions were given

<b>Bachelor of Arts and Bachelor of Education</b>		
GEOG 101L	Fundamentals of Cartography lab	Minor Change
GEOG 102	Human Geography	Minor Change
GEOG 103	Physical Geography	No change
GEOG 104L	Statistical Techniques and Data Representation lab	Minor Change
GEOG 201	Economic Geography	Minor Change
GEOG 202	Introduction to Geography of India	Minor Change
GEOG 203L	Mapping and Prismatic Compass Survey lab	No change
GEOG 204L	Relief Representation and Topographical Maps lab	Minor Change
GEOG 301L	Fundamentals of Geoinformatics lab	No change
GEOG 302	Geographical Thought	Major Change
GEOG 303L	Map Projection lab	Minor Change
GEOG 304	World Regional Geography	Major change

The Board proposed introduction of pool of Discipline Elective courses and agreed upon it. The courses *Geographical Thought* (Course Code: GEOG 302) and *World Regional Geography* (Course Code: GEOG 304) has been shifted in the pool as courses *Geographical Thought* (Course Code: GEOG\_ to be generated) and *World Regional Geography* (Course Code: GEOG\_ to be generated) of Discipline electives and another two new courses has also been added.

The board reviewed the courses of Bachelor of Arts and Bachelor of Education and recommended to implement as per **Annexure 1 (PP. 1-4) & Annexure 2(PP. 1-38)** .

<b>Bachelor of Science and Bachelor of Education</b>		
GEOG 101L	Fundamentals of Cartography lab	Minor Change
GEOG 102	Human Geography	Minor Change
GEOG 103	Physical Geography	No change
GEOG 104L	Statistical Techniques and Data Representation lab	Minor Change
GEOG 201	Economic Geography	Minor Change
GEOG 202	Introduction to Geography of India	Minor Change
GEOG 203L	Mapping and Prismatic Compass Survey lab	No change
GEOG 204L	Relief Representation and Topographical Maps lab	Minor Change
GEOG 301L	Fundamentals of Geoinformatics lab	No change
GEOG302	Geographical Thought	Major Change
GEOG 303L	Map Projection lab	Minor Change
GEOG 304	World Regional Geography	Major change
GEOL 101	Mineralogy, Crystallography and Economic Geology	Major Change
GEOL 101L	Mineralogy, Crystallography and Economic Geology Lab	Major Change
GEOL 102	Physical Geology and Plate Tectonics	Major Change
GEOL 102L	Physical Geology and Plate Tectonics Lab	Major Change
GEOL 201	Palaeontology and Stratigraphy	Major Change
GEOL 201L	Palaeontology and Stratigraphy Lab	Major Change
GEOL 202	Petrology and Structural Geology	Major Change
GEOL 202L	Petrology and Structural Geology Lab	Major Change
GEOL 301	Hydrology, Environmental and Engineering Geology	Major Change
GEOL 301L	Hydrology, Environmental and Engineering Geology Lab	Major Change
GEOL 303	Geochemistry, Geomorphology, Photogeology and Remote Sensing	Major Change
GEOL 303L	Geochemistry, Geomorphology, Photogeology and Remote Sensing Lab	Major Change

In B.Sc. Geology I Semester, the courses *Physical Geology and Plate Tectonics* (Course Code: GEOL 102) & *Physical Geology and Plate Tectonics Lab* (Course Code: GEOL 102

L) have been proposed to be replaced by new course *Physical Geology* (Course Code: *to be generated*) containing both theory and practical. In B.Sc. Geology II Semester, the courses *Mineralogy, Crystallography and Economic Geology* (Course Code: GEOL 101) & *Mineralogy, Crystallography and Economic Geology Lab* (Course Code: GEOL 101L) have been proposed to be replaced by new course *Structural Geology and Plate Tectonics* (Course Code: *to be generated*) containing both theory and practical. In B.Sc. Geology III Semester, the courses *Petrology and Structural Geology* (Course Code: GEOL 202) & *Petrology and Structural Geology Lab* (Course Code: GEOL 202L) have been proposed to be replaced by new course *Mineralogy, Crystallography and Geochemistry* (Course Code: *to be generated*) containing both theory and practical. In B.Sc. Geology IV Semester, the courses *Palaeontology and Stratigraphy* (Course Code: GEOL 201) & *Palaeontology and Stratigraphy Lab* (Course Code: GEOL 201L) have been proposed to be replaced by new course *Petrology and Economic Geology* (Course Code: *to be generated*) containing both theory and practical. In B.Sc. Geology V Semester, the courses *Geochemistry, Geomorphology, Photogeology and Remote Sensing* (Course Code: 5.1) & *Geochemistry, Geomorphology, Photogeology and Remote Sensing Lab* (Course Code: 5.2) have been proposed to be replaced by newly introduced pool of Discipline Electives containing both theory and practical. In B.Sc. Geology VI Semester, the courses *Hydrogeology, Environmental and Engineering Geology* (Course Code: 6.1) & *Hydrogeology, Environmental and Engineering Geology Lab* (Course Code: 6.2) have been replaced by newly introduced pool of Discipline Electives containing both theory and practical.

The board reviewed the courses of Bachelor of Science and Bachelor of Education and recommended to implement as per **Annexure 1 (PP. 1-4) & Annexure 2 (PP. 1-37) and Annexure 3 (PP. 1-5) & Annexure 4 (PP. 1-55).**

<b>Master of Arts (Textile Designing - Printing)</b>		
ENVS 408	Environmental Studies	Deal by Design Department
<b>Master of Arts (Textile Designing - Weaving)</b>		
ENVS 408	Environmental Studies	Deal by Design Department

It will be submitted by Design Department.

<b>Bachelor of Technology (Computer Science and Engineering)</b>		
RS 401	Geoinformatics	No change
<b>Bachelor of Technology (Electronics and Communication Engineering)</b>		
RS 401	Geoinformatics	No change
<b>Bachelor of Technology (Information Technology)</b>		
RS 401	Geoinformatics	No change



Bachelor of Technology (Electronics and Electricals)		
RS 401	Geoinformatics	No change
Bachelor of Technology (Electronics and Instrumentation)		
RS 401	Geoinformatics	No change
Bachelor of Technology (Biotechnology)		
RS 401	Geoinformatics	No change

The Board also recommended to introduce RS 401 Geoinformatics in Chemical Engineering Fourth Year.

The course scheme, learning outcomes, list of recommended books and e-learning materials of the (RS 401 Geoinformatics) programme is attached and marked as **Annexure- 16 (PP.1) and 17 (PP. 1-2)**.

5. Board reviewed the reports received from the examiners of different examinations of 2017 and 2018. All the reports were found to be satisfactory. It was noted that the examiners have generally reported 'to the point' answers and have found expression/method of representation satisfactory/good. Few examiners suggested to give more emphasis on maps & charts, graphical representation and labeled diagrams to support their answers.

6. The board evaluated the semester examination papers and found that most of them were descriptive and few analytic & application based depending on the nature of course. The Board concluded that the quality of question papers is good but sometimes some questions are out of syllabus, format is not clear, so, the board recommended for consideration of the syllabi while setting question papers.

The analysis of question papers is enclosed in **Annexure-18 (PP. 1-9)**.

7. a).

<b>Foundation Course (Environment Studies)</b>		
BVF 002	Environment Studies	No change

Board reviewed the learning outcomes and syllabus and agreed to continue with the existing syllabus of *Environment Studies*(Course Code:BVF 002).

The course scheme, learning outcomes, list of suggested books and e-resources of the Foundation Course (Environment Studies)programme is attached and marked as **Annexure-19(PP. 1) and Annexure - 20 (PP. 1)**.

**b). Online courses**

The Board suggested to introduce online courses as a substitute of Reading Electives in PG Programmes in III & IV Semester, respectively of School of Earth Sciences.

List of Alternate online courses (to be given in BOS minutes)

S No	Agency/ Portal	Name of course	Duration	(Core/ Elective/ Reading Elective)	Credit point(s)	URL
<b>In M.Sc.( Environmental Science/Geology/ Geography) and M.A. (Geography) III &amp; IV Semester Reading Electives</b>						
1	<b>Indian Institute of Technology</b> Roorkee, NPTEL	Mineral Resources: Geology, Exploration, Economics and Environment	Self paced 48h (Registration at any time)	Reading Elective I	2	<a href="https://onlinecourses.nptel.ac.in/noc18_ge13/preview">https://onlinecourses.nptel.ac.in/noc18_ge13/preview</a>
2	<b>Indian Institute of Technology</b> Kanpur, NPTEL	Natural Hazards Part 1	Self paced 48h (Registration at any time)	Reading Elective I	2	<a href="https://onlinecourses.nptel.ac.in/noc19_">https://onlinecourses.nptel.ac.in/noc19_</a>
3	<b>Indian Institute of Technology Madras,</b> NPTEL	Non-Conventional Energy Resources	Self paced 48h (Registration at any time)	Reading Elective II	2	<a href="https://onlinecourses.nptel.ac.in/noc18_ge09/preview">https://onlinecourses.nptel.ac.in/noc18_ge09/preview</a>

The alternate online course name, duration, credits and URL is attached and marked as **Annexure -21(PP. 1)**.

**BANASTHALI VIDYAPITH  
SCHOOL OF EARTH SCIENCES**

Name of Programme: M.Sc. (Environmental Science)

**Programme Educational Objectives:**

Banasthali Vidyapith is an epitome of tradition and modernity. Vidyapith aims to preserve and inculcate the essential values and ideals of Indian culture. It believes in simple living and high thinking. Our educational ideology is based on the concept of fivefold education focusing on physical, practical, aesthetic, moral and intellectual aspects in order to develop a balanced personality.

The M.Sc. in Environmental Science is an interdisciplinary programme which emphasizes the current issues of environment and serious environmental challenges of local, regional and international level that the world confronts. Students will be able to comprehend the interaction between man and its environment along with effect of human activities on the environment and its functions through a series of academic courses and co-curricular activities. Additionally, students will acquire critical thinking and problem solving skills in order to enrich the quality of the environment.

This programme values an integrated approach on learning, conservation, resource management together with inculcation of solution centric approach in resolving the environmental problems to achieve sustainable development. The programme also envisions developing practical leaders having academic excellence and passion to work for the betterment of the environment and create a better dwelling place built on the principles of environmental justice and sustainability. The main objectives of the M.Sc. Environmental Science programme are:

- To prepare competent environmental professionals in India and across the globe.
- To prepare individuals who are environmentally conscious, empathetic and aware.
- To cultivate an interconnected and interdisciplinary approach towards environmental studies to appreciate the interconnected nature of the world and surroundings in which they live.
- To provide environmental education in a stimulating environment integrated with nationally and internationally recognized research to develop solutions for common environmental issues.
- To prepare students that will communicate excellently about environmental issues in speech and writing.
- To instruct digital literacy to support their professional growth.
- To develop ethical reasoning, diverse viewpoints and decision-making aptitude in students so they can confront environmental issues while considering the perspectives of a variety of stakeholders and systems.
- To foster a spirit in students which lets them to work towards attaining goals and cultivate entrepreneurial capacities.

**Programme Outcomes:**

**PO1:Environmental Knowledge: Describe the diverse concepts and methods of environmental sciences and their application in various aspects of environmental issues.**

**PO2:Planning abilities: Demonstrate effective planning to deal with different problems associated with environmental issues such as solid waste management, Energy auditing and Impact assessment of various developmental activities.**

**PO3:Problem analysis: Formulate mitigation measures for various environmental issues such as waste management and pollution, food and agriculture, energy, climate change, population, resource management and loss of biodiversity.**

**PO4: Design/development of solution for problems:The research skills strengthen them to formulate hypothesis, identification of environmental problems and develop solution for the betterment of the environment.**

**PO5:Modern tool usage: Apply various tools commonly used in field research, particularly in the study of air water and soil quality along with spatial analysis software and tools such as GIS and GPS technology.**

**PO6:Leadership skills: Use their knowledge of EIA and Environmental laws to critically think about their roles and identities as citizens, consumers and environmental actors in an interconnected world.**

**PO7:Professional Identity: Demonstrate the ability to interpret the consequences of developing projects and consult various environmental agencies to a focused solution.**

**PO8:Environmental Ethics: Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.**

**PO9:Communication: Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, along with written and oral communication needed to conduct high-level work as interdisciplinary scholars.**

**PO10:The Environment and society: Describe various problems associated with sustainable development of project and its impact on society.**

**PO11:Environment and sustainability: Formulate an action plan for sustainable alternatives that integrate science, humanist, and social perspectives.**

**PO12:Life- long learning: Prepare them for meaningful careers and higher education in fields related to environmental science and beyond.**

**Programme Scheme:  
Semester: I**

Existing					
Course Code	Course Name	L	T	P	C
ENVS 402	Ecology and Environment	4	0	0	4
ENVS 405	Environmental Chemistry	4	0	0	4
ENVS 409	Fundamentals of Remote Sensing and GIS	4	0	0	4
ENVS 410	<del>Geography of Environment</del>	4	0	0	4
ENVS 411	Introduction to Computer for Environmental Science	4	0	0	4
ENVS 403L	Environment Lab - I	0	0	12	6
<b>Total:</b>		<b>20</b>	<b>0</b>	<b>12</b>	<b>26</b>

**Semester: II**

Existing					
Course Code	Course Name	L	T	P	C
ENVS 401	Applications of Remote Sensing for Natural Resource Management	4	0	0	4
BIO 406	<del>Biostatistics and Research Methodology</del>	4	0	0	4
BIO 408	<del>Environmental Biology and Toxicology</del>	4	0	0	4
ENVS 406	Environmental Legislation	4	0	0	4
ENVS 407	<del>Environmental Physics</del>	4	0	0	4
ENVS 404L	Environment Lab - II	0	0	12	6
<b>Total:</b>		<b>20</b>	<b>0</b>	<b>12</b>	<b>26</b>

Proposed					
Course Code	Course Name	L	T	P	C
ENVS__	<b>Climate change and Environment</b>	4	0	0	4
ENVS 402	<b>Ecology and Environment</b>	4	0	0	4
ENVS 405	<b>Environmental Chemistry</b>	4	0	0	4
ENVS 409	Fundamentals of Remote Sensing and GIS	4	0	0	4
ENVS 411	Introduction to Computer for Environmental Science	4	0	0	4
ENVS 403L	<b>Environment Lab - I</b>	0	0	12	6
<b>Total:</b>		<b>20</b>	<b>0</b>	<b>12</b>	<b>26</b>

Proposed					
Course Code	Course Name	L	T	P	C
ENVS 401	Applications of Remote Sensing for Natural Resource Management	4	0	0	4
ENVS__	<b>Biodiversity and Conservation</b>	4	0	0	4
ENVS 406	<b>Environmental Legislation</b>	4	0	0	4
ENVS__	<b>Environmental Statistics and Research Methodology</b>	4	0	0	4
ENVS__	<b>Environmental Toxicology</b>	4	0	0	4
ENVS 404L	<b>Environment Lab - II</b>	0	0	12	6
<b>Total:</b>		<b>20</b>	<b>0</b>	<b>12</b>	<b>26</b>

**Semester: III**

Existing					
Course Code	Course Name	L	T	P	C
ENVS 504	Disaster Management and Mitigation Strategies	4	0	0	4
ENVS 505	Energy Auditing and Conservation	4	0	0	4
ENVS 508	Environmental Impact Assessment and Management	4	0	0	4
ENVS 510	Solid Waste Management	4	0	0	4
ENVS 506L	Environment Lab - III	0	0	12	6
	<b>Elective</b>	4	0	0	4
<b>Total:</b>		<b>20</b>	<b>0</b>	<b>12</b>	<b>26</b>

Proposed					
Course Code	Course Name	L	T	P	C
ENVS ____	<b>Air Pollution Monitoring, Control Technology and Management</b>	4	0	0	4
ENVS 510	Solid Waste Management	4	0	0	4
ENVS ____	<b>Water Pollution Monitoring, Control Technology and Management</b>	4	0	0	4
ENVS 506L	<b>Environment Lab - III</b>	0	0	12	6
ENVS ____	<b>Discipline Elective</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
	<b>Open Elective</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
	<b>Reading Elective I</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Total:</b>		<b>20</b>	<b>0</b>	<b>12</b>	<b>28</b>

**Semester: IV**

Existing					
Course Code	Course Name	L	T	P	C
ENVS 509P	Project	0	0	<del>52</del>	<del>26</del>
<b>Total:</b>		<b>0</b>	<b>0</b>	<b><del>52</del></b>	<b><del>26</del></b>

Proposed					
Course Code	Course Name	L	T	P	C
	<b>Reading Elective II</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
ENVS ____P	Project	<b>0</b>	<b>0</b>	<b>48</b>	<b>24</b>
<b>Total:</b>		<b>0</b>	<b>0</b>	<b>48</b>	<b>26</b>

<b>Electives</b>					
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
ENVS 501	Air Pollution Monitoring, Control Technology and Management	4	0	0	4
ENVS 502	Biodiversity and Conservation	4	0	0	4
ENVS 503	Biotechnology Application to Environmental Science	4	0	0	4
ENVS 507	Environmental Health Management	4	0	0	4
ENVS 511	Water Pollution Monitoring, Control Technology and Management	4	0	0	4

<b>List of Discipline Electives</b>				<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>Course Code</b>	<b>Course Name</b>						
ENVS 503	Biotechnology Application to Environmental Science	4	0	0	4		
ENVS__	<b>Disaster Management and Mitigation Strategies</b>	4	0	0	4		
ENVS__	<b>Energy Auditing and Conservation</b>	4	0	0	4		
ENVS 507	Environmental Health Management	4	0	0	4		
ENVS__	<b>Environmental Impact Assessment and Management</b>	4	0	0	4		
ENVS__	<b>Environmental Physics</b>	4	0	0	4		

<b>List of Reading Electives</b>					
<b>Course Code</b>	<b>Course Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
ENVS_R	<b>Agroforestry</b>	0	0	0	2
ENVS_R	<b>Energy Resources and Conservation</b>	0	0	0	2
ENVS_R	<b>Man and Environment</b>	0	0	0	2
ENVS_R	<b>Water and Sustainable Development</b>	0	0	0	2
GEOG_R	<b>Environmental Challenges and Disaster Management</b>	0	0	0	2
GEOG_R	<b>India: Socio-Political and Environmental Scenario</b>	0	0	0	2
GEOG_R	<b>Rajasthan: Challenges and Prospects</b>	0	0	0	2
GEOG_R	<b>Transforming India</b>	0	0	0	2
GEOL_R	<b>Geo Tourism</b>	0	0	0	2
GEOL_R	<b>Indian Mineral Deposits, Economics and Mining Ethics</b>	0	0	0	2
GEOL_R	<b>Innovation and Entrepreneurship in Earth Sciences</b>	0	0	0	2
GEOL_R	<b>Natural Hazards and Disasters</b>	0	0	0	2

List of Online Reading Electives				
S. No.	Course Name	Proposed Alternative On-line Course	Credit point(s)	URL link
1	ENVS__R Energy Resource and Conservation	Non-Conventional Energy Resources	2	<a href="https://onlinecourses.nptel.ac.in/noc18_ge09/preview">https://onlinecourses.nptel.ac.in/noc18_ge09/preview</a>
2	GEOL__R Indian Mineral Deposits, Economics and Mining Ethics	Mineral Resources: Geology, Exploration, Economics and Environment	2	<a href="https://onlinecourses.nptel.ac.in/noc18_ce13/preview">https://onlinecourses.nptel.ac.in/noc18_ce13/preview</a>
3	GEOL__R Natural Hazards and Disasters	Natural Hazards Part 1	2	<a href="https://onlinecourses.nptel.ac.in/noc19_ce14/preview">https://onlinecourses.nptel.ac.in/noc19_ce14/preview</a>

Note:

**Semester I**

ENVS 410 Geography of Environment has been replaced by new course ENVS \_\_Climate change and Environment.

**Semester II**

BIO 406 Biostatistics and Research Methodology and BIO 408 Environmental Biology and Toxicology have been replaced by two new courses ENVS\_\_Environmental Statistics and Research Methodology and ENVS\_\_Environmental Toxicology respectively. ENVS 407 Environmental Physics has been replaced by ENVS 502 Biodiversity and conservation, although ENVS 502 was an elective course of III semester (which is now core course of II semester)&ENVS 407 was shifted from core of II semester to discipline elective of III semester.

**Semester III**

ENVS 501 Air Pollution Monitoring, Control Technology and Management and ENVS 511 Water Pollution Monitoring, Control Technology and Management both have been shifted from elective of III semester to core courses of III semester.

ENVS 504 Disaster Management and Mitigation Strategies and ENVS 505 Energy Auditing and Conservation have been shifted to pool of Discipline Electives in III semester from core course of III semester.

ENVS 407 Environmental Physics has been shifted to Discipline Elective pool of III semester from core course of II semester.

ENVS 508 Environmental Impact Assessment and Management has been shifted to Discipline Elective pool of semester III.

Pool of Discipline Elective has been introduced in III semester

Common Pool of Reading Elective has been introduced in III and IV semester

Open Elective has been introduced in semester III

**Semester IV**

Project credit has been changed.

L - Lecture hrs/week; T - Tutorial hrs/week;

P - Project/Practical/Lab/All other non-classroom academic activities, etc. hrs/week; C - Credit Points of the Course

**Note: Yellow highlighted and bold content illustrate the modification in the syllabus.**



Name of Programme: M.Sc. (Environmental Science)

COURSE DETAILS:

## FIRST SEMESTER

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	ENVS _____  Climate Change and Environment	After the completion of this course, students will be able to:  • Describe the concept of climate change.  • Identify the indicators of climate change and explain the various theories.  • Explain the impact of El Niño and La Niña.  • Describe carbon sequestration policies related to climate change.		<p><b>Section A</b> Concept of Climate change, Indicators and theories. Global Carbon Cycle: Stocks and Fluxes of Carbon in terrestrial and marine ecosystems and anthropogenic impact, Carbon Sequestration Impact of El Niño and La Niña on environment, Insolation and Heat Budget.</p> <p><b>Section B</b> Ozone depletion: Mechanism and consequences Impact of acid rain on environment Photochemical smog: Mechanism and formation, Impact of Deforestation, Mining on environment</p> <p><b>Section C</b> Policy Perspective: UNFCCC, Role and Function of IPCC, Kyoto Protocol and its implication on Developed and developing countries. Clean Development Mechanism (CDM) and its operation Environmental protection efforts in India and abroad.</p> <p><b>Recommended Books:</b> 1. Bal, A. S. (2009). <i>An Introduction to Environmental Management</i>(1<sup>st</sup>ed.). Mumbai, India: Himalaya. 2. Bayon, R., Hawn, A.,&amp;Hamilton, K. (2009). <i>Voluntary Carbon Markets</i>(2<sup>nd</sup>ed.).Abingdon, United Kingdom: Routledge. 3. Hester, R. E., &amp; Harrison, R. M. (Eds.). (2010). <i>Carbon capture: sequestration and storage</i>.Cambridge, United Kingdom: Royal Society of Chemistry. 4. Kumar, S. (2011). <i>Protecting Environmental Issues- A Quest for NGO's</i>. New Delhi, India: AVON.</p>	Introduction of New Course

				<p>5. Rajagopalan, R. (2014). <i>Environmental Studies</i>(2<sup>nd</sup>ed.). New Delhi, India: Oxford University Press.</p> <p>6. Singh, S. (2015). <i>Environmental Geography</i>.Allahabad, India:Pravalika.</p> <p>7. Strahler, A.N. (1988). <i>Earth Science</i>. New Delhi, India:Harper and Row.</p> <p>8. Wilson, E., &amp;Gerard, D.(2007). <i>Carbon Capture and Sequestration Integrating Technology, Monitoring, Regulation</i>. Ames, IA: Blackwell.</p> <p><b>Suggested e-learning materials:</b></p> <p><b>1. Climate Change</b>  <a href="https://swayam.gov.in/courses/5257-climate-change">https://swayam.gov.in/courses/5257-climate-change</a>  <a href="https://nptel.ac.in/courses/119106008/40">https://nptel.ac.in/courses/119106008/40</a></p>	
--	--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
2	ENVS 402 Ecology and Environment	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe the interaction of organisms with their environment.</li> <li>• Identify the various threats to biodiversity.</li> <li>• Explain the concept of biomes.</li> <li>• Describe the various biogeochemical cycles.</li> </ul>	<p><b>Section A</b> <b>Introduction to Environment</b></p> <ol style="list-style-type: none"> <li>a) Concept of Environment</li> <li>b) Factors of the environment: Physiographic, Climatic, Edaphic, Biotic and Anthropogenic.</li> <li>c) Bio Geochemical Cycles: The Carbon cycle, the Oxygen cycle, the Nitrogen cycle.</li> <li>d) The Hydrological cycle.</li> </ol> <p><b>Section B</b> <b>Concept of Ecology, Ecosystem and Biomes</b></p> <ol style="list-style-type: none"> <li>a) Concept of Ecosystem: With special reference to desert, forest and aquatic ecosystem.</li> <li>b) Food chain, Food web &amp; succession.</li> <li>c) Ecological Pyramids and their types.</li> <li>d) Energy flow in ecosystem.</li> <li>e) Concepts of Biomes. Major biomes of the world: Tropical forest, Temperate forest, Grassland and Tundra.</li> </ol> <p><b>Section C</b> <b>Environmental Pollution and its Effect</b></p> <ol style="list-style-type: none"> <li>a) Environmental pollution-Pollutants and sources: <ol style="list-style-type: none"> <li>1. Water pollution,</li> <li>2. Soil pollution,</li> <li>3. Air pollution and,</li> <li>4. Noise pollution.</li> </ol> </li> <li>b) Global warming</li> <li>e) <del>Global climatic changes: Indicators and</del></li> </ol>	<p><b>Section A</b> <b>Introduction to Environment</b> Concept of Environment, Factors of the environment: Physiographic, Climatic, Edaphic, Biotic and Anthropogenic. Bio Geochemical Cycles: The Carbon cycle, the Oxygen cycle, the Nitrogen cycle, The Hydrological cycle.</p> <p><b>Section B</b> <b>Concept of Ecology, Ecosystem and Biomes</b> Concept of Ecosystem: With special reference to desert, forest and aquatic ecosystem. Food chain, Food web &amp; succession. Ecological Pyramids and their types. Energy flow in ecosystem, Concepts of Biomes. Major biomes of the world: Tropical forest, Temperate forest, Grassland and Tundra.</p> <p><b>Section C</b> <b>Environmental Pollution and its Effect</b> Environmental pollution-Pollutants and sources: Water pollution, Soil pollution, Air pollution and, Noise pollution. <b>Greenhouse Effect</b>, Global warming Biodiversity: Threats and Conservation.</p> <p><b>Recommended Books:</b> 1. Atkinson, Raw, M. (2007). <i>Biogeography</i>. Philip Allan Updates.</p>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>The repeated content is removed to maintain the level of detailing and an essential component are added.</p>

			<p>Theories</p> <p>d) Biodiversity: Threats and Conservation</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. <del>Atkinson &amp; Raw, Michael (2007): Biogeography. Philip Allan Updates.</del></li> <li>2. <del>Gautam, A (2007): Environmental Geography, ShardaPustakBhawan, Allahabad.</del></li> <li>3. <del>Gautam, A. (2005): Resource and Environment (in Hindi), ShardaPustakBhawan, Allahabad.</del></li> <li>4. <del>Huggett, R. J (1998): Fundamental of Biogeography. Routledge, London.</del></li> <li>5. <del>Kayastha, S.L. and Kumra V.K. (1986): Environmental Studies. Tara Book Agency, Varanasi.</del></li> <li>6. <del>Mathur, H.S.(1998) : Essentials of Biogeography, Pointer Publishers, Jaipur.</del></li> <li>7. <del>Mehtani, S. &amp;Sinha, A. (2010): Biogeography. Commonwealth Publisher.</del></li> <li>8. <del>New begin : Plant and Animal Geography.</del></li> <li>9. <del>Odum, E. P. (1975): Ecology. Rowman and Littlefield, Lanham USA.</del></li> <li>10. <del>Odum, E.P.(1968) : Fundamentals of Ecology, W.B. Sanders. Company, Philadelphia and London.</del></li> <li>11. <del>Saxena, H. M. (1999): Environmental Geography. Rawat Publications., Jaipur and New Delhi.</del></li> <li>12. <del>Saxena, H. M. (2000): Environmental</del></li> </ol>	<ol style="list-style-type: none"> <li>2. <b>Gautam, A. (2007). <i>Environmental Geography</i>. Allahabad,India:ShardaPustakBhawan.</b></li> <li>3. <b>Huggett, R. J. (1998). <i>Fundamental of Biogeography</i>. London,UK:Routledge.</b></li> <li>4. <b>Kayastha, S.L., &amp;Kumra, V.K. (1986). <i>Environmental Studies</i>. Varanasi, India: Tara Book Agency.</b></li> <li>5. <b>Mathur, H.S. (1998). <i>Essentials of Biogeography</i>. Jaipur, India: Pointer.</b></li> <li>6. <b>Mehtani, S., &amp;Sinha, A. (2010). <i>Biogeography</i>. Commonwealth.</b></li> <li>7. <b>Odum, E. P. (1975). <i>Ecology</i>. Lanham, MD:Rowman and Littlefield.</b></li> <li>8. <b>Odum, E.P. (1968).<i>Fundamentals of Ecology</i>. London, UK:W.B. Sanders Company</b></li> <li>9. <b>Saxena, H. M. (1999). <i>Environmental Geography</i>. Jaipur, India:Rawat.</b></li> <li>10. <b>Saxena, H. M. (2000). <i>Environmental Management</i>. Jaipur, India:Rawat.</b></li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. <b>Environment and Ecology</b> <a href="https://nptel.ac.in/courses/122102006/16">https://nptel.ac.in/courses/122102006/16</a></li> <li>2. <b>Ecology and Environment</b> <a href="https://swayam.gov.in/courses/4905-july-2018-ecology-and-environment">https://swayam.gov.in/courses/4905-july-2018-ecology-and-environment</a></li> </ol>	
--	--	--	--	---	--

			<p><b>Management. Rawat Publications., Jaipur and New Delhi.</b></p> <p>13. बाकरे, बाकरे, बाधवा (2005 — 2006) : पर्यावरणीय अध्ययन, स्वतोमीपब्लिकेशन्स, मंगोत्री, शिवाजीरोड, मेरठ।</p> <p>14. भाटिया, डॉ. ए. एल, कोहली, डॉ. के. एस : जन्तुपरिस्थितिकी एवं जन्तुवितरण</p> <p>15. डॉ. अरुण रघुवंशी, पर्यावरणतथाप्रदुषण, मध्य प्रदेशहिन्दीग्रन्थअकादमी।</p> <p>16. डॉ. नरेन्द्रमोहनअवस्थी, एवंडॉ. आर के तिवारी, पर्यावरणभूगोल, मध्य प्रदेशहिन्दीग्रन्थअकादमी।</p> <p>17. डॉ. मायत्री प्रसाद एवंमहें. नोटियाल, पर्यावरणभूगोल, शांतापब्लिशर्स।</p> <p>18. एच. एम. सक्सेनापर्यावरणभूगोल, राजस्थान, हिन्दीग्रन्थअकादमी।</p>	
--	--	--	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
3	ENVS 405 Environmental Chemistry	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>Describe the various chemical processes occurring in the air, water and soil.</li> <li>Explain the effect of hydrocarbons and synthetic compounds on biological organisms.</li> <li>Explain the degradation of hydrocarbon and synthetic compounds.</li> <li>Illustrate the working principle, merits and demerits of analytical techniques.</li> </ul>	<p><b>Section A</b></p> <p>a) Concept and Scope of Environmental Chemistry: Definition and explanation for various terms, segments of environment. Principles and cyclic pathways in the environment: Sulphur, Oxygen, Nitrogen, Phosphorous cycle.</p> <p>b) Chemistry of Water: Unusual physical properties, unusual solvent properties, changes in water properties by addition of solute.</p> <p>c) Soil Chemistry: Formation, constituents and properties of soils, adsorption of contaminants in soil, soil fertility, surface exchange reaction, soil redox potential and adsorption-desorption.</p> <p><b>Section B</b></p> <p>Chemistry of various organic, inorganic, carcinogenic compounds and their effects.</p> <p>a) Hydrocarbons: Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms. Surfactants: Cationic, anionic and nonionic detergents, modified detergents.</p> <p>b) Pesticides: Classification, degradation, analysis, pollution due to pesticides and DDT problems.</p> <p>c) Synthetic Polymers: Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives.</p> <p>d) <del>Lead and its compounds: Physical and chemical properties, behavior, human exposure, absorption, influence. Aflatoxin occurrence, chemical composition and properties metabolism, acute toxicity, carcinogenicity.</del></p> <p>e) <del>Destruction of some hazardous substances: Acid halides and anhydrides, alkali metals, cyanides</del></p>	<p><b>Section A</b></p> <p>Concept and Scope of Environmental Chemistry: Definition and explanation for various terms, segments of environment. Principles and cyclic pathways in the environment: Sulphur, Oxygen, Nitrogen, Phosphorous cycle.</p> <p>Chemistry of Water: Unusual physical properties, unusual solvent properties, changes in water properties by addition of solute.</p> <p>Soil Chemistry: Formation, constituents and properties of soils, adsorption of contaminants in soil, soil fertility, surface exchange reaction, soil redox potential and adsorption-desorption.</p> <p><b>Section B</b></p> <p>Chemistry of various organic, inorganic, carcinogenic compounds and their effects.</p> <p>Hydrocarbons: Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms. Surfactants: Cationic, anionic and nonionic detergents, modified detergents.</p> <p>Pesticides: Classification, degradation, analysis, pollution due to pesticides and DDT problems.</p> <p>Synthetic Polymers: Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives.</p> <p>Aflatoxin occurrence, chemical</p>	<p><b>Reviewed outcomes and suggested e-learning materials</b></p> <p><b>Some topic of this course was introduced in Environmental Toxicology course of II semester</b></p>

			<p>and cyanogens bromides, chromium, aflotoxins, halogenated compounds.</p> <p><b>Section C</b></p> <p>a) Physico-Chemical methods for analysis of environmental samples: Physico-chemical parameters; Definition and determination of conductivity, pH, COD, BOD.</p> <p>b) <del>Estimation of various elements at major, minor trace, ultra traces level concentrations; Choice of a technique.</del></p> <p>c) Principle, merits and demerits of the techniques: colorimetry, atomic absorption spectroscopy, gas chromatography, HPLC, ion exchange chromatography.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li><del>Bhatia S. C., Environmental Chemistry, Cbs Publisher.</del></li> <li><del>De, A. K. &amp; De, A. K., Environmental Chemistry, New Age International Publishers.</del></li> <li><del>Gary W.V., Stephen J. D., <u>Environmental Chemistry, A global perspective (Third Edition)</u>, Oxford University Press.</del></li> <li><del>Rao P. Venugopala, Principles Of Environmental Science And Engineering, PHI Learning Pvt. Ltd.</del></li> <li><del>Séamus P. J. H., 2003, Analytical Chemistry, Oxford University Press, UK.</del> <del>Stanley Manahan &amp; Stanley E. Manahan, Environmental Chemistry, Ninth Edition, CRC Press.</del></li> </ol>	<p>composition and properties metabolism.</p> <p><b>Section C</b></p> <p>Physico-Chemical methods for analysis of environmental samples: Definition and determination of conductivity, pH, COD, BOD.</p> <p><b>Principle, merits and demerits of Centrifuge, and Ultra centrifuge.</b></p> <p>Principle, merits and demerits of the techniques: colorimetry, atomic absorption spectroscopy, Atomic emission Spectroscopy, gas chromatography, HPLC, ion exchange chromatography.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li><b>1. Bhatia, S. C. (2006). <i>Environmental Chemistry</i>. New Delhi, India: CBS.</b></li> <li><b>2. De, A. K., &amp; De, A. K. (2007). <i>Environmental Chemistry</i>. New Delhi, India: New Age International.</b></li> <li><b>3. Gary, W.V., &amp; Stephen, J. D. (2010). <i>Environmental Chemistry. A global perspective (3<sup>rd</sup> ed.)</i>. London, UK: Oxford University Press.</b></li> <li><b>4. Rao, P. V. (2006). <i>Principles of Environmental Science and Engineering</i>. New Delhi, India: PHI.</b></li> <li><b>5. Séamus, P. J. H. (2003). <i>Analytical Chemistry</i>. London, UK: Oxford University Press.</b></li> <li><b>6. Manahan, S., &amp; Manahan, S. E. (2009). <i>Environmental Chemistry (Ninth Edition)</i>. Florida, FL: CRC Press.</b></li> <li><b>7. Wilson, K., &amp; Walker, J. (2010). <i>Principals and Techniques of</i></b></li> </ol>	<p>The repeated content is removed to maintain the level of detailing and an essential component are added.</p>
--	--	--	---	--	---

				<p><b><i>Biochemistry and Molecular Biology.</i></b> New York, NY:Cambridge University Press.</p> <p><b>Suggested e-learning materials:</b></p> <p><b>1. Environmental Chemistry and Analysis</b> <a href="https://nptel.ac.in/courses/122106030/">https://nptel.ac.in/courses/122106030/</a></p> <p><b>2. Environmental Chemistry</b> <a href="https://swayam.gov.in/course/251-environmental-chemistry">https://swayam.gov.in/course/251-environmental-chemistry</a></p>	
--	--	--	--	--	--



S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
4	ENVS 409 Fundamentals of Remote Sensing and GIS	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>Explain about Remote Sensing, Geographical Information System and Global Positioning System.</li> <li>Outline and interpret the elements of aerial photographs.</li> <li>Describe principles and applications of thermal and microwave remote sensing.</li> <li>Differentiate GIS and science of map making, non spatial versus spatial data</li> </ul>		<p>Recommended Books:</p> <ol style="list-style-type: none"> <li>Abbasi, S. A. (2005). <i>Application of GIS &amp; Remote Sensing in Environment Managements</i>. New Delhi, India:Discovery.</li> <li>Avery, T. E., &amp;Berlin, G. L. (1985). <i>Interpretation of Aerial photographs</i>(4<sup>th</sup>ed.). Minneapolis, Minnesota:Burgess.</li> <li>Bhatta, B. (2011). <i>Remote Sensing and GIS</i>(2<sup>nd</sup>ed). New Delhi, India: Oxford University Press.</li> </ol>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>No Change in content</p>

				<p>4. Burrough, P.A., &amp; Rachael A. M. (2015). <i>Principles of Geographic Information Systems</i> (3<sup>rd</sup> ed.). Oxford, UK: Oxford University Press.</p> <p>5. Ciciarelli, J. A. (1991). <i>A Practical Guide to Aerial Photography with an Introduction to Surveying</i>. US: Springer.</p> <p>6. Curran, P. J. (1985). <i>Principles of Remote Sensing</i>. London, UK: Longman.</p> <p>7. Fazal, S. (2008). <i>GIS Basics</i>. New Delhi, India: New Age International.</p> <p>8. Ganesh, A., &amp; Narayanakumat, R. (2006). <i>GPS Principles and Applications</i>. Satish Serial.</p> <p>9. George, J. (2008). <i>Fundamentals of Remote Sensing</i>. Hyderabad, India: Universities Press.</p> <p>10. Heywood, I., Cornelius, S., &amp; Carver, S. (2000). <i>Introduction to GIS</i>. New York, NY: Addison Wesley Longman.</p> <p>11. Lillesand, T.M., Kiefer, &amp; R.W., Chipman, J.W. (2011). <i>Remote Sensing and Image interpretation</i>. Hoboken, NJ: Wiley and Sons.</p> <p>12. Lo, C.P., &amp; Yeung, A.K.W. (2004). <i>Concepts and Techniques of GIS</i>. New Delhi, India: Prentice-Hall of India.</p> <p>13. Paine, D. P., &amp; Kiser, J. D. (2012). <i>Aerial Photograph and Image interpretation</i>. New Jersey, NJ: John Wiley and Sons.</p> <p>14. Palet, A.N, (1992). <i>Remote Sensing-Principles &amp; Application</i>. Jodhpur, India: Scientific.</p>	
--	--	--	--	---	--

				<p><b>Suggested e-learning materials:</b></p> <p><b>1. Introduction to Remote Sensing</b> <a href="https://swayam.gov.in/course/3612">https://swayam.gov.in/course/3612</a></p> <p><b>2. Introduction to Geographic Information Systems</b> <a href="https://onlinecourses.nptel.ac.in/noc16_ce12/preview">https://onlinecourses.nptel.ac.in/noc16_ce12/preview</a></p>	
--	--	--	--	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
5	<b>ENVS 410</b> <b>Geography of Environment</b>	<p><del>After the completion of this course, students will be able to:</del></p> <ul style="list-style-type: none"> <li><del>• Describe the Physical Dimensions of environment.</del></li> <li><del>• Identify the Impact of human activities on environment.</del></li> <li><del>• Explain the concept and Significance of Environmental Movements.</del></li> <li><del>• Describe the role of Environmental Awareness and policies.</del></li> </ul>	<p style="text-align: center;"><b>Section A</b></p> <p><b>Physical Dimensions-</b></p> <ul style="list-style-type: none"> <li>a) <del>Endogenetic Process: Concept of Plate Tectonics, Earthquakes and Volcanoes</del></li> <li>b) <del>Exogenetic process: Weathering and Mass wasting</del></li> <li>c) <del>Geomorphic processes and resulting landforms :Fluvial, Arid and Coastal</del></li> <li>d) <del>Composition and Stratification of Atmosphere, Insolation and Heat Budget, Temperature</del></li> <li>e) <del>Bottom Relief of Ocean, Oceanic Temperature and Salinity</del></li> </ul> <p style="text-align: center;"><b>Section B</b></p> <p><b>Human Dimensions</b></p> <ul style="list-style-type: none"> <li>a) <del>Human Population: Growth and Distribution</del></li> <li>b) <del>Population Growth and Environmental Deterioration</del></li> <li>c) <del>Man Induced Environmental Changes</del></li> <li>d) <del>Types of Human Activities</del></li> <li>e) <del>Impact of Human Activities: Deforestation, Mining and Industrialization</del></li> </ul> <p style="text-align: center;"><b>Section C</b></p> <p><b>Environmental Awareness and Policies</b></p> <ul style="list-style-type: none"> <li>a) <del>Environmental Awareness Need and Role in Amelioration of Environment</del></li> <li>b) <del>Concept and Significance of Environmental Movements, Environmental Movements in India with special reference to The Chipko Movement, Narmada Bachao Andolan</del></li> <li>c) <del>Environmental Protection Efforts in India</del></li> <li>d) <del>International Environmental Policy with special</del></li> </ul>		Course deleted and replaced with a new course of Climate Change and Environment in the same semester.

			<p>reference to THE AGENDA 21 EARTH SUMMIT National Environmental Policy of India</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. BalAnand S. (2005) An Introduction to Environmental Management, Himalaya Publishing House Mumbai</li> <li>2. Bloom.A. L. (1998/ 2001): Geomorphology: 3<sup>rd</sup> edition. Prentice Hall of India, New Delhi.</li> <li>3. Chandana, R. C (2008): A Geography of population, Kalyani Publishers, New Delhi.</li> <li>4. Chopra, Girish (2006): Population Geography. Commonwealth Publishers</li> <li>5. Chorley, R.J., Schumm S A and Sugden D E. (1984). Geomorphology. Methuen and Company Ltd., London.</li> <li>6. Dayal, P. (1994): A Text Book of Geomorphology. Kalyani Publishers, New Delhi.</li> <li>7. Husain Majid (2002), Fundamentals of Physical Geography, 2<sup>nd</sup> Ed. Rawat Pub. Jaipur and New Delhi.</li> <li>8. Jadhav H.V. and Purohit S.H. (2011): Environmental Studies, Himalaya Publishing House, Mumbai</li> <li>9. Kale, V. and Gupta, A. (2001): Introduction to Geomorphology. Orient Longman, Hyderabad.</li> <li>10. King, C.A.M. (1966): Techniques in Geomorphology. Edward Arnold, London.</li> <li>11. Kumar Satish (2011): Protecting Environmental Issues A Quest for NGO's, AVON Publication, New Delhi</li> <li>12. Levag&amp;Goh Cherry (1982), Human &amp; Economic Geography, Oxford University, Press Oxford London</li> </ol>	
--	--	--	--	--

			<p>13. Rajagopalan R. (2014): Environmental Studies 2<sup>nd</sup> Ed. Oxford University Press, Delhi</p> <p>14. Singh, S. (2004): Geomorphology. PrayagPustakBhawan, Allahabad.</p> <p>15. Singh, S. [1993]: Physical Geography. PrayagPustakBhawan, Allahabad.</p> <p>16. Singh, S. [1993]: Environmental Geography. PrayagPustakBhawan, Allahabad</p> <p>17. Strahler, A.N. (1988) Earth Science, Harper and Row Publishers, New Delhi (India reprint).</p> <p>18. Strahler, A.N. and Strahler, A.H.(1996); Introducing Physical Geography. John Willey and Sons, New York.</p> <p>19. Thornbury, W.D. (2005): Principles of Geomorphology. John Wiley and Sons, New Delhi (India Reprint).</p> <p>20. उपाध्याय एल. एन. : भौतिकभूगोलसंज्ञानहिन्दीग्रन्थशुक्रादमी, जयपुर।</p> <p>21. बटुभुजंगमोरिया एवंजैन (1961) : भौतिकभूगोल एवंजीवमण्डल, सहित्य भवन, आगरा।</p> <p>22. तिव्या, रामनाथ : भौतिकभूगोल, केदारनाथसामनाथ, मेरठ।</p> <p>23. पी. दयाल : भूआकृतिविज्ञान, शुक्रादमीकठिणे।</p> <p>24. शर्मा एच. एस., शर्मा एम.एल. औरसिआआर.एल. : भौतिकभूगोल पंचशीलप्रकाशनजयपुर।</p> <p>25. सविन्द्र सिंह : भूआकृतिविज्ञान, प्रयागपुस्तकभवन, इलाहाबाद।</p> <p>26. सविन्द्र सिंह (1971) : भौतिकभूगोल, बसुधराप्रकाशन, गोरखपुर।</p>	
--	--	--	---	--

S. No.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
6	ENVS 411 Introduction to Computer for Environmental Science	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>Describe the elements of a computer system and functions of its components</li> <li>Use various computer operating systems.</li> <li>Create worksheets, charts, documents, inserting tables and pictures and presentation package.</li> <li>Use photographs and document editing software.</li> </ul>	—	<p>Recommended Books:</p> <ol style="list-style-type: none"> <li>Sinha, P.K. (2017). <i>Computer Fundamentals</i>. New Delhi, India: BPB.</li> <li>Taxali, R.K. (2000). <i>PC Software for window - made simple</i>. New Delhi, India: Tata Mcgraw Hill.</li> </ol> <p>Suggested e-learning materials:</p> <ol style="list-style-type: none"> <li>Computer Fundamentals <a href="https://swayam.gov.in/course/4067-computer-fundamentals">https://swayam.gov.in/course/4067-computer-fundamentals</a></li> <li>Introduction to System: Software <a href="https://nptel.ac.in/courses/106106092/2">https://nptel.ac.in/courses/106106092/2</a></li> </ol>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>No Change in the content</p>

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
7	ENVS 403L Environment Lab-I	<p><b>After the completion of this course, students will be able to:</b></p> <ul style="list-style-type: none"> <li>• <b>Conduct soil sample analysis.</b></li> <li>• <b>Conduct water sample analysis.</b></li> <li>• <b>Use MS office Package, CorelDraw, Internet services.</b></li> <li>• <b>Create and interpret geospatial data.</b></li> </ul>	<ol style="list-style-type: none"> <li>1. Working with Windows.</li> <li>2. Working with MS office Package (MS-Word, Excel, Power Point).</li> <li>3. Working with CorelDraw</li> <li>4. Using Internet services</li> <li>5. Using subject specific application packages.</li> <li>6. Determination of conductivity of water/soil samples.</li> <li>7. Determination of pH for water/soil samples.</li> <li>8. Determination of TSS and TDS in water samples.</li> <li>9. Determination of turbidity in water/soil samples.</li> <li>10. <del>Determination of COD in water samples.</del></li> <li>11. Determination of BOD in water samples.</li> <li>12. Determination of Dissolved Oxygen (DO) in water samples.</li> <li>13. <del>Determination of Alkalinity in water/soil samples.</del></li> <li>14. Determination of Acidity in water/soil samples.</li> <li>15. <del>Determination of Nitrate in water/soil samples.</del></li> <li>16. <del>Determination of Nitrogen, Phosphorus and Potassium (N, P, K) in soil samples.</del></li> <li>17. <del>Determination of water, CaCO<sub>3</sub> and Carbon contents in soil samples.</del></li> <li>18. Determination of Grain size of soil samples.</li> <li>19. Determination of micronutrients (Cu, Fe, Mn and Zn) in soil samples.</li> <li>20. Identify the products of combustion of hydrocarbons.</li> <li>21. Test the effect of green house on the</li> </ol>	<ol style="list-style-type: none"> <li>1. Working with Windows.</li> <li>2. Working with MS office Package (MS-Word, Excel, Power Point).</li> <li>3. Working with CorelDraw</li> <li>4. Using Internet services</li> <li>5. Using subject specific application packages.</li> <li>6. Determination of conductivity of water/soil samples.</li> <li>7. Determination of pH for water/soil samples.</li> <li>8. Determination of TSS and TDS in water samples.</li> <li>9. Determination of turbidity in water/soil samples.</li> <li>10. Determination of BOD in water samples.</li> <li>11. Determination of Dissolved Oxygen (DO) in water samples.</li> <li><b>12. Determination of Sodium, (Na) in water samples.</b></li> <li><b>13. Determination of Potassium, (K) in water samples.</b></li> <li>14. Determination of Acidity in water samples</li> <li>15. Determination of Total Hardness in water samples.</li> <li>16. Determination of Magnesium Hardness in water samples.</li> <li>17. Determination of Total Metals (Cr, Fe and Cd) in water samples.</li> <li>18. Determination of Grain size of soil samples.</li> <li><b>19. Determination of leaf area.</b></li> <li>20. Introduction to Satellite Images, TCC, FCC</li> <li>21. Visual Interpretation</li> <li>22. Stereoscopic Vision</li> <li>23. Object Identification with Aerial Photograph</li> <li>24. Introduction to GIS Software</li> </ol>	<p><b>Reviewed outcomes and suggested e-learning materials</b></p> <p><b>Some of the repeated practical's of the forthcoming semester have been removed and replaced by new ones, viz., sodium and Potassium estimation in water samples</b></p>



			<p>temperature.</p> <p>22. Introduction to Satellite Images, TCC, FCC</p> <p>23. Visual Interpretation</p> <p>24. Stereoscopic Vision</p> <p>25. Object Identification with Aerial Photograph</p> <p>26. Introduction to GIS Software</p> <p>27. Georeferencing</p> <p>28. Creation of spatial data</p> <p>29. Joining Non spatial with spatial data</p> <p>30. Buffering</p> <p>31. Map layout</p>	<p>25. Georeferencing</p> <p>26. Creation of spatial data</p> <p>27. Joining Non spatial with spatial data</p> <p>28. Buffering</p> <p>29. Map layout</p> <p><b>Recommended Books:</b></p> <p><b>1. Narasalah, G. L. (2012). <i>Environmental Science : A Practical Manual</i>. Delhi, India: B.S.</b></p> <p><b>2. Maiti, S.K. (2011). <i>Handbook of Methods in Environmental Studies. Vol. 2: Soil and Air Analysis</i>. Jaipur, India: Oxford Book Company.</b></p> <p><b>3. Rajaraman, V., &amp; Adabala, N. (2014) <i>Fundamentals of Computers (6<sup>th</sup> ed.)</i>. New Delhi, India: Prentice Hall.</b></p> <p><b>Suggested e-learning materials:</b></p> <p><b>1. Water Quality Monitoring</b> <a href="https://nptel.ac.in/courses/103107084/4">https://nptel.ac.in/courses/103107084/4</a></p> <p><b>2. Particle Size Distribution</b> <a href="https://nptel.ac.in/courses/105103097/10">https://nptel.ac.in/courses/105103097/10</a></p>	
--	--	--	---	--	--

SECOND SEMESTER

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1.	ENVS 401 Applications of Remote Sensing for Natural Resource Management	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Use geographical and spatial databases pertaining to land use land cover.</li> <li>• Perform interactive geospatial analysis, display and interpret results.</li> <li>• Assess the biophysical and social applications of remote sensing.</li> <li>• Develop skills to access and plot geospatial data for natural resource management.</li> </ul>	—	—	<p>Reviewed outcomes and suggested e-learning materials</p> <p>No Change in content</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Jenson, J.R. (2007). <i>Remote Sensing of the Environment-An Earth Resource Perspective</i>(2<sup>nd</sup>ed.). New Jersey, NJ: Prentice Hall.</li> <li>2. Joshi, P.K., &amp; Singh, T.P. (2011). <i>Geoinformatics for Climate Change Studies</i>. New Delhi, India: TERI Press.</li> <li>3. Joshi, P.K., Pani, S., Mohapartra, N., &amp; Singh, T.P. (2010). <i>Geoinformatics for Natural Resource Management</i>. Punjab, India: Nova Science.</li> </ol>

				<p>4. Kumar, P., Rani, M., &amp; Pandey, P. (2012). <i>Conservation areas to beat the heat</i>. Saarbrücken, Germany: LAP LAMBERT Academic.</p> <p>5. Lillesand, T., Keifer, R.W., &amp; Chipman, J. (2015). <i>Remote Sensing and Image Interpretation</i> (7<sup>th</sup> ed.). Hoboken, NJ: John Wiley and Sons.</p> <p>6. Schultz, G.A. &amp; Engman, E.T. (2000). <i>Remote Sensing in Hydrology and Water Management</i>. Berlin, Germany: Springer-Verlag.</p> <p><b>Suggested e-learning materials:</b></p> <p>1. Introduction to Remote Sensing  <a href="https://nptel.ac.in/courses/121107009/">https://nptel.ac.in/courses/121107009/</a></p> <p>2. Remote Sensing Applications  <a href="https://nptel.ac.in/courses/105108077/">https://nptel.ac.in/courses/105108077/</a></p>	
--	--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
2	ENVS_ Biodiversity and Conservation	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Explain importance of biological diversity.</li> <li>• Describe major threats to biodiversity.</li> <li>• Recognize and implement the various methods of biodiversity conservation with co-existence of various environmental pressures.</li> <li>• Identify different geographical biodiversity hotspots and</li> </ul>		<p><b>Section A</b>  Introduction to biodiversity concepts, significance, magnitude and distribution. Biodiversity trends, diversity gradients and related hypotheses methods for monitoring biodiversity trends. Threats to biodiversity, major causes, extinction's, vulnerability of species to extinction, IUCN threat categories, Red data book.</p> <p><b>Section B</b>  Principles of biodiversity conservation Ex situ and In situ methods of conservation, Genetical and evolutionary principles in conservation. Conservation of biological diversity and its significance- source of food, medicine, raw material, aesthetic, cultural and ecosystem services. Concepts, distribution and importance of Hot spots. Strategies for sustainable exploitation of biodiversity.</p>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>ENVS 407 Environmental Physics has been replaced by ENVS 502 Biodiversity &amp; conservation. This course has been shifted from pool of electives of III</p>

		mega-diversity centers.		<p style="text-align: center;">Section C</p> <p>Conservation – efforts in India, Endangered flora &amp; fauna of India. Ethno botany in India &amp; selected medicinal plants. Wildlife conservation in India- Project Tiger, Project crocodile, silent valley controversy. Conservation of Himalayan, Gangetic ecosystems.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Kumar, U. &amp; Asija, M.J. (2007). <i>Biodiversity – Principles and conservation</i> (2<sup>nd</sup> ed.). Jodhpur, India: Agrobios.</li> <li>2. Mishra, R. (1968). <i>Ecology Workbook</i> (2<sup>nd</sup> ed.). Calcutta, India: Oxford and IBH.</li> <li>3. Odum, E.P. (1983). <i>Basic Ecology</i> (2<sup>nd</sup> ed.). Philadelphia, PA: Holt-Saunders International.</li> <li>4. Odum, E.P. (2004). <i>Fundamentals of Ecology</i>. Dehradun, India: Natraj.</li> <li>5. Singh, M.P., Singh, J.K., Mohanka, R., &amp; Sah, R.B. (2007). <i>Forest environment and biodiversity</i> (2<sup>nd</sup> ed.). New Delhi, India: Daya.</li> <li>6. Sinha, B.N. (1990). <i>Ecosystem Degradation in India</i>. New Delhi, India: Ashish.</li> <li>7. Tewari, D.N. (1994) <i>Biodiversity and forest genetic resources</i>. Dehradun, India: International Book.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Aquatic Biodiversity and</li> </ol>	<p>Semester to core of II semester.</p> <p>ENVS 407 was shifted from core of II semester to discipline elective pool of III semester</p>
--	--	-------------------------	--	--	--

				<a href="https://nptel.ac.in/courses/120108002/16">Environmental Pollution https://nptel.ac.in/courses/120108002/16</a> <b>2. Wildlife Conservation</b> <a href="https://nptel.ac.in/noc/individual_course.php?id=noc18-bt26">https://nptel.ac.in/noc/individual_course.php?id=noc18-bt26</a>	
--	--	--	--	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
3	<b>BIO 406 Biostatistics and Research Methodology</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>Apply statistical tools to perform data analysis and data interpretation.</li> <li>Develop problem formulation using multiple statistical relationships and solve them using standard techniques.</li> <li>Draw conclusions from the use of tables, graphs, and charts.</li> <li>Have the versatility to work effectively in a broad range of analytic and scientific positions.</li> </ul>	<p><b>Section A</b></p> <p>a) <del>Scope of Biostatistics, variables in biology, collection, classification, tabulation of data.</del></p> <p>b) <del>Frequency distribution, Diagrammatic and graphical presentation of statistical data, Sampling techniques.</del></p> <p>c) <del>Measures of central location and dispersion, Simple measure of skewness and Kurtosis.</del></p> <p>d) <del>Probability, conditional probability.</del></p> <p><b>Section B</b></p> <p>a) <del>Binomial, Poisson and Normal Distribution.</del></p> <p>b) <del>Correlation and Regression: Least Square method of fitting, Standard error of estimate, Correlation and regression coefficient.</del></p> <p>c) <del>Basic idea of significance testing, level of significance, students' t' test, <math>\chi^2</math> (chi-square) test and F test, Analysis of variance.</del></p> <p><b>Section C</b></p>		This course has been replaced by new course of ENVS Environmental Statistics and Research Methodology in II semester

		<p>a) Introduction of Research Methodology: Meaning and importance, Nature and areas of research in Biological Sciences.</p> <p>b) Formulation of a research problem (Hypothesis).</p> <p>c) Elements in Research Methodology; Research Designs (CRD, RBD, LSD).</p> <p>d) Ethical, Legal and Social Issues in Biological Research.</p> <p>e) Writing of Research Report/Research Paper : Various components and their organization.</p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>1. Basotia, G.R. &amp; K.K. Sharma, Research Methodology :.</li> <li>2. Chaudhary, C.H., Research Methodology, RBSA Publication.</li> <li>3. Daniell, W., Elements of Biostatistical in Health Science –</li> <li>4. Enhance, D.N., Fundamentals of Statistics.</li> <li>5. Gupta, S.P., Statistical Methods S. Chand Publications.</li> <li>6. Khan and Khanam , Fundamentals of Biostatistics , Ukaz Publications.</li> <li>7. Singh, S., et. al. (1988), Statistical methods for Research Central Publishing, Ludhiana.</li> <li>8. Zerold Jar, 2008, Biostatistical Analysis (3rd edition) Pearson Dorling Kindersley (India), Pvt ltd.</li> </ol>	
--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
4	<b>BIO-408 Environmental Biology and Toxicology</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>Recognize dangerous toxic compounds and what properties make them toxic.</li> <li>Discuss the toxicological concepts of different toxic substances.</li> <li>Predict the transport and fate of toxicants in environment.</li> <li>Assess the effect of toxic substances on the environment health.</li> </ul>	<p style="text-align: center;"><b>Section A</b></p> <p>a) <del>Concept of energy, conventional &amp; non-conventional energy sources. Fossil fuels, hydro, wind and nuclear power, geothermal, solar and bioenergy.</del></p> <p>b) <del>Energy flow in organisms, energy pathways &amp; models, energy efficiencies, conservation of energy.</del></p> <p>c) <del>Classification &amp; characteristics of resources: water, soil, forest, wild life, land use.</del></p> <p>d) <del>Conservation of natural resources: water, soil, forest and wild life.</del></p> <p style="text-align: center;"><b>Section B</b></p> <p>a) <del>Origin of pollutants: industrial, agricultural, domestic and vehicular sources.</del></p> <p>b) <del>Pollutant &amp; their toxicology: Heavy metals and trace elements, agrochemicals (Pesticides, herbicides, rodenticides &amp; fungicides, detergents) &amp; particulate matter.</del></p> <p>c) <del>Types of radiations including ionizing &amp; non-ionizing radiations &amp; their interaction with matter.</del></p> <p>d) <del>Radiations as environmental pollutants.</del></p> <p>e) <del>Effects of radiations at cellular, molecular &amp; genetic level.</del></p> <p style="text-align: center;"><b>Section C</b></p> <p>a) <del>Mutagenicity, carcinogenicity.</del></p> <p>b) <del>Green house effect, acid rains.</del></p> <p>c) <del>Ozone layer depletion, photochemical smog.</del></p> <p>d) <del>Types of solid wastes, transport, reuse &amp; recycling.</del></p> <p><b>Recommended Books:</b></p> <p>1. <del>Clark, Bissel&amp;Watham , Environmental Impact</del></p>		<p>This course has been replaced by new course of ENVS Environmental Toxicology in II semester</p> <p>Some essential components regarding toxicology have been added in proposed syllabus</p>



			<p>Assessment:</p> <p>2. <del>Encyclopedia of pollution &amp; its control : Vol. I-VI</del></p> <p>3. <del>Eugene P. Odum., Fundamentals of Ecology</del></p> <p>4. <del>R.L. Smith, Field Biology</del></p> <p><del>Timberell J.A, Introduction to Toxicology</del></p>		
--	--	--	--	--	--



		<p><b>environmental regimes</b></p>	<p>d) Bio-Medical waste (management &amp; handling) rules 1998,  e) Hazardous waste (Management and Handling) Rules 1989 and 2000</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Diwan, Shyam and Rosencranz, Armin (2002) : Environmental Law and Policy in India, New Delhi, Oxford University Press.</li> <li>2. Krishna, Leela. Environmental Law in India, Delhi, Lexis Nexis, Butterworth wadhwa ,</li> <li>3. S.Santakumar's Introduction to Environmental Law, Nagpur, Lexis Nexis, Butterworth wadhwa</li> <li>4. Sahasranaman, (2009) : P.B. Handbook of Environmental Law in India , New Delhi , Oxford University Press.</li> </ol>	<p>rules 1998,  Hazardous waste (Management and Handling) Rules 1989 and 2000)</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. <b>Bhatt, S. (2004). <i>Environment Protection and Sustainable Development</i>. New Delhi, India: APH.</b></li> <li>2. <b>Diwan, S. &amp; Rosencranz, A. (2002). <i>Environmental Law and Policy in India</i> (2<sup>nd</sup> ed.). New Delhi, India: Oxford University Press.</b></li> <li>3. <b>Leelakrishnan, P. (2010). <i>Environmental Law in India</i> (3<sup>rd</sup> ed.). New York, NY: Lexis Nexis.</b></li> <li>4. <b>Naseem, M., &amp; Naseem, S. (2018). <i>International Environmental Law</i>. Netherlands: Wolters Kluwer.</b></li> <li>5. <b>Sahasranaman, P.B. (2012). <i>Handbook of Environmental Law</i> (2<sup>nd</sup> ed.). New Delhi, India: Oxford University Press.</b></li> <li>6. <b>Shantha, K. S. (2008). <i>Introduction to Environmental Law</i> (2<sup>nd</sup> ed.). New York, NY: LexisNexis.</b></li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. <b>Environmental Legislation in India</b>  <a href="https://nptel.ac.in/courses/105104099/39">https://nptel.ac.in/courses/105104099/39</a></li> <li>2. <b>Environmental Law</b>  <a href="https://swayam.gov.in/courses/5163">https://swayam.gov.in/courses/5163</a></li> </ol>	
--	--	-------------------------------------	---	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
6	ENVS 407 Environmental Physics	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Apply the concepts and laws of physics that govern the environment.</li> <li>• Measure different environmental parameters.</li> <li>• Describe applications of laser and detection of environmental pollutants by laser absorption.</li> <li>• Describe LIDAR technique and its applications.</li> </ul>	<p><b>Section-A</b></p> <p>a) The scope of environmental physics  b) Laws of thermodynamics, reversible and irreversible thermodynamical process and entropy, Specific heats, Gas Laws for isothermal and adiabatic processes, Lapse rate  c) Water and Water Vapour: vapour pressure, dew point, saturation vapour pressure deflect, specific and relative humidity  d) Transport laws: General transfer equation, molecular transfer process, diffusion coefficients  e) Radiation Laws: black body radiations, Wien's law, Stefan's law, Planck's law, Cosine law for emission and absorption, reflectivity, radiance and irradiance, Wind chill, Hypothermia</p> <p><b>Section-B</b></p> <p>a) Radiation Environment- Solar Radiation: solar constant, sun-earth geometry, attenuation in the atmosphere, solar radiation at the ground; Terrestrial Radiation; Cloudless skies, Cloudy skies  b) Microclimatology of radiations (interception): Direct and diffused solar radiations, Shape factors, canopies of black leaves  c) Microclimatology of radiations (absorption and reflection): radiative properties of natural materials</p> <p><b>Section-C</b></p> <p>a) Laser applications, Laser light transmission through the atmosphere, molecular absorption and particle scattering techniques for detection of molecules of pollutants by absorption of laser,</p>		Course has been shifted to pool of discipline electives in III semester.

			<p>b) Remote monitoring capabilities of laser systems, LIDAR technique and its applications</p> <p>⇒ Microwaves; Environmental aspects of microwaveradiations, Microwave decomposition of toxicvapour stimulants-</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. <del>Garg S. C., Bansal R. M., Ghosh C. K., Thermal Physics;; Publisher: McGraw Hill Education (India):</del></li> <li>2. <del>John, Monteith L. and Unsworth M.H., Principles of Environmental Physies; Publisher: Eastern Book Linkers, London (2<sup>nd</sup> Edition)</del></li> <li>3. <del>Orazio S., Principles of Laser, Publisher: Springer.</del></li> <li>4. <del>Wei G., Schmoldt D., Slusser J.R., UV Radiation in Global Climate Change: Measurements, Modeling and Effects on Ecosystem; Publisher: Springer (2010).</del></li> </ol>	
--	--	--	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
7	ENVS _____ Environmental Statistics and Research Methodology	After the completion of this course, students will be able to: <ul style="list-style-type: none"> <li>• Apply statistical tools to perform data analysis and data interpretation.</li> <li>• Develop problem formulation using multiple statistical relationships and solve them using standard techniques.</li> <li>• Draw conclusions from the use of tables, graphs, and charts.</li> <li>• Have the versatility to work effectively in a broad range of analytic and scientific positions.</li> </ul>		<p style="text-align: center;"><b>Section A</b></p> <p>Basic idea of Environmental Statistics and its applications in Environmental research. Collection, classification, tabulation of data. Frequency distribution Diagrammatic and graphical presentation of statistical data, sampling techniques. Central tendency – concept; arithmetic mean, median, mode for ungrouped and grouped data. Measures of dispersion: range, mean deviation, standard deviation and variance.</p> <p style="text-align: center;"><b>Section B</b></p> <p>Probability, Binomial, Poisson and Normal Distribution, simple measure of Skewness and Kurtosis. Correlation and Regression: Karl Pearson correlation coefficient and Spearman rank correlation coefficient, Regression. Basic idea of significance testing, level of significance, Student's t-test, <math>\chi^2</math> (chi-square) test and F-test and analysis of variance (ANOVA).</p> <p style="text-align: center;"><b>Section C</b></p> <p>Introduction of Research Methodology: Formulation of a research problem (Hypothesis). Simple experimental designs, Writing of Research Report/Research Paper: Review of literature, The IMRaD format, Citation and Impact factor, Science citation index (SCI)/ Science citation index Expanded (SCI-E), H-index, Citation style (APA, MLA) Academic Ethics and Plagiarism, Intellectual Property Rights and Patent law.</p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>1. Basotia, G.R. &amp; Sharma, K.K. (1999). <i>Research Methodology</i>. Jaipur, India: Mangal Deep.</li> <li>2. Chaudhary, C.H. (2009). <i>Research Methodology</i>. Rajasthan, India: RBSA.</li> <li>3. Daniel, W. (1987). <i>Biostatistics: A Foundation for Analysis in the Health Sciences</i> (4<sup>th</sup> ed.). New York, NY: John Wiley &amp; Sons Inc.</li> </ol>	Introduction of new course.

				<p>4. Elhance, D.N., Elhance, V., &amp; Aggarwal, B.M. (2014). <i>Fundamentals of Statistics</i>. New Delhi, India: KitabMahal.</p> <p>5. Gupta, S.P. (2014). <i>Statistical Methods</i> (43<sup>rd</sup> ed.). New Delhi, India: S. Chand.</p> <p>6. Khan, I.A., &amp; Khanum, A. (2009). <i>Fundamentals of Biostatistics</i>. Hyderabad, India: Ukaaz.</p> <p>7. Zerold, J. (2008). <i>Biostatistical Analysis</i> (3<sup>rd</sup> ed.). Noida, India: Dorling Kindersley.</p> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Descriptive Statistics- Measures of Central Tendency and Dispersion <a href="https://nptel.ac.in/courses/110106064/4">https://nptel.ac.in/courses/110106064/4</a></li> <li>2. Guidelines for Thesis Preparation <a href="http://www.iitk.ac.in/doaaold/thesisguide.pdf">http://www.iitk.ac.in/doaaold/thesisguide.pdf</a></li> <li>3. How to Write a Paper <a href="http://www-mech.eng.cam.ac.uk/mmd/ashby-paper-V6.pdf">www-mech.eng.cam.ac.uk/mmd/ashby-paper-V6.pdf</a></li> <li>4. Introduction to research <a href="https://nptel.ac.in/courses/121106007">https://nptel.ac.in/courses/121106007</a></li> <li>5. Methodology for Design Research <a href="https://nptel.ac.in/courses/107108011">https://nptel.ac.in/courses/107108011</a></li> <li>6. Research Writing <a href="https://onlinecourses.nptel.ac.in/noc18_mg13/prview">https://onlinecourses.nptel.ac.in/noc18_mg13/prview</a></li> </ol>	
--	--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
8	ENVS _____ Environmental Toxicology	After the completion of this course, students will be able to: <ul style="list-style-type: none"> <li>Recognize dangerous toxic compounds and what properties make them toxic.</li> <li>Discuss the toxicological concepts of different toxic substances.</li> <li>Predict the transport and fate of toxicants in environment.</li> <li>Assess the effect of toxic substances on the environment health.</li> </ul>		<p><b>Section A</b> Principles in toxicology; Definition of Xenobiotics. Concepts of LD50; Dose-effect and dose-response relationship. Biological and chemical factors that influence toxicity; Bio-transformation and bio-accumulation. Eco-system influence on the fate and transport of toxicants Abiotic Stress response in living systems.</p> <p><b>Section B</b> Origin of pollutants: industrial, agricultural, domestic and vehicular sources. Pollutant &amp; their toxicology: Heavy metals (Pb and Cr) and trace elements. agrochemicals (Pesticides, herbicides, &amp; fungicides, detergents) &amp; particulate matter. Global dispersion of toxic substance Types of radiations including ionizing &amp; non-ionizing radiations &amp; their interaction with matter.</p> <p><b>Section C</b> Radiations as environmental pollutants. Effects of radiations at cellular, molecular &amp; genetic level, Mutagenesis, Carcinogenicity.</p> <p><b>Recommended Books:</b> 1. Ahmad, P., &amp; Prasad, M. N. V. (2012). <i>Abiotic Stress Responses in Plants: Metabolism, Productivity and Sustainability</i>. New York, NY: Springer-Verlag.</p>	Introduction of new course.



				<p>2. Ahmad, P., Ahanger, M.A., Singh, V.P., Tripathi, D.K., Alam, P., &amp; Alyemini, M.N. (2018). <i>Plant Metabolites and Regulation under Environmental Stress</i>. Massachusetts, MA: Academic Press.</p> <p>3. Cockerham, L.G., &amp; Shane, B.S. (1993). <i>Basic Environmental Toxicology</i>. Florida, FL: CRC Press.</p> <p>4. Gaur, R.K., &amp; Sharma, P. (2013). <i>Molecular Approaches in Plant Abiotic Stress</i>. Florida, FL: CRC Press.</p> <p>5. Gaur, R.K., &amp; Sharma, P. (2014). <i>Approaches to Plant Stress and their Management</i>. New Delhi, India: Springer.</p> <p>6. Newman, M.C. (2014). <i>Fundamentals of Ecotoxicology: The Science of Pollution</i> 4<sup>th</sup>ed.). Florida, FL: CRC Press.</p> <p><b>Suggested e-learning materials:</b></p> <p>1.Environmental Toxicology  <a href="https://nptel.ac.in/courses/120108002/">https://nptel.ac.in/courses/120108002/</a></p> <p>2.Toxicological Chemistry  <a href="https://nptel.ac.in/courses/122106030/">https://nptel.ac.in/courses/122106030/</a></p>	
--	--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
9.	ENVS 404L Environment Lab-II	<p><b>After the completion of this course, students will be able to:</b></p> <ul style="list-style-type: none"> <li>• <b>Perform water quality analysis.</b></li> <li>• <b>Perform biochemical analysis of plant samples.</b></li> <li>• <b>Access and plot geospatial data for environmental modeling.</b></li> <li>• <b>Demonstrate applications of remote sensing in natural resource management.</b></li> </ul>	<ol style="list-style-type: none"> <li>1. Measurement of size of particles by laser technique</li> <li>2. Measurement of thermal conductivity of different materials</li> <li>3. Measurement of speed of electromagnetic radiations of different frequencies</li> <li>4. Measurement of nuclear radiations in environment</li> <li>5. Study of heat transfer by radiations and convections</li> <li>6. To Determine the Hydraulic Conductivity</li> <li>7. To verify Stefan's law</li> <li>8. To verify Planck's law</li> <li>9. Estimation of total hardness.</li> <li>10. Estimation of Calcium content.</li> <li>11. Estimation of Magnesium content.</li> <li>12. Estimation of Chloride content.</li> <li>13. Estimation of Sulphate content.</li> <li>14. Estimation of Alkalinity.</li> <li>15. Estimation of dissolved Oxygen.</li> <li>16. Estimation of Fluoride.</li> <li>17. Effect of toxicants on insects.</li> <li>18. Experiment based on food preferences in insects.</li> <li>19. Land Use/ Land Cover mapping</li> <li>20. Crop area estimation using remote sensing</li> <li>21. Forest cover and density mapping</li> <li>22. Water quality modelling using remote sensing and GIS</li> <li>23. Flood hazard analysis using multi- temporal imagery</li> <li>24. Site suitability for solid waste management</li> </ol>	<ol style="list-style-type: none"> <li>1. Estimation of Chloride content.</li> <li>2. Estimation of Alkalinity.</li> <li>3. <b>Estimation of organic carbon in soil sample.</b></li> <li>4. Estimation of Fluoride.</li> <li>5. <b>Estimation of MDA in plant sample.</b></li> <li>6. <b>Estimation of Chlorophyll a in plant samples</b></li> <li>7. <b>Estimation of Chlorophyll b in plant samples</b></li> <li>8. <b>Estimation of Carotenoids in plant sample</b></li> <li>9. <b>To study plant population density by quadrat method</b></li> <li>10. <b>To study plant frequency by quadrat method</b></li> <li>11. Estimation of sodium in soil samples/ sludge sample</li> <li>12. Estimation of Potassium in soil samples</li> <li>13. Estimation of Cr and Pb in soil samples/ sludge sample</li> <li>14. Crop area estimation using remote sensing</li> <li>15. Forest cover and density mapping</li> <li>16. Water quality modeling using remote sensing and GIS</li> <li>17. Flood hazard analysis using multi- temporal imagery</li> <li>18. Site suitability for solid waste management</li> <li>19. Effect of toxicants on insects.</li> <li>20. Experiment based on food preferences in insects.</li> </ol> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. <b>Avery, T.E. &amp; Berlin, G.L. (1985). <i>Interpretation of Aerial photographs</i> (4<sup>th</sup>ed.). Minneapolis: Burgess.</b></li> <li>2. <b>Burrough, P.A. &amp; McDonnell, R.A. (1998). <i>Principles of Geographic Information Systems (Spatial Information Systems)</i> (2<sup>nd</sup>ed.). Oxford, UK: Oxford University Press.</b></li> <li>3. <b>Heywood, I., Cornelius, S., &amp; Carver, S. (2006). <i>An introduction to geographical information</i></b></li> </ol>	<p><b>Reviewed outcomes and suggested e-learning materials</b></p> <p><b>Some new practical's on chlorophyll, carotenoids have been introduced in the second semester to avoid replication and some repeated practical's are deleted</b></p>

				<p>systems (3<sup>rd</sup> ed.). Harlow, England: Pearson Prentice Hall.</p> <p>4. Lillesand, T.M., Kiefer, R.W. &amp; Chipman J.W. (2011). <i>Remote Sensing and Image interpretation</i> (7<sup>th</sup> ed.). Hoboken, NJ: John Wiley and Sons.</p> <p>5. Maiti, S.K. (2011). <i>Handbook of Methods in Environmental Studies. Vol. 1: Water and Wastewater Analysis</i>. Jaipur, India: Oxford Book Company.</p> <p>6. Maiti, S.K. (2011). <i>Handbook of Methods in Environmental Studies. Vol. 2: Soil and Air Analysis</i>. Jaipur, India: Oxford Book Company.</p> <p>7. Rajaraman, V., &amp; Adabala, N. (2014) <i>Fundamentals of Computers</i> (6<sup>th</sup> ed.). New Delhi, India: Prentice Hall.</p> <p><b>Suggested e-learning materials:</b></p> <p>1. Analysis of major constituents in water  <a href="https://nptel.ac.in/courses/122106030/">https://nptel.ac.in/courses/122106030/</a></p> <p>2. Water Quality Monitoring: Collection of water samples and estimation of physical parameters  <a href="https://nptel.ac.in/courses/103107084/4">https://nptel.ac.in/courses/103107084/4</a></p>	
--	--	--	--	--	--

**THIRD SEMESTER**

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	<p style="text-align: center;"><b>ENVS_</b>  <b>Air Pollution</b>  <b>Monitoring,</b>  <b>Control</b>  <b>Technology and</b>  <b>Management</b></p>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe various air pollutants and their sources.</li> <li>• Describe the consequences on human health.</li> <li>• Predict the control measures of air pollutant depending upon source and type.</li> <li>• Illustrate stack sampling and mitigation strategies of SO<sub>x</sub> and NO<sub>x</sub></li> </ul>		<p style="text-align: center;"><b>Section A</b></p> <p>Air pollution: Definition, sources and effects. Air pollutants; Classification and properties, emission sources, major emissions from global sources and importance of Anthropogenic sources. Effects of air pollution on health, vegetation and materials damages. Photochemical smog.</p> <p style="text-align: center;"><b>Section B</b></p> <p>Control techniques and equipments for air pollution, particulate emission control: Gravitational settling chambers, cyclone separators, fabric filters, electrostatic precipitator, wet scrubbers. Control of specific gaseous pollutants; control of SO<sub>x</sub>, control of NO<sub>x</sub>, control of hydrocarbons, and control of carbon mono-oxide</p> <p style="text-align: center;"><b>Section C</b></p> <p>Air pollution sampling and measurement: Types of pollutant sampling and measurement, ambient air sampling, collection of gaseous air pollutants, collection of particulate pollutants, stack sampling, analysis of air pollutants</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Buonicore, A., &amp; Theodore L. (1994). <i>Air Pollution Control Equipment: Selection, Design, Operation and Maintenance</i>. New York, NY: Springer-Verlag.</li> <li>2. Buonicore, A., Wayne, T., &amp; Davis (1992). <i>Air Pollution Engineering Manual</i>. New York, NY: Van Nostrand Reinhold.</li> <li>3. Burke, G., Singh, B. R. &amp; Theodore, L. (2000). <i>Handbook of Environmental Management and Technology</i> (2<sup>nd</sup> ed.). New York, NY: John Wiley &amp; Sons.</li> <li>4. Cavaseno, V. (1980). <i>Industrial Air Pollution Engineering</i>. New York, NY: Mcgraw-Hill.</li> <li>5. Cheremisinoff, N. P., (2002). <i>Handbook of Air pollution prevention and control</i>. Oxford, UK: Butterworth-Heinemann/Elsevier science.</li> </ol>	<p><b>Introduction of New Course</b></p> <p><b>This course has been shifted to core of III semester from pool of elective of III semester.</b></p>

				<p>6. Cheremisinoff, P. N. (1993). <i>Air Pollution Control and Design for Industry</i>. New York, NY: Marcel Dekker.</p> <p>7. De, N. N. (2000). <i>Air Pollution Control Engineering</i> (2<sup>nd</sup> ed.). New York, NY: McGraw-Hill Companies.</p> <p>8. Heinsohn, R.J. &amp; Kabel, R.L. (1999). <i>Sources and Control of Air Pollution</i>. New Jersey, NJ: Prentice.</p> <p>9. Kovacs, M. 1995. <i>Pollution Control and Conservation</i>. Chichester: Ellis Horwood.</p> <p>10. Kumar, S. &amp; Kumar, R. (2012) <i>Air Quality – Monitoring and Modeling</i>. Croatia, Rijeka: InTech Janeza Trdine.</p> <p>11. Lodge, J. P. (1988). <i>Methods of Air Sampling and Analysis</i> (3<sup>rd</sup> ed.). Boca Raton, FL: Lewis.</p> <p>12. Metcalf &amp; Eddy, Inc. (1991). <i>Wastewater Engineering- Treatment, Disposal and Reuse</i> (3<sup>rd</sup> ed.). New York, NY: McGraw-Hill.</p> <p>13. Stern, A. C. (1976). <i>AIR POLLUTION Measuring, monitoring and surveillance of air pollution</i> (3<sup>rd</sup> ed.). Massachusetts, MA: Academic Press.</p> <p>14. Stern, A. C. (1986). <i>AIR POLLUTION. Supplement to measuring, monitoring and surveillance and engineering control of air pollution</i> (3<sup>rd</sup> ed.). Massachusetts, MA: Academic Press.</p> <p>15. William, F., &amp; DeRose, (2004) <i>Principles and Practices of Air Pollution Control</i>, United States Air Pollution Training Institute (APTI)</p> <p><b>Suggested e-learning materials:</b></p> <p>1. <b>Environmental air pollution</b>  <a href="https://nptel.ac.in/courses/105102089/air%20pollution%20(Civil)/Module-2/1.htm">https://nptel.ac.in/courses/105102089/air%20pollution%20(Civil)/Module-2/1.htm</a></p> <p>2. <b>Stack Monitoring</b>  <a href="https://nptel.ac.in/courses/105102089/8">https://nptel.ac.in/courses/105102089/8</a></p> <p>3. <b>Guidelines for the Measurement of Ambient Air Pollutants</b>  <a href="http://epcb.nic.in/openpdffile.php?id=UmVwb3J0RmIsZXMvMjdfMTQ1ODExMDQvNi90ZXdlJdGVtXzE5Ni90QUFRTVNFVm9sdW1lLUkucGRm">http://epcb.nic.in/openpdffile.php?id=UmVwb3J0RmIsZXMvMjdfMTQ1ODExMDQvNi90ZXdlJdGVtXzE5Ni90QUFRTVNFVm9sdW1lLUkucGRm</a></p> <p>4. <b>Air pollution control technologies</b></p>	
--	--	--	--	--	--

				<a href="http://capacitydevelopment.unido.org/wp-content/uploads/2014/11/25.-Air-Pollution-Control-Technologies-Compendium.pdf">http://capacitydevelopment.unido.org/wp-content/uploads/2014/11/25.-Air-Pollution-Control-Technologies-Compendium.pdf</a> <b>5. Kinetics of Air Pollution and Combustion Process</b> <a href="https://nptel.ac.in/courses/105104099/">https://nptel.ac.in/courses/105104099/</a>	
--	--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
2	<b>ENVS 504 Disaster Management and Mitigation Strategies</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• <b>Explain natural and manmade disaster and associated socio-economic impact .</b></li> <li>• <b>Discuss key concepts, definitions and perspectives of disaster Management</b></li> <li>• <b>Describe the Disaster Management Cycle.</b></li> <li>• <b>Describe planning for hazard mitigation.</b></li> </ul>	<p style="text-align: center;"><b>Section A</b></p> <p><b>Introduction to Disaster and Hazards</b></p> <ol style="list-style-type: none"> <li>Hazards and Disaster: Definition and Difference; Types of Hazards and Disaster; causes and consequences</li> <li>Prediction and Indicators of Natural Disasters</li> <li>Natural Disasters – Earthquakes, Cyclones, Floods, Drought and Landslides</li> <li>Man Made Disaster – Nuclear and Chemical</li> </ol> <p style="text-align: center;"><b>Section B</b></p> <p><b>Impact of Disaster and Case Studies</b></p> <ol style="list-style-type: none"> <li>Social, Economic and Health impacts of Disaster</li> <li>Floods - one case study with special reference to Brahmaputra Basin</li> <li>Drought – one case study with special reference to Vidarbha and Telangana region</li> <li>Earthquake – one case study with special reference to Himalayan region</li> <li>Nuclear – Hiroshima and Nagashakhi</li> </ol> <p style="text-align: center;"><b>Section C</b></p> <p><b>Natural Disaster Management and Preparedness</b></p> <ol style="list-style-type: none"> <li>Disaster Management: Prevention, Preparedness and Mitigation</li> <li>Planning and control of Natural Disaster</li> <li>National and State level planning for Hazard Mitigation</li> <li>Role of Natural Disaster Management Authority</li> </ol> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li><del>BMTPC &amp; CDMM (2003) : Landslide Hazard Zonation of India, New Delhi.</del></li> <li><del>Bolt, B.A. (1988) : Earthquakes WH Freeman</del></li> </ol>	<b>Discipline Elective</b>	The course has been shifted to pool of discipline electives in III semester.

			<p>&amp; Company, New York.</p> <p>3. Decker, R.W. &amp; BB Decker (1998): Volcanoes, 3<sup>rd</sup> Edition WH Freeman &amp; Company, New York.</p> <p>4. Dowrick, D. (2003) : Earthquake Risk Reduction Zone Wiley &amp; Sons Ltd, Sushex England.</p> <p>5. Drake, F. (2000) :Global Warming the Science of Climate Change, Oxford University Press, New York.</p> <p>6. Gere, J.M., Shah., H.C. (1984) : Terra Non Firme Understanding and Preparing for Earthquakes, WH Fremman&amp; Company, New York.</p> <p>7. Govt. of India, (2002), Drought2002 a Report (part I), Ministry of Agriculture, Dept. of Agriculture and Cooperation , New Delhi.</p> <p>8. Govt. of India, (2002), Drought 2002 States Report (part II), Ministry of Agriculture, Dept. of Agriculture and Cooperation , New Delhi.</p> <p>9. Govt. of India, (2004), Annual Reports, Ministry of Agriculture, Dept. of Agriculture and Cooperation, 1999-2000, 2002-2003, 2003-2004, New Delhi.</p> <p>10. IGNOU (2005) :Understanding Natural Disasters, Shagun Offset Press, Noida.</p> <p>11. IMD (1972) :Cyclone and safeguards, New Delhi.</p> <p>12. Inca., M. (1990) : The Rising Seas, Earthscan, London.</p> <p>13. IPCC (2001) : Climate Change, University of Cambridge.</p> <p>14. Prakash, I. (1994) :Disaster Management— RastriyaPrahariPrakashan, Ghaziabad.</p> <p>15. Roy., S. (2004) : Natural Disaster Management —a case study of Tornado, Abhijit</p>	
--	--	--	--	--



			<p>Publications, New Delhi.</p> <p>16. Savindra S. (2015) : Environmental Geography, Pravika Publications, Allahabad.</p> <p>17. Sharma, V.K. (1995) : Disaster Management (ed.), IIPA, New Delhi.</p> <p>18. Singh, Tej (2006) : Disaster Management Approaches and Strategies, Akanksha Publishing House, New Delhi</p> <p>19. Sinha, D.K. (2006) : Towards Basics of Natural Disaster Reduction, Reasearcheo, Book Centre, New Delhi.</p> <p>20. Thomas, B. (1993) : disaster response: A Handbook for Emergencies, CASA, New Delhi.</p> <p>21. Ward, R. (1978) : Floods A Geographical perspective, Mac. Millan press Ltd.</p> <p>suggested e-learning materials:</p>		
--	--	--	---	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
3	<b>ENVS 505 Energy Auditing and Conservation</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe Energy audits for building.</li> <li>• Describe energy conservation measures.</li> <li>• Explain energy efficient lighting technologies and its application in commercial and residential sectors.</li> <li>• Describe Energy storage technologies and Energy Auditing</li> </ul>	<p style="text-align: center;"><b>Section A</b></p> <p>a) Barriers to energy conservation, Key energy issues to 2025, Carbon dioxide emission, Energy Audits for building (Background, Energy Audit Procedures, Energy Management Programs &amp; Energy Conservation Measures).</p> <p>b) Electrical Energy Management in Buildings (Principal Electricity Uses in Building, Strategies for Electricity End-Use Management), Heating, Ventilating and Air-Conditioning Control Systems (Modes of Feedback Control, Basic Control Hardware, Basic Control Systems Design Considerations &amp; Example of HVAC Control Systems).</p> <p>c) Energy Efficient Lighting Technologies and Their Applications in the Commercial And Residential Sectors (Design of Energy-Efficient Lighting Systems, Lighting Technologies, Efficient Lighting Operation, Current Lighting Markets and Trends</p> <p style="text-align: center;"><b>Section B</b></p> <p>a) Energy Efficient Technologies: Major Appliances and Space Conditioning Equipment (Description of Major Appliances and Space Conditioning Equipment, Current Production &amp; Efficient Designs), Heat Pumps (Basic Principles, Solar-Assisted Heat Pump Systems &amp; Geothermal Heat Pumps).</p> <p>b) Industrial Energy Efficiency and Energy Management (Energy Efficiency and Energy Management Improvement, Improving Energy Audits, Electricity End Uses and Electrical Energy Management).</p> <p style="text-align: center;"><b>Section C</b></p> <p>a) Electric Motor System Efficiency (Motor System Efficiency &amp; Energy Saving Applications).</p>	<b>Discipline Elective</b>	The course has been shifted to pool of discipline electives in III semester.

			<p>b) Energy Storage Technologies (Overview of Storage Technologies, Principal Forms of Stored Energy, Applications of Energy Storage, Specifying Energy Storage Devices, Specifying Fuels, Energy Storage: Direct Electric, Electrochemical, Mechanical, Direct Thermal &amp; Thermochemical).</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. <del>Abbi YP and Jain S., (2006) : Handbook on Energy Audit and Environment Management,(TERI Press).</del></li> <li>2. <del>Goswami D. Y., &amp; Frank K., (2007) : Energy Management and Conservation Handbook (edited) (CRC Press (Taylor &amp; Francis Group).</del></li> <li>3. <del>Goswami D. Y., &amp; Frank K., (2015) : Energy Efficiency &amp; Renewable Energy Handbook, (edited) Second Edition, CRC Press (Taylor &amp; Francis Group).</del></li> <li>4. <del>Polimeros G., (1981) :Energy Cogeneration Handbook, (Industrial Press, Inc., New York.</del></li> <li>5. <del>Threlkeld J.L., (1970) : Thermal Environmental Engineering, Second Edition (Prentice Hall).</del></li> <li>6. <del>Trinks, W., Mawhinney, M.H., Shannon, R.A. Reed R.J., Garvey J.R. (2003): Industrial Furnaces, Sixth Edition, (John Wiley &amp; Sons).</del></li> <li>7. <del>Turner WC (2007) :Energy Management Handbook, Seventh Edition, (Fairmont Press Inc.).</del></li> <li>8. <del>Witte, LC., Schmidt PS and Brown D.R., (1998) : Industrial Energy Management and Utilization (Hemisphere Publishing Corporation, Washington).</del></li> </ol>		
--	--	--	---	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
4	ENVS 508 Environmental Impact Assessment and Management	After the completion of this course, students will be able to: <ul style="list-style-type: none"> <li>Describe Scope of Environmental Impact Assessment and its Objectives.</li> <li>Describe various approaches for various environmental impact studies</li> <li>Illustrate various steps of Environmental Impact Assessment and its methodologies.</li> <li>Construct Environmental Impact Assessment plan for Industrial projects</li> </ul>	<p style="text-align: center;"><b>Section A</b></p> <p><b>Introduction:</b></p> <ol style="list-style-type: none"> <li>Historical development of Environmental Impact Assessment (EIA)</li> <li>Definition and scope of EIA</li> <li>Objectives of EIA</li> <li>Basic EIA principles.</li> </ol> <p><b>Impact study:</b></p> <ol style="list-style-type: none"> <li>Approach for environmental impact studies</li> <li>EIA as planning tool</li> <li>EIA methodology</li> <li>Predictive model of impact assessment.</li> </ol> <p style="text-align: center;"><b>Section B</b></p> <p><b>Impact Prediction and assessment for air, water and noise: Air:</b></p> <ol style="list-style-type: none"> <li>Knowledge of air quality, Air quality standards, Sources of pollutants, Effects of pollutions</li> <li>Conceptual approach for air impacts prediction.</li> </ol> <p><b>Water:</b></p> <ol style="list-style-type: none"> <li>Information on water quality (Surface water and ground water), water quality standards</li> <li>Identification and prediction of impact and assessment.</li> </ol> <p><b>Noise:</b></p> <ol style="list-style-type: none"> <li>Information on noise legislation and guidelines</li> <li>Methodology for noise-impacts prediction</li> <li>Assessment of impact significance.</li> </ol> <p style="text-align: center;"><b>Section C</b></p> <p><b>Environmental Risk Assessment (ERA) and Management in EIA:</b> Environmental risk assessment, treatment of uncertainty, key steps.</p> <p><b>Management Plan:</b></p> <ol style="list-style-type: none"> <li>Impact prediction, evaluation and mitigation</li> <li>Preparation of EIA plan for industrial project and</li> </ol>	Discipline Elective	The course has been shifted to pool of discipline electives in III semester.

			<p>functions</p> <p>c) Factors for consideration, managing the EIA process, Monitoring and auditing.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. <del>Anjaneyulu, Y. (2003). <i>Environmental Impact Assessment</i> (2<sup>nd</sup> ed.). Hyderabad, India: B.S.</del></li> <li>2. <del>Attri S. D., &amp; Tyagi A. (2010). <i>Climate Profile of India</i>. Ministry of Earth Sciences, New Delhi, India</del></li> <li>3. <del>Glasson J., Therivel R. &amp; Chadwick A. (1999). <i>Introduction to Environmental Impact Assessment</i> (4<sup>th</sup> ed.). London, UK: Routledge.</del></li> <li>4. <del>Lawrence, D. P. (2003). <i>Environmental Impact Assessment — Practical solutions to recurrent problems</i>. New Jersey, NJ: Wiley-Interscience.</del></li> <li>5. <del>Petts, J. (1999). <i>Handbook of Environmental Impact Assessment</i>. New Jersey, NJ: Blackwell Science.</del></li> </ol>		
--	--	--	---	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
5	ENVS 510 Solid Waste Management	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>Describe solid waste generation, composition and characterization.</li> <li>Describe waste recycling, 3R technology and fly ash management.</li> <li>Outline the landfill design.</li> <li>Discuss monitoring and control of radiation pollution.</li> </ul>	_____	<p>Recommended Books:</p> <ol style="list-style-type: none"> <li>Agarwal, S. K. (1997). <i>Environmental Issues and Threats</i>. New Delhi, India: A P H.</li> <li>Barrow, C. (1993). <i>Developing the Environment Problems and Management</i>. Abingdon, UK: Routledge</li> <li>Dhamija, U. (2006). <i>Sustainable Solid Waste Management-Issues Policies and Structures</i>. New Delhi, India: Academic Foundation.</li> <li>Hosetti, B. B., &amp; Kumar, D. (1998). <i>Environmental Impact Assessment and Management</i>. New Delhi, India: Daya.</li> <li>Manual on Municipal Solid Waste Management (2011). <i>Prepared by the Expert Committee constituted by the Government of India, Ministry of Urban Development</i>.</li> <li>Peter, C. (1998). <i>Handbook of Environmental risk Assessment and Management</i>. New Jersey, NJ: Blackwell Science.</li> <li>Rasure, K. A. (2007). <i>Solid Waste Management, Environment and Sustainable</i></li> </ol>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>No change in content</p>

				<p><i>Development</i>. New Delhi, India: Serials.</p> <p>8. Salomons, W. &amp;Forstner, S. L. (1990). <i>Environmental Management of Solid waste</i>. Heidelberg, Berlin: Springer-Verlag.</p> <p>9. Sundaresan, A. D., &amp;Bhide, B. B. (1987). <i>Solid Waste Management in Developing countries</i>. New Delhi, India: INSDOC.</p> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Solid waste Management <a href="https://nptel.ac.in/courses/104103020/42">https://nptel.ac.in/courses/104103020/42</a></li> <li>2. Hazardous waste Management <a href="https://nptel.ac.in/courses/120108005/module9/lecture9.pdf">https://nptel.ac.in/courses/120108005/module9/lecture9.pdf</a></li> <li>3. Landfill Engineering System <a href="https://nptel.ac.in/courses/105106052/downloads/Lecture-40.pdf">https://nptel.ac.in/courses/105106052/downloads/Lecture-40.pdf</a></li> <li>4. Landfill Type and Liner Systems <a href="http://ce561.ce.metu.edu.tr/files/2013/11/liner-1.pdf">http://ce561.ce.metu.edu.tr/files/2013/11/liner-1.pdf</a></li> <li>5. Types of Landfill <a href="http://www.mfe.govt.nz/waste/guidance-and-technical-information/types-of-landfills">http://www.mfe.govt.nz/waste/guidance-and-technical-information/types-of-landfills</a></li> <li>6. Management of High Level Radioactive waste <a href="http://www.barc.gov.in/pubaware/nw.html">http://www.barc.gov.in/pubaware/nw.html</a></li> <li>7. Radioactive waste Management <a href="http://www.barc.gov.in/pubaware/nw_n3.html">http://www.barc.gov.in/pubaware/nw_n3.html</a></li> </ol>	
--	--	--	--	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
6	ENVS _ Water Pollution Monitoring, Control Technology and Management	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe water pollution and water resource management</li> <li>• Describe waste water sampling method</li> <li>• Illustrate characterization of waste water.</li> <li>• Distinguish primary, secondary and tertiary waste water treatment methods.</li> </ul>		<p><b>Section A</b> Water pollution- Causes and Pollutants, Categories of waste water, generation of waste water, Water resource management.</p> <p><b>Section B</b> Waste water sampling and monitoring ,Methods of analysis, determination of organic matter, inorganic substances, Physical characteristics of bacterial measurement</p> <p><b>Section C</b> Waste water treatment, Basic processes of primary treatments; Pre treatment, sedimentation and floatation. Secondary treatments; Activated sludge process, Trickling filter, sludge treatment and disposal. Advanced waste water treatment, N-removal, P-removal, Advanced Biological Systems, Chemical oxidation, Removal of suspended solids, Dissolved solids.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Bartram, J., &amp; Balance, R. (2007). <i>Water Quality Monitoring. A practical guide to the design and implementation of freshwater quality studies and monitoring programmes.</i> London,UK:Chapman&amp; Hall.</li> <li>2. Burke, G., Singh, B. R., &amp; Theodore, L. (2000). <i>Handbook of Environmental Management and Technology</i>(2<sup>nd</sup>ed.).New York, NY: John Wiley &amp; Sons.</li> <li>3. Eilbeck, W. J. &amp; Mattock, G. (1987). <i>Chemical Processes in Waste Water Treatment.</i>Chichester, UK:EllisHorwood Limited.</li> <li>4. Gray, N. F. (1990). <i>Activated Sludge, Theory and Practice.</i> Oxford, UK:Oxford University Press.</li> </ol>	The course has been shifted to core of III semester from the electives in III semester.



				<p>5. Helmer, R., &amp; Hespanhol, I. (1997). <i>Water Pollution Control - A Guide to the Use of Water Quality Management Principles</i>. UNEP. Suffolk, Great Britain: St Edmundsbury Press.</p> <p>6. Kostas, V., &amp; Dimitra, V. (2012). <i>Water Quality Monitoring and Assessment</i>. Rijeka, Croatia: InTechOpen.</p> <p>7. Loucks, D. P., &amp; Beek, E. V. (2005). <i>Water Resources Systems Planning and Management An Introduction to Methods, Models and Applications, Studies and Reports in Hydrology</i>. UNESCO.</p> <p>8. UNEP, (2008). <i>Water Quality for Ecosystem and Human Health</i> (2nd ed.). Ontario, Canada: UNEP</p> <p>9. UNICEF, (2008). <i>Handbook on Water Quality</i>. New York. NY: Children's Fund UNICEF.</p> <p>Suggested e-learning materials:</p> <ol style="list-style-type: none"> <li>1. Wastewater Management <a href="https://nptel.ac.in/courses/105105048/">https://nptel.ac.in/courses/105105048/</a></li> <li>2. Water and Waste Water Engineering <a href="https://nptel.ac.in/courses/105104102/">https://nptel.ac.in/courses/105104102/</a></li> <li>3. Industrial Waste Water Engineering <a href="https://nptel.ac.in/courses/105106119/36">https://nptel.ac.in/courses/105106119/36</a></li> <li>4. Waste water sampling procedure <a href="http://www.epa.ie/licences/lic_eDMS/090151b28036bb01.pdf">http://www.epa.ie/licences/lic_eDMS/090151b28036bb01.pdf</a></li> <li>5. Waste water Nutrient Removal <a href="https://www.des.nh.gov/organization/divisions/water/wmb/rivers/watershed_conference/documents/2009_fri_infrastructure_3.pdf">https://www.des.nh.gov/organization/divisions/water/wmb/rivers/watershed_conference/documents/2009_fri_infrastructure_3.pdf</a></li> </ol>	
--	--	--	--	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
------	-------------	------------------	-------------------	--------------------	---------

7	<b>ENVS 506L: Environment Lab-III</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Illustrate physical and chemical characterization of waste.</li> <li>• Illustrate the process of vermiculture.</li> <li>• Enlist major steps of Environmental Impact Assessment (EIA) process.</li> <li>• Determine sound level from various sources.</li> </ul>	<ul style="list-style-type: none"> <li>• Impact of land use patterns on biodiversity over a period of time (Field Survey).</li> <li>• List of Impacts at the stage of construction and operation.</li> <li>• To collect and interpret various water sample data.</li> <li>• To conduct survey of microorganisms of water and soil.</li> <li>• To measure sound from different sources.</li> <li>• To record and analysis of climate trends by taking meteorological data of rainfall and temperature.</li> <li>• Physical composition of solid waste / refuse</li> <li>• Physical characterization of solid waste / refuse.</li> <li>• Construct the composting pit.</li> <li>• Construct the pit for vermiculture.</li> <li>• Planning and design of landfill sites.</li> <li>• EIA methods in Solid waste disposal- Leopold matrix and overlay.</li> <li>• Study of biogas plant.</li> <li>• Determination of soluble and insoluble fraction in community solid waste.</li> <li>• Measurement of intensity of solar radiation.</li> <li>• Estimation of efficiency of solar photovoltaic panels</li> <li>• Effect of Shadow &amp; tilt angle on solar photo voltaic panel</li> <li>• Study on solar photo voltaic panel in series and parallel combination</li> <li>• Study on charging characteristics of a lead acid battery using solar photo voltaic</li> <li>• Study on green house effect on solar flat plate collector</li> </ul>	<ol style="list-style-type: none"> <li>1. Determination of Flouride in water sample.</li> <li>2. Determination of Sulphate in water sample.</li> <li>3. Physical characterization of solid waste / refuse.</li> <li>4. To determine COD in waste water samples.</li> <li>5. Determination of VSS and TSS in soil/sludge samples</li> <li>6. Determination of available Phosphorous in soil/sludge samples</li> <li>7. EIA methods in Solid waste disposal- Leopold matrix and overlay.</li> <li>8. To measure the intensity of sound from different sources.</li> <li>9. To analyze Particulate matter in air samples</li> <li>10. To analyse SO<sub>2</sub> in air samples</li> <li>11. To analyse NO<sub>2</sub> in air samples</li> <li>12. To estimate Proline in plant leaves</li> <li>13. To record and analysis of climate trends by taking meteorological data of rainfall and temperature.</li> <li>14. Construct the composting pit.</li> <li>15. Construct the pit for vermiculture.</li> <li>16. Planning and design of landfill sites.</li> <li>17. Study of biogas plant.</li> <li>18. Field Survey</li> </ol> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Lakshmi, G. S. (2012). <i>Environmental Science : A Practical Manual</i>. Delhi, India: B.S.</li> <li>2. Maiti, S.K. (2011). <i>Handbook of Methods in Environmental Studies. Vol. 1: Water and</i></li> </ol>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>Some basic Environmental Science practical exercises on estimation of fluoride and COD was introduced in the course curriculum and some practical's were eliminated.</p>
---	---	---	--	--	---

			<ul style="list-style-type: none"> <li>• Estimation of instantaneous efficiency of a solar liquid flat plate collector</li> <li>• Study on solar flat plate collector in series and parallel combination</li> <li>• Estimation of efficiency of solar air heaters</li> <li>• Performance evaluation of concentrating solar collector</li> <li>• Performance evaluation of solar cooker</li> </ul>	<p><b>Wastewater Analysis. Jaipur, India: Oxford Book Company.</b></p> <p><b>3. Maiti, S.K. (2011). <i>Handbook of Methods in Environmental Studies. Vol. 2: Soil and Air Analysis.</i> Jaipur, India: Oxford Book Company.</b></p> <p><b>4. Narasalah, G. L. (2012). <i>Environmental Science : A Practical Manual.</i> Delhi, India: B.S.</b></p> <p><b>Suggested e-learning materials:</b></p> <p><b>1. Environmental Science,</b> <a href="http://download.nos.org/333course/prac_manual.pdf">http://download.nos.org/333course/prac_manual.pdf</a></p> <p><b>2. Virtual Lab</b> <a href="http://www.vlab.co.in/">http://www.vlab.co.in/</a></p> <p><b>3. Environmental Science Basics</b> <a href="https://www.nios.ac.in/online-course-material/sr-secondary-courses/enviornmental-science-(333).aspx">https://www.nios.ac.in/online-course-material/sr-secondary-courses/enviornmental-science-(333).aspx</a></p>	
--	--	--	---	--	--

**ELECTIVES**

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	<b>ENVS 501 Air Pollution Monitoring, Control Technology and Management</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe various air pollutants and their sources.</li> <li>• Describe the consequences on human health.</li> <li>• Predict the control measures of air pollutant depending upon source and type.</li> <li>• Illustrate stack sampling and mitigation strategies of SO<sub>x</sub> and NO<sub>x</sub></li> </ul>	<p align="center"><b>Section A</b></p> <p>a) Air pollution: Definition, sources and effects.            b) Air pollutants; Classification and properties, emission sources, major emissions from global sources and importance of Anthropogenic sources.            c) Effects of air pollution on health, vegetation and materials damages. Photochemical smog.</p> <p align="center"><b>Section B</b></p> <p>a) Control techniques and equipments for air pollution, particulate emission control: Gravitational settling chambers, cyclone separators, fabric filters, electrostatic precipitator, wet scrubbers.            b) Control of specific gaseous pollutants; control of SO<sub>x</sub>, control of NO<sub>x</sub>, control of hydrocarbons, and control of carbon mono-oxide</p> <p align="center"><b>Section C</b></p> <p>Air pollution sampling and measurement: Types of pollutant sampling and measurement, ambient air sampling, collection of gaseous air pollutants, collection of particulate pollutants, stack sampling, analysis of air pollutants</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Alan Andrews (2014), The Clean Air A Practical Guide To EU Air Quality Law, Clientearth274 Richmond Road London</li> <li>2. Arthur C Stern (1976.), AIR POLLUTION. Volume III Measuring, monitoring and surveillance of air pollution. THIRD EDITION.. Academic Press.</li> <li>3. Arthur C Stern (1986), AIR POLLUTION. Volume VII. Supplement to measuring, monitoring and surveillance and engineering control of air pollution. THIRD EDITION.. Academic Press.</li> <li>4. Buonicore A, Wayne T. Davis (1992). Air Pollution Engineering Manual. Van Nostrand Reinhold, New York, USA.</li> <li>5. Buonicore A., Theodore L. (1994). Air Pollution Control</li> </ol>		<p><b>This course has been shifted to core of III semester from the pool of discipline electives in III semester.</b></p>

			<p>Equipment: Selection, Design, Operation and Maintenance. Springer Verlag, New York, USA.</p> <p>6. Burke G, Singh B R and Theodore L (2000). <i>Handbook of Environmental Management and Technology</i>, 2nd edition. John Wiley &amp; Sons, Inc. New York.</p> <p>7. Burke G.H., Singh B.R., and Theodore L. (2000). <i>Handbook of Environmental Management and Technology (Second Edition)</i>. John Wiley &amp; Sons, Inc., New York, USA.</p> <p>8. Cavaseno V. (1980). <i>Industrial Air Pollution Engineering</i>. McGraw Hill Publications Co., New York, N.Y., USA.</p> <p>9. Cheremisinoff P.N. (1993). <i>Air Pollution Control and Design for Industry</i>. Marcel Dekker, Inc., New York, USA.</p> <p>10. De Nevers N. (2000). <i>Air Pollution Control Engineering (second edition)</i>. McGraw Hill Companies, USA.</p> <p>11. Franek, William and DeRose, (2004) <i>Principles and Practices of Air Pollution Control</i>, United States Air Pollution Training Institute (APTI)</p> <p>12. Heinsohn R.J. and Kabel R.L. (1999). <i>Sources and Control of Air Pollution</i>. Prentice, New Jersey, USA.</p> <p>13. James P Lodge (1988.), <i>Methods of Air Sampling and Analysis</i>. Third Edition. Lewis Publishers.</p> <p>14. Kovacs, M. 1995. <i>Pollution Control and Conservation</i>. Ellis Horwood Ltd., Chichester. 398p</p> <p>15. Kumar S. and Kumar R. (2012) <i>Air Quality — Monitoring and Modeling</i> Published by InTech Janeza Trdine 9, 51000 Rijeka, C</p> <p>16. Metcalf &amp; Eddy, Inc. (1991). <i>Wastewater Engineering—Treatment, Disposal, and Reuse</i>, 3rd edition, McGraw Hill, New York.</p> <p>17. Nicholas p. Cheremisinoff, (2002) <i>handbook of Air pollution prevention and control</i>, butterworth heinemann of elsevier science. Printed in the United States of America</p>		
--	--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
2	<b>ENVS 502 Biodiversity and Conservation</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• <b>Explain importance of biological diversity.</b></li> <li>• <b>Describe major threats to biodiversity.</b></li> <li>• <b>Recognize and implement the various methods of biodiversity conservation with co-existence of various environmental pressures.</b></li> <li>• <b>Identify different geographical biodiversity hotspots and mega-diversity centers.</b></li> </ul>	<p><b>ENVS 502 Biodiversity &amp; Conservation</b></p> <p><b>Section A</b></p> <ol style="list-style-type: none"> <li>Introduction to biodiversity concepts, significance, magnitude and distribution.</li> <li>Biodiversity trends, diversity gradients and related hypotheses methods for monitoring biodiversity trends.</li> <li>Threats to biodiversity, major causes, extinction's, vulnerability of species to extinction, IUCN threat categories, Red data book.</li> </ol> <p><b>Section B</b></p> <ol style="list-style-type: none"> <li>Principles of biodiversity conservation Ex situ and In situ methods of conservation, Genetical and evolutionary principles in conservation.</li> <li>Conservation of biological diversity and its significance- source of food, medicine, raw material, aesthetic, cultural and ecosystem services.</li> <li>Concepts, distribution and importance of Hot spots.</li> <li>Strategies for sustainable exploitation of biodiversity.</li> </ol> <p><b>Section C</b></p> <ol style="list-style-type: none"> <li>Conservation – efforts in India, Endangered flora &amp; fauna of India.</li> <li>Ethan botany in India &amp; selected medicinal plants.</li> <li>Wildlife conservation in India- Project Tiger, Project crocodile, silent valley controversy.</li> </ol> <p>Conservation of Himalayan, Gangetic ecosystems.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li><del>Global biodiversity status of the earth's living resources. Published by Crapman and Hall, 2-6 Boundary Row, London SE1 8HN. Compiled by World Conservation Monitoring Centre.</del></li> </ol>		<b>This course has been moved to semester II as a core paper.</b>

			<p>2. Kovaes, M. (1995) : Pollution Control and Conservation, Ellis Horwood Ltd., Chichester. 398p</p> <p>3. Kumar A., Biodiversity and environment. Published by A.P.M. Publishing Corporation, New Delhi.</p> <p>4. Kumar and Asija. Biodiversity Principles and conservation. Published by UpdeshPurohit for Agrobios, Jodhpur, India.</p> <p>5. Mishra, R. (1968) : Ecology Work Book Oxford and IBH Publishing Co, Calcutta, pp. 244.</p> <p>6. Odum, E.P. (1983) : Basic Ecology. Saunders College Publishing, Holt Saunders, Japan, 613.</p> <p>7. Odum, E.P. Fundamentals of Ecology, Natraj Publisher, Dehradun</p> <p>8. Singh, Vishwakarma. Forest environment and biodiversity. Daya Publishing House, Delhi.</p> <p>9. Sinha, B.N. (1990) : Eco system Degradation in India. Ashish Publishing House, New Delhi.</p> <p>Tewari, D.N. Biodiversity and forest genetic resources. Published by InternationalBook Distributions, Dehra Dun</p>		
--	--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
3	ENVS 503 Biotechnology Application to Environmental Science	After the completion of this course, students will be able to: <ul style="list-style-type: none"> <li>Describe heavy metal pollution and outline control measure of global warming.</li> <li>Describe ozone depletion, acid rain and nuclear accidents</li> <li>Describe biosensor development to monitor pollution</li> <li>Explain the management of sludge and biodegradation of hydrocarbons.</li> </ul>	<p style="text-align: center;"><b>Section A</b></p> <p>a) Definition and Scope of Environmental Biotechnology; Environmental Pollution; Types, Causes and Effects of Soil, air, water, oil and heavy metal.</p> <p>b) Pollution, control measures. Social Issues- Green House Gases, Global Warming, Acid Rain, Ozone depletion, nuclear accidents and holocaust.</p> <p>c) Purification of waste water; Aerobic and anaerobic treatments; Laboratory methods for the detection of coli form organisms in water; Water recycling methods; Management of radioactive pollutants in water, VOC, COD BOD and BOD sensors.</p> <p style="text-align: center;"><b>Section B</b></p> <p>a) Molecular biology tools for Environmental management, rDNA technology in waste treatment, Genetically modified organisms in Waste management, Genetic Sensors, Metagenomics, Bioprospecting, Nanoscience in Environmental management, Phytoremediation for heavy metal pollution, Biosensor development to monitor pollution.</p> <p>b) Biomass waste as renewable source of energy, Cellulose and Hemi cellulose as source of energy Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biofuels, Biomineralization, Bioethanol and Biohydrogen,</p> <p style="text-align: center;"><b>Section C</b></p> <p>a) Bioelectricity through microbial fuel cell,</p>	<b>Discipline Electives</b>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>No change in content</p> <p>Move to Discipline Electives</p>



			<p>Conversion of Solid Waste to Methane; Biogas production, Management of Sludge and Solid waste treatment- Land filling, lagooning, Ecofriendly agriculture.</p> <p>b) Definition, Types- Ex situ and In situ Bioremediation; genetically Engineered Microbes for Bioremediation; Bioremediation of Ground Water; Biodegradation of Hydrocarbons, Pesticides, Herbicides, Insecticides and Xenobiotics.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Chakraborty K.D. Omen G.S. (1989) : Biotechnology and Bio degradation, Advances in Applied Biotechnology series, Vol. I, Gulf Publications Co. London.</li> <li>2. Foster C.F; Johnware D.A. (1987) : Environmental Biotechnology. Ellis Harwood Ltd.</li> <li>3. Sharma DL., Organic farming Thakur, I.S., (2006): Environmental Biotechnology- Basic concepts and Applications.</li> </ol>	
--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
4	ENVS 507 Environmental Health Management	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Explain the concept of environmental health.</li> <li>• Identify different environmental factors that affect health.</li> <li>• Discuss the preventive and protection measures for various water borne diseases.</li> <li>• Describe the seasonal changes and protection measures for various air borne bio-allergen.</li> </ul>	<p><b>Section A</b></p> <p>a) Meaning of health: Physical, Mental and Social</p> <p>b) Environmental factors influencing health: Urbanization &amp; congestion, pollution.</p> <p>c) Environmental health criteria, Concept of environmental health management</p> <p><b>Section B</b></p> <p>a) WHO classification of diseases and their distribution: Water borne diseases; Prevention and protection of community health from water borne diseases.</p> <p>b) Air borne bio-allergens; present in the ambient air, seasonal changes, mode of dispersal, disease intensity and control.</p> <p><b>Section C</b></p> <p>a) Effects of Physical Environment on Accidents, Crime, Suicide and Diseases of Man</p> <p>b) Effects of temperature, humidity, ionization, ultra violet radiation and acidity of air on skin, lungs, throat, nose, eye, nervous system.</p> <p>c) Effects of weather and climate on diseases, mental processes, working efficiency, traffic and industrial accidents, behaviour, suicide and suicide attempts, effect of thermal stress and altitude on the action of drug.</p> <p><b>Recommended Books:</b></p> <p>1. Abdul, M., et.al. (2014) : Environmental</p>	Discipline Electives	<p>Reviewed outcomes and suggested e-learning materials</p> <p>No change in content</p> <p>Move to pool of Discipline Elective</p>

			<p>Deterioration and Human Health, Springer Dordrecht Heidelberg London.</p> <p>2. Ahluwalia, V.K. (2015) : Environmental Pollution and Health, TERI, New Delhi.</p> <p>3. Annalee, Y., et.al. (2001) : Basic Environmental Health, Oxford University Press, New York.</p> <p>4. Kathryn, H. (2006) : Environmental Health Ecological Perspective, Jones &amp; Bartlett Learning, Sudbury, Massachussetts.</p> <p>5. Robert, H.F., Essentials of Environmental Health, 2<sup>nd</sup> Edition, Jones &amp; Bartlett Learning, Sudbury, Massachussetts.</p> <p>Singh, A.L. (2010) : Environment and Health, B.R. Publishers, New Delhi.</p>	
--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
5	<b>ENVS 511 Water Pollution Monitoring, Control Technology and Management</b>	<p><b>After the completion of this course, students will be able to:</b></p> <ul style="list-style-type: none"> <li>• Describe water pollution and water resource management</li> <li>• Describe waste water sampling method</li> <li>• Illustrate characterization of waste water.</li> <li>• Distinguish primary, secondary and tertiary waste water treatment methods.</li> </ul>	<p align="center"><b>Section A</b></p> <p>a) Water pollution- Causes and Pollutants b) Categories of waste water, generation of waste water c) Water resource management.</p> <p align="center"><b>Section B</b></p> <p>a) Waste water sampling and monitoring b) Methods of analysis, determination of organic matter, inorganic substances c) Physical characteristics of bacterial measurements.</p> <p align="center"><b>Section C</b></p> <p>a) Waste water treatment, Basic processes of primary treatments; Pre treatment, sedimentation and floatation. b) Secondary treatments; Activated sludge process, Trickling filter, sludge treatment and disposal.</p> <p>Advanced waste water treatment, N-removal, P-removal, Advanced Biological Systems, Chemical oxidation, Removal of suspended solids, Dissolved solids.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li><del>1. Burke G, Singh B R and Theodore L (2000) :<i>Handbook of Environmental Management and Technology</i>, 2nd edition. John Wiley &amp; Sons, Inc. New York.</del></li> <li><del>2. Daniel P. Loucks and Ecleo van Beck (2005) : <i>Water Resources Systems Planning and Management An Introduction to Methods, Models and Applications</i>, Studies and Reports in Hydrology UNESCO PUBLISHING</del></li> <li><del>3. Eilbeck W J and Mattoek G (1987). <i>Chemical Processes in Waste Water Treatment</i>, Ellis Horwood Limited.</del></li> <li><del>4. Gray N F (1990). <i>Activated Sludge, Theory and Practice</i>, Oxford University Press, Oxford.</del></li> <li><del>5. Jamie Bartram and Richard Balance (2007) <i>Water Quality</i></del></li> </ol>		This course has been moved from elective pool of Semester III to core of semester III.

			<p>Monitoring. A practical guide to the design and implementation of freshwater quality studies and monitoring programmes. Published on behalf of United Nations Environment Programme. Published by E&amp;FN Spon, an imprint of Chapman &amp; Hall, 2-6 Boundary Row, London UK</p> <p>6. Kostas Voudouris and Dimitra Voutsas, (2012) <i>Water Quality Monitoring and Assessment</i>. Published by InTech. Janeza Trdine 9, 51000 Rijeka, Croatia</p> <p>7. Metcalf &amp; Eddy, Inc. (1991). <i>Wastewater Engineering: Treatment, Disposal, and Reuse</i>, 3rd edition, McGraw Hill, New York.</p> <p>8. Richard Helmer and Ivanildo Hespanhol (1997) <i>Water Pollution Control - A Guide to the Use of Water Quality Management Principles</i>. Edited by, United Nations Environment Programme, First edition 1997 © WHO/UNEP. Printed in Great Britain by St Edmundsbury Press, Bury St Edmunds, Suffolk</p> <p>9. UNEP, <i>Water Quality for Ecosystem and Human Health</i>, 2nd Edition. Prepared and published by the United Nations Environment Programme Global Environment Monitoring System (GEMS)/Water Programme. Burlington, Ontario, CANADA</p> <p>10. UNICEF (2008) : <i>Handbook on Water Quality</i>, United Nations Children's Fund (UNICEF), New York.</p>		
--	--	--	--	--	--

**List of Discipline Electives**

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
1	<b>ENVS 503 Biotechnology Application to Environmental Science</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Describe heavy metal pollution and outline control measure of global warming.</li> <li>• Describe ozone depletion, acid rain and nuclear accidents</li> <li>• Describe biosensor development to monitor pollution</li> <li>• Explain the management of sludge and biodegradation of hydrocarbons.</li> </ul>		<p><b>Section A</b></p> <p>Definition and Scope of Environmental Biotechnology; Environmental Pollution; Types, Causes and Effects of Soil, air, water, oil and heavy metal.</p> <p>Pollution, control measures. Social Issues- Green House Gases, Global Warming, Acid Rain, Ozone depletion, nuclear accidents and holocaust.</p> <p>Purification of waste water; Aerobic and anaerobic treatments; Laboratory methods for the detection of coli form organisms in water; Water recycling methods; Management of radioactive pollutants in water, VOC, COD BOD and BOD sensors.</p> <p><b>Section B</b></p> <p>Molecular biology tools for Environmental management, rDNA technology in waste treatment, Genetically modified organisms in Waste management, Genetic Sensors, Metagenomics, Bioprospecting, Nanoscience in Environmental management, Phytoremediation for heavy metal pollution, Biosensor development to monitor pollution.</p> <p>Biomass waste as renewable source of energy, Cellulose and Hemi cellulose as source of energy Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biofuels, Biomineralization, Bioethanol and Biohydrogen,</p> <p><b>Section C</b></p> <p>Bioelectricity through microbial fuel cell,</p>	<p><b>Reviewed outcomes and suggested e-learning materials</b></p> <p><b>No change in content</b></p> <p><b>Shifted to the pool of Discipline Electives</b></p>

				<p>Conversion of Solid Waste to Methane; Biogas production, Management of Sludge and Solid waste treatment- Land filling, lagooning, Ecofriendly agriculture.</p> <p>Definition, Types- Ex situ and In situ Bioremediation; genetically Engineered Microbes for Bioremediation; Bioremediation of Ground Water; Biodegradation of Hydrocarbons, Pesticides, Herbicides, Insecticides and Xenobiotics.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Chakraborty, K. D., &amp; Omen, G. S. (1989). <i>Biotechnology and Bio degradation, Advances in Applied Biotechnology series</i>. London, UK:Gulf.</li> <li>2. Rittmann, B. E. (2018). <i>Environmental Biotechnology</i>. New York, NY: Mcgraw-hill education.</li> <li>3. Sharma, D. L. (2002). <i>Organic farming</i>. Rajasthan: India:Agro-Bios.</li> <li>4. Thakur, I. S. (2006). <i>Environmental Biotechnology- Basic concepts and Applications</i>.New Delhi, India: I K International.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Nanobiotechnology in Environment <a href="https://nptel.ac.in/courses/102103045/download/mod6.pdf">https://nptel.ac.in/courses/102103045/download/mod6.pdf</a></li> <li>2. Biotechnology <a href="https://nptel.ac.in/courses/118107015/33">https://nptel.ac.in/courses/118107015/33</a></li> <li>3. Gene therapy in the treatment of disease <a href="https://nptel.ac.in/courses/102103013/39">https://nptel.ac.in/courses/102103013/39</a></li> </ol>	
--	--	--	--	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
2	<b>ENVS Disaster Management and Mitigation Strategies</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Explain natural and manmade disaster and associated socio-economic impact .</li> <li>• Discuss key concepts, definitions and perspectives of disaster Management</li> <li>• Describe the Disaster Management Cycle.</li> <li>• Describe planning for hazard mitigation.</li> </ul>		<p><b>Section A</b> Introduction to Disaster and Hazards Hazards and Disaster: Definition and Difference; Types of Hazards and Disaster; causes and consequences, Prediction and Indicators of Natural Disasters, Natural Disasters – Earthquakes, Cyclones, Floods, Drought and Landslides, Man Made Disaster – Nuclear and Chemical</p> <p><b>Section B</b> Impact of Disaster and Case Studies Social, Economic and Health impacts of Disaster, Floods - one case study with special reference to Brahmaputra Basin, Drought – one case study with special reference to Vidarbha and Telangana region, Earthquake – one case study with special reference to Himalayan region, Nuclear – Hiroshima and Nagashakhi</p> <p><b>Section C</b> Natural Disaster Management and Preparedness Disaster Management: Prevention, Preparedness and Mitigation, Planning and control of Natural Disaster, National and State level planning for Hazard Mitigation, Role of Natural Disaster Management Authority</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1.BMTPC &amp; CDMM (2003). <i>Landslide Hazard Zonation of India</i>. New Delhi, India.</li> <li>2.Decker, R. W. &amp; Decker, B. B. (1998): <i>Volcanoes</i> (3<sup>rd</sup> ed.).NY, New York: WH Freeman &amp; Company.</li> <li>3.Dowrick, D. (2003). <i>Earthquake Risk Reduction Zone</i>.Sushex, England: Wiley &amp; Sons.</li> <li>4.Drake, F. (2000). <i>Global Warming the Science of Climate Change</i>.New York, NY: Oxford University Press.</li> <li>5.Gere, J. M. &amp; Shah, H.C. (1984). <i>Terra Non</i></li> </ol>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>This course was moved from core course of III semester to pool of discipline electives of III semester</p> <p>Shifted to the pool of Discipline Electives</p>



				<p><i>Firme Understanding and Preparing for Earthquakes.</i> New York, NY:WHFremman&amp; Company.</p> <p>6.Govt. of India, (2002). <i>Drought 2002 a Report (part I), Ministry of Agriculture, Dept. of Agriculture and Cooperation.</i> New Delhi, India.</p> <p>7.Govt. of India, (2002). <i>Drought 2002 States Report (part II), Ministry of Agriculture, Dept. of Agriculture and Cooperation.</i> New Delhi, India.</p> <p>8.Govt. of India, (2004). <i>Annual Reports, Ministry of Agriculture, Dept. of Agriculture and Cooperation, 1999-2000, 2002-2003, 2003-2004.</i> New Delhi, India.</p> <p>9.IGNOU (2005): <i>Understanding Natural Disasters.</i> Noida, India: Shagun Offset Press.</p> <p>10. IMD (1972) <i>Cyclone and safeguards.</i> New Delhi, India.</p> <p>11. Inca, M. (1990). <i>The Rising Seas.</i> London, UK:Earthscan.</p> <p>12. Prakash, I. (1994).<i>Disaster Management.</i>Ghaziabad, India: RastriyaPrahari.</p> <p>13. Roy, S. (2004). <i>Natural Disaster Management – a case study of Tornado.</i> New Delhi, India:Abhijit.</p> <p>14. Savindra, S. (2015). <i>Environmental Geography.</i> Allahabad, India: Pravika.</p> <p>15. Sharma, V. K. (1995). <i>Disaster Management.</i> New Delhi, India: IIPA.</p> <p>16. Singh, T. (2006). <i>Disaster Management Approaches and Strategies.</i> New Delhi, India: Akanksha.</p> <p>17. Sinha, D. K. (2006). <i>Towards Basics of Natural Disaster Reduction.</i> New Delhi, India: Reasearch.</p> <p>18. Thomas, B. (1993). <i>Disaster Response: A Handbook for Emergencies.</i> New Delhi, India: CASA.</p> <p><b>Suggested e-learning materials:</b></p>
--	--	--	--	--

				<ol style="list-style-type: none"><li>1. Disaster Management <a href="https://swayam.gov.in/courses/4983-disaster-management">https://swayam.gov.in/courses/4983-disaster-management</a></li><li>2. Natural and Man-Made Environment and Disasters <a href="https://nptel.ac.in/courses/122102006/9">https://nptel.ac.in/courses/122102006/9</a></li><li>3. Floods and Cyclones <a href="https://www.sac.gov.in/SACSITE/SAC-Flyers/menu-links/society/9.1%20FLOODS%20&amp;%20CYCLONE S.pdf">https://www.sac.gov.in/SACSITE/SAC-Flyers/menu-links/society/9.1%20FLOODS%20&amp;%20CYCLONE S.pdf</a></li><li>4. Surface and Ground water resources <a href="https://nptel.ac.in/courses/105105110/pdf/m6102.pdf">https://nptel.ac.in/courses/105105110/pdf/m6102.pdf</a></li><li>5. Introduction to Engineering Seismology <a href="http://nptel.ac.in/courses/105108076/module6/lecture16.pdf">http://nptel.ac.in/courses/105108076/module6/lecture16.pdf</a></li></ol>	
--	--	--	--	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
3	ENVS_ Energy Auditing and Conservation	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>Describe Energy audits for building.</li> <li>Describe energy conservation measures.</li> <li>Explain energy efficient lighting technologies and its application in commercial and residential sectors.</li> <li>Describe Energy storage technologies and Energy Auditing.</li> </ul>		<p><b>Section A</b></p> <p>Barriers to energy conservation, Key energy issues to 2025, Carbon dioxide emission, Energy Audits for building (Background, Energy Audit Procedures, Energy Management Programs &amp; Energy Conservation Measures).Electrical Energy Management in Buildings (Principal Electricity Uses in Building, Strategies for Electricity End-Use Management), Heating, Ventilating and Air-Conditioning Control Systems (Modes of Feedback Control, Basic Control Hardware, Basic Control Systems Design Considerations &amp; Example of HVAC Control Systems).Energy Efficient Lighting Technologies and Their Applications in the Commercial And Residential Sectors (Design of Energy-Efficient Lighting Systems, Lighting Technologies, Efficient Lighting Operation, Current Lighting Markets and Trends</p> <p><b>Section B</b></p> <p>Energy Efficient Technologies: Major Appliances and Space Conditioning Equipment (Description of Major Appliances and Space Conditioning Equipment, Current Production &amp; Efficient Designs), Heat Pumps (Basic Principles, Solar-Assisted Heat Pump Systems &amp; Geothermal Heat Pumps).Industrial Energy Efficiency and Energy Management (Energy Efficiency and Energy Management Improvement, Improving Energy Audits, Electricity End Uses and Electrical Energy Management).</p> <p><b>Section C</b></p> <p>Electric Motor System Efficiency (Motor System Efficiency &amp; Energy Saving Applications).Energy Storage Technologies (Overview of Storage Technologies, Principal Forms of Stored Energy, Applications of Energy Storage, Specifying Energy Storage Devices, Specifying Fuels, Energy Storage: Direct Electric, Electrochemical, Mechanical, Direct Thermal &amp; Thermochemical).</p>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>This course was shifted from core of III semester to pool of discipline elective in III semester.</p> <p>Shifted to the pool of Discipline Electives</p>

				<p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Abbi, Y.P., &amp; Jain S. (2006). <i>Handbook on Energy Audit and Environment Management</i>. Delhi, India: TERI Press.</li> <li>2. Goswami, D. Y., &amp; Frank K. (2015). <i>Energy Efficiency &amp; Renewable Energy Handbook</i>. Florida, FL: CRC Press (Taylor &amp; Francis Group).</li> <li>3. Polimeros, G., (1981). <i>Energy Cogeneration Handbook</i>. New York, NY: Industrial Press.</li> <li>4. Threlkeld J, L. (1970): <i>Thermal Environmental Engineering</i> (2<sup>nd</sup> Ed.). New Jersey, NJ: Prentice Hall.</li> <li>5. Trinks, W., Mawhinney, M. H., Shannon, R. A. &amp; Reed, R. J., &amp; Garvey J. R. (2003). <i>Industrial Furnaces</i> (6<sup>th</sup> ed.). New Jersey, NJ: John Wiley &amp; Sons.</li> <li>6. Turner, W. C. (2007). <i>Energy Management Handbook</i> (7<sup>th</sup> ed.). Georgia, USA: Fairmont Press.</li> <li>7. Witte, L. C., Schmidt, P. S., &amp; Brown, D. R. (1998). <i>Industrial Energy Management and Utilization</i>. Washington, WA: Hemisphere.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <p><b>Energy Efficiency, Acoustics and daylighting in Building</b>  <a href="https://onlinecourses.nptel.ac.in/noc18_ce06/preview">https://onlinecourses.nptel.ac.in/noc18_ce06/preview</a></p> <ol style="list-style-type: none"> <li>1. Environment Management  <a href="https://nptel.ac.in/courses/120108004/module9/lecture12.pdf">https://nptel.ac.in/courses/120108004/module9/lecture12.pdf</a></li> <li>2. Energy Audit  <a href="https://ecozenolutions.com/audit.pdf">https://ecozenolutions.com/audit.pdf</a></li> <li>3. Energy Management and Audit  <a href="https://beeindia.gov.in/sites/default/files/1Ch3.pdf">https://beeindia.gov.in/sites/default/files/1Ch3.pdf</a></li> <li>4. Energy Conservation and waste heat recovery  <a href="https://nptel.ac.in/courses/112105221">https://nptel.ac.in/courses/112105221</a></li> </ol>	
--	--	--	--	---	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
4	<b>ENVS 507 Environmental Health Management</b>	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Explain the concept of environmental health.</li> <li>• Identify different environmental factors that affect health.</li> <li>• Discuss the preventive and protection measures for various water borne diseases.</li> <li>• Describe the seasonal changes and protection measures for various air borne bio-allergen.</li> </ul>		<p><b>Section A</b> Meaning of health: Physical, Mental and Social, Environmental factors influencing health: Urbanization &amp; congestion, pollution. Environmental health criteria, Concept of environmental health management</p> <p><b>Section B</b> WHO classification of diseases and their distribution: Water borne diseases; Prevention and protection of community health from water borne diseases. Air borne bio-allergens; present in the ambient air, seasonal changes, mode of dispersal, disease intensity and control.</p> <p><b>Section C</b> Effects of Physical Environment on Accidents, Crime, Suicide and Diseases of Man, Effects of temperature, humidity, ionization, ultra violet radiation and acidity of air on skin, lungs, throat, nose, eye, nervous system. Effects of weather and climate on diseases, mental processes, working efficiency, traffic and industrial accidents, behaviour, suicide and suicide attempts, effect of thermal stress and altitude on the action of drug.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Abdul, M. et.al. (2014). <i>Environmental Deterioration and Human Health</i>. Dordrecht Heidelberg London, England: Springer.</li> <li>2. Ahluwalia, V. K. (2015). <i>Environmental Pollution and Health</i>. New Delhi, India: TERI.</li> <li>3. Annalee, Y. et.al. (2001). <i>Basic Environmental</i></li> </ol>	<p><b>Reviewed outcomes and suggested e-learning materials</b></p> <p><b>No change in content</b></p> <p><b>Shifted to the pool of Discipline Elective</b></p>

				<p><i>Health</i>. New York, NY: Oxford University Press.</p> <p>4. Kathryn, H. (2006). <i>Environmental Health Ecological Perspective</i>. Sudbury, Massachusetts, MA: Jones &amp; Bartlett.</p> <p>5. Robert, H. F. (2012). <i>Essentials of Environmental Health</i>(2<sup>nd</sup> ed.).Sudbury, Massachusetts, MA: Jones &amp; Bartlett.</p> <p>6. Singh, A. L. (2010). <i>Environment and Health</i>. New Delhi,India:B.R.</p> <p>Suggested e-learning materials:</p> <p>1. Indoor Environmental Delhi  <a href="http://textofvideo.nptel.ac.in/112107208/lec38.pdf">http://textofvideo.nptel.ac.in/112107208/lec38.pdf</a></p> <p>2. Introduction to Environmental Health  <a href="http://ocw.jhsph.edu/courses/environmentalhealth/lectureNotes.cfm">http://ocw.jhsph.edu/courses/environmentalhealth/lectureNotes.cfm</a></p> <p>3. The effects of temperature on human health  <a href="https://www oulu.fi/sites/default/files/content/Ikaheimo_TM_Temperature_and_human_health_28102014.pdf">https://www oulu.fi/sites/default/files/content/Ikaheimo_TM_Temperature_and_human_health_28102014.pdf</a></p>	
--	--	--	--	--	--

S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
5	ENVS _ Environmental Impact Assessment and Management	After the completion of this course, students will be able to: <ul style="list-style-type: none"> <li>Describe Scope of Environmental Impact Assessment and its Objectives.</li> <li>Describe various approaches for various environmental impact studies</li> <li>Illustrate various steps of Environmental Impact Assessment and its methodologies.</li> <li>Construct Environmental Impact Assessment plan for Industrial projects</li> </ul>		<p style="text-align: center;"><b>Section A</b></p> <p><b>Introduction:</b> Historical development of Environmental Impact Assessment (EIA) Definition and scope of EIA, Objectives of EIA, Basic EIA principles.</p> <p><b>Impact study:</b> Approach for environmental impact studies EIA as planning tool, EIA methodology Predictive model of impact assessment.</p> <p style="text-align: center;"><b>Section B</b></p> <p><b>Impact Prediction and assessment for air, water and noise: Air:</b> Knowledge of air quality, Air quality standards, Sources of pollutants, Effects of pollutions, Conceptual approach for air impacts prediction.</p> <p><b>Water:</b> Information on water quality (Surface water and ground water), water quality standards, Identification and prediction of impact and assessment.</p> <p><b>Noise:</b> Information on noise legislation and guidelines, Methodology for noise-impacts prediction, Assessment of impact significance.</p> <p style="text-align: center;"><b>Section C</b></p> <p><b>Environmental Risk Assessment (ERA) and Management in EIA:</b> Environmental risk assessment, treatment of uncertainty, key steps.</p> <p><b>Management Plan:</b> Impact prediction, evaluation and mitigation Preparation of EIA plan for industrial project and functions Factors for consideration, managing the EIA</p>	<p>The course has been shifted to pool of discipline electives in III semester. From the core course.</p> <p>Shifted to the pool of Discipline Electives</p>

				<p>process, Monitoring and auditing.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>1. Anjaneyulu, Y. (2003). <i>Environmental Impact Assessment</i> (2<sup>nd</sup>ed.).Hyderabad, India: B.S.</li> <li>2. Attri S. D.,&amp;Tyagi A. (2010). <i>Climate Profile of India</i>. Ministry of Earth Sciences, New Delhi, India</li> <li>3. Glasson J., Therivel R. &amp; Chadwick A. (1999). <i>Introduction to Environmental Impact Assessment</i>(4<sup>th</sup>ed.). London, UK: Routledge.</li> <li>4. Lawrence, D. P. (2003). <i>Environmental Impact Assessment – Practical solutions to recurrent problems</i>.New Jersey, NJ:Wiley-Interscience.</li> <li>5. Petts, J. (1999). <i>Handbook of Environmental Impact Assessment</i>. New Jersey, NJ:Blackwell Science.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Environment Impact Assessment, <a href="http://www.moef.nic.in/division/introduction-8">http://www.moef.nic.in/division/introduction-8</a> <a href="https://nptel.ac.in/courses/120108004/module3/lecture3.pdf">https://nptel.ac.in/courses/120108004/module3/lecture3.pdf</a></li> <li>2. EIA Documentation and Processes <a href="https://nptel.ac.in/courses/120108004/module4/lecture4.pdf">https://nptel.ac.in/courses/120108004/module4/lecture4.pdf</a></li> <li>3. EIA, EMP and EA <a href="https://nptel.ac.in/courses/123105001/36">https://nptel.ac.in/courses/123105001/36</a></li> </ol>	
--	--	--	--	---	--



S.N.	Course List	Learning Outcome	Existing Syllabus	Suggested Syllabus	Remarks
6	ENVS_ Environmental Physics	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>Apply the concepts and laws of physics that govern the environment.</li> <li>Measure different environmental parameters.</li> <li>Describe applications of laser and detection of environmental pollutants by laser absorption.</li> <li>Describe LiDAR technique and its applications.</li> </ul>		<p><b>Section-A</b></p> <p>The scope of environmental physics Laws of thermodynamics, reversible and irreversible thermodynamical process and entropy, Specific heats, Gas Laws for isothermal and adiabatic processes, Lapse rate Water and Water Vapour: vapour pressure, dew point, saturation vapour pressure defect, specific and relative humidity, Transport laws: General transfer equation, molecular transfer process, diffusion coefficients Radiation Laws: black body radiations, Wien's law, Stefan's law, Planck's law, Cosine law for emission and absorption, reflectivity, radiance and irradiance, Wind chill, Hypothermia</p> <p><b>Section-B</b></p> <p>Radiation Environment- Solar Radiation: solar constant, sun-earth geometry, attenuation in the atmosphere, solar radiation at the ground; Terrestrial Radiation; Cloudless skies, Cloudy skies, Microclimatology of radiations (interception): Direct and diffused solar radiations, Shape factors, canopies of black leaves, Microclimatology of radiations (absorption and reflection): radiative properties of natural materials</p> <p><b>Section-C</b></p> <p>Laser applications, Laser light transmission through the atmosphere, molecular absorption and particle scattering techniques for detection of molecules of pollutants by absorption of laser, Remote monitoring capabilities of laser systems, LiDAR technique and its applications, Microwaves; Environmental aspects of microwave radiations, Microwave decomposition of toxic vapour stimulants.</p> <p><b>Recommended Books:</b></p>	<p>Reviewed outcomes and suggested e-learning materials</p> <p>This course has been shifted from core course of II semester to discipline electives Pool of III semester</p>

				<p>1. Garg, S. C., Bansal, R. M., &amp; Ghosh, C. K. (2017). <i>Thermal Physics</i>. New Delhi, India: McGraw Hill.</p> <p>2. John, M. L. &amp; Unsworth M. H. (2013). <i>Principles of Environmental Physics</i> (4<sup>th</sup> ed.). London, UK: Academic Press.</p> <p>3. Wei, G., Schmoltdt, D., &amp; Slusser J. R. (2010). <i>UV Radiation in Global Climate Change: Measurements, Modeling and Effects on Ecosystem</i>. Netherland: Springer</p> <p>4. Boeker, E., &amp; Van Grondelle, R. (2011). <i>Environmental physics: sustainable energy and climate change</i> (3<sup>rd</sup> ed.). New Jersey, NJ: John Wiley &amp; Sons.</p> <p><b>Suggested e-learning materials:</b></p> <p>1. Laws of Thermodynamics  <a href="https://onlinecourses.nptel.ac.in/noc17_mm16/preview">https://onlinecourses.nptel.ac.in/noc17_mm16/preview</a></p> <p>2. Radiation heat radiation  <a href="https://nptel.ac.in/courses/112108149/pdf/M9/Student_Slides_M9.pdf">https://nptel.ac.in/courses/112108149/pdf/M9/Student_Slides_M9.pdf</a></p> <p>3. An introduction to underground mine environment and ventilation,  <a href="https://nptel.ac.in/courses/123106002/MODULE%20-%20III/Lecture%201.pdf">https://nptel.ac.in/courses/123106002/MODULE%20-%20III/Lecture%201.pdf</a></p> <p>4. Lidar basic principles and applications,  <a href="https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000017GE/P001697/M024733/ET/1509971402LIDARbasicprincipleandapplications(1.pdf">https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000017GE/P001697/M024733/ET/1509971402LIDARbasicprincipleandapplications(1.pdf</a></p>	
--	--	--	--	--	--

**FOURTH SEMESTER**

S.N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
1	ENVS P Project	<p>After completion of this course students should be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate competence for independent work in the field of Environmental Science and Technology.</li> <li>• Develop competency in , collection, classification, interpretation</li> <li>• Develop skills to analysis the collected data.</li> <li>• Handle the complex tasks of lab experiments including project report writing.</li> </ul>			Reviewed outcomes

List of Reading Electives

S. No.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
1.	ENVS ___R Agroforestry	<p>After completion of this course students should be able to:</p> <ul style="list-style-type: none"> <li>• Describe agroforestry and agroforestry interventions.</li> <li>• Assess the role of Agroforestry as a sustainable land-use activity.</li> <li>• Describe Nutrient cycling and role of agroforestry in soil and water conservation</li> <li>• Describe various energy plantation methods.</li> </ul>		<p><b>Agroforestry - definition and scope. Tropical deforestation, rising demands of fuel wood, fodder and timber, social, ecological and economic reasons for agroforestry. Traditional agroforestry systems: shifting cultivation, taungya, homegardens. Recent trends in Silviculture and Energy plantations. Trees in agricultural fields and farm boundaries. Commercial crops under shade of planted trees as well as natural forests. Agroforestry for wasteland development and temperate agroforestry practices. Nutrient cycling and role of agroforestry in soil and water conservation. Nitrogen fixation, improvement in soil physico-chemical properties. Soil organic matter status and soil organic matter, Soil fertility considerations in agroforestry nutrient needs of trees and crops.</b></p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>1. Chundawat, B. S., &amp;Gautam, S. K. (2016). <i>Textbook of Agroforestry</i>. New Delhi, India: Oxford &amp;Ibh.</li> <li>2. Jose, S. (2009). <i>Agroforestry for Ecosystem Services and Environmental Benefits (Advances in Agroforestry)</i>. Dordrecht Netherlands: Springer</li> <li>3. Mukherjee, A. (2016). <i>Agroforestry and Watershed Management: An Interlocked System</i>. New Delhi, India: Random.</li> <li>4. Raj, A. J. (2017). <i>Agroforestry Theory and Practices</i>. Jodhpur, India: Scientific.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Introductory Agroforestry <a href="http://ecoursesonline.iasri.res.in/course/view.php?id=157">http://ecoursesonline.iasri.res.in/course/view.php?id=157</a></li> <li>2. Forestry Technologies <a href="http://agritech.tnau.ac.in/forestry/agroforestry_index.html">http://agritech.tnau.ac.in/forestry/agroforestry_index.html</a></li> </ol>	<p>Introduction of New Course</p> <p>Reading Elective-II has been introduced in Semester IV along with Project</p>

S. No.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
2.	ENVS__R Energy Resources and Conservation	<p>After completion of this course students should be able to:</p> <ul style="list-style-type: none"> <li>Describe the non-conventional sources of energy.</li> <li>Explain concepts on energy utilization and conservation.</li> <li>Emphasize energy conservation strategies in residential, industrial and transportation sector.</li> <li>Describe National Energy Policy.</li> </ul>		<p><b>Introduction: Energy, work and power. Classification of energy resources, An overview of the current global and National Energy Scenario. Fossil Fuels: Sources, exploration of oil, coal, natural gas, shale; Exploitation of Fossil fuels and their Environmental consequences. Nuclear Energy: Nuclear fission and Fusion; Nuclear fuel cycle, Nuclear reactor and nuclear power, Renewable and Alternative Energy Sources, Solar energy, Solar power, Photovoltaic cells; Wind power; Geothermal energy; Ocean energy. Environmental consequences of biomass resource harnessing, Energy Conservation: National Energy Policy, Energy efficient appliances, BEE Label, Modes of Energy Conservation in residential, industrial and transportation sector.</b></p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>Agarwal, S. K. (2003). <i>Nuclear Energy: Principles Practice and Prospects</i>. New Delhi, India: APH.</li> <li>Chaturvedi, P. (1995). <i>Bio-Energy Resources</i>. New Delhi, India: Concept.</li> <li>Dayal, M. (1997). <i>Renewable Energy: Environment and Development</i>. New Delhi, India: Konark.</li> <li>Mahajan, V. S. (1991). <i>National Energy: policy, crisis and growth</i>. New Delhi, India: Ashish.</li> <li>Markuszewski, R., &amp; Blaustein, B. D. (1986). <i>Fossil fuels utilization. Environmental concerns</i>. Washington, DC: American Chemical Society.</li> <li>Vandana, S. (2002). <i>Alternative Energy</i>. New Delhi, India: APH.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li><b>Biodiesel production</b> <a href="https://nptel.ac.in/courses/102105058/52">https://nptel.ac.in/courses/102105058/52</a></li> <li><b>Sustainability through Green Manufacturing Systems: An Applied Approach</b> <a href="https://nptel.ac.in/courses/112104225/22">https://nptel.ac.in/courses/112104225/22</a></li> </ol>	<p>Introduction of New Course</p> <p>Reading Elective-II has been introduced in Semester IV along with Project</p>

S.N.	Course List	Learning Outcomes	Existing Syllabus	77	Suggested Syllabus	Remark
------	-------------	-------------------	-------------------	----	--------------------	--------

3.	ENVS __R Man and Environment	<p>After the completion of this course, students should be able to:</p> <ul style="list-style-type: none"> <li>• Describe the complex interactions of humans and ecological systems in the natural world.</li> <li>• Synthesize and apply a wide range of scientific literature in the ecological and environmental science.</li> <li>• Interpret a wide range of scientific literature in ecology and environmental science.</li> <li>• Apply the information in the realms of environmental sciences and sustainability.</li> </ul>		<p><b>Human Population, its Growth and Distribution, Environmental Deterioration associated with population growth, Man Induced Environmental Changes, Types of Human Activities, Impact of Human Activities such as Deforestation, Mining and Industrialization. Environmental Awareness- Need and Role in Betterment of Environment Concept and Significance of Environmental Movements, Environmental Movements in India with special reference to The Bishnoi Movement, Chipko Movement, Appiko Movement, Narmada Bachao Andolan, Silent Valley Movement. Components of natural and built environment: Resources and human settlements, modifications in natural environment, causes and consequences.</b></p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>1. BalAnand, S. (2005). <i>An Introduction to Environmental Management</i>. Mumbai, India : Himalaya.</li> <li>2. Chandana, R. (2008). <i>A Geography of population</i>. New Delhi, India: Kalyani.</li> <li>3. Chopra, G. (2006). <i>Population Geography</i>. New Delhi, India: Commonwealth.</li> <li>4. Chorley, R. J., Schumm, S. A., &amp; Sugden, D. E. (1984). <i>Geomorphology</i>. London, UK: Methuen and Company.</li> <li>5. Dayal, P. (1994). <i>A Text Book of Geomorphology</i>. New Delhi, India: Kalyani.</li> <li>6. Rapoport, A. (2016). <i>Human aspects of urban form: towards a man—environment approach to urban form and design</i>. Oxford, U.K. : Elsevier Pergamon Press.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Environment and Ecology <a href="https://nptel.ac.in/courses/122102006/">https://nptel.ac.in/courses/122102006/</a></li> <li>2. Ecological Degradation and Environmental Protection <a href="https://nptel.ac.in/courses/109104045/35#">https://nptel.ac.in/courses/109104045/35#</a></li> </ol>	Introduc tion of New Course
----	------------------------------------	---	--	---	--------------------------------------

S.N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
4.	ENVS__R Water and Sustainable Development	<p>After the completion of this course, students should be able to:</p> <ul style="list-style-type: none"> <li>Classify major causes of exploitation of water resources, particularly in the Indian and Asian context.</li> <li>Summarize rainwater harvesting and water conservation measures.</li> <li>Describe methods of Irrigation management.</li> <li>Describe importance of Wetlands and its conservation.</li> </ul>		<p>Water and sustainable development. Water and human health – Access to safe drinking water and sanitation; public health issues. Water and food production – Role of irrigation in food security. Shifts in cropping patterns, Rain-fed agriculture, increasing use of groundwater. Environmental, economic and social implications of exploitation of ground water resources. Water and human amenities – Urban water supplies; exploitation, conservation and rainwater harvesting. Wetland, its use and abuse with Ramsar Convention. Urban floods, storm water drainage and integrated urban water management (IUWM). Irrigation management – canals and micro-irrigation.</p> <p>Recommended Books :</p> <ol style="list-style-type: none"> <li>Asawa, G. L. (2005). <i>Irrigation and Water Resources Engineering</i>, New Delhi, India: New Age.</li> <li>Biswas, A. K., Jellau, M., &amp; Stout, G. (1993). <i>Water for sustainable development in 21st century – A Global perspective</i>. New Delhi, India: Oxford University Press.</li> <li>David, L. F. (2007). <i>Water Policy for Sustainable Development</i>. Baltimore, Maryland: Johns Hopkins University Press.</li> <li>Jain, S. K., &amp; Singh, V. P. (2003). <i>Water Resources Systems Planning and Management</i>. Amsterdam, Netherlands: Elsevier.</li> </ol> <p>Suggested e-learning materials:</p> <ol style="list-style-type: none"> <li>Water, Society and Sustainability <a href="https://onlinecourses.nptel.ac.in/noc18_hs36/preview">https://onlinecourses.nptel.ac.in/noc18_hs36/preview</a></li> <li>Irrigation Efficiencies - II and Irrigation Methods and their Suitability <a href="https://nptel.ac.in/courses/105102159/15">https://nptel.ac.in/courses/105102159/15</a></li> </ol>	Introduction of New Course

S. No.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
5.	<b>GEOG ___ R Environmental Challenges and Disaster Management</b>	<p>After the completion of this course, students should be able to:</p> <ul style="list-style-type: none"> <li>• Explain approaches to study environmental development and crisis.</li> <li>• Describe world energy crisis with its causes and suggested measures for improvement.</li> <li>• Describe several environmental problems their causes, consequences and mitigation.</li> <li>• Depict the major disasters and their management with the help of case studies.</li> </ul>		<p><b>Environment:-</b>Definition and types of Environment; <b>Environmental Development Crisis:-</b>Introduction and its causes; <b>Energy Crisis:-</b> Concept, Causes and Remedies; <b>Environmental issues associated with Green Revolution; Impact of Urbanization on Environment.</b></p> <p><b>Deforestation:-</b> Concept, Causes, Effects and Conservation; <b>Desertification:-</b> Concept, Causes, Impacts and Preventions; <b>Water Scarcity:-</b> Causes ; Methods of Rain Water Harvesting (special reference to Traditional Methods); <b>Acid Rain:-</b> Causes, Consequences and Mitigation Measures; <b>Solid Waste:-</b> Introduction, Types and Management.</p> <p><b>Disaster:-</b> Definition and Classification; <b>Natural Disaster:-</b> Nature and Types; <b>Flood:-</b> Causes, Impacts and Methods of Management; <b>Earthquake:-</b> Introduction, Types, Causes, Effects and Mitigation; <b>Case Studies:-</b> Bhuj Earthquake-2001, Tsunami (Southern India)-2004 and Kedarnath Disaster-2013.</p> <p>* Note – Stencils are to be permitted during the examination.</p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>1. Gautam, A. (2010). <i>Environmental Geography</i>. Allahabad, India: Sharda Pustak Bhawan.</li> <li>2. Ghosh, G.K. (2015). <i>Disaster Management</i>. New Delhi, India: A.P.H.</li> <li>3. Singh, S. (2002). <i>Physical Geography</i>. Gorakhpur, India: Vasundhara.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Deforestation:- Concept, Causes, Effects <a href="https://www.livescience.com/27692-deforestation.html">https://www.livescience.com/27692-deforestation.html</a></li> <li>2. Acid Rain:- Causes, Consequences and mitigation measures <a href="https://www.conserve-energy-future.com/causes-and-effects-of-acid-rain.php">https://www.conserve-energy-future.com/causes-and-effects-of-acid-rain.php</a></li> <li>3. Solid Waste:- Introduction, Types and Management <a href="https://www.indiawaterportal.org/topics/solid-waste">https://www.indiawaterportal.org/topics/solid-waste</a></li> </ol>	<p>Introduction of New Course</p> <p>Reading Elective-II has been introduced in Semester IV along with Project</p>

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
-------	-------------	-------------------	-------------------	--------------------	--------



6.	<b>GEOG R</b> <b>India: Socio- Political and Environmental Scenario</b>	<p>After the completion of this course, students should be able to:</p> <ul style="list-style-type: none"> <li>• Understand the current issues related with boundaries, water sharing, agricultural disparities, food security in India.</li> <li>• Describe problems in Agricultural Development.</li> <li>• Discuss Gender Issues and Women Safety.</li> <li>• Find the role of non – conventional energy resources for solving energy crisis.</li> </ul>		<p>Relation of India with neighbouring countries and border disputes with China and Pakistan. Drought problems, Interlinking of rivers as a solution of water crises and disputes of river water sharing with reference to Narmada, Krishna, Cauvery and Sutlej-Yamuna Link (SYL). Problems and disparities in agricultural development, food security and farmer suicides in India. Energy crisis in India and its solution with the help of nuclear, solar, hydro and wind power. Gender issues and women safety, poverty and unemployment.</p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>1. Deshpande, C.D. (1992). <i>India, A Regional Interpretation</i>. New Delhi, India: ICSSR &amp; Northern Book Centre.</li> <li>2. Gallaher, C. et al. (2012). <i>Key Concepts in Political Geography</i> (Reprint). New Delhi, India: Sage.</li> <li>3. Hussain, A. (2007). <i>Political Geography</i>. New Delhi, India: Vishvabharti.</li> <li>4. Singh, R. L. (Ed.). (1971). <i>India - A Regional Geography</i>. Varanasi, India: National Geographical Society.</li> <li>5. Tirtha, R., &amp; Gopal, K. (1996). <i>Emerging India</i>. Jaipur, India: Rawat.</li> <li>6. बंसल, एस. सी. (2011). <i>भारतका भूगोल</i>. मेरठ, भारत: मीनाक्षी.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Interlinking of rivers <a href="https://www.geocomar.ro/website/publicatii/Nr.192013/12_mehta_web_2013.pdf">https://www.geocomar.ro/website/publicatii/Nr.192013/12_mehta_web_2013.pdf</a></li> <li>2. Farmer suicides <a href="http://www.ipcinfo.org/fileadmin/user_upload/fsn/docs/Agriculture%20and%20rural%20development%20in%20India.pdf">http://www.ipcinfo.org/fileadmin/user_upload/fsn/docs/Agriculture%20and%20rural%20development%20in%20India.pdf</a></li> <li>3. Food Security <a href="https://dfpd.nic.in/LwB3AHIAaQB0AGUAcgB1AGEAZABkAGEAdABhAC8AUABvAHIAAdABhAGwALwBNAGEAZwBhAHoAaQBuAGUALwBEAG8AYwB1AG0AZOBuAHQALwA=1_93_1_Original.pdf">https://dfpd.nic.in/LwB3AHIAaQB0AGUAcgB1AGEAZABkAGEAdABhAC8AUABvAHIAAdABhAGwALwBNAGEAZwBhAHoAaQBuAGUALwBEAG8AYwB1AG0AZOBuAHQALwA=1_93_1_Original.pdf</a></li> <li>4. Gender Issues in India <a href="https://www.indiacelebrating.com/social-issues/gender-inequality-in-india/">https://www.indiacelebrating.com/social-issues/gender-inequality-in-india/</a></li> </ol>	Introducti on of New Course
----	--	---	--	---	-----------------------------------

S.N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
7.	<b>GEOG __ R Rajasthan: Challenges and Prospects</b>	<p>After the completion of this course, students should be able to:</p> <ul style="list-style-type: none"> <li>Describe the major environmental, socio economic problems of Rajasthan.</li> <li>Explain desertification, Aravalli development, agriculture and tourism of Rajasthan.</li> <li>Analyze existing state and national policies in terms of socio economic conditions.</li> <li>Aware society regarding existing policies related to child marriage, Female feticide and other Social problems.</li> </ul>		<p><b>Major Canal Irrigation Project and Its impact; Desertification and Desert Development programmes; Identification of drought prone areas and mitigation, problem of mining and Aravalli Development Programme, Problems and measures of Agricultural development; Programmes for forest conservation; Poultry farming, Planning for livestock development; Role of Tourism in the economy.</b></p> <p><b>Socio- economic issues and Government policies and programmes: child marriage, female feticide, female education, gender discrimination and caste; unemployment and poverty .</b></p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>Singh, G. (2010). <i>Geography of India</i>(9<sup>th</sup> ed.). Delhi, India: Atma Ram.</li> <li>शर्मा, आर. (2010). <i>राजस्थानकाभूगोल</i>. उदयपुर, भारत: हिमाशुं.</li> <li>शर्मा एच. एस., एवं शर्मा, एम. एल. (2015). <i>राजस्थानकाभूगोल</i>. जयपुर, भारत: पंचशील.</li> <li>सक्सेना, एच. (2014). <i>राजस्थानकाभूगोल</i>. जयपुर, भारत: राजस्थान हिन्दी ग्रंथ अकादमी.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li><b>Indira Gandhi Canal</b> <a href="https://www.rajras.in/index.php/indira-gandhi-canal/">https://www.rajras.in/index.php/indira-gandhi-canal/</a></li> <li><b>tourist spots in Rajasthan</b> <a href="http://www.transindiatravels.com/rajasthan/tourist-places-to-visit-in-rajasthan/">http://www.transindiatravels.com/rajasthan/tourist-places-to-visit-in-rajasthan/</a></li> <li><b>Problem of Desertification</b> <a href="http://www.cazri.res.in/annals/1993/1993JA-1.pdf">http://www.cazri.res.in/annals/1993/1993JA-1.pdf</a>.</li> </ol>	<p><b>Introduction of New Course</b></p> <p><b>Reading Elective-II has been introduced in Semester IV along with Project</b></p>

S. No.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
8.	<b>GEOG __R Transforming India</b>	<p>After the completion of this course, students should be able to:</p> <ul style="list-style-type: none"> <li>• Assess the ongoing governmental policies applicable to socio-economic and health sectors.</li> <li>• Aware society about the injustice caused to women in terms of Triple Talaq.</li> <li>• Explain current livelihood struggle in the society and the role of skill development in enhancing quality of life.</li> <li>• Suggest the measures of improvement in the policies.</li> </ul>		<p>Transforming India into a digitally empowered society and development through digitalization, its effects and problems. Demonetization- a step to less cash to cash less economy. Indian youth as a change agent and quality of education for empowering Indian youth, Skill development and empowering youth, Population pressure in job sector and creating livelihood opportunities. Swachh Bharat Mission and Sanitation revolution for clean and healthy society, Ayushman Bharat Yojana- a step towards Health for all. Beti Bachao Beti Padhao- a step for girl's development and Triple Talaq in India- an injustice for women or religious issue.</p> <p>Recommended Books :</p> <ol style="list-style-type: none"> <li>1. Ghosh, J., Chandrashekra, C.P., &amp; Patnaik, P. (2017). <i>Demonetisation Decoded</i>. New York, NY: Routledge.</li> <li>2. Panigrahi, R.L. (2005). <i>Population problems in India</i>. New Delhi, India: DPH.</li> <li>3. Sinha, M., &amp; Sinha, R.K. (Ed). (2008). <i>Swachh Bharat, A clean India</i>. New Delhi, India: Prabhat.</li> </ol> <p>Suggested e-learning materials:</p> <ol style="list-style-type: none"> <li>1. Transforming India <a href="http://transformingindia.in/">http://transformingindia.in/</a></li> <li>2. Digital India <a href="https://www.indianeconomy.net/splclassroom/what-is-digital-india/">https://www.indianeconomy.net/splclassroom/what-is-digital-india/</a></li> <li>3. Demonetization <a href="http://www.mbauniverse.com/group-discussion/topic/business-economy/demonetisation">http://www.mbauniverse.com/group-discussion/topic/business-economy/demonetisation</a></li> <li>4. Skill Development in India <a href="https://www.indiaonline.com/article/article-latest/skill-development-in-india-gaps-and-opportunities-118092700366-1.html">https://www.indiaonline.com/article/article-latest/skill-development-in-india-gaps-and-opportunities-118092700366-1.html</a></li> <li>5. Swachh Bharat Mission <a href="https://www.mapsofindia.com/my-india/society/swachh-bharat-abhiyan-making-india-clean-more">https://www.mapsofindia.com/my-india/society/swachh-bharat-abhiyan-making-india-clean-more</a></li> <li>6. Beti Bachao and Beti Padhao <a href="http://www.mbauniverse.com/group-discussion/topic/social-issues/beti-bachao-beti-padhao">http://www.mbauniverse.com/group-discussion/topic/social-issues/beti-bachao-beti-padhao</a></li> </ol>	<p>Introduction of New Course</p> <p>Reading Elective-II has been introduced in Semester IV along with Project</p>

S. N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
9.	GEOL___ R Geo Tourism	<p>After the completion of this course, students should be able to:</p> <ul style="list-style-type: none"> <li>• Elucidate the criterion require for designating geotour sites.</li> <li>• Explore the geological and geographical attributes of the geosites.</li> <li>• Develop a geo-conservation plan for geotour sites.</li> <li>• Evaluate the potential of geosites for revenue generation.</li> </ul>		<p>Definition and scope of Geotourism. Principles of Geotourism. Geoconservation Plans. Introduction to geodiversity and Geopark. UNESCO's Global Geopark development program. Overview of GSI monuments and geotour sites-Sendra Granite of Pali District Rajasthan, Lonar Lake of Buldana District Maharastra, Peninsular Gneiss at Lalbagh Bangalore Karnataka, Natural Arch in Tirumala hills, Chitoor District-Barr Conglomerate, Pali District Rajasthan, Marine Gondwana Fossil Park, Fossil Wood Parks, Siwalik Fossil Park, Stromatolite Parks, Columnar Basalt, Pillow Lava, Pyroclastic Rocks, Nepheline Syenite, Welded Tuff, Charnockite, Great Boundary Fault, Eparchaeon Unconformity, Tirumala hills. World's major geotour sites.</p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>1. Chen, A. (2015). <i>The Principles of Geotourism</i>. Beijing, China: Springer-Verlag.</li> <li>2. Dowling, R., &amp; Newsome, D. (Eds.). (2018). <i>Handbook of Geotourism</i>. Gloucestershire, UK: Edward Elgar.</li> <li>3. Dowling, R., &amp; Newsome, D. (Eds.). (2005). <i>Geotourism</i>. Oxford, UK: Elsevier.</li> <li>4. Newsome, D., &amp; Dowling, R. (Eds.). (2010). <i>Geotourism: The Tourism of Geology and Landscape</i>. Oxford, UK: Goodfellow.</li> </ol> <p><b>Suggested e-learning materials</b></p> <ol style="list-style-type: none"> <li>1. UNESCO geological heritage and geo-tourism in Peru <a href="http://www.unesco.org/new/en/media-services/single-view/news/unesco_geoparks_geological_heritage_and_geo_tourism_in_peru/">http://www.unesco.org/new/en/media-services/single-view/news/unesco_geoparks_geological_heritage_and_geo_tourism_in_peru/</a></li> <li>2. Geotourism <a href="https://link.springer.com/referenceworkentry/10.1007%2F978-3-319-01669-6_93-1">https://link.springer.com/referenceworkentry/10.1007%2F978-3-319-01669-6_93-1</a></li> <li>3. Geotourism in India <a href="https://www.gsi.gov.in">https://www.gsi.gov.in</a></li> </ol>	<p>Reading Elective-I was Introduced in III semester</p> <p>Introduction of New Course</p>


S.N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
10.	GEOL_R Indian Mineral Deposits, Economics and Mining Ethics	<p>After the completion of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Explain the distribution of mineral resources in India.</li> <li>• Evaluate the mineral resources and reserves in Indian and global perspective.</li> <li>• Familiarize with the concept of mineral legislation and policies.</li> <li>• Delineate the different environmental issues associated with mining activities.</li> </ul>		<p>Introduction to types and distribution of various mineral deposits in India. Occurrences of important metallic, non-metallic/industrial and fuel mineral deposits of India. Mineral economics and its major concept. Introduction for Global mineral resources. Conservation and substitution of minerals; changing pattern of mineral consumption, Growth of mineral industry and economy, Mineral industry and its adverse effect to the environment. Environmental baseline data needed for mine planning-Its acquisition and documentation during different stages of exploration. Nature and extent of environmental problems due to surface and underground mining. Legislation and control measures for mining. Mineral legislation in Indian context (The Mines and Minerals Regulation and Development Act, 1957). Reclamation and restoration of mined land.</p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>1. Arogyaswamy, R.N.P. (1995). <i>Courses in Mining Geology</i>(4<sup>th</sup>ed.). New Delhi, India: Oxford and IBH.</li> <li>2. Banerjee, D. K. (1998). <i>Mineral Resources of India</i>(2<sup>nd</sup>ed.). Kolkata, India: The World Press.</li> <li>3. Chatterjee, K.K. (1993). <i>An Introduction to Mineral Economics</i> (2<sup>nd</sup> ed.).Bangalore, India: New Age International.</li> <li>4. Sharma, N.L.,&amp; Ram, K.S.V. (1964). <i>Introduction to India's economic minerals</i>. Dhanbad, India: Dhanbad.</li> <li>5. Sinha, R.K.,&amp; Sharma, N.L. (1988). <i>Mineral Economics</i> (4<sup>th</sup> ed.).New Delhi, India: Oxford &amp; IBH.</li> </ol> <p><b>Suggested e-learning materials:</b></p> <ol style="list-style-type: none"> <li>1. Mineral and energy resources <a href="http://ncert.nic.in/ncerts/l/legy207.pdf">http://ncert.nic.in/ncerts/l/legy207.pdf</a></li> <li>2. Economic Minerals of India: <a href="https://www.researchgate.net/publication/315831629_Economic_Minerals_of_India">https://www.researchgate.net/publication/315831629_Economic_Minerals_of_India</a></li> </ol>	Introducti on of New Course

S. No.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
11.	<b>GEOL____R Innovation and Entrepreneurship in Earth Sciences</b>	<p>After the completion of this course, students should be able to:</p> <ul style="list-style-type: none"> <li>• Understand necessary steps to open a new venture.</li> <li>• Gain an understanding of creating products or services, launching innovative projects and making R&amp;D investments in a start-up context.</li> <li>• Develop marketing strategies for tools and technical products used in earth sciences.</li> <li>• Familiarize with the legal concepts and financial planning for a successful new venture.</li> </ul>		<p>An overview of Entrepreneurs and Entrepreneurship. Evolution and Growth of Earth Science. Entrepreneurship in India, Starting small business. Planning-Organization and Management. Basic layout of Proposal for seeking loan from financial institution, Legal requirements, Basic Financial Planning and problems. Case study of successful Earth Science Entrepreneurs in India Earth Science component in Government of India PSU (MECL, NHPC Mini Ratna, ONGC, NTPC, CIL Maharatna) and in MNC (Larsen and Toubro, Tata, Reliance, Vedanta, Dalmiya groups, Aditya Birla). Entrepreneurs Skills and Competencies. Earth Science technology for harnessing Innovation. Challenges of new startups, Marketing Strategies development, Tools and techniques for market Assessments, Methods and sources for market survey and Market Information. Presentation of Market Survey Report.</p> <p>Recommended Books :</p> <ol style="list-style-type: none"> <li>1. Clarysse, B. (2011). <i>The Smart Entrepreneur: How to Build for a Successful Business</i>. London, UK: Elliott &amp; Thompson.</li> <li>2. Sethi, A. (2016). <i>From Science to Startup: The Inside Track of Technology. Entrepreneurship</i>.Göttingen, Germany: Copernicus &amp; Springer.</li> <li>3. Westhead, P.,&amp; Wright, M.(2013). <i>Entrepreneurship. A very short introduction</i>. Oxford, UK: Oxford University Press.</li> </ol> <p>Suggested e-learning materials:</p> <ol style="list-style-type: none"> <li>1. Sustainability, Innovation and Entrepreneurship <a href="https://nptel.ac.in/courses/110107094/26">https://nptel.ac.in/courses/110107094/26</a></li> <li>2. New Enterprises <a href="https://ocw.mit.edu/courses/sloan-school-of-management/15-390-new-enterprises-spring">https://ocw.mit.edu/courses/sloan-school-of-management/15-390-new-enterprises-spring</a></li> </ol>	<p>Introduction of New Course</p> <p>Reading Elective-II has been introduced in Semester IV along with Project</p>

S.N.	Course List	Learning Outcomes	Existing Syllabus	Suggested Syllabus	Remark
12.	GEOL Natural Hazards and Disasters	<p>After the completion of this course, students should be able to:</p> <ul style="list-style-type: none"> <li>• Explain the key concepts, definitions, perspectives of all hazards and management.</li> <li>• Describe prevention and mitigation of natural hazards.</li> <li>• Depict the preparedness response and recovery management of natural disasters.</li> <li>• Elucidate the sustainable development methods in disaster mitigation.</li> </ul>		<p><b>Introduction to Disasters and Hazards, Processes (Internal and External), Types of Hazards: causes and consequences, Prediction and Indicators of Natural Disasters, Socio-economic and Health impacts of Natural Disasters.</b></p> <p><b>Natural Disasters – Earthquake: Processes, Magnitude, Intensity and Impact. Volcanism: Types, Risks and Impact. Tsunami and Cyclone: Types, Causes, processes and Impact. Floods: Introduction, Magnitude, Frequency, Zonation and Impact. Mass Wasting: Classification, causes and Impact. Disaster Management: Prevention, Preparedness and Mitigation, Planning and control of Natural Disaster. Case Studies: Nepal Earthquake, Kedarnath Disaster, Bhuj Earthquake 2001.</b></p> <p><b>Recommended Books :</b></p> <ol style="list-style-type: none"> <li>1. Bolt, B.A. (1988). <i>Earthquakes</i>. New York, NY: WH Freeman &amp; Company.</li> <li>2. Decker, R. W. &amp; Decker, B. B. (2005). <i>Volcanoes</i> (4<sup>th</sup>ed.). New York, NY: WH Freeman &amp; Company.</li> <li>3. Dowrick, D. (2003). <i>Earthquake Risk Reduction Zone</i>. England,UK:John Wiley &amp; Sons.</li> <li>4. Gere, J.M.,&amp; Shah, H.C. (1984). <i>Terra Non Firme Understanding and Preparing for Earthquakes</i>. New York, NY: WH Freeman &amp; Company.</li> <li>5. IGNOU (2005). <i>Understanding Natural Disasters</i>. eGyanKosh, Noida, India: Shagun Offset Press.</li> <li>6. Keller, E.A.,&amp;Devecchio, E.D. (2015). <i>Natural Hazards</i> (4<sup>th</sup>ed.). New York, NY: Pearson.</li> <li>7. Keller, E.A. (1978). <i>Environmental Geology</i>(9<sup>th</sup>ed.). North Carolina, NC: Bell &amp; Howell.</li> <li>8. Montgomery, C.W. (2013). <i>Environmental Geology</i> (10<sup>th</sup>ed.). New York, NY:Mc-Graw-Hill.</li> <li>9. Prakash, I. (1994). <i>Disaster Management</i>. Ghaziabad,India:RastriyaPrahari.</li> <li>10. Sharma, V.K. (1995). <i>Disaster Management</i>. New Delhi, India: Indian</li> </ol>	Introduction of New Course

				<p><b>Institute of Public Administration (IIPA).</b></p> <p><b>11. Singh, S. (2015). <i>Environmental Geography</i>. Allahabad, India: Pravalika.</b></p> <p><b>Suggested e-learning materials:</b></p> <p><b>1. Introduction to Natural hazards</b>  <a href="https://epgp.inflibnet.ac.in/ahl.php?csrno=17">https://epgp.inflibnet.ac.in/ahl.php?csrno=17</a>  <a href="https://onlinecourses.nptel.ac.in/noc19_ce14/preview">https://onlinecourses.nptel.ac.in/noc19_ce14/preview</a></p> <p><b>2. Disasters and Hazards</b>  <a href="https://ndma.gov.in/en/">https://ndma.gov.in/en/</a></p>	
--	--	--	--	--	--

**Note: Yellow highlighted and bold content illustrate the modification in the syllabus.**

Verified  
  
 Offg. Secretary  
 Banasthali Vidyapith  
 P.O. Banasthali Vidyapith  
 Distt. Tonk (Raj.)-304022