SYLLABUS

FOR

M. Sc. (Environment & Safety)
Faculty of Science – Under CBCS System

(To be implemented from Academic Year 2021-22)

DEPARTMENT OF ENVIRONMENT MANAGEMENT

CHHATRAPATI SHAHU INSTITUTE OF BUSINESS EDUCATION AND RESEARCH (CSIBER), (AN AUTONOMOUS INSTITUTE) UNIVERSITY ROAD, KOLHAPUR 416 004 (M. S.), INDIA

2021

REVISED CURRICULUM OF M. Sc. (Environment & Safety) PROGRAMME

The M. Sc. (Environment & Safety) Programme is of Two-year duration and is divided into four semesters. Semester I & II will be taught in the First Year of the programme and Semester III & IV during the second year of the programme.

Objectives:

The specific objectives of Master's Degree Programme are:

(i) To provide in-depth knowledge to the students in respect of current environmental problems faced by human society and to develop among students scientific attitude based on interdisciplinary approach to enable them to take holistic view in decision taking.

(ii) To provide students typical problem-oriented situations in environmental protection and safety management

(iii) To develop managerial competence among students in managing environmental development programs sponsored by the Government.

(iv) To provide information about the importance of industrial safety, occupational health and prevention of accidents/incidents which cause loss of life / property.

Eligibility for Admission:

Graduates in Science discipline, passed under 10+2+3 pattern from any recognized University are eligible to take admission.

Intake: 30

Reservation:

Reservation for special categories such as SC, ST, NT, OBC, etc. will be as per the Government of Maharashtra and Shivaji University.

Selection Procedure:

All eligible applicants will be required to be present themselves at the Institute for the Written Test, Group Discussion Test and the Personal Interview at their own cost.

The final selection of students will be on merit on the basis of

Basic Degree	100 marks
Written Test	50 marks
Group Discussion Test	25 marks
Personal Interview	25 marks
Total:	200 marks

Seats will be reserved for the Scheduled Castes, Scheduled Tribes and other Backward Classes as per Government circular.

The written test will be of 2 hours duration having 3 sections viz.

a) English 30 marks

b) General knowledge & Intellectual Test 40 marks

c) Elementary Mathematics 30 marks

(These marks shall be converted out of 50)

On the basis of marks at the degree level and the performance at the written test, the candidate will be selected for Group Discussion and Personal Interview.

The Written test:

The written test will be held by the Institute after the last degree examination is held, which is one of the qualifications for admission.

The Interview:

a) The Interview will consist of Group Discussion (GD) and Personal Interview (PI) to be held by the selection committee.

b) The topics for Group Discussion will be notified and a batch of 10 to 12 candidates will be discussing one topic given by the members of the committee. The discussion will take place under strict supervision and the student's ability to express, to understand the problem, to think clearly and to present systematically will be assessed.

c) At the time of interview the selection committee will take into consideration normally the candidates academic qualifications as well as personal qualities, aptitude, interest, general knowledge and work experience in the field of management.

d) The final selection will be strictly done on merit. The committee after conduct of the group discussion and personal interview will prepare the final list of selected candidates.

Duration:

The degree of **M. Sc.** (Environment & Safety) shall be fulltime programme and its duration shall be of Two Years. The programme consists of four semesters. The examination to be held in the First, Second semester will be called Part – I (First Year) and the examination to be held in the third and fourth semester will be called Part – II (Second Year).

If a candidate fails to clear all the theory papers and project report within four years of his/her registration, the past performance will stand automatically nullified.

If a candidate discontinues any of the terms (i. e. semester – I to IV) on any account, he/she will be allowed to complete the in-completed terms in the subsequent years subject to the condition that it is within the stipulated time duration of **Six** years.

In addition to the above, once a student's term (semester) is granted, he/she shall be allowed to appear and pass in any of the subsequent examinations held, provided the examinations are within the stipulated period of **Six** years.

In case the term (semester) is not granted the student has to seek fresh admission in the next year and complete the term and pass the examination. This too within **Six** years of his/her registration.

Course Completion with Break in Between:

A student who has passed M. Sc. – I and is seeking admission to M.Sc. – II after a long gap (Provided the gap lies within the stipulated duration of **Six** years) should complete the course syllabus which is in existence at the time he has sought the admission for the academic year.

Award of degree:

After successful completion of four semesters of **M. Sc.** (Environment & Safety) mark list ledgers will be forwarded to the Shivaji University for the award of degree.

CBCS Pattern:

M. Sc. (Environment & Safety) under CBCS pattern shall carry certain number of credits. Credits normally represent the weightage of a course and area function of teaching, learning and evaluation strategies such as number of contact hours, the course content, teaching methodology, learning expectations, etc. The credits shall be based on the number of instructional hours perweek, generally1credit per one hour of instruction in and 1creditfor 2 hours of practical/summer in- plant project/ lab based project / Fieldwork/internship.

General features of the Choice Based Credit System are:

a) The **M. Sc.** (Environment & Safety) programme is structured CBCS Patten.

b) The Programme consists of Compulsory Core (CC), Discipline Specific Electives (DSE), Generic Electives (GE) and Ability Enhancement Compulsory Courses (AEC). The core papers deal with the specific discipline and the other papers deal with interdisciplinary nature including soft skill aspects.

c) The relative importance of subjects of study is quantified in terms of credits.

d) The choice based courses may be offered with in the faculty and/or across the faculty.

e) The curricula should be unitized giving equal weightage in terms of contact hours and marks.

f) Well defined model outline of question paper consisting of long answers, brief answers and short notes

g) The evaluation will be on Continuous Internal Assessment (CIA) and End Semester Assessment (ESA). The final results shall be declared after integration of CIA and ESA

h) The declaration of result is based on the Grade Point Average (GPA) earned towards the end of each semester and the Cumulative Grade Point Average(CGPA)earned towards the end of the program.

i) Under the CBCS, students have option to choose courses from other departments as well.

Outline of Choice Based Credit System:

1. Core Courses:

1.1 Compulsory Core (CC):

A course which should compulsorily be studied by a candidate as Core Course.

1.2 Summer Inplant Project (SIP):

An elective course in the terms of topic & Industry/organization, designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher / faculty member is called Summer Inplant Project.

1.3 Lab Based/ Survey Project (Research Oriented)):

An elective course designed to acquire special/advanced knowledge such as supplement study/support study, which is research oriented work, and a candidate studies such a course on his own with an advisory support by a teacher / faculty member is called lab based/survey project.

2. Elective Courses:

Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline / subject / domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 Discipline Specific Elective (DSE) Courses:

Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 Generic Elective (GE) Courses:

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

3. Ability Enhancement Courses (AEC):

The Ability Enhancement (AEC) Courses are designed that leads to Knowledge enhancement in functional areas; such as Managerial communication at work, foreign languages, skill development

for career management. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

Credit Pattern:

Every course offered will have three components associated with the teaching-learning process of the course, namely

Lecture - L, Tutorial - T, Practice - P

Where, **L** stands for ***Lecture*** session, **T** stands for ***Tutorial*** Session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes and **P** stands for ***Practice*** Session on MOODLE , E – Library and it consists of Hands on experience / Laboratory Experiments / Field Studies / Case studies that equip students to acquire the much required skill component.

In terms of credits, every one hour session amounts to 1 credit per semester and a minimum of two hour session of T or P amounts to 1 credit per semester, over a period of one semester of 15 weeks for teaching-learning process. The total duration of a semester is 20 weeks inclusive of semester-end examination.

M. Sc. (Environment & Safety) consists of all the three components with weightage depending upon the paper.

The total credits earned by a student at the end of the semester upon successfully completing the course are L + T + P. The credit pattern of the course is indicated as L: T: P.

If a course is of 4 credits then the different credit distribution patterns in L: T: P format could be:

Theory Papers: 3: 0.5: 0.5

Practical: 1: 0: 3.0

If a course is of 2 credits then the different credit distribution patterns in L:T: P format could be:

Theory Papers: 1.5: 0.25: 0.25

Practical: 0.5: 0: 1.5

Summer in-plant Project: 0:0.5:1.5

Project work: 0:0.5:1.5

Teaching programme for each Semester shall consist of:

a) Theory Lectures: There will be 60 contact hours / paper / semester for four credits ; @ 4 lectures /paper /week and 30 contact hours / paper / semester @ 2 lectures /paper / week for two credits. Each lecture is of the duration of 60 minutes.

b) Practical: 3 practical / week. Each practical is of the duration of 3 clock hours, number of students in batches should not exceed 15.

Credit Grade Based Performance Assessment System (CGPA):

I. ASSESSMENT:

Taking into consideration the UGC and AICTE requirements, CSIBER has adopted "Credit Grade Based Performance Assessment System" (CGPA). Each paper is of 100 marks and contact hours for each paper is 60. One credit is allotted to 15 contact hours. All papers are considered as Full credit papers i.e. **Four** credits are allotted to each paper. Practical of 50 marks are considered as half credit i.e. Two credit is allotted to each practical.

1. For the paper of 100 marks. The distribution of the marks for theory, practical and project work will be as follows –
   i) Internal Marks i.e. Concurrent evaluation - 40 Marks
   ii) External Marks i.e. End Semester examination - 60 marks
2. For the paper of 50 marks. The distribution of the marks will be as follows –
   i) Internal Marks i.e. Concurrent evaluation - 20 Marks
   ii) External Marks i.e. End Semester examination - 30 marks
3. SIP project/ Lab based Project Evaluation:
   i) Internal Marks i.e. Concurrent evaluation - 20 Marks
   ii) External Marks i.e. End Semester examination - 30 marks

   External marks will be given at the time of viva by external and internal and average marks will be calculated out of 30.
4. Breakup of Internal Marks (Concurrent Evaluation)

Sr. No.	Head	Marks Out of 40	Marks Out of 20
1.	Class Participation	10	05
2.	Field Based Visit Report / Case study	10	05
3.	Test / Quiz / Class Test	10	05
4.	Assignment / Seminar	10	05
	Total	40	20

The Internal Marks assessed by the teachers be shown to the students and their signature will be obtained.

The assessment of papers will be done by an Internal and External examiner. A difference of more than **20%** in the marks awarded by these examiners would necessitate the valuation of the paper by Third examiner. The **'highest nearest'** marks will be considered for determining the average mark of such papers.

5. Once the Student passes in the internal marks (Concurrent evaluation out of 40) and the record is submitted to the examination department, it should be carried forward whenever required and it cannot be change.
6. Students who fail in the internal marks (Concurrent evaluation out of 40) should reappear for the same, then only the revised marks will be considered for further calculation.

II. STANDARD OF PASSING:

1. In order to pass in a paper / head, a candidate will have to obtain 50% in the internal marks (Concurrent evaluation), 40% marks in theory, and a minimum of 50% of the marks in aggregate in each paper head.
2. To pass the M. Sc. examination, a candidate will have to pass in all Four Semester in Two Parts i.e. Part – I (Semester – I & II) and Part – II (Semester – III & IV)
3. A candidate from the first year M. Sc. will be eligible to proceed to the Semester III, if he /she is not having more than **5 (Five)** papers backlog of the First Year (that is Semester – I & II).

I Grading System:
Full Credit 100 Marks

Grade Table for Trimester/Semester Examination			
Marks Obtained	**Letter Grade**	**Grade Point**	**Description of Performance**
96-100	S+	10.0	SUPER
91-95	S	9.0	
86-90	E+	8.5	Exemplary
81-85	E	8.0	
76-80	O+	7.5	Outstanding
71-75	O	7.0	
66-70	A+	6.5	Good
61-65	A	6.0	
56-60	B+	5.5	Average
50-55	B	5.0	
--	X	0.0	Defaulter
--	XX	---	Incomplete

Half Credit 50 Marks

Grade Table for Trimester/Semester Examination			
Marks Obtained	**Letter Grade**	**Grade Point**	**Description of Performance**
48 – 50	S+	10.0	SUPER
46 – 47	S	9.0	
43 – 45	E+	8.5	Exemplary
41 – 42	E	8.0	
38 – 40	O+	7.5	Outstanding
36 – 37	O	7.0	
33 – 35	A+	6.5	Good
31 – 32	A	6.0	
28 – 30	B+	5.5	Average
25 – 27	B	5.0	
--	X	0.0	Defaulter
--	XX	---	Incomplete

Final Result: For the final result of the student Cumulative Performance Index (CPI) based on total earned credits vis-à-vis total earned grade points shall be calculated will be as follows.

Total earned grade points / Total credits i.e. **108** credits.

Result		
CPI	**Final Grade**	**Classification of Final Result.**
9.0 – 10.0	S	Extraordinary
8.0 – 8.9	E	Excellent
7.0 – 7.9	O	Outstanding
6.0 – 6.9	A	Very Good
5.5 – 5.9	B+	Good
5.0 – 5.4	B	Average
0.0 – 4.9	X	Unsatisfactory (Fail)

Note: An aggregate of **5.0** credit points are required to pass the MCA program.

CALCULATION OF PERFORMANCE INDICES:

A distinction of the performance of one student from the other student is rather impossible to carry out from the grades obtained by a student in all the courses taken by him in a semester/year. Hence, the evaluation of various courses is cumulated in two performance indices termed as semester performance index (SPI) and cumulative performance index (CPI), the explanation of which is given below:

Semester Performance Index (SPI):

The performance of a student in a semester is indicated by a number called Semester Performance Index (SPI). SPI is the weighted average of all the grade points obtained by him in all the courses registered during the semester. If gi is a grade with numerical equivalent as gi obtained by a student for the course with credit Ci then, SPI for that semester is calculated using formula.

$$SPI = \frac{\sum_{i} C_i g_i}{\sum_{i} C_i}$$

where summation is for all the courses registered by a student and Semester SPI is calculated to two decimal places and rounded off. SPI once calculated shall never be modified. Generally, for the students failed in regular examinations SPI is calculated only after the declaration of re-examination grades.

Cumulative Performance Index (CPI):

An up-to-date assessment of the overall performance of a student from the first semester till completion of the programme is obtained by calculating an index called as Cumulative Performance Index (CPI). The CPI is weighted average of the grade points obtained in all the courses registered by a student since the first semester of the programme.

$$CPI = \frac{\sum_{i} C_i g_i}{\sum_{i} C_i}$$

Besides SPI, CPI is also calculated at the end of every semester upto two decimal places and is rounded off. It is necessary to ensure that one course appears only once in calculation of CPI and the denominator in above equation does not exceed the total number of credits registered by him.

GRACE MARKS UNDER DIFFERENT ORDINANCE.

S.O. No. 1:-Grace Marks for Passing in each head of Passing (Theory/Practical/Oral/ Sessional/External).

The Examinee shall be given the benefit of grace marks only for passing in each head of Passing Theory/Practical/Oral/Sessional/ in External examination as follows.

Head of Passing	Grace Marks
Up to – 50	2
051-100	3
101-150	4
151-200	5
201-250	6
251-300	7
301-350	8
351-400	9
And 401 and above.	10

Subject to the following conditions:

The benefit of such gracing marks in different heads of passing shall not exceed 1% of the aggregate marks in that examination.

The benefit of gracing of Marks under this Ordinance shall be applicable only if the candidate passes the entire examination of Semester.

The gracing is concurrent with the rules and guidelines of Professional statutory bodies at the All India level such as AICTE, MCI, Bar Council, CCIM, and CCIII. NCTE, UGC etc.

S.O. No. 2:- **Grace Marks for Getting Higher Class**

A Candidate who passes in all the courses and heads of passing in the examination without the benefit of either gracing or condonation rules and whose total number of Marks falls short for securing Second Class/Higher Second Class or First Class by marks not more 1% of the aggregate marks of that examination or up to 10 marks, whichever is less, shall be given the required marks to get the next higher class of grade as the case may be.

Provided that benefits of above mentioned grace marks shall not be given, if the candidate fails to secure necessary passing marks in the aggregate head of passing also, if prescribed in the examination concerned.

Provided further that the benefits of above mentioned grace marks shall be given to the candidate for such examination/s only for which provision of award of class has been prescribed.

Provided further that this gracing is concurrent with the rules and guidelines of Professional statutory bodies at the All India level such as AICTE, MCI, Bar Council, CCIM, and CCIII. NCTE, UGC etc.

S.O. No. 3 Condonation

If a candidate fails in more than one head of passing, his/her deficiency of marks in such head of passing may be condoned by not more than 1% at the aggregate marks of the examination. However condonation, whether in one head of passing or aggregate head of passing be restricted to maximum upto 10 marks only.

Condonation of deficiency of marks be shown in the statement of Marks in the form of asterisk and Ordinance number

Provided further that this gracing is concurrent with the rules and guidelines of Professional statutory bodies at the All India level such as AICTE, MCI, Bar Council, CCIM, and CCIII. NCTE, UGC etc..

BACKLOG:

1. A candidate will be permitted to proceed to the second Semester unconditionally even though he/she fails in one or more courses of the first semester, provided the first semester term is granted.
2. The students who have a backlog of not more than **five courses (25% of passing heads)** in the First year examination (Semester I & II) will be eligible to be admitted to the Second year (III Semester) of MCA.
3. A Candidate will be permitted to proceed to the Fourth Semester unconditionally even though he/she fails in one or more courses of the third semester, provided the third semester term is granted.

Assessment of AEC and AECC Courses

AEC Courses will be assessed as follows:

i) Internal Marks i.e. concurrent evaluation	-	20 Marks
ii) External Marks	-	30 Marks

- External Marks (out of 30) will be given on the Viva or presentation by panel consisting of one internal and one external member.
- The Internal Marks assessed by the teachers be shown to the students and their signature will be obtained.

CBCS Structure of M. Sc. (Environment & Safety)
(To be Implemented from 2021-22)
M.Sc. - I Year

Semester – I

Nature of Choice Base	Choice Code	Subject	Total Credits	L:T:P	Contact Hours	Int. Marks	Ext. Marks	Total Marks
Core Courses (CC)	**CC-101**	Introduction to Ecology and Environment	4	3:0.5:0.5	60	40	60	100
	CC-102	Natural Resources	4	3:0.5:0.5	60	40	60	100
	CC-103	Fundamentals of Safety	4	3:0.5:0.5	60	40	60	100
	CC-104	Practical-I	4	1:0:3	60	40	60	100
	CC-105	Practical –II	4	1:0:3	60	40	60	100
Discipline Specific Elective (DSE)	**DSE-101 (Any One)**	**DSE-101(A) :** Environmental Chemistry **DSE-101(B) :** Ecological Foot Prints and Carbon sequestration	4	3:0.5:0.5	60	40	60	100
		Total Credits	**24**		**360**	**240**	**360**	**600**

Semester – II

Nature of Choice Base	Subject Code	Subject	Total Credits	L:T:P	Hours	Int. Marks	Ext. Marks	Total Marks
Core Courses (CC)	**CC-201**	Water Pollution	4	3:0.5:0.5	60	40	60	100
	CC-202	Environmental Engineering and Design	4	3:0.5:0.5	60	40	60	100
	CC-203	Computer Applications	2	1.5:.25:.25	30	20	30	50
	CC-204	Statistical Methods	2	1.5:.25:.25	30	20	30	50
	CC-205	Practical –III	4	1:0:3	60	40	60	100
	CC-206	Practical –IV	4	1:0:3	60	40	60	100
Discipline Specific Elective (DSE)	**DSE-201 (**Any One **)**	**DSE-201(A):** Industrial Hygiene and Occupational Health **DSE-201(B):** Aquaculture and Agriculture	4	3:0.5:0.5	60	40	60	100
Generic Elective Course (GE)	**GE-201** (Any one elective paper from other department courses)	**GE-201-A:** Fundamentals of Management **GE-201-B**:Office Automation **GE-201-C:** Indian Social Problems & Social Services **GE-201-D:** Principles of Economics **GE 201-E :** Environment and Development.	2	1.5:.25:.25	30	20	30	50
Ability Enhancement Courses (AEC)	**AEC 201**	**Foreign Languages :** **AEC-201-A:** German **AEC-201-B:** Japanese **AEC-201-C:** French	2	1.5:0.25:0.25	30	20	30	50
Ability Enhancement Compulsory Course (AECC)	**AECC-201**	**AECC-201(A) :** Professional Communication Skills	2	1.5:0.25:0.25	30	20	30	50
		Total Credits	**30**		**450**	**300**	**450**	**750**

M.Sc. - II Year

Semester – III

Nature of Choice Base	Subject Code	Subject	Total Credits	L:T:P	Hours	Int. Marks	Ext. Marks	Total Marks
Core Courses (CC)	**CC-301**	Environmental Education, Policy, forest and wildlife management	4	3:0.5:0.5	60	40	60	100
	CC-302	Air and Noise Pollution	4	3:0.5:0.5	60	40	60	100
	CC-303	Disaster management	4	3:0.5:0.5	60	40	60	100
	CC-304	Summer In-plant Project (SIP)	2	0:0.5:1.5	30 Days	20	30	50
	CC-305	Practical V	4	1:0:3	60	40	60	100
	CC-306	Practical VI	4	1:0:3	60	40	60	100
Discipline Specific Elective (DSE)	**DSE-301 (Any One Specializations)**	**DSE-301(A) :** Environmental Impact Assessment (EIA) And Environment Management System (EMS). **DSE-301(B):** Safety Legislations and Management.	4	3:0.5:0.5	60	40	60	100
Generic Elective (GE)	**GE-301** (Any one elective paper from other department courses)	**GE-301(A):** Entrepreneurship Development **GE-301(B):** E-Commerce **GE-301(C) :** Corporate Social Responsibility **GE-301(D):** Basics of Indian Economy. **GE- 301 (E)** : Disaster Management	2	1.5:0.25:0.25	30	20	30	50
Ability Enhancement Courses (AEC)	**AEC 301**	**AEC 301-A :** Environment Legislation **AEC 301-B :** Remote Sensing and GIS	2	1.5:0.25:0.25	30	20	30	50
Ability Enhancement Compulsory Course (AECC)	**AECC-301**	**AECC-301(A):** Employability Skills	2	1.5:.25:.25	30	20	30	50
		Total Credits	**32**		**480**	**320**	**480**	**800**

Semester – IV

Nature of Choice Base	Subject Code	Subject	Total Credits	L:T:P	Contact Hours	Int. Marks	Ext. Marks	Total Marks
Core Courses (CC)	**CC-401**	Environmental Microbiology, Biotechnology and Toxicology	4	3:0.5:0.5	60	40	60	100
	CC-402	Management of Industrial and Civic Wastes.	4	3:0.5:0.5	60	40	60	100
	CC-403	Project Work (Lab./Field/ Survey)	2	0:0.5:1.5	30	20	30	50
	CC-404	Practical VII	4	1:0:3	60	40	60	100
	CC-405	Practical VIII	4	1:0:3	60	40	60	100
Discipline Specific Elective (DSE Any One)	**DSE-401**	**DSE-401(A):** Land and Water Management. **DSE-401(B):** Safety Engineering	4	3:0.5:0.5	60	40	60	100
		Total Credits	**22**		**330**	**220**	**330**	**550**

M. Sc. (Environment & Safety)

Total Credits:

Semester	Core Credits	DSE	GE	AEC	AECC	Total Credits	Contact Hours	Total marks
I	**5 x 4 = 20**	**1 x 4= 4**				**24**	**360**	**600**
II	**4 x 4 = 16** **2 x 2 = 4**	**1 x 4= 4**	**1 x 2= 2**	**1 x 2= 2**	**1 x 2=2**	**30**	**450**	**750**
III	**5 x 4 = 20** **1 x 2 = 2**	**1 x 4= 4**	**1 x 2 =2**	**1 x 2= 2**	**1 x 2=2**	**32**	**480**	**800**
IV	**4 x 4 = 16** **1 x 2= 2**	**1 x 4= 4**				**22**	**330**	**550**
Total	**80**	**16**	**04**	**04**	**04**	**108**	**1620**	**2700**
Percentage	**74.07**	**14.81**	**3.70**	**3.70**	**3.70**	**99.98**		

M.Sc (ENVIRONMENT & SAFETY)-I

SEMESTER – I

Semester	**I**	**Total Credit**	**4**
Course Code	**CC101**	**Credit Pattern**	**L-45, T-8, P-7**
Course Title	**INTRODUCTION TO ECOLOGY AND ENVIRONMENT**		

Course Objectives	
1	Summarize and infuse major ecological concepts.
2	Compare the interrelationship between living organism and environment.
3	Use technique and scientific skills to solve ecological problems.
4	Use scientific literacy and knowledge of ecology to evaluate social and environmental issues.

Course Outcomes: The students will able to	
1.	Differentiate biotic and a biotic components of the ecosystem & multidisciplinary nature of the Environmental Science.
2.	Acquire the knowledge about environmental components, ecological succession, types of ecosystem, and ecological energetics.
3.	Inculcate the concepts of population dynamics, population regulation, population structure and its characteristics.
4.	Interpret the consequences of the upset of biogeochemical cycles & processes like bio accumulation & bio magnification of toxic chemicals.

Syllabus:

Unit Number	**Contents**	**Number of Sessions**	
1	**Ecology and Environment:** Introduction to Environmental Science as a multi-disciplinary subject, scope and subdivisions of ecology. Environmental components i.e Atmosphere, lithosphere, hydrosphere. General Accounts of Biosphere and Limits of Biosphere.	**L= 11**	
		T=2	**P=2**
2	**Concepts of Ecosystem – Structure and Functions:** Principles of organism-environment relationship; Ecological amplitudes, limits and tolerance to stresses; Concept of habitat; Ecological succession; Types of Ecosystem. Ecological energetics, energy flow in an ecosystem, Ecological food chain, detritus food chain and food web.	**L= 12**	
		T= 2	**P= 1**
3	**Population and Community Ecology:** Population dynamics and population regulations, Population structure, characteristics and processes, population age structures, population dynamics. Concept of carrying capacity, population dispersion, r and k selection, ecotypes and ecophene, `J' and `S' shaped growth curves and limits.	**L= 11**	
		T= 2	**P= 2**
4	**Autecology and Biogeochemical Cycles:** Concept of Autocology, study of autecology of plant species. Nutrient cycling in the ecosystems, Gaseous cycles (Carbon and Nitrogen) and sedimentary cycles (Phosphorus and Sulphur), Human interference in cyclic processes, Cycling of toxic elements, Bioaccumulation, Biomagnifications and its persistence.	**L=11**	
		T=2	**P= 2**

Learning Resources		
1	**Text Books**	• A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018. • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017.
2	**Reference books**	• Fundamentals of Ecology by Odum, E.P. • Desert Ecology by Ishwar Prakash. • Ecology of Urban India by Pramod Singh. • Ecology of Rural India by Singh. • Ecology 2000 by Sir Edmand Hillary. • Environmental Chemistry – II Edition by A.K. De. • Principles of Environmental Science by Watt, K.E.F. (1973), McGraw-Hill Book Company. • Environmental Science by Nobel, B.J. and Kormandy, E.J. (1981), The Way the World Works, Prentice-Hall Inc., N.J. • Basic Ecology by Odum, E.P. (1973). • Environmental Science by Turk A., Turk, J. Wittes J.T. and Wittes, R.E. (1978). • Manual for field ecology by R. Mishra. • Modern concepts of ecology by H.D. Kumar. • Plant ecology by Ambhast. • Environmental Biology by P.S. Verma and V.K. Agrawal. • Ecology & Environment by P.D.Sharma. • Environmental Science : An Introduction by G. T. Miller-1991.
3	**Websites**	• https://www.toppr.com/guides/biology/ecosystem/biogeochemical-cycle/ • https://nca2014.globalchange.gov/report/sectors/biogeochemical-cycles
4	**Journals**	• Journal of Biosciences, ISSN No. 0250-5991 • Journal of Environmental Biology, ISSN No. 0254-8704
5	**Supplementary Reading**	• National Geographic • Down to Earth, CSE
6	**Practical Components**	• Field visit to study pond water & forest Ecosystem. • Practicals based of this paper will be conducted (Practical I & II)

Semester	I	Total Credit	4
Course Code	CC 102	Credit Pattern	L-45, T-8, P-7
Course Title	NATURAL RESOURCES		

Course Objectives	
1	Elucidate the natural resource and the manner in which they are affected.
2	Procedural interventions that can be used to manage natural resources.

Course Outcomes: The students will able to	
1.	Infer about Earths structure & its composition.
2.	Grasp the importance of natural resources its exploration, mismanagement & degradation.
3.	Acquire knowledge about mineral resources: utilization of metallic minerals and non-metallic minerals, marine, soil, floral & faunal resources, their exploration & environmental consequences.
4.	Interpret energy scenario, renewable and non-renewable energy resources, and concept of entropy.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**The universe, solar system and origin of earth:** Introduction to universe, Sun – its structure and atmosphere, physical characteristics of planets, brief description of – comets, asteroid, meteors, origin of earth. Structure and composition of the earth.	**L= 11**	
		T=2	**P=2**
2	**Introduction to Natural Resource:** Concept of resource, Concept of Natural Resources, their classification, review of natural resources with special reference to fossil fuels and radioactive minerals. Ecological, social and economic dimension of resource management. Natural resources and development. Different types of rocks and Minerals and physical properties of rocks and minerals.	**L= 12**	
		T= 2	**P= 1**
3	**Natural Resources of India and World :** Mineral Resources: Utilization of metallic minerals (Iron, Aluminum and Manganese) and non-metallic minerals (Mica, Asbestos, Common Salt), Floral and faunal resources: Biological diversity and concept Forest resources: Forest vegetation, status and distribution, contribution as resource. Forest cover and types, Major and minor forest products Water resources : Concept of hydrological cycles, monsoons Distribution of surface and Ground, Marine resources: Food, Mineral and Energy, Soil and land resources : General account with respect to land use pattern.	**L= 11**	
		T= 2	**P= 2**
4	**Energy Resources :** Fundamental of Energy: Energy; work and power; different forms of energy; first and second law of thermodynamics, concept of entropy. Non renewable Energy resources: Coal; petroleum; natural gas; nuclear energy- Fusion & Fission. Renewable Energy Resources: Solar, Wind, Ocean, Geo-thermal, Hydel, Biomass Energy & energy conversion technology; Environmental impacts of large scale exploitation of renewable and non renewable energy resources. Growing energy needs. Energy scenario at national and International level.	**L=11**	
		T=2	**P= 2**

Learning Resources		
1	**Text Books**	• Text Book Of Soil Science by PAL, CBS publishers, 2018 • Textbook Of Environmental Science And Technology by REDDY, BSP publishers, 2019 • A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018 • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017
2	**Reference books**	• Sterner. 2002. Policy Instruments for Environmental and Natural Resource Management. RFF and World Bank. • Cubbage, Frederick, Jay O'Laughlin, and Nils Peterson. 2015 (in preparation). Natural Resource Policy. Waveland Press. Chapters available on-line at NC State University electronic reserves. • Environmental Geology by KS Valdiya • Chaudhuri AB and Sarkar DD (2003) Megadiversity Conservation, Flora, Fauna and Medicinal Plants of India's Hotspots. Daya Publishing House, New Delhi. • Environmental Resources by Mathur • Singh MP, Singh BS and Soma S. Dey (2004) Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi. • Kotwal, P.C. and S. Banerjee. Biodiversity Conservation – In Managed forest and Protected areas, (2002). Agrobios, India. • Singh, B. K. 2004: Biodiversity Conservation and Management, Mangaldeep Publications, Jaipur • Krishnamurthy, K.V. 2003. An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi. • Mital, K. M. 1997: Non-conventional Energy System, Wheeler Publishers, New Delhi • Ranjana Arya 2005: Biodiversity, Deep & Deep Publications Pvt. Ltd., New Delhi • Puri, G. S. *et al:* Forest Ecology, Oxford & IBH, Bombay • Desai, V. : Forest Management in India : Issues and Problems, Himalaya Publishing House, New Delhi
		• Singh, A. K. 1987: Forest Resources, Ecology and Environment, Concept Publishing Co., New Delhi • Sarma, P. K.: Forest Resources and their Utilization in India, Mittal Publishers, New Delhi • Agrawal, V. P.: Forests in India, Oxford & IBH, New Delhi
3	**Websites**	• https://www.conserve-energy-future.com/what-is-environmental-science-and-its-components.php • http://www.biologydiscussion.com/natural-resources/natural-resources-of-india-availability-and-problems/16685 • http://www.yourarticlelibrary.com/economics/what-are-the-different-types-of-natural-resources-produced-in-india/2683
4	**Journals**	• Journal of Biosciences, ISSN No. 0250-5991 • Journal of Environmental Biology, ISSN No. 0254-8704 • Journal of Earth System Science, ISSN No .2253-4126
5	**Supplementary Reading**	• National Geographic • Down to Earth, CSE
6	**Practical Components**	• Field visit to study Natural Resources.. • Practicals based of this paper will be conducted (Practical I&II)

Semester	I	Total Credit	4
Course Code	CC 103	Credit Pattern	L-45, T-8, P-7
Course Title	FUNDAMENTALS OF SAFETY		

Course Objectives	
1	Demonstrate the basic concepts and fundamentals of Industrial Safety
2	Outline the functions and implementation of Safety in Industrial Sector.

Course Outcomes: The students will able to	
1.	Interpret and make use of the concepts of Health and Occupational Safety while performing Safety Audit.
2.	Summarize the role of Safety Committee & Legal requirements in Industrial Safety
3.	Develop Material Safety Data Sheets and improve the safety measures in chemical industries
4.	Assess the fire chemistry and implement the knowledge for fire fighting

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Introduction to Safety** **Health & Safety Management:** Occupational Health and Safety Management System, Definition, goals, needs, Principles & Practices of industrial safety Role of Management in Industrial Safety. **Safety Planning :** Definition, purpose, nature, scope and procedure Strategic planning and tools of implementation. Employee Participation in Safety. **Industrial Safety & Policy Formulation** **Industrial Safety Auditing & Safety Monitoring :** Concept & Importance of Safety Audit, Types of Safety Audit, Standards on Safety Audit:Health & Safety Monitoring: ISO 45001: 2018 (Occupational Health & Safety Management System). **OH & S Policy Formulation, Types of Accident & Accidents Prevention :** Leadership: Role, functions and attributes of a leader. Leadership & commitment, Organizational roles , responsibilities and authorities, Concept of OH & S Policy, Policy formulation and implementation. Definition: Incident, Accident, Injury, Dangerous Occurrences, Unsafe Acts, Unsafe Conditions, Hazards, Near Miss Situations, Hazard Identification and Risk Assessment (HIRA), Accident Investigation, Cost of Accident- Direct & Indirect, Accidental Reporting, Emergency Evacuation Plan. Accident Prevention: Major Theories,Principles of accident Prevention,	L= 12	
		T=2	P=1

2	**Behavioral Safety & MIS** **Behavioural Safety :** Human behaviour: Individual differences, behaviour as function of self and situation, perception of danger and acceptance of risk, knowledge, and responsibility vis-a-vis safety performance. Theories of motivation and their application to safety, role of supervisors and safety departments in motivation. Organisational Behaviour, Conflict & Frustration: Identification of situations leading to conflict and frustration and techniques of management. **Employee Participation in Safety :** Purpose, areas of participation, methods, Role of trade union in Health and Safety Protection. **Safety Committes & its legal requirements Structure and functions** Safety Promotion and Safety Awards and Suggestion Schemes, Safety Competitions, Safety Incentives, Publicity Schemes, Audio Visual Publicity, other Promotional Methods. **Management information System :** Sources of information on Safety, Health and Environment Protection. Compilation and collation of information, Analysis & use of modern methods of programming, storing and retrieval of MIS for Safety, Health and Environment. Status and future goals of computer utilization in Safety, Health and Environment (SHE) Services in Industries.	**L= 11** **T= 2**	**P= 2**
3	**Safety in Chemical Industries, processes & unit Operations** U.N, MISHC and other classification of chemicals. Safety in chemical industry & Fire Safety. Use of Material Safety Data Sheets (MSDS). **Hazard in Unit Processes and Unit Operations :** Control, precautions and prevention. Specific safety measures for certain chemical industry like fertiliser, insecticide, pesticides-chloro-alkali, explosives, polymer plants.	**L= 11** **T= 2**	**P= 2**
Unit-IV: **4**	**Fire Safety Management :** Chemistry of fire, Factors contributing towards fire, Classification of fires. Common causes of industrial fires. Prevention of fire. Portable Fire Extinguishers (Water type, Carbon-dioxide Type, Foam Type, Dry Chemical Type Extinguishers, ABC type), Maintenance of Fire Extinguishers. Special Industrial fire detection and alarms. Sprinkler systems. Special safety precautionary measures for control of fire and explosion in handling/ processing flammable liquids, gases, vapours, mists and dusts etc. Fixed Fire Fighting Installations (Hydrant/ Sprinklers/ Major Foam pourer/ Steam Drenching/ CO2 flooding/ DCP spraying) Fire Emergency Action Plan, On-Site & Off-Site Emergency Plan.	**(11)** **L=11** **T=2**	**P= 2**

Learning Resources		
1	**Text Books**	• A Text Book of Engineering Chemistry, Dara, Chand • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017 • Textbook Of Environmental Science And Technology by REDDY, BSP publishers, 2019 • Current Science, ISSN No. 0011-3891Industrial Safety Management by L.M. Deshmukh, McGraw Hill Education Publication, 1st July, 2017 • Industrial Safety & Environment by Er. A. K. Gupta, ISBN: 9788131804544
2	**Reference books**	• Pre-Accident Investigations: Better Questions - An Applied Approach to Operational Learning. Todd Conklin, 2016. • Industrial Safety and Environment. V. K. Gupta, 2006. • Industrial Safety and Health Management. C. Asfahl, 1984. • Leading with safety. Thomas R Krause, 2005 • Safe by Accident?: Take the Luck Out of Safety : Leadership Practices that Build a Sustainable. • Industrial Safety and Risk Management. Doug McCutcheon and Laird Wilson, 2003. • Culture. Judy L. Agnew, Aubrey C. Daniels, 2010. • Practical Industrial Safety, Risk Assessment and Shutdown Systems for Industry. Dave Macdonald, 2004. • Safety-I and Safety-II: The Past and Future of Safety Management. Erik Hollnagel, 2014. • Practical Guide to Industrial Safety. Cheremisinoff, 2000. • Accident/incident prevention techniques. Charles D. Reese, 2001. • Industrial Safety Handbook. William Handley, 1969. • Environmental Pollution and Health Hazards Kumar, R • Action Research In Healthcare - Elizabeth. • Industrial Safety and Human Behaviour - Kaila, H.L. • Environmental Chemical Hazards Kumar. • Food Safety & Toxicity,1997. • ISO 45001 : 2018 standard copy.
3	**Websites**	• www.nsc.org.in • www.osha.gov • www.ilo.org • www.ohsonline.com • www.worldsafety.org
4	**Journals**	• International Journal of Occupational Safety and Ergonomics. **ISSN : 2376-9130** • International Journal of Occupational Safety and Health. ISSN : 2091-0878 • Journal of Industrial Safety Engineering. ISSN : 2395-6674
5	**Supplementary Reading**	• Industrial Safety Chronicle. Published by National Safety Council., Mumbai
6	**Practical Components**	• Visit to various Industry to study safety aspects. • Demonstration of Water & Fire Safety.

Semester	I	Total Credit	4
Course Code	CC 104	Credit Pattern	L-15, T-0, P-45
Course Title	PRACTICAL- I		

Course Objectives	
1	The students should know the experimental procedures for analysis of environmental samples.

Course Outcomes: After completion of this course students will have capability to	
1	Develop methodology for sample collection, processing and preservation for environmental analysis.
2	Make use of glassware, their appropriate cleaning, preparation and standardization of solutions.
3	Plan analytical techniques/experiments/ classical methods with easy to run experiments.
4	Interpret the experimental results to study environmental processes.

Syllabus:

Sr. No.	Title of the Experiment	Paper No.	Number of Sessions	
1	Estimation of Biomass	CC 104	L= 15	
2	Determination of Minimum Number of Quadrates	CC 104	T=0	P=45
3	Determination of Minimum size of Quadrates	CC 104		
4	Determination of Species Diversity Index	CC 104		
5	Determination of Frequency Distribution	CC 104		
6	Determination of Density & Relative Density	CC 104		
7	Estimation of Chlorophyll	CC 104		
8	Wood Pyrolysis	CC 104		
9	Determination of GPP/NPP/RR	CC 104		
10	Determination of Frequency & Relative Frequency	CC 104		
11	Determination of Biological Index of Pollution	CC 104		
12	Determination of Calorific Value of Fuel wood	CC 104		
13	Organic Carbon & Organic Matter in soil	CC 104		
14	Standardization Titration	CC 104		
15	Determination of Acidity & Alkalinity of Water	CC 104		
16	Backlog/Remedial Practicals	CC 104		
17	Repeation Practicals	CC 104		

Learning Resources

1	Reference books	• Water & WasteWater analysis : Dr. R.K. Trivedy & Dr. P.K.Goel (1984).. • Standard Methods of water & Waste water analysis: APHA. • Hand book of Methods in Environmental Studies (Vol.I) : S.K.Maiti. • Hand book of Methods in Environmental Studies (Vol.II) : S.K.Maiti. • A text book of Soil analysis : Baruah & Barthakur.

Semester	I	Total Credit	4
Course Code	CC 105	Credit Pattern	L-15, T-0, P-45
Course Title	PRACTICAL- II		

Course Objectives	
1	The students should know the experimental procedures for analysis of environmental samples.

Course Outcomes: After completion of this course students will have capacity to	
1	Relate and demonstrate the basic laboratory instruments used in environmental analysis and understand the principle of measurements using those instruments.
2	Experiment with work safely and competently in an environmental laboratory settings, with confidence.
3	Identify and describe steps that are included in analysis, like sampling, sample processing, removal of interferences, detection of component of interest and data evaluation.
4	Interpret the chemical methods used to study environmental processes.

Syllabus:

Sr.No.	Title of the Experiment	Paper No.	Number of Sessions	
1	Mathematical Energy Calculation	CC 105	L= 15	
2	Turbidity measurement by Nephelometer	CC 105	T=0	P=45
3	Verification of Beers Law in Spectrophotometry	CC 105		
4	Determination of pH of Water & Soil	CC 105		
5	Determination of EC of water & Soil	CC 105		
6	Determination of Na by Flame photometer	CC 105		
7	Precipitation Analysis	CC 105		
8	Determination of Hardness of Water	CC 105		
9	Atomic Absorption Spectrophotometer-Compo. & Working	CC 105		
10	Gas Chromatograph-Components& Working	CC 105		
11	Statistics Practicals-1	CC 105		
12	Statistics Practicals-2	CC 105		
13	Statistics Practicals-3	CC 105		
14	Statistics Practicals-4	CC 105		
15	High Volume Sampler –Components & working	CC 105		
16	Backlog/Remedial Practicals	CC 105		
17	Repeation Practicals	CC 105		

Learning Resources

1	Reference books	• Water & WasteWater analysis : Dr. R.K. Trivedy & Dr. P.K.Goel • Standard Methods of water & Waste water analysis: APHA • Hand book of Methods in Environmental Studies (Vol.I) : S.K.Maiti • Hand book of Methods in Environmental Studies (Vol.II) : S.K.Maiti • A text book of Soil analysis : Baruah & Barthakur

Semester	I	Total Credit	4
Course Code	DSE 101 (A)	Credit Pattern	L-45, T-8, P-7
Course Title	ENVIRONMENTAL CHEMISTRY		

Course Objectives	
1	To study chemicals & chemical processes in the environment.
2	To study the Procedures for handling processing & analysis of Environmental Sample.
3	To Study various Spectrophotometric & Chromatographic techniques for qualitative & quantitative analysis.
4	To equip the students with the other related Instrumental Techniques of Analysis.

Course Outcomes: After completion of this course students will have capacity to	
1	Demonstrate and relate chemical processes involved in the environment and concept of sampling and chemical analysis for monitoring of environmental pollution and related issues.
2	Apply basic chemical concepts to analyze and interpret different environmental problems related with the pollution of precious natural resources.
3	Make use, elaborate and Interpret wide range of chromatographic and other techniques involved in the study of environmental processes through sampling and analysis.
4	Elaborate, interpret and adapt reporting on a range of spectro-photometric and electro-analytical methods involved and used to study environmental processes.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Concept & Scope of Environmental Chemistry** Fundamentals of Environmental Analytical Chemistry , Particals, ions & radicals in the atmosphere, chemical speciation, Gibbs Energy, Chemical Potential, Chemical equilibria, , Solubility products, Carbonate system, unsaturated & saturated hydrocarbons, radioisotopes , Chemistry of the Inorganic & organic chemicals in the environment, thermochemical & photochemical reactions in the atmosphere, Pesticides & their classification, Biochemical aspects of heavy metals(Hg, Cd, Pb, Cr) & metalloids(As, Se). Qualitative & Quantitative Analysis, Major steps involved in chemical Analysis, Equilibrium & Kinetic Methods. **Air Monitoring**-High Volume Sampler (HVS) & Stack Monitoring Kit.	**L= 11** **T=2**	**P=2**
2	**Classical Methods of Analysis** Volumertry-Concept of Standard Solutions, Primary & Secondary Standards , Expression of Concentration of Solution, Preparation & standardization of reagents, Classification of Volumetric Methods-Acid base titrations, Complexometric Titrations, Redox titrations, Precipitation titrations ,Gravimetry-Precipitation Methods. **Separative Techniques**- Precipitation & Filtration, Fractional Distillation, Ion Exchange Separation, Masking & Solvent Extraction. **Electro-analytical Methods**-Principle, Components & Working of pH Meter, Conductivity Meter.	**L= 11** **T= 2**	**P= 2**
3	**Chromatographic Techniques For Separation, Identification & Characterization of Chemical Compounds** - Paper Chromatography, Thin Layer Chromatography (TLC), Adsorption Column Chromatography, Ion Exchange Column Chromatography, High Performance Liquid Chromatography (HPLC),Gas Chromatography (GLC & GSC), GC-MS, Gel Filtration Chromatography.	**L= 11** **T= 2**	**P= 2**

4	**Spectrophotometric Methods-** Colorimetry, Spectrophotometry, UV-VIS Spectrophotometer, Beer-Lamberts Law, Applications & Limitations, Nephelometry-Turbidimetry, Flame Techniques- Flame Emission Spectrophotometry & Atomic Absorption Spectrophotometry (AAS), Electrophoresis, SEM.	**L=12**	
		T=2	**P= 1**

Learning Resources		
1	**Text Books**	• Vogel's Textbook of Quantitative Chemical Analysis, 5th edition, J H Basett, J. Nendham and Denny, R.C. • A Text Book of Environmental Chemistry & Pollution Control, Dara, Chand. • A Text Book of Green Chemistry, Ahluwalia, Narosa
2	**Reference books**	• Handbook of Analytical Instruments, Khandpur R.S. • Environmental Pollution Analysis, Khopkar S.M. • Instrumental methods of Chemical Analysis, B K Sharma. • Instrumental methods of analysis, Willard, Meritt, Dean and Settle. • S Watts and L. Halliwell; Essential Environmental Science and Techniques, Routledge (1996). • Environmental Chemistry, A.K.De, New age International, 8th Edition, 2017. • Instrumental Methods of Analysis, B. Sivasankar, Oxford University Press, 2015. • Basic Concepts of Analytical Chemistry, S.M. Khopkar, New Age International Publishers,3rd edition, 2008.
3	**Websites**	• https://www.niwa.co.nz/education-and-training/schools/students/layers • https://sustainabledevelopment.un.org/milestones/unced • http://www.imd.gov.in/Welcome%20To%20IMD/Welcome.php
4	**Journals**	• International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842 • Current Science, ISSN No. 0011-3891 • Down to Earth
5	**Supplementary Reading**	• Down to Earth
6	**Practical Components**	• Field visit to Laboratories.. • Practicals based of this paper will be conducted (Practical I&II)

Semester	I	Total Credit	4
Course Code	DSE 101 (B)	Credit Pattern	L-45, T-8, P-7
Course Title	ECOLOGICAL FOOTPRINT & CARBON SEQUESTRATION		

Course Objectives	
1	Define Ecological Footprint and Carbon Sequestration.
2	Understand applications, status and impact of ecological foot prints and carbon sequestration.
3	Compare global strategies for climate change.

Course Outcomes: The students	
1.	Explain ecological footprint standards, reporting framework & economic applications
2.	Estimate Carbon Footprint, GWP, Carbon Trading and Carbon Sequestration
3.	Calculate Carbon sequestration, carbon footprint and ecological footprint
4.	Elaborate mitigation and adaptation strategies for carbon footprints in India

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Understanding to Ecological Footprint :** Concept of Ecological Foot Prints ; Background of ecological foot printing: An introduction to the background and development of ecological foot printing, Need, applications of ecological footprints Definitions of ecological deficit, ecological reserve, ecological overshoot, water footprint, equivalence factor etc. Ecological Footprint relation with carrying capacity, Biodiversity and Ecological footprint. Global and Indian Footprint Accounts: Ecological Footprints & Biocapacity	**L= 11** **T=2**	**P=2**
2	**Accounts of Ecological Footprint :** Impacts of food, mobility, shelter, consumer/goods services on ecological footprint. Ecological footprint standards and reporting frameworks. Ecological footprint measurements, case studies. Ecological Footprint Calculations. Global Footprint Network. Ecological Footprint account for pollution and toxic waste. Ecological Footprint addresses waste flows, recycling. Applications of Ecological foot print in Ecological Economics Perspectives. Limitations of ecological footprints.	**L= 11** **T= 2**	**P= 2**
3	**Carbon Sequestration:** Introduction of Carbon Footprint, GWP, Carbon Trading, Carbon Marketing, Introduction of Carbon Sequestration. C-pool, C-stock, C-Flux, C-sink, C-source, sequestration/uptake. Role of Agriculture in Carbon Sequestration, Effects of land use, land cover & land management on carbon sequestration, Types of Carbon Sequestration.	**L= 11** **T= 2**	**P= 2**
4	**Climate Change Scenario & Advances of Carbon Sequestration :** The Indian scenario: Projected impact of climate change on India; India's response to climate change; National Action Plan on climate change; India's position and actions. International response: Intergovernmental panel for climate change (IPCC)	**L=12** **T=2**	**P= 1**

	and its role; United Nations framework convention on climate change (UNFCCC), CDM and Kyoto Protocol, The Copenhagen Accord, REDD+, CBD, Paris Agreement etc. Mitigation and adaptation: Carbon storage and sequestration, carbon management through abiotic sequestration; oceanic injection, geologic injection, scrubbing and mineral carbonation; carbon management through biotic sequestration; forest ecosystems, wetlands; soil carbon sequestration; biofuels, carbon farming and carbon trading. Carbon Sequestration Leadership Forum.		

Learning Resources		
1	**Text Books**	• A Text Book of Ecology, S K Dubey, Dominant Publication • A Text Book of Ecology, Tyler Miller, Cengage Learning • A Text Book Environmental Studies, Chatawal & Sharma, HPH • A Text Book Environmental Science, Joshi & Joshi, APH • A Text Book of Environmatal Studies, Nambiar, STP
2	**Reference books**	• Carbon Sequestration in Forest Ecosystems. Klaus J. Lorenz, 2009. • Introduction to Carbon Capture and Sequestration. Berend Smit, Curtis M. Oldenburg, Ian C. Bourg, and Jeffrey A. Reimer, 2014. • Carbon Capture. Jennifer Wilcox, 2012 • Carbon Sequestration in Urban Ecosystems. Bruce Augustin, 2011 • Geologic Carbon Sequestration: Understanding Reservoir Behavior. V. Vishal, T.N. Singh, 2016 • Ecosystem Services and Carbon Sequestration in the Biosphere. Rattan Lal, Klaus • Lorenz, Reinhard F. Hüttl, Bernd Uwe Schneider, Joachim von Braun, 2013 • The Ecological Footprint: New Developments in Policy and Practice. Andrea Collins, Andrew Flynn, 2015 • Our Ecological Footprint: Reducing Human Impact on the Earth. Mathis Wackernagel, 1994 • Our ecological footprint. Mathis Wackernagel, William E. Rees, William Rees, 1998 • Ecological Footprint. Nicolaj Stenkjaer, 2010 • The Nature of Economies. Jane Jacobs, 2001
3	**Websites**	• https://www.conserve-energy-future.com/what-is-environmental-science-and-its-components.php • http://www.biologydiscussion.com/natural-resources/natural-resources-of-india-availability-and-problems/16685 • http://www.yourarticlelibrary.com/economics/what-are-the-different-types-of-natural-resources-produced-in-india/2683
4	**Journals**	• International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842 • Journal of Biosciences, ISSN No. 0250-5991 • Journal of Earth System Science, ISSN No .2253-4126
5	**Supplementary Reading**	• Down to Earth • National Geographic
6	**Practical Components**	• Field visit to Industries. • Practicals based of this paper will be conducted (Practical I&II) • Case Studies on Carbon Footprints.

SEMESTER –II

Semester	**II**	**Total Credit**	**4**
Course Code	**CC 201**	**Credit Pattern**	**L-45, T-8, P-7**
Course Title	**WATER POLLUTION**		

	Course Objectives
1	Examine the interrelationship between industrial activities and water pollution.
2	Outline the various characteristics and parameters of water for water quality index.
3	Prioritize the scientific, technological, economic and political solutions to waste water treatment.

	Course Outcomes: The students will able to
1.	Classify the sources of water pollution and arrange sampling for water and waste water analysis.
2.	Identify the issues associated with water pollution due to local industries.
3.	Assess the water quality on studying the associated parameters.
4.	Analyze the causes of ground water, thermal and marine pollution.

Syllabus:

Unit Number	**Contents**	**Number of Sessions**	
1	Definition, Concept and sources of water pollution. Major Pollution parameters: pH, Solids, Dissolved Oxygen, Chemical Oxygen Demand, Biochemical Oxygen Demand, Trace inorganics, Most Probable Number of Coliform Bacteria. Methods of water sampling, handling and preservation.	**L= 11**	
		T=2	**P=2**
2	Characteristics of wastewater generated by industries: pulp and paper, sugar, distillery, textile, dairy, **T**annery, Community (sewage), Food processing and Petrochemical industries.	**L= 12**	
		T= 2	**P= 1**
3	Eutrophication: Meaning of eutrophication, Causes and effects of eutrophication on water quality. Water quality standards: World Health Organisation, Bureau of Indian Standards (BIS), Indian Council of Medical Research (ICMR).	**L= 11**	
		T= 2	**P= 2**
4	Ground Water Pollution, Causes of ground water pollution. Effects of pollutants on ground water table, Path (movement) of pollutants reaching to ground water. Thermal Pollution, Concept of thermal pollution, Effects of thermal pollution on water quality and on aquatic flora and fauna. Marine pollution: Causes of marine pollution, Effects of marine pollution on ocean water quality and on marine flora and fauna.	**L=11**	
		T=2	**P= 2**

Learning Resources		
	Text Books	• A Text Book Environmental Studies, Chatawal & Sharma, HPH • A Text Book Environmental Science, Joshi & Joshi, APH • A Text Book of Environmatal Studies, Nambiar, STP • A Text Book of Environmental Chemistry & Pollution Control, Dara, Chand • A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018 • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017
	Reference books	• Environmental Pollution of cadmium by Rohatgi • Land Pollution, causes and control by Harrusson and Laxon • Environmental Pollution and Bhopal killing • Waste Water Treatment by M.N.Rao and A.K. Datta, Oxford and IBH Publication Co. New Delhi, 1978. • Environmental analysis of water, soil air by Saxena • Water pollution and management by C.K. Vershney • Responses to oil and chemical marine pollution by Cormack D. (1993), Appl. Science Publishers, New York • Soil and Water conservation engineering by Schwab, SD, Frevert, RK, Edminster, TW and Barns, KK, John Wiley and Sons. • Analytical chemistry of industrial poisons, Hazards and solvents by Jacons, M.B. (1969) Interscience, New York. • Standard Methods for the Examination of Water and Wastewater (1984): American Public Health Association (APHA, AWWA, WPCF), New York • Chemical and Biological Methods For Water Pollution Studies by R.K.Trivedy and P.K.Goel, 1984, Environmental publication , Karad, India. • Water Pollution- Causes, Effects and Control, by P.K.Goel,1997, New Age Publication, New Delhi. • Environmental Studies by Anindita Basak,2009, Dorling Kindersley Publication, Delhi.
	Websites	• https://www.lenntech.com/water-pollution-faq.htm • https://www.everythingconnects.org/soil-pollution.html • http://www.fao.org/3/i9183en/i9183en.pdf • https://wwf.panda.org/knowledge_hub/teacher_resources/webfieldtrips/water_pollution/
	Journals	• International Journal of Environmental Engineering Science, ISSN No .2229-3094 • International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842 • Journal of Biosciences, ISSN No. 0250-5991 • Down to Earth • Journal of Earth System Science, ISSN No .2253-4126 • Journal of Environmental Biology, ISSN No. 0254-870
	Supplementary Reading	• UNEP reports • WHO notifications
	Practical Components	• Field Visit to Panchagannga River & Rankala Lake during Ganesh Festivals. • Practical Based on this Paper. (Practical III & IV)

Semester	II	Total Credit	4
Course Code	CC 202	Credit Pattern	L-45, T-8, P-7
Course Title	ENVIRONMENTAL ENGINEERING AND DESIGN		

Course Objectives	
1	Explain the students the waste water treatments.
2	Describe the effect and control methods of the effluent and sewage.

Course Outcomes: The students will able to	
1.	Design water treatment plant.
2.	Select appropriate method for water and wastewater treatment.
3.	Grade the existing water and wastewater treatment methods.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Fundamentals of Water Treatment:** Flow diagram of general water treatment plant, Water demand, factors affecting water demand, population forecasting, Concept of wastewater flows and variations, Flow measurement and types of notches, Sanitary survey of source, protection of sources.	**L= 11**	
		T=2	**P=2**
2	**Methods of Water Treatment:** Unit operation in water treatment: intakes, aeration Coagulation and flocculation process, common coagulants, Filtration, mechanism of filtration, slow sand, rapid sand and dual media filters, backwashing of filters. Sedimentation, particle settling theory and types of sedimentation tank Disinfection of water, minor methods of disinfection, ideal disinfectant Types of hardness and methods of water softening, Iron and manganese removal, fluoridation and de-fluoridation, Taste and odor removal	**L= 12**	
		T= 2	**P= 1**
3	**Waste Water Treatment:** General methods of volume and strength reduction of waste Flow diagram of general waste water treatment plant,Low cost treatments, stabilization ponds, septic tanks, lagoons Primary treatments– racks and screens, types of screens grit removal, types of grit chambers, disposal of grit, oil and grease removal, corrosion, types of corrosion and corrosion control.	**L= 11**	
		T= 2	**P= 2**
4	**Secondary and Tertiary Treatment:** Secondary treatments– Trickling filers, types of trickling filters, Activated sludge process, modifications of activated process, Rotating biological contactors, bio-digesters, significance of F/M ratio Tertiary treatment– Wet land and aquatic treatment, Root zone treatment, Reverse osmosis, carbon adsorption, phosphorus removal, nitrogen removal.	**L=11**	
		T=2	**P= 2**

Learning Resources		
1	**Text Books**	• A Text Book of Engineering Chemistry, Dara, Chand • A Text Book of Environmental Chemistry & Pollution Control, Dara, Chand. • Textbook Of Remote Sensing & Geographical Inform. Systems by KALI CHARAN, Atlantic Publisiers, 2018 • Text Book Of Soil Science by PAL, CBS publishers, 2018 • A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018 • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017 • Environmental Science by Turk A., Turk, J. Wittes J.T. and Wittes, R.E. (1978) • Environmental Studies by Anindita Basak, 2009, Dorling Kindersley, New Delhi Publication. • Vogel's Textbook of Quantitative Chemical Analysis, 5th edition, J H Basett, J. Nendham and Denny, R.C.
2	**Reference books**	• Wastewater Engineering Treatment Disposal Reuse, By Metcalf & Eddy, Publisher: Tata-McGraw-Hill Publishing Company Ltd., New Delhi, Fourth Edition, (2010) • A Text Book of Sanitary Engineering, Theory, Design and Practice, By Prof. Vinayak N. Ghorpade, Publisher: Engineering Book Publishing Company, Poona-16 Fourth Edition (1984). • Environmental Engineering: Water Supply, Sanitary Engineering and Pollution, By A. Kamala and D. L. Kanth Rao, Publisher: Tata-Mc. Graw Hill Publishing Company Ltd., New Delhi, (1988). • Fundamentals of Water Supply and Sanitary Engineering, By S. C. Rangwala & K. S. Rangwala, Publisher: Chartor Publishing House, Anand, India, Eleventh Edition, (1986). • Water and Wastewater Technology, By Mark J. Hammer & Mark J. Hammer, Jr., Publisher: Prentice-Hall of India Pvt. Ltd., New Delhi (1998). • Water Supply and Sanitary Engineering Including Environmental Engineering, By G. S. Birdie & J. S. Birdie, Publisher: Dhanpat Rai & Sons, New Delhi, Fifth Edition, (1997).
3	**Websites**	• https://globalhydration.com/waterborne-disease/common-methods-of-water-purification/ • https://www.cdc.gov/healthywater/drinking/public/water_treatment.html • https://www.asce.org/fundamentals-of-water-treatment-processes-physical-chemical-and-biological/ • https://www.organicawater.com/primary-secondary-tertiary-wastewater-treatment-work/
4	**Journals**	• International Journal of Environmental Engineering Science, ISSN No .2229-3094 • International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842 • Current Science, ISSN No. 0011-3891 • Journal of Environmental Biology, ISSN No. 0254-8704 • Resonance, ISSN No. 0971-8044 • Journal of Earth System Science, ISSN No .2253-4126
5	**Supplementary Reading**	• CPCB and MPCB reports
6	**Practical Components**	• Industrial Visits • Practical's based on this Paper. (Practical III & IV)

Semester	II	Total Credit	2
Course Code	CC 203	Credit Pattern	L-23, T-2, P-5
Course Title	COMPUTER APPLICATIONS		

Course Objectives	
1	Learn basic concepts of Windows operation system.
2	Learn basic word processing skills with Microsoft Word, how to gathering and analysis data using MS-Excel and presenting data with MS-PowerPoint

Course Outcomes: The students will able	
1.	Understand Computer Fundamentals in detail.
2.	Manage the desktop, files, folders using control panel and other utilities.
3.	Create & present data in Word, PowerPoint and Excel.
4.	Use various features and tools of MSOffice, and use different formulas and functions.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Computer Fundamentals:** Computer Definition, characteristics, Generations, Block Diagram, Concept of Hardware and Software , Input devices- Keyboard, mouse, scanning devices MICR, OMR, OCR. Output Devices- Monitor, Printers (Impact and non impact), Selection of printer and paper for output depending upon user requirements. Memory- concept, primary memory – RAM-SRAM, DRAM, ROM- PROM, EPROM, EEPROM, cache memory, Secondary memory- floppy disk, hard disk, Optical storage devices, **Windows OS-** Operating system- definition, functions, features, Windows. Working with Windows OS- start menu, control panel, Standard icons- my computer, recycle bin, network places etc. Windows terms – desktop, folder, drives, Cut copy and paste operations, Computer Application in Environment Management.	**L= 12**	
		T=2	**P=1**
2	.**MS Word :** Introduction and feature , Creating word document, Editing features, Text formatting options, page formatting –adding header and footer, page number, insert page break, blank page, cover page, page orientation, print options. Working with tables, creating Table of Contents, Mail merge, shortcut keys, cursor control keys. **MS Excel :** Basics of Excel – Ribbon, Workbook, worksheet, Format options, templates, data validation , sorting and filtering of data ,Functions- Count and Sum, Logical, Date and Time, Text, Lookup and References, financial and statistical functions, using formula , Charts- column, pie, bar, line, scatter plot, data series **MS PowerPoint:** Features, factors to be considered for effective presentation**,** Creating Basic presentation, Editing and formatting options, inserting picture, chart, table, audio and video to slide, using animation and slide transition, using hyperlinks.	**L= 12**	
		T=1	**P=2**

Learning Resources		
1	**Text Books**	• Computer Fundamentals by P. K. Sinha&PritiSinha, 5th edition, BPB pub. • Computer Fundamentals by Balguruswami • Microsoft Office 2013 All-In-One For Dummies By Peter Weverka, Wiley India Pvt Ltd, ISBN 10: 812654175X • Microsoft Office 2010 Digital Classroom by AGI Creative Team John Wiley & Sons; Pap/Psc edition (1 March 2011) ISBN-10: 0470577770 • Operating System Concepts: International Student Version By Silberschatz Wiley; Eighth edition (20 April 2009) ISBN-10: 8126520515
2	**Reference books**	• Microsoft Office 2010 Bible By John Walkenbach Wiley India Private Limited (28 September 2010) ISBN-10: 8126528397 • Microsoft Windows Operating System Essentials By Tom CarpenterJohn Wiley & Sons (9 February 2012) ISBN-10: 1118195523 • Microsoft Windows Operating System Essentials ByTom CarpenterISBN: 978-1-118-19552-9 • Fundamentals Of Computers 5Ed By V. RajaramanPublisher: Phi Learning Pvt Ltd ISBN 10: 8120340114
3	**Websites**	• https://www.zuaneducation.co • www.klientsolutech.com • https://www.udemy.com • https://koreinfotech.com • https://www.homeandlearn.co
4	**Journals**	• Compute Journals by Oxford University Press – ISSN: 0010-4620 (print); 1460-2067 (web) • Journals in computer Science. • Journal of Information Technology, ISSN No .2253-4126 • Journals in Computer Science - Elsevier
5	**Supplementary Reading**	• Various articles • Various Magazine on Information Technology
6	**Practical Components**	• Total **eight** practical sessions on MS-Word, MS-Excel and MS-PowerPoint

Semester	II	Total Credit	2
Course Code	CC 204	Credit Pattern	L-23, T-2, P-5
Course Title	Statistical Methods		

Course Objectives	
1	To impart the knowledge of statistical methods so that the students would be capable of performing data analysis to support empirical studies on environment.

Course Outcomes: The students will get	
1.	Conceptual clarity on statistical methods.
2.	Ability to analyze and interpret data.

Syllabus:

Unit Number	Contents	Number of Sessions
1	Definition, uses and limitations of statistics. Importance of statistics in environmental science. Measurement and levels of measurement. Tabulation and diagrammatic representation of data. Averages and measures of dispersion	L= 11 T=2 P=2
2	Correlation Regression analysis Introduction to sampling, Random sampling and stratified sampling, sampling in physical environmental sciences. Introduction to tests of significance. Z, t and Chi square tests.	L= 12 T=0 P=3

Learning Resources		
1	Text Books	• S Boslaugh & P A Watters, Statistics in a nutshell, O'REILLY, 2008 • R P Hooda , Introduction to statistics, MacMillan, 2002
1	Reference books	• H Frank & S C Altheon, Statistics: Concepts and Applications, Cambridge University Press, 2002 • A S Gaur & S S Gaur, Statistical Methods for practice and research, Response Books, 2006 • K V S Sarma, Statistics made simple: Do it yourself on PC, PHI,2001
2	Journals	• Journal of Agricultural, Biological, and Environmental Statistics. Springer(Available in JSTOR, INFLIBNET NLIST) • The annals of applied statistics (Available in JSTOR, INFLIBNET NLIST)
3	Web sites	• https://www.khanacademy.org • http://www.statsoft.com/ • https://stattrek.com • https://www.tutorialspoint.com/statistics/index.htm

Semester	II	Total Credit	4
Course Code	CC 205	Credit Pattern	L-15, T-0, P-45
Course Title	PRACTICAL- III		

Course Objectives	
1	The students should know the experimental procedures for analysis of environmental samples.

Course Outcomes: After completion of this course students will have capability to	
1	Make use of water sampling methods, processing and preservation of water samples.
2	Determine water pollution levels using appropriate methodology/ instrumentation.
3	Perceive skills in analytical techniques/experimental for BOD,COD measurements.
4	Interpret the experimental results to study water pollution levels.

Syllabus:

Sr.No.	Title of the Experiment	Paper No.	Number of Sessions	
1	Determination of Nitrates by UV/ VIS	CC 205	L= 15	
2	Determination of TS/TDS/TSS in Water	CC 205	T=0	P=45
3	Determination of Ammonical Nitrogen in Water	CC 205		
4	Estimation of Boron in Water	CC 205		
5	Determination of DO & CO2 in water	CC 205		
6	Determination of Particle Density and Pore Space of Soil	CC 205		
7	Determination of Nitrites in water	CC 205		
8	Determination of COD in water	CC 205		
9	Determination of Iron by Chemical method	CC 205		
10	Determination of Water Holding Cap., Bulk Density, Moisture content of soil	CC 205		
11	Determination of BOD	CC 205		
12	Determination of H2S in water	CC 205		
13	Determination of Oil & Grease in water	CC 205		
14	Interpretation of Aerial Photographs	CC 205		
15	Determination of Scale of Areal Photograph	CC 205		
16	Backlog/Remedial Practicals	CC 205		
17	Repeation Practicals	CC 205		

Learning Resources		
1	Reference books	• Water & WasteWater analysis : Dr. R.K. Trivedy & Dr. P.K.Goel • Standard Methods of water & Waste water analysis: APHA • Hand book of Methods in Environmental Studies (Vol.I) : S.K.Maiti • Hand book of Methods in Environmental Studies (Vol.II) : S.K.Maiti • A text book of Soil analysis : Baruah & Barthakur

Semester	II	Total Credit	4
Course Code	CC 206	Credit Pattern	L-15, T-0, P-45
Course Title	PRACTICAL- IV		

Course Objectives	
1	The students should know the experimental procedures for analysis of environmental samples.

Course Outcomes: After completion of this course students will have capability to	
1	Make use of designing of water and waste water treatment plant.
2	Experiment with the maintenance of water and waste water treatment plant .
3	Adapt statistical methods for interpretation of results.
4	Perceive computer & GIS applications in the interpretation and presentation of results.

Syllabus:

Sr. No.	Title	Paper No.	Number of Sessions	
1	Determination of Permanganate value	CC 206	L= 15	
2	Determination of Chlorine Dose	CC 206	T=0	P=45
3	Determination of SVI/MLSS/MLVS	CC 206		
4	Determination of Residual Chlorine/B P Analysis	CC 206		
5	Determination of Volatile Fatty Acids	CC 206		
6	Personal Protective Equipment's	CC 206		
7	Coagulation-flocculation-- Jar Test	CC 206		
8	Computer-I	CC 206		
9	GIS-I	CC 206		
10	Computer-II	CC 206		
11	GIS-II	CC 206		
12	Computer-III	CC 206		
13	GIS-III	CC 206		
14	Computer-IV	CC 206		
15	GIS-IV	CC 206		
16	Backlog/Remedial Practicals	CC 206		
17	Repeation Practicals	CC 206		

Learning Resources		
1	Reference books	• Water & WasteWater analysis : Dr. R.K. Trivedy & Dr. P.K.Goel • Standard Methods of water & Waste water analysis: APHA • Hand book of Methods in Environmental Studies (Vol.I) : S.K.Maiti • Hand book of Methods in Environmental Studies (Vol.II) : S.K.Maiti • A text book of Soil analysis : Baruah & Barthakur

Semester	II	Total Credit	4
Course Code	DSE 201- A	Credit Pattern	L-45, T-8, P-7
Course Title	INDUSTRIAL HYGIENE AND OCCUPATIONAL HEALTH		

Course Objectives	
1	This paper elaborate the Industrial Hygiene and Occupational Health.
2	To provide complete knowledge with respect to application of Industrial Hygiene, Occupational Health & Ergonomics at work place.
3	To study Importance of Nutrition, & Ergonomics in Occupational. Health.

Course Outcomes: The students will able to	
1.	Recognize, evaluate industrial and occupational hazards and propose control measures.
2.	Correlate occupational health and hazards at the workplace.
3.	Compare and contrast nutritional requirements with health issues.
4.	Identify the importance of ergonomics, create design of work station for improving safety and productivity.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Industrial Hygiene:**	**L= 12**	
	Definition of Industrial Hygiene, Work Site Analysis & job hazards, Types of Hazards, (Air Contaminants, Chemical Hazards, Biological Hazards, Physical Hazards, Ergonomic Hazards) Industrial Hazards (Anticipation, Recognition, Evaluation & Control) Control of Hazards: Elimination, Substitution, Engineering Controls, Administrative Controls & Personal Protective Equipments, Personal hygiene, Housekeeping, 5 S concept, Industrial Waste Disposal, Route of entry to human system, recognition, evaluation and control of basic hazards, concepts of dose response relationship, bio-chemical action of toxic substances. Concept of threshold, limit values, air sampling strategies, personal exposure monitoring. **Personal Protective Equipment** : Need for Personal Protection Equipment (PPE), PPE Selection: Applicable standards, supply, use, care & maintenance Types of PPE: Non-respiratory personal protective devices: Head protection, Ear protection. Face and Eye protection, Hand protection, Foot protection, Body protection. Respiratory personal protective devices: Classification of respiratory personal protective devices, Selection of respiratory personal protective devices. Instructions and training for the use, maintenance and care of self contained breathing apparatus and open circuits & close unit breathing apparatus, PPE Testing Procedures and Standards.	**T=1**	**P=2**
2	**Occupational Health and Hazards :**	**L= 11**	
	Definition : As per WHO, Common Occupational Diseases & Occupations involving risk of contracting these disease, Occupational Health Management Services at the work place. List of notifiable diseases Schedule III of Factories Act - 1948. Adverse health effects of noise, vibration, cold, heat stress, improper illumination, thermal radiation, ionising & non-ionising radiations. Permissible threshold exposure limits of radiations - short term and long	**T= 2**	**P= 2**

	term effects of radiation exposures – Preventive and control measures. Pre-employment, periodic medical examination of workers. Medical surveillance for control of occupational diseases and health records.		
3	**Nutrition and Health:** Physiology of respiration, cardiac cycle, muscle contraction, nerve conduction system, etc. Assessment of Workload based on Human Physiological reactions. Permissible limits of load for manual lifting and carrying. Criteria for fixation limits. Working posture: Its effect on cardio-vascular and musculo-skeletal system and implications on health. Nutrition and its importance in manual work. Nutritional requirements and nutritional of diet. Assessment of Work Capacity Fatigue and Rest Allowances. Physiological Tests for Assessment of Occupational Health. Nutrition: Nutritional requirements and the Diets Work, Exercise and Physical Fitness. Aerobic work capacity (physical work capacity), Factors affecting aerobic capacity and work performance, Environmental Physiology	**L= 11** **T= 2**	**P= 2**
4	**Ergonomics:** Introduction to Ergonomics, Definition, Aims and Scope, Man-machine (Job), Environment System, Constituents of Ergonomics, Application of Ergonomics in industry for Safety, Health and Environment. Ergonomics of Automation / Assembly, Visual Fatigue, Ergonomics of Rehabilitation while assigning alternate jobs. Anthropometry and fundamental of bio-mechanics: Basic and applied aspects: Anthropometric measurements and their usefulness in industry. Ergonomic Design of Work Station: Concept of workstation and its design. Improving safety and productivity through work station design. Technical and engineering control measures. Economics consideration.	**L=11** **T=2**	**P= 2**

Learning Resources		
1	**Text Books**	• Handbook of occupational safety and health, Louis J. DiBerardinis, John Wiley, 1999 • Handbook of Occupational Health and Wellness. Izabela Z. Schultz, 2012 • Current Science, ISSN No. 0011-3891Industrial Safety Management by L.M. Deshmukh, McGraw Hill Education Publication, 1st July, 2017 • Industrial Safety & Environment by Er. A. K. Gupta, ISBN: 9788131804544
2	**Reference books**	• Fundamentals of Industrial Hygiene (6th, Edition). Barbara A. Plog, Patricia J. Quinlan, 2012 • Global Occupational Health. Tee L. Guidotti, 2011 • Oxford Handbook of Occupational Health. Julia Smedley, Finlay Dick, Steven Sadhra, 2007 • Occupational Health Psychology. Stavroula Leka, 2010 • Fundamental principles of occupational health and safety. B. O. Alli, 2001 • Principles of Occupational Health and Hygiene: An Introduction. Sue Reed, Dino Pisaniello, Geza Benke, Kerrie Burton, 2013 • Basics of Industrial Hygiene. Debra Nims, 1999 • Occupational Safety and Health for Technologists, Engineers, and Managers. David L. Goetsch, 1995 • Industrial Hygiene & Chemical Safety - M.H.Fulekar: I. K.International Publishing House, New Delhi. • Industrial Hygiene Reference And Study Guide- Allan K. Fleeger, Dean Lillquist, AIHA, 01-May-2006 • Personal Protective Equipment -Guide to Ports/Dock Workers - M.H.Fulekar : Government of India's Publication • Fundamentals of Industrial Hygiene-Barbara A. Plog, Patricia J. Quinlan, National Safety Council Press, 2002 • Occupational safety management and engineering, Willie Hammer, Dennis Price, Prentice Hall, 2001 • Fundamentals of Occupational Safety and Health, Mark A. Friend, James P. Kohn, Government Institutes, 16-Aug-2010 • Fire and Explosion Hazards Handbook of Industrial Chemicals, 2003 • Industrial Hygiene Evaluation Methods. Micheal S. Bisesi. CRC Press, 28-Aug-2003
3	**Websites**	• www.nsc.org.in • www.osha.gov • www.ilo.org • www.ohsonline.com • www.worldsafety.org
4	**Journals**	• International Journal of Occupational Safety and Ergonomics. **ISSN : 2376-9130** • International Journal of Occupational Safety and Health. ISSN : 2091-0878 • Journal of Industrial Safety Engineering. ISSN : 2395-6674
5	**Supplementary Reading**	• Industrial Safety Chronicle. Published by National Safety Council., Mumbai
6	**Practical Components**	• Visit to Textile & Flour mill to study Occupational Health effects on workers. • Practicals based on this paper (Practical III & IV)

Semester	II	Total Credit	4
Course Code	DSE 201-B	Credit Pattern	L-45, T-8, P-7
Course Title	AQUACULTURE AND AGRICULTURE		

Course Objectives	
1	To understand the importance of fresh water Aquaculture in environment.
2	To understand the importance agri ecosystem & to maintain sustainability of Natural Capitals.

Course Outcomes: The students will able to	
1.	Demonstrate techniques and develop technologies in aquaculture practices.
2.	Perceive the importance of coastal and fresh water aquaculture, global scenario, present status in India-prospects and scope.
3.	Develop competitively, skills and technology required for sustainable development in agri ecosystem.
4.	Identify and overcome the challenges encountered sustainability in agri-ecosystem.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**AQUACULTURE** **Unit I: Aquaculture Management** Freshwater fish culture, Procurement of stocking material, establishment and management of fish frames and hatcheries, Poly-culture, Development and advances in freshwater aquaculture in India, Weeds: Types and control measures, fish feed.	**L= 12** **T=1**	**P=2**
2	**AGRICULTURE** **Fundamentals of Agriculture** Importance of Agriculture for Tropical Developing Countries ,Essential Features of Agriculture/ Crop Production ,Branches of Agriculture, Factors affecting Modern Crop production, Methods of Propagation, Concept & Quality of Seeds Weather, Climate & Agriculture Agricultural Production Systems-Environmental Impacts of Monoculture & Poly-culture /Multiple Cropping ,Crop Rotation Crop Farms as Agro-ecosystem, Different agricultural related revolutions in India (green, yellow, blue, white, silver etc). Source of Irrigation and its management, Cropping system and soil groups formed in different parts of the country as defined by ICAR	**L= 11** **T= 2**	**P= 2**
3	**Agriculture Management -I** Soil &Water Conservation , Systems & Methods of Irrigation- Surface, Subsurface & Micro-irrigation, their Advantages & Disadvantages Environmental Consequences of Unskilled Irrigation practices Irrigation Water Quality-Salt Contents & Sodium Absorption Ratio(SAR) Irrigation Scheduling & Agricultural Drainage Systems Integrated plant nutrient management, Integrated Pest management, Post harvest technology.	**L= 11** **T= 2**	**P= 2**
4	**Agriculture Management II** By-product from industrial and agriculture sources and their utilization, Recycling and reuse of resources, Definition and concept; Hitch Agriculture, precision farming, sustainable agriculture, contract farming, crop modeling, Concept & importance of Bio-fertilizers , Agro forestry Energy Use in Crop Production, Energy Crops, Organic Crop Production Constraints to Organic Farming Technology, Green House Technology.	**L=11** **T=2**	**P= 2**

Learning Resources		
1	**Text Books**	• A Text book of Agricultural Biotechnology, Ahindra Nag, PHI • A Text Book of Plant pathology, Sambamurty, I K Intarnetional. • Text Book Of Soil Science by PAL, CBS publishers, 2018 • Textbook Of Environmental Science And Technology by REDDY, BSP publishers, 2019.
2	**Reference books**	• Santhanam *et al*., R 2002: A Manual of Freshwater Aquaculture, Oxford IBH Publishing Co. Pvt. Ltd., New Delhi. • Lucky, Z. 1977: Methods for the Diagnosis of Fish Diseases, Amerind Publishing Co. Pvt. Ltd., New Delhi. • Yadav, B. N. 1997: Fish and Fisheries, Daya Publishing House, Delhi. • Schaperclaus, W. 1991: Fish Diseases, Oxonian Press Pvt. Ltd.., New Delhi. • Jhingran, V.: Fish and Fisheries of India, Hindustan Publication Corporation, New Delhi. • Mary Chandy: Fishes, National book Trust India, New Delhi. • Fundamentals Of Agriculture Vol. 2 Paperback, 2012, by Katyayan Jain Brothers, 7th Edition, 2017. • Fertilizer Technology and Management Paperback, 2012, Mishra Brahma (Author) I K International Publishing House Pvt. Ltd; First Edition. • Management of Horticultural Crops, T. Pradeepkumar, New India Publishing, 2008. • Integrated Pest Management: Volume 2: Dissemination and Impact, Editors Rajinder Peshin, Ashok K. Dhawan, Springer Science & Business Media, 2009. • Nature & Properties of Soil, Nyle Brady, 2005.
3	**Websites**	• https://www.icrisat.org • https://icar.org.in • https://www.mssrf.org • Chinimandi.com
4	**Journals**	• Journal of Environmental Biology, ISSN No. 0254-8704 • Resonance, ISSN No. 0971-8044 • Current Science, ISSN No. 0011-3891 • Every Thing About Water • Journal of Earth System Science, ISSN No .2253-4126
5	**Supplementary Reading**	• Down to Earth • Agroone (Sakal)
6	**Practical Components**	• Visit to Kanerimath to Study Organic Farming. • Practical Based on Aquaculture & Agriculture.

Semester	II	Total Credit	2
Course Code	GE 201 A	Credit Pattern	L-22, T-8
Course Title	FUNDAMENTALS OF MANAGEMENT		

Course Objectives	
1	To Understand the different concepts in Management.
2	To understand the different Functions of Management
Course Outcomes: Students will be able to;	
1.	Discuss management functions and how it can affect future managers
2.	Analyze and attain elementary level of skills in management process and functions: planning, organizing, directing and controlling.

Syllabus:

Unit Number	Contents	Number of Sessions
1	**Introduction to Management** Management- Definition, Scope, Characteristics, Significance. Managerial Skills, Levels of Management and their functions, Henri Mintzberg- Roles of a Manager, Management Vs Administration.	**L= 11** **T= 4**
2	**Functions of Management** **Planning** -Nature, Types, Process and Importance of Planning, Limitations of Planning. **Organizing -** Meaning, Departmentalization, Span of Management, Concept of Responsibility, Authority, Accountability and Delegation **Directing-** Definition, Characteristics and Importance. **Controlling-** Need, Process of Controlling, Benefits of Controlling.	**L= 11** **T= 4**

Note:

1. Case Studies on Each of the Aspects Mentioned in the Syllabus need to be discussed.
2. Video cases and Documentary Films relating to the syllabus to be exhibited in the class

Learning Resources		
1	**Text Books**	1. Principles of Management – T Ramasamy 2. Principles of Management – P.C. Tripathi and P.N. Reddy 3. Fred Luthans, Organisational Behavior, McGraw Hill, 11th Edition, 2001
2	**Reference books**	1. Essentials Of Management – Koontz And Weinrich 2. Modern Management – Certo – Prentice Hall 3. Principles Of Management – L.M. Prasad 4. Principles Of Management – R.M. Srivastava 5. New Era of Management – Richard L. Daft 6. Essentials of Management – Peter Drucker 7. Management – Stephen P. Robins – Prentice Hall 8. Modern Business Administration and Management – S. A. Sherlekar - Himalaya Publication 9. Management Concept and Strategies – J. S. Chandra
3	**Websites**	1. www.iupindia.in 2. https://iedunote.com 3. http://www.yourarticlelibrary.com

4	**Journals**	1. Asian Journal of Management 2. AIMS Journal of Management 3. Casefolio The IUP Journal of Management case studies. 4. IUP Journal of Management Case Studies 5. IUP Journal of Organisational Behavior
5	**Supplementary Reading**	1. South Asian Journal of Practical Research **2.** Business India – The Magzine of Corporate World. **3.** Articles in Economic Times, Deccan Herald, Times of India
6	**Practical Component**	• Study organizational Structure of any company and present in the class. • Class debate on different basis of departmentalisation • Identify any business leader and list his qualities that made him a good leader. • Visit any organization and find out how it motivates its employees and discuss in class. • Library Exercise on CSR activities undertaken by any one company of your choice. • To interview Manager of any local business to understand responsibilities and limitations of manager. • Identifying a job profile and list the various types abilities required for that job and also the personality traits/attributes required for that job. • Management games on **Team building** will be conducted.

Semester	II	Total Credit	2
Course Code	GE-201 B	Credit Pattern	L-30, T-8, P-7
Course Title	Office Automation		

Course Objectives	
1	To teach basic concepts about computers and peripheral devices
2	To explain the concept of computer languages and features of operating system
3	To demonstrate use of Word processor for documentations.
4	To explain effective use of presentation technology.
5	To demonstrate use of spreadsheet for analysis of data

Course Outcomes	
After completion of this course the student will be able to:	
1	Understand basic concepts and computer terminology.
2	Use operating system features
3	Prepare proper documents
4	Prepare effective presentation
5	Analyze any data with the help of spreadsheets.

Unit Number	Contents		
1	**Introduction to Computer, Concept of Operating System & Word Processing** Definition of Computer, Characteristics & Limitations of Computer, Generations of Computer, Block Diagram of Computer, Concept of Hardware and Software, **Operating System:** Function of Operating System, Types of O.S., Features of Windows Operating System, Default Icons on Desktop – My Computer, Recycle Bin, My Network Places and Internet Explorer, Important Terms in Windows – Icons, Desktop, Folder, Star Button, Concept of Cut, Copy and Paste operation, Concept of Start Button **MS-Word:** Component of MS-Word window, Page-Setup in MS-Word, How of Print Document, Formatting the Document, Inserting & Formatting table, Inserting various objects in the document, Mail-Merge Utility, Cursor Control Keys,	**L=11**	**T=2** **P=2**
2	**Data Analysis Through Excel and Presentation Techniques.** **MS-Excel:** Features Of Excel, Formatting Work Sheet- Formatting cell, conditional formatting, Lookup Functions, IF, SUM, SUMIF, SUMIFS, COUNT, COUNTIF, COUNTIFS, COUNTBLANK Functions, Function For Financial Decision – PV, FV, PMT, PPMT, IPMT Functions, TEXT Functions, Date and Time Functions, Decision Making Using – Goal Seek, Scenario Manager, Basic Data Analysis – Sorting, Summarizing, Filtering, Validating Data, Summarizing Data With Chart, Describe Data Using Pivot Table,	**L=11**	**T=2** **P=2**

	MS-PowerPoint: Factors To Be Considered Before Creating A Presentation, Creating and setting Presentations With PowerPoint, Applying Animation Effects, Slide Transition Effects, Views In PowerPoint, Use of Text, Images, ClipArt's, Hyperlinks, Video and Audio and Action Buttons In Presentation,			
Learning Resources				
1	**Text books**	1. Computer Fundamentals by P. K. Sinha&PritiSinha, 5th edition, BPB pub. 2. Computer Fundamentals by Balguruswami 3. Microsoft Office 2013 All-In-One For Dummies By Peter Weverka, Wiley India Pvt Ltd, ISBN 10: 812654175X 4. Microsoft Office 2010 Digital Classroom by AGI Creative Team John Wiley & Sons; Pap/Psc edition (1 March 2011) ISBN-10: 0470577770 5. Operating System Concepts: International Student Version By Silberschatz Wiley; Eighth edition (20 April 2009) ISBN-10: 8126520515		
2	**References**	1. Microsoft Office 2010 Bible By **John Walkenbach** Wiley India Private Limited (28 September 2010) ISBN-10: 8126528397 2. Microsoft Windows Operating System Essentials By **Tom Carpenter**John Wiley & Sons (9 February 2012) ISBN-10: 1118195523 3. Microsoft Windows Operating System Essentials By**Tom Carpenter**ISBN: 978-1-118-19552-9 4. Fundamentals Of Computers 5Ed By V. RajaramanPublisher: Phi Learning Pvt Ltd ISBN 10: 8120340114		

Semester	II	Total Credit	2
Course Code	GE-201- C	Credit Pattern	L-20, T-05, P-05
Course Title	Indian Social Problems And Social Services		

Course Outcomes: Students will be able to	
1	Implement various social welfare services provided by GO's & NGO's
2	Asses the socio- economic factors and their implications of beneficiaries

Syllabus:

Unit Number	Contents	Number of Sessions	
1	Genesis and nature of various categories of Social Problems Definition of Social deviance and control, social disorganization and social problems, study and analysis of specifics social problems in relation to their nature, causative factors, extent and magnitude	L=10	
		T=3	P=2
2	An overview of major social problems, Juvenile delinquency, Crime, Prostitution, Dowry, AIDS, Beggary-Alcoholism and Drug Addition.	L=10	
		T=2	P=3

Learning Resources		
1	**Text Books**	1. Ahuja R 1993 Indian Social System-Rawat Publication New Delhi. 2. Akbar M.J. 1988 Riot After Tiot; Reports on caste & Communal Violence in India New Delhi : Penguin Books. 3. Bardhan P. 1984 the Political Economy of Development in India Delhi: Oxford Press. 4. Betelle A. 1966 Caste, Class and Power Bombay: Oxford Uni, Press. 5. Black C.E. 1966 The Dynamics of Modernization: A study in Comparative History New York: Harper & Row. 6. Madan G.R. 1985 Indian Social Problems Vol. I and II Allied Pub. Pvt. Ltd. Bombay
2	**Reference Books**	1. Coser I.A. 1956 The functions of Social Conflict Glencoc Illinois; Free Press. 2. Dahrendorf R. 1957 Class & Class ' Conflicts in an Industrialized Society London Routldge & Kengan Paul. 3. Dandekar V.M. 1977 Nature of Class Conflict in the Indian Society Bom Bharat Foundation. 4. Das A. & Nilkanth V. (Ed.) 1979Agrarian Relations in India Delhi: Manohar.
3	**Website**	https//journals.sagpub.com www.ndpublisher.in www.ukessays.com www.open.edu7.sociology
4	**Journals**	International Journal of Social Science Indian Journal of Social Work
5	**Supplementary reading**	Encyclopedia in Social Work Vol-I & II Dictionary of Social Work
6	**Practical Component**	1. Visit to various NGO's 2. Concurrent Field Work 3. Case studies on various social problems 4. Organized Group discussion with problematic 5. Celebrate different days related to Social issues.

Semester	II	Total Credit	2
Course Code	GE 201 D	Credit Pattern	L-22, T-04, P-04
Course Title	Principles of Economics		

Course Outcomes: Students will be able to	
1	Understand the micro variables and approach for microeconomic issues
2	Identify the macro variables in any economy

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Unit 1: Demand & Supply Analysis** Basic Economic Concepts, Definitions of Economics, Branches or approaches to economics, Basic Economic Problems or the Central problems of a Society, Law of Diminishing Marginal Utility, Demand curve derivation and its properties, Elasticity of Demand Supply Analysis- Meaning, Types and Determinants of Supply, Supply Function and Law of Supply, Elasticities of Supply and Their Utilities.	**L= 11**	
		T= 2	**P= 2**
2	**Unit 2. Market Theory & N.I** Types of Markets, Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly: Features and price determination Basic Concepts of NI, GDP, GNP, etc, Estimation of NI and Difficulties, Circular Flow of Aggregate Income and Expenditure	**L= 11**	
		T= 2	**P= 2**

Learning Resources		
1	**Text Books**	• Paul Samuelson(2000), Economics, McGraw Hill Inc, New Delhi, Ahuja H.L, Modern Micro Economics, S Chand& Co., New Delhi, • Koutsyanis (2015), Micro Economics. • Jhingan M.L., Microeconomics, Vrinda Publications, New Delhi. • C.Rangarajan and Dholokia B.H, Principles of Macro Economics, Tata Mcgraw-Hill, New Delhi, (1998). • Blanchard, Olivier (2000), *Macroeconomics*, Prentice Hall.
2	**Reference books**	• Robert S Pindyck and Daniel L Rubinfeld(2017), Microeconomics, Pearson Education Ltd., UP • Mankwin Gregory N(2016), Principles of Microeconomics, Cengage Learning India Pvt. Ltd. • Hal R Varian(2015), Microeconomic analysis, Viva Books Pvt. Ltd., New Delhi • Mankiw Gregory (2002), Macroeconomics, 5th Edition, Worth Publishers • Ahuja H L(2015), Macroeconomics Theory And Policy, 19th Edition, SCHAND • Gupta G S(2011), Keynesian and Post Keynesian
3	**Websites**	**www.rbi.org.in** www.mygov.gov.in www.cmie.com

4	**Journals**	Arth Samwad Economic and Political Weekly Indian-Economic-Journal Journal-of Indian-School-of-Political-Economy
5	**Supplementary Reading**	Economics Survey Union Budget of India
6	**Practical Component**	• Conduct consumer survey and identify consumer utility for various consumer goods • Review reference books on economics, and prepare a report on liner, cubic and quadratic production functions • Visit various service vendors and prepare a report on price determining factors and challenges for their products in the market

Semester	II	Total Credit	2
Course Code	GE 201 E	Credit Pattern	L-23, T-07, P-0
Course Title	**Environment And Development**		

Course Objectives	
1	Understand the basics functional areas of Environment.
2	Define concepts of pollution, pollutants and natural resources
3	Explain historical development of struggle for Environmental protection

Course Outcomes: The students will able to	
1.	Differentiate biotic and abiotic components of ecosystem & able to understand concept of habitat, interactions in between different components & their Interrelationships.
2.	Develop ability of identification of local issues related with natural resources.
3.	Adopt various pollution control techniques.
4.	Able to know various environmental policies as well as National & International Organizations involved.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Ecological concept and Natural Resources :** Introduction to Environmental Science as a multi-disciplinary, its scope and necessity; Concepts of Ecosystem and its Structure and Functions, Principles of Organism-environment relationship; Concept and classification of Natural Resources. Energy Resources, Renewable and Nonrenewable.	**L= 11** **T= 3**	**P=0**
2	**Environmental Pollution and Policy:** Definition, sources and effects of water pollution. Definition, sources of air pollution, Effect of air pollution and acid rain, climate change, ozone depletion. Definition, Sources of noise pollution. Effect of noise pollution on human-beings. Noise control measures. Government policies in the protection and development of environment. National environmental policy. United Nations Environmental Programme (UNEP).	**L= 12** **T= 4**	**P= 0**

Learning Resources

1	**Text Books**	• A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018 • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017 • A Text Book of Environmental Chemistry & Pollution Control, Dara, Chand • A Text Book of Ecology, S K Dubey, Dominant Publication • A Text Book of Ecology, Tyler Miller, Cengage Learning • A Text Book Environmental Studies, Chatawal & Sharma, HPH • A Text Book Environmental Science, Joshi & Joshi, APH • A Text Book of Environmatal Studies, Nambiar, STP
2	**Reference books**	• Fundamentals of Ecology by Odum, E.P. • Desert Ecology by Ishwar Prakash • Ecology of Urban India by Pramod Singh

		• Ecology of Rural India by Singh • Ecology 2000 by Sir Edmand Hillary • Environmental Protection and the Laws by CN Mehta, 1991 • India's Forests, Myth and Reality by J.B. Lal 1989 • Legal aspects of Environmental Pollution and its Management by Ed. S.M. Ali, 1992 • Man – Nature and Environmental Law by GS Nathawal, S. Shastri and JP Vyyar, 1988 • International Environmental Policy: Emergence and Dimensions by LK Caldwell, 1990 • Lal's Commentaries on Water, Air Pollution Laws along with the Environmental (Protection) Act and Rules, 1986, 3rd Ed., 1992 Law Publisher – India • The Wildlife (Protection) Act, 1972 (with amendment-1991) • Our Common Future – WCED, 1991 • Universal's Environment and Pollution Law Manual by SK Mohanty, 1998. • A Guide to Implementation of the ISO 14000 Series on Environmental Management (Prentice Hall Ptr Environmental Management and Engineering Series) Har/Dskt Edition • Environmental manager's guide to ISO 14000 by Bruce W Perry • Implementing ISO 14000 Hardcover – November 1, 1996 by Tom Tibor (Author), Ira Feldman (Author • Environmental Impact Assessment By: Larry W Canter. McGraw-Hill International Editions, 2nd Edn, New York (1996). • EIA Theory & Practice By: Peter Wathern. Unwin Hyman, London (1990) • Environmental Impact Assessment By: PR Trivedi. APH Publishing Corporation, New Delhi (2004) • EIA Practical Solutions to Recurrent Problems By: David P Lawrence. Wiley Interscience Publication (2003)
3	**Websites**	• https://www.toppr.com/guides/biology/ecosystem/biogeochemical-cycle/ • https://nca2014.globalchange.gov/report/sectors/biogeochemical-cycles • https://www.conserve-energy-future.com/what-is-environmental-science-and-its-components.php
4	**Journals**	• Current Science, ISSN No. 0011-3891 • Every Thing About Water • Down to Earth • Resonance, ISSN No. 0971-8044 • Journal of Earth System Science, ISSN No .2253-4126
5	**Supplementary Reading**	• National Geographic • Down to Earth, CSE
6	**Practical Components**	• Field visit to study pond water & forest Ecosystem.

Semester	II	Total Credit	2
Course Code	AEC 201 - A	Credit Pattern	L-22, T-4, P-4
Course Title	GERMAN		

Course Objectives	
1	To create an awareness about a foreign language
2	To understand the basic script of the language
3	To understand the culture and tradition of the county
Course Outcomes: Students will be able to;	
1	Use basic words & sentences in German Language
2	Develop basic vocabulary in German Language..

Syllabus:

Unit Number	Contents
1	Introduction (Name, country, living place, languages etc.), Asking theperson's information, Greeting German Alphabets, Number (1-100), Giving and asking information relatedto number (age, telephone number, mobile number etc. Difference between formal and informal, Personal Pronouns, verb conjugation Europa-Countries, capitates and languages Learning about the things in the class room, Definite, indefinite, negative articles Possessive Articles with the reference of all the nouns learnt in the last lecture Watching timing learning
2	Conjugation of strong verbs, Use of separable verbs in the sentences Routine activities, Questions related to time, (use of prepositions am, pm) Eating and drinking (Grocery, fruits, vegetables, beverages), Learning of vocabulary related to eating and drinking, Use of accusative in the sentence Learning the professions, Telling about and asking for the professions Ordinal number Verbs- haben, sein, Revising the syllabus

Note:

1. There will not be any fixed text book for the above given syllabus
2. The extra notes will be provided to the students to complete the required syllabus.

Semester	II	Total Credit	2
Course Code	AEC 201 - B	Credit Pattern	L-22, T-4, P-4
Course Title	JAPANESE		

Course Objectives	
1	To create an awareness about a foreign language
2	To understand the basic script of the language
3	To understand the culture and tradition of the county
Course Outcomes: Students will be able to;	
1	Use basic words & sentences in Japanese Language
2	Develop basic vocabulary in Japanese Language..

Syllabus:

Unit Number	Contents
1	Introduction to Japan as country and language basics. Hiragana Script, Hiragana Activity, Katakana Script, Katakana Activity, Cultural Ethics and Survival Greetings, Classroom Language (Speaking), Number system, Vocab for Daily Uses, Grammar, Calendar Family Tree, Grammar
2	Self-Introduction, Introduction to Japanese Work-Culture Grammar, Introduction to –Kanji‖, Visit Restaurant'(Speaking), Visit guest's house' (Speaking), Shopping' (Speaking), Farewell

Learning Resources		
1	Reference books	1. Living Language Ultimate Japanese Beginner-Intermediate 2. The Kanji Learner's Dictionary by Jack Halpern 3. Japanese from zero 1 and 2 by George Tromphy 4. Basic Japanese by Eriko Sato 5. Handbook of Japanese verbs by Taeko Kamiya 6. Japanese- English, English- Japanese Dictiomary by Seigo Nakao 7. Modern Japanese vocabulary A Guide for 21st century student by Edward Trimell 8. Minna no Nihongo Series 9. Seiichi Makino Michio Tsutsui Biiks (Dictionary) 10. Genki An Integrated Course in Elementary Japanese 11. Improving your communication skills 12. Pod 101 series (audio)

Semester	II	Total Credit	2
Course Code	AEC 201- C	Credit Pattern	L-22, T-4, P-4
Course Title	FRENCH		

Course Objectives	
1	To create an awareness about a foreign language
2	To understand the basic script of the language
3	To understand the culture and tradition of the county
Course Outcomes: Students will be able to;	
1	Use basic words & sentences in French Language
2	Develop basic vocabulary in French Language.

Syllabus:

Unit Number	Contents
1	Introduction (Name, country, living place, languages etc.), Asking the person's information, Greetings and Salutations, French Alphabets, French Accents, Numbers (1-1000), Giving and asking information related to numbers (age, telephone number, mobile number etc.) Difference between formal and informal, Personal Pronouns, Verb conjugations Countries, nationalities, capitals and languages Articles, Prepositions, Colours Gender, Nouns and Pronouns, Singular Plural Possessive Pronouns, Family Vocabulary Telling Time, Days of the week, Months of the Year, Parts of the Day About France and Francophone Countries, French Culture and Etiquettes, French Monuments
2	Conjugation of ER, IR and RE verbs, Use verbs in the sentences Routine activities, Questions related to time, (use of prepositions am, pm) Eating and drinking (Grocery, fruits, vegetables, beverages), Learning ofvocabulary related to eating and drinking, Use of accusative in the sentence Learning the professions, Telling about and asking for the professionsOrdinal numbers Negative Sentences, Interrogatives Describing Oneself, Family Simple Letter Writing and Essay Writing Revising the syllabus

Note:

1. There will not be any fixed text book for the above given syllabus
2. The extra notes will be provided to the students to complete the required syllabus.

Learning Resources		
1	Reference books	1. Echo A1 Méthode de Francais – Goyalsaab Publishers 2. Le Flambeau , Méthode de Français –Preeti Bhutani 3. Saison 1 Méthode de français- Alliance française 4. Larousse French Dictionary-W.R.Goyal

Semester	**II**	**Total Credit**	**2**
Course Code	**AECC- 201**	**Credit Pattern**	**L-26, T-4**
Course Title	**Professional Communication Skills**		

Course Objectives	
1	To familiarize learners with the mechanics of communication.
2	To develop students written expression of thought and build connections between content areas
3	To develop students oral communication skills by a variety of communication activities, from informal discussion to formal presentation

Unit Number	**Contents**
1	**Effective Business Communication: (15)** □ Meaning & Definition, Role of communication in today's business Basic Grammar and how to use in English Communication Personal Introductions, Facing Audience Verbal and Non-Verbal Communication □ Effective communication in Formal and Informal Environment □ Barriers to communication □ Measures to overcome barriers to communication Understand and use JoHari Window for self development □ Non-verbal communication: Nonverbal Cues, Kinesics, Haptic and Proxemics Body language, Facial Expressions How to carry yourself professionally (grooming and dining etiquettes) □ Public Speaking
2	**Communication Technology: (15)** □ Social Media Communication □ Email Writing & Professional Writing □ Presentations Skills □ Group Discussion □ Critical Thinking

Practical Components:

1. To be well in Verbal and Non- verbal communication
2. Make students enact and analyze the non-verbal cues
3. Each student to give presentation of 15 minutes (this can be spread throughout the semester) and to be evaluated by the faculty
4. Each Student will give 10 minutes speech on given topic that will be evaluated by the Faculty

Learning Resources		
1	**Recommended Books**	1. **1** Business Communication – Lesikar, Flatley, Rentz&Pande, 11/e, TMH, 2010 2. How to win Friends and Influence People by Dale Carnegie 3. Skill with People by Les Giblin 4. The Power of Communication: Skills to Build Trust, Inspire Loyalty, and Lead Effectively, by Helio Fred Garcia, 2012
2	**Reference Books**	1. Business Communication - Sehgal M. K &Khetrapal V, Excel BOOKS. 2. Business Communication – Krizan, Merrier, Jones, 8/e, Cengage Learning, 2012.

M.Sc (ENVIRONMENT& SAFETY)-II

SEMESTER III

Semester	**III**	**Total Credit**	**4**
Course Code	**CC 301**	**Credit Pattern**	**L-45, T-8, P-7**
Course Title	***ENVIRONMENTAL EDUCATION, POLICY, FOREST AND WILDLIFE MANAGEMENT***		

Course Objectives	
1	Understand the importance of Forest & wildlife
2	Describe management methods for conservation & protection of forest & wildlife,

Course Outcomes: The students will able to	
1.	Appreciate concepts and methods from ecology and their application in environmental problem solving in environmental education and policies.
2.	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
3.	Explain importance of forest with its ecological functions, describe forest conservation strategies and Develop a plan for forest management
4	Distinguish between various wildlife conservation strategies and prepare a strategy for conservation of wildlife at local to international level.

Syllabus:

Unit Number	**Contents**	**Number of Sessions**	
1	**Environmental Education:** Environmental education - need and objectives, Status of environmental education in new education policy, Government policies and role of various institutions in protection and development of environment. Government policies in the protection and development of environment. Environmental considerations in economic planning and development in India. NCEP and district environmental committee. Emerging environmental concerns in India-Case study of Silent Valley, Sardar Sarovar project, Tehri Garwal dams.	**L = 12** **T=2**	**P=1**
2	**Global Environment Conservation Strategy:** United Nations Environmental Programme (UNEP), Intergovernmental Panel on Climate Change (IPCC), International Union for conservation of Nature and Natural Resources (IUCN) World Wide Fund for Nature (WWF). Stockholm Conference (UNCHE), World Commission on Environment and Development (WCED) – "Our Common Future", Rio-Conference (UNCED)	**L=11** **T=2**	**P=2**
3	**Forest Management** Forest and ecological balance. Productive, protective & regulatory benefits of forest, forest ecology, forest environment and development, Exploitation of forests, Deforestation. Forest Management strategies –*Insitu* and *Exsitu* ,Protection/conservation forestry & Extension forestry. Afforestation: Concept & practices of Social forestry, Agro-forestry , forest and tribal, waste land development,	**L= 12** **T=2**	**P=1**

	Forest development corporation, Endangered species, concept of Biosphere reserves.		
4	**Wildlife Management :** Wildlife wealth of India, threats to wildlife resources , Endangered fauna of India, Concept & Criteria of Ecological Sensitive Zone, Wild-life conservation and management strategy, Application of tissue culture in forest management, conservation of plant and animal species, wildlife censes methods. Conversation of wildlife: National Parks, Sanctuaries and facilities, National and international organizations. Improvement and development of wildlife environment, Project Tiger, Tiger Reserves in India, Crocodile Breeding, Project Elephant, Save Barasingha, etc	**L= 12** **T=2**	**P=1**

Learning Resources		
1	**Text Books**	• Wildlife Management and Conservation: Contemporary Principles and Practices, Paul R. Krausman, James W. Cain, JHU Press • **Fundamentals of Wildlife Management,** Author: Rajesh Gopal, Publisher: Natraj • Concepts in Wildlife Management, by B.B. Hosetti (Author), Daya Publishing House, 2nd Revised edition edition, 2005 • A Text Book of Ecology, S K Dubey, Dominant Publication • A Text Book of Ecology, Tyler Miller, Cengage Learning • A Text Book of Plant pathology, Sambamurty, I K Intarnetional. • A Text book of Agricultural Biotechnology, Ahindra Nag, PHI
2	**Reference books**	• Environmental Management Strategies: The 21st Century Perspective Volume 5 (Environmental Management and Engineering Series) Gabriele Crognale (Author) Publisher: Prentice Hall, 1999. • Corporate Environmental Strategy: The Avalanche of Change Since Bhopal Bruce Piasecki Wiley. • Environmental Strategies for Industry: International Perspectives On Research Needs And Policy Implications (The Greening of Industry Ne Island Press; 4th edition (twork Series), Kurt Fischer (Editor), Johan Schot (Editor). • Corporate Environmental Strategy and Competitive Advantage (New Perspectives in Research on Corporate Sustainability Series) Hardcover – Import, 27 Jul 2005 by Sanjay Sharma (Editor), J. Alberto Aragon-Correa (Editor), Edward Elgar Publishing Ltd (27 July 2005). • Environmental Management, N K Uberoi, Published by Excel Books. • Forest Management and Planning Peter Bettinger, Pete Bettinger, Kevin Boston, Jacek P. Siry, Donald L. Grebner, Academic Press, 2010. • Forest Management in India, S.S. Negi, Published by Bishen Singh Mahendra Pal Singh, 2011. • Forest Management and Planning Peter Bettinger, Pete Bettinger. Forest Management in India, S.S. Negi, Published by Bishen Singh Mahendra Pal Singh, 2011. • Wildlife Management and Conservation: Contemporary Principles and

		Practices, Paul R. Krausman, James W. Cain, JHU Press. • **Fundamentals of Wildlife Management,** Author: Rajesh Gopal, Publisher: Natraj. • Concepts in Wildlife Management, by B.B. Hosetti (Author), Daya Publishing House. • Wildlife Management and Conservation: Contemporary Principles and Practices, Paul R. Krausman, James W. Cain, JHU Press.
3	**Websites**	• http://www.fao.org/forestry/sfm/85084/en/ • https://en.wikipedia.org/wiki/Forest_management • http://www.legalserviceindia.com/article/l215-Forest-Management-In-India.html • https://unfccc.int/process/transparency-and-reporting/greenhouse-gas-data/greenhouse-gas-data-unfccc/global-warming-potentials. • http://moef.gov.in/wildlife/ • https://www.iucn.org/ • https://www.worldwildlife.org/ • http://extwprlegs1.fao.org/docs/pdf/ind3171.pdf
	Journals	• Current Science, ISSN No. 0011-3891 • Down to Earth • Journal of Environmental Biology, ISSN No. 0254-8704 • Journal of Biosciences, ISSN No. 0250-5991
	Supplementary Reading	• National Forest Policy

Semester	III	Total Credit	4
Course Code	CC 302	Credit Pattern	L-45, T-8, P-7
Course Title	AIR AND NOISE POLLUTION		

Course Objectives	
1	Make the students aware about the facts of air pollution.
2	Explain the effect and control methods of the air and Noise pollution.

Course Outcomes:	
1.	Appraisal of present air pollution status.
2.	Identify existing and potential sources of air pollution.
3.	Identify and Classify existing sources of noise pollution.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Meteorology and Atmosphere:** Primary and secondary atmosphere, weather and climate, Atmosphere engine, physical and chemical properties off atmosphere, vertical structure of atmosphere. Meteorological elements – Definition and measurements: Temperature, pressure, humidity, Wind speed and direction, precipitation, forms of precipitation. Atmospheric circulation Lapse rate – Environmental, dry adiabatic lapse rate and effective. Atmospheric stability: concept and types, pasquill stability classification. wind rose, heat island effect,Inversion of temperature and turbulence, Mixing heights, plume behavior.	**L= 12**	
		T=2	**P=1**
2	**Air Pollution:** Definition, terminology, sources of air pollution Classification of air pollutants, Air quality standards Acid rain, Green house effect and Global Warming Ozone layer depletion, Dispersion of pollutants in the atmosphere: Gaussion dispersion model, Effect of air pollution and acid rain on plants, animals and property.	**L= 11**	
		T= 2	**P= 2**
3	**Air Pollution Control :** Particulate matter– settling chamber, cyclone, Wet collector, Fabric filter and Electro Static Precipitators Gaseous Pollutants: Adsorption and absorption, Condensation, wet scrubber Mobile sources: Incineration, Adsorption and absorption, alternative fuels Indoor air pollution, Air pollution episodes.	**L= 11**	
		T= 2	**P= 2**
4	**Noise Pollution:** Definition, scope, properties of sound; Theory of noise measurement; Sound pressure, loudness, sound intensity; Hearing mechanism; Threshold noise level, Sources of noise pollution, Effect of noise pollution on human-beings and wildlife, Noise control measures.	**L=11**	
		T=2	**P= 2**

Learning Resources		
1	**Text Book**	• A Text Book of Engineering Chemistry, Dara, Chand • A Text Book Environmental Studies, Chatawal & Sharma, HPH • Textbook Of Environmental Science And Technology by REDDY, BSP publishers, 2019 • A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018 • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017 • Textbook On Biotechnology by Hd Kumar, Affiliated East-West Press Pvt Ltd, 2003 • Fundamentals of Ecology by Odum, E.P. • Environmental Science by Nobel, B.J. and Kormandy, E.J. (1981), The Way the World Works, Prentice-Hall Inc., N.J. • Environmental Science by Turk A., Turk, J. Wittes J.T. and Wittes, R.E. (1978) • Environmental Studies by Anindita Basak,2009, Dorling Kindersley, New Delhi Publication. • Vogel's Textbook of Quantitative Chemical Analysis, 5th edition, J H Basett, J. Nendham and Denny, R.C.
2	**Reference books**	• Air Pollution By: Arthur C Stern. 3rd Edn. Vol. I, II, VI, VII, Academic Press (1986) • Air Quality By: Thad Godish, 3rd Edition, Lewis Publishers, New York (1997) • Understanding Environmental Pollution By: Marquita K Hill. Cambridge University Press (1997) • Pollution: Causes, Effects & Control Edited By: Roy M Harrison. 2nd Edn. The Royal Society of Chemistry Cambridge (1995) • Environmental Chemistry: A Global Perspective By: Gary W vanLoon & Stephen J Duffy. Oxford University Press (2000) • Handbook of Air Pollution Control Engineering & Technology By: John C Mycock, John D McKenna & Louis Theodore. Lewis Publishers, CRC London (1995) • Handbook of Pollution Control Processes By: Robert Noyes. Jaico Publisheing House, Mumbai (2001) • An Introduction to Air Pollution By: RK Trivedy & PK Goel. ABD Publishers Jaipur, India (2003) • Air Pollution By MN Rao & HVN Rao. Tata McGraw-Hill Publishing company Ltd., New Delhi (1994) • Environmental Chemistry By: AK De. 3rd Edn. New Age International (P) Ltd. Pub. (1999) • Environmental Air Pollution and its Control By: GR Chhatwal, MC Mehra, M Satake, T Katyal, Mohan Katyal, T Nagahiro. Anmol Publications, Delhi (1993) • Environmental Chemistry By: BK Sharma. Krishna Prakashan Media, Meerut (1994) • Air Pollution by Perkin HG

		• Air monitoring survey design by Noll KE and Miller TL • Fundamentals of Air Pollution by Stern AC, Henry Wohlers, GR Richard, Boulal, W and William Lowry, P. • Air Pollution by Wack, K and Warner CF • Air Pollution by Sainfeld JH • Air Pollution by HC Pertin • Air Pollution by Strauss • Air Pollution Control Theory by Crawford • The Atmosphere by Tarbuch and Lutgen • The Weather Book by Williams, Jack, USA
3	**Website**	• http://www.imd.gov.in/Welcome%20To%20IMD/Welcome.php • https://www.niwa.co.nz/education-and-training/schools/students/layers • http://www.indiaenvironmentportal.org.in/category/37/thesaurus/air-pollution-control/ • https://www.environmentalpollutioncenters.org/noise-pollution/
4	**Journals**	• International Journal of Environmental Engineering Science, ISSN No .2229-3094 • International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842 • Journal of Biosciences, ISSN No. 0250-5991 • Current Science, ISSN No. 0011-3891
5	**Supplementary reading**	• CPCB reports • MPCB reports
6	**Practical Component**	• Industrial visit to learn air pollution sources • Noise monitoring during festivals like Ganpati, Navratra and Diwali • Traffic noise monitoring • Traffic air pollution monitoring

Semester	III	Total Credit	4
Course Code	CC 303	Credit Pattern	L-45, T-8, P-7
Course Title	DISASTER MANAGEMENT		

Course Objectives	
1	To understand the concept and impact of disasters.
2	To understand the causes, effects and control measures of disasters.

Course Outcomes: After completion of this course students will have capacity to	
1	Summarize the various global and regional environmental concerns due to natural causes and/or human activities, and the impact of these on various forms of life .
2.	Identify, analyze, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios.
3.	Integrate knowledge to manage different public health aspects of disaster events at a local and global levels.
4.	Appraise work theoretically and practically in the process of disaster management (disaster risk reduction, response, and recovery) and relate their interconnections.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Introduction to Disaster Management:** Definition of hazard and Disaster, Classification of disasters, Fundamentals of disasters, Natural and Man-made Disasters, Dimensions and Typology of Disasters, Risk Assessment, Policy Initiatives and Future Plans. Disaster Management: Pre-disaster Planning; Planning during Disaster; Post- disaster Planning; Disaster Management Action Plan.	**L= 11**	
		T=2	**P=2**
2	**Geological Mass Movement and Land related Disaster:** Causes and effects of Earthquakes; Volcanoes; Mass Movement Hazards; Avalanches; Land Slides; Mud Slides; Droughts and Famines; Hazard Zoning, Physical & biological indicators of hazard, Risk assessment & hazard preparedness plan, collection of data for preparation of hazard preparedness plan.	**L= 11**	
		T= 2	**P= 2**
3	**Hydrological, Coastal, Marine & Technological Disasters:** Flood Hazards, Control and Management; Dams and Dam Bursts; Tsunami, El Nino; Sea Level Rise; Coastal and Marine Degradation; Marine Pollution and Control Floods Forecasting and Mitigation; Tropical Cyclones; Storms, Cyclones, Tornadoes, Lightning, Frost, Technological disasters: Mining; Chemical, Biological and Nuclear Disasters; Industrial Disaster.	**L= 12**	
		T= 2	**P= 1**
4	**Atmospheric Disasters:** Green House Gases, Green house gas effects & global climate, Global Warming, Ozone Depletion, Climate Change and Acid Rain **Forest Related Disasters :** Wild Fires, Biodiversity and Biodiversity Extinction; Deforestation; Biosafety; Role of various organizations – District Disaster Management Committee, National Disaster Management Authority (NDMA), Non-Governmental Organizations, Military operations; Awareness, community participation, forecasting & dissemination of information, Education, training for public in emergency preparedness plan. Rescue & rehabilitation programmes.	**L=11**	
		T=2	**P= 2**

Learning Resources		
1	**Text Books**	• Textbook Of Environmental Science And Technology by REDDY, BSP publishers, 2019 • A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018 • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017 • A Text Book of Ecology, Tyler Miller, Cengage Learning • A Text Book Environmental Studies, Chatawal & Sharma, HPH • A Text Book Environmental Science, Joshi & Joshi, APH • A Text Book of Environmatal Studies, Nambiar, STP
2	**Reference books**	• Nuclear Accidents (Man Made Disasters) Mark Mayell Publisher: Lucent Books • Management of Man-made Disasters, **S. L. Goel, Motilal Banarsidass Publishers Private Limited, New Delhi,** ISBN: **8176297151** • Handbook of Pollution Control Processes By: Robert Noyes. Jaico Publishing House, Mumbai (2003) • Fire & Explosion Hazards Handbook of Industrial Chemicals By: TA Davletshina & NP Cheremisinhoff, Noyes Publications, Mumbai (2003) • Environmental Geology by K. Valdiya, Tata McGraw Hill Publishing Co. • Perspectives on Environment by I.R. Manners, M.W. Micksell • Our Planet, Our Health by WHO (!992) • Report of the Panel on Industry by WHO (1992) • Natural Disasters, Author: Claire Watts / Trevor DayPublisher: Dk Publishing, ISBN: 9781465438096 • Resource Book on Chemical (Industrial) Disaster Management, http://nidm.gov.in/PDF/pubs/chemical_mdc.pdf • Directory of Institutions and Resource Persons for Landslide Management In India http://nidm.gov.in/PDF/pubs/directory%20landslide.pdf
3	**Websites**	• Directory of Institutions and Resource Persons for Landslide Management In India • http://nidm.gov.in/PDF/pubs/directory%20landslide.pdf • https://www.ifrc.org/en/what-we-do/disaster-management/about-disaster-management/ • https://en.wikipedia.org/wiki/Disaster_management_in_India
4	**Journals**	• Current Science, ISSN No. 0011-3891 • Down to Earth • Journal of Biosciences, ISSN No. 0250-5991 • Journal of Environmental Biology, ISSN No. 0254-8704 • Resonance, ISSN No. 0971-8044 • Journal of Earth System Science, ISSN No .2253-4126 • Industrial Safety Chronicle • International Journal of Environmental Engineering Science, ISSN No .2229-3094
5	**Supplementary Reading**	• Demonstration of Fire & Water Safety.
6	**Practical Components**	• Mock drill for various disaster • Disaster Management Action Plan

Semester	III	Total Credit	4
Course Code	CC 304	Credit Pattern	L-0, T-15, P-45
Course Title	SUMMAR INPLANT PROJET (SIP)		

Course Objectives	
1	It is an academic requirement for the students of M Sc (Environmental Science) to undergo Summer Inplant Training for a period of minimum one month during May & June (Summer Vacations) by working & learning from Industry/Organization to gain an experience in the real world situation.

Course Outcomes: After completion of this SIP students will have capability to	
1	Select and defend a topic of their SIP and effectively plan, execute, evaluate and discuss their innovative ideas and experiments.
2	Identify systematically the relevant theory and concepts, and relate these to appropriate methodologies and evidences.
3	Apply appropriate techniques and draw appropriate conclusions, develop communication and interpersonal skills.
4	Propose and present scientific approach to solve the problem. Interpret, discuss and communicate scientific results in written form.

Syllabus:

	Contents	Number of Sessions	
		L= 0	
		T=15	P=45
1	They will study the working environmental conditions & problems in the organization. Areas for SIP are- 1.Waste Water Treatment — 2. Solid Waste Management 3. Characterization of Effluent Technologies — 4. Air Pollution & Control 5.Noise Pollution — 6. Toxicological Study 7. Industrial Safety — 8. Disaster Management 9.Environmental Auditing — 10. ISO 14000 11. OSHAS-18001 — 12. Energy Management 13. Composting — 14. Wormicomposting 15. Bioremediation — 16. Phyto-remediation 17. Water Budget — 18. Energy Audit 19. Carbon Footprint — 20. Biomedical Waste Management		

Semester	III	Total Credit	4
Course Code	CC 305	Credit Pattern	L-15, T-0, P-45
Course Title	PRACTICAL -V		

Course Objectives	
1	The students should know the experimental procedures for analysis of environmental samples.

Course Outcomes: After completion of this course students will be able to	
1	Extend use of technical and analytical skills to quantify the level and effects of noise pollution.
2	Utilize the technical skills for air sampling, using high volume sampler and stack monitoring kit.
3	Develop analytical skills to quantify the level and effects of air pollution by conventional methods .
4	Elaborate and Integrate scientific processes to analyze soil samples for soil rating and fertilizer dose recommendation .

Syllabus:

Sr.No.	Title of the Experiment	Paper No.	Number of Sessions	
1	Sound Level Measurements	CC 305	L= 15	
2	Determination of Chloride, Carbonates Bicarbonates in Water	CC 305	T=0	P=45
3	Determination of Phenolic Compounds	CC 305		
4	Prediction of Impact	CC 305		
5	Determination of Reducing Sugars in Plant	CC 305		
6	Site Selection for Air Pollution Monitoring	CC 305		
7	Stack monitoring	CC 305		
8	Available Sulphur in Soil	CC 305		
9	Audiometry	CC 305		
10	Mechanical Analysis of Soil	CC 305		
11	Determination of Available Phosphorus in soil	CC 305		
12	Determination of Avalable Potassium in soil	CC 305		
13	Determination of Available Nitrogen in soil	CC 305		
14	Step test	CC 305		
15	Determination of SPM/RPM	CC 305		
16	Backlog/Remedial Practicals	CC 305		
17	Repeation Practicals	CC 305		

Learning Resources		
1	Reference books	• Water & WasteWater analysis : Dr. R.K. Trivedy & Dr. P.K.Goel • Standard Methods of water & Waste water analysis: APHA • Hand book of Methods in Environmental Studies (Vol.I) : S.K.Maiti • Hand book of Methods in Environmental Studies (Vol.II) : S.K.Maiti • A text book of Soil analysis : Baruah & Barthakur

Semester	III	Total Credit	4
Course Code	CC 306	Credit Pattern	L-15, T-0, P-45
Course Title	PRACTICAL -VI		

Course Objectives	
1	The students should know the experimental procedures for analysis of environmental samples.

Course Outcomes: After completion of this course students will	
1	Make use of methods of Isolation of pure cultures of micro-organisms from environmental samples using appropriate microbial techniques.
2	Apply Screening of microbial cultures in the different areas of environment management and for further enterpreunership development.
3	Evaluate dispersal of air pollutants by drawing wind rose diagram.
4	Elaborate and explore Soxlet extraction method as a separative technique.

Syllabus:

Sr.No.	Title of the Experiment	Paper No.	Number of Sessions	
1	Isolation of Pure Culture of MOs	CC 306	L= 15	
2	Determination of SOx	CC 306	T=0	P=45
3	Determination of NOx	CC 306		
4	Determination of Carbohydrates from Plant	CC 306		
5	Soxlet Extraction	CC 306		
6	Windrose Diagram	CC 306		
7	Metal Bio-sorption	CC 306		
8	Fire Safety Demo.	CC 306		
9	Determination of Sulphate content in Water	CC 306		
10	Lung performance Test	CC 306		
11	Determination of Most Probable Number(MPN)	CC 306		
12	Determination of Cultural(Colony) Characters	CC 306		
13	Langilar Saturation Index	CC 306		
14	Demo of Total Weather Station	CC 306		
15	Water Safety Demo	CC 306		
16	Backlog/Remedial Practicals	CC 306		
17	Repeation Practicals	CC 306		

Learning Resources		
1	Reference books	• Water & WasteWater analysis : Dr. R.K. Trivedy & Dr. P.K.Goel • Standard Methods of water & Waste water analysis: APHA • Hand book of Methods in Environmental Studies (Vol.I) : S.K.Maiti • Hand book of Methods in Environmental Studies (Vol.II) : S.K.Maiti • A text book of Soil analysis : Baruah & Barthakur

Semester	III	Total Credit	4
Course Code	DSE 301 (A)	Credit Pattern	L-45, T-8, P-7
Course Title	ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT SYSTEM		

Course Objectives	
1	Apprise concept and signifiance of environnemental impact assessment.
2	Discuss various steps in conducting environmental management plan.

Course Outcomes: The students will able to	
1.	Design EMP for particular industry.
2.	Prépare Environnemental Impact Assessment report.
3.	Design EMS for particular Industry.
4.	Prepare Environmental Audit reports of a industry.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Unit- I. Fundamentals of Environmental Impact Assessment**: Development vis-à-vis environment Sustainable development, Definition of EIA, its concept, scope and objectives.Negative and positive, primary and secondary, reversible and irreversible, tangible and intangible impacts, Elements or components of EIA,Baseline studies in EIA,Prediction of impacts and its methodology EIA in developed countries and developing countries, Public participation in EIA, Composition of expert committee.	**L= 12**	**T=2** **P=1**
2	Methodologies of EIA, Uncertainties in EIA,Environmental monitoring and environmental management plan,Planning and management of impacts studies,Cost-benefit analysis of the project: present and future worth of project, feasibility report ,Preparation, writing and appreciation of EIA reports pertaining to Dam, Mining and other industries. Concept of Social Impact Assessment (SIA).	**L= 11**	**T= 2** **P= 2**
3	**Unit- III: Environmental Management System (EMS):** Scope, application and benefits of ISO certification; Introduction, terms and definitions, Need for EMS, ISO 14000 (Series) – The Basic Principles; Environmental Management System Requirement - Deming Cycle of continual improvement. Environmental Policy, Environmental aspects and impacts. Environmental objectives. ISO 14001: Preparation of documentation. Steps for certifications; Actual conduct of audit for certification; Implementation of ISO 14000, Reporting of Non conformity and follow audit trails.	**L= 11**	**T= 2** **P= 2**
4	**Unit-IV : Environmental Auditing :** Preamble, scope and objectives of environmental auditing, Applicability of statutory environmental statement audit, Qualities of an environment auditor, Contents of EA report. Preparation of documents for consent to establish/ consent to operate / Renewal, Types of Environmental audits, - Preset audit, Impact assessment audit, compliance audit, Awareness audit and improvement / Green audit. General approach towards environmental audit, preparation of questionnaire for audit, presentation of data and certification.	**L=11**	**T=2** **P= 2**

Learning Resources		
1	**Text Books**	• A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018 • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017 • A Text Book Environmental Studies, Chatawal & Sharma, HPH • A Text Book Environmental Science, Joshi & Joshi, APH • A Text Book of Environmatal Studies, Nambiar, STP
2	**Reference books**	• Environmental Impact Assessment By: Larry W Canter. McGraw-Hill International Editions, 2nd Edn, New York (1996) • EIA Theory & Practice By: Peter Wathern. Unwin Hyman, London (1990) • Environmental Impact Assessment By: PR Trivedi. APH Publishing Corporation, New Delhi (2004) • EIA Practical Solutions to Recurrent Problems By: David P Lawrence. Wiley Interscience Publication (2003) • A Handbook of EIA By: VS Kulkarni, SN Kaul & RK Trivedy. Scientific Publishers (India) • EIA (Available Techniques, Emerging Trends) By: SA Abbasi & DS Arya. Discovery Publishing House, New Delhi (2000) • Environmental Impacts of Agricultural Production Activities By: Larry W Canter. Lewis Publishers, Inc. USA (1986) • Environmental audit by Mhaskar AK • EIA – A Bibliography with abstracts By: B.D. Clark, R. Bisset, P. Wathern (1980), Mansell London • Manners, IR, Micksell MW (1974) Perspectives on Environment Association American Geographers, Pub. 13. • Environmental Assessment and Statements by Harr and Hagerty (1977) • Environmental Auditing by Central Pollution Control Board. • Stoner, Freeman, Gilbert – Management – Prentice Hall of India Ltd., New Delhi – VIth Edition • Kathryan M. Bartol & David C. Martin – Management – Mc Graw – Hill Services in management, Second Edition • Terry – Franklin – Principles of Management – All India Traveler Bookseller • R.S.Gupta, B.D. Sharma, N.S.Bhalla – Principles and Practic of Management – Kalyani Publishers Edition 1990 • P.C. Tripathi , P.N.Reddy – Principles of Management – Tata Mc Graw – Hill publishing Co. Ltd. Vth Edition • Harold Koontz & Cyril O' Donnell – Management - Mc Graw – Hill publication. • Environmental audit by Mhaskar AK • A Bibliography with abstracts y B.D. Clark, R. Bisset, P. Wathern (1980), Mansell London • Manners, IR, Micksell MW (1974) Perspectives on Environment Association American Geographers, Pub, 13.

		• Environmental Impact Assessment by Canter, L. (1977), McGraw Hill • Environmental Assessment and Statements by Harr and Hagerty (1977) • Environmental Auditing by Central Pollution Control Board
3	**Websites**	• https://www.cbd.int/impact/whatis.shtml • https://nptel.ac.in/courses/120108004/module3/lecture3.pdf • https://nptel.ac.in/courses/120108004/module2/lecture2.pdf • http://mpcb.gov.in/ • https://www.cseindia.org/tag/state-pollution-control-board--(spcb) • https://www.iaia.org/wiki-details.php?ID=23
4	**Journals**	• Current Science, ISSN No. 0011-3891 • Every Thing About Water • Down to Earth • Industrial Safety Chronicle • International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842 • Resonance, ISSN No. 0971-8044 • Journal of Earth System Science, ISSN No .2253-4126
5	**Supplementary Reading**	• CPCB Report • MPCB Report
6	**Practical Components**	• Project report preparation on EIA & EMS

Semester	III	Total Credit	4
Course Code	DSE 301 (B)	Credit Pattern	L-45, T-8, P-7
Course Title	SAFETY LEGISLATION AND MANAGEMENT		

Course Objectives	
1	Outline the legislative provisions in India in accordance to occupational health and safety.
2	Relate the major OHS legislations in India like The Factories Act, The Mines Act etc.

Course Outcomes: The students will able to	
1.	Interpret role and function of occupational Safety in Industry.
2.	Discover certain laws concerning to Occupational health.
3.	Prioritize the socio legal aspects of Occupational Health and Safety.
4.	Conclude compensatory & Environmental Laws.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Introduction to Occupational Health and Safety** Meaning of Occupational Health and Safety, Role of International Labour Organisation for OHS,Provision of Right to health under Indian Constitution: Articles 24,39(e and f) and 42 Remedies : Ministry of Labour, Art.32 and 226, Public Interest Litigation, Role of Judiciary.	**L= 11** **T=2**	**P=2**
2	**Occupational Health Laws** Factories Act, 1948 : Inspecting Staff, Health and Safety Provision, Offences & Penalties related to Health and Safety, Mines Act, 1952: Salient Feature of the Act, Provision as to Health and Safety, Hours and limitation of employment. Dock Workers (Safety, Health and Welfare) Act, 1986: provisions relating to health and safety, The Indian Boiler's Act, 1923 : Definitions, Offences and Penalties, Exemption The Hazardous and other Wastes (Management and Transboundary Movement) Rules 2016.	**L= 11** **T= 2**	**P= 2**
3	**Socio-legal Aspects of Occupational Health and Safety** The Sexual,Harassment of Women at Workplace (Prevention, Prohibition and Redressal)Act, 2013, National Policy on Safety, Health and Environment 2009,Challenges of OHS : Resources, Unorganized sector, to build OHS culture-Education, Awareness, Mental Health Act 1987 : Objectives, features, Penalties and Procedure, The Bio-Medical Waste (Management and Handling) Rules, 1998.	**L= 11** **T= 2**	**P= 2**
4	The Workman Compensation Act, 1923 : Rules for workman's compensation, legal remedies,The Employees State Insurance Act 1948 : Contribution and Benefits, related penalties,The Employment Provident Fund Act, 1952 : Applicability and eligibility, Penalties,The Public Liability Insurance Act, 1991 : Offences and Penalties,The Maternity Benefit Act 1961 : Features and Provisions **Environmental Protection Legislation** Stockholm Conference, Rio Conference, Indian Constitution-Art.14,21,	**L=12** **T=2**	**P= 1**

	48(A),51(1)(g), Noise Pollution Laws : Indian Penal Code,1860, Cr.P.C., Noise Pollution Rules 2000, Law of Torts, Environment Protection Act, 1986 : General Powers of Central Government, Offences and Penalties The Motor Vehicle Act, 1988 : Features, Offences and Penalties		

Learning Resources		
1	**Text Books**	• Labour and Industrial Law, K M Pillai, Allahabad Law Agency, Allahabad. • Environmental Law, Paramjit S.Jaswal, Nishtha Jaswal, Allahabad Law Agency, Allahabad. • Current Science, ISSN No. 0011-3891Industrial Safety Management by L.M. Deshmukh, McGraw Hill Education Publication, 1st July, 2017 • Industrial Safety & Environment by Er. A. K. Gupta, ISBN: 9788131804544
2	**Reference books**	• The Constitution of India, P.M.Bakshi, Universal Law Publishing, New Delhi • The Law of Consumer Protection (Student Ed.), Dr.G.B.Reddy, Gogia Law Agency, Hyderabad • Commentary on Labour and Industrial Law (2nd Ed. 2013), Ahmedullah Khan, Asia Law House, Hyderabad • Introduction to the Constitution of India, Durga Das Basu, Wadhava and Company Publisher, New Delhi • Labour and Industrial Laws, S.N.Mishra, Central Law publications, Allahabad.
3	**Websites**	• http://mpcb.gov.in/ • https://www.cseindia.org/tag/state-pollution-control-board--(spcb) • https://www.iaia.org/wiki-details.php?ID=23
4	**Journals**	• Current Science, ISSN No. 0011-3891 • Every Thing About Water • Down to Earth • Industrial Safety Chronicle • International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842 • Resonance, ISSN No. 0971-8044 Journal of Earth System Science, ISSN No .2253-4126
5	**Supplementary Reading**	• Factory Act 1948 • Industrial Safety Chronicle. Published by National Safety Council., Mumbai
6	**Practical Components**	• Visit to various Industries to study safety aspects.

Semester		**Total Credit**	**2**
Course Code	**GE 301-A**	**Credit Pattern**	**L-22, T-4, P-4**
Course Title	**Entrepreneurship Development**		

Course Objectives	
1	To understand the concept and importance of entrepreneurship
2	To develop entrepreneurial skills and abilities among the students to run business efficiently and effectively
3	To provide insights to the students on entrepreneurship opportunities
4	To familiarize students with the support system provided by the government for entrepreneurship.

Course Outcomes: Students will be able to	
1	Explain Basic Concept of Entrepreneurship and link the Entrepreneurship with Economic Development.
2	Develop the Business Plan for any kind of new enterprise.
3	Discuss Role of Central and State Government in Entrepreneurship Development.

Syllabus:

Unit Number	**Contents**	**Number of Sessions**	
1	**Introduction to Entrepreneurship** Concept of Entrepreneur & Entrepreneurship, Types of Entrepreneurs, Characteristics and Skills of Successful Entrepreneurs, Entrepreneur Vs Manager, Role of Entrepreneurship In Economic Development, Challenges faced by Entrepreneurs, Role of Central and State Governments in Promoting Entrepreneurship	**L= 11**	
		T= 2	**P= 2**
2	**Developing Business Plan** Sources of Business Ideas, Evaluation of New Business Ideas, Business Idea Feasibility Study, Developing a Business Plan: Contents, Importance, Advantages. Presentation of Business Plan, Sources of Business Finance: Internal and External Funds.	**L= 11**	
		T= 2	**P= 2**

Learning Resources		
1	**Text Books**	1. S.S. Khanka, Entrepreneurial Development, S. Chand And Company Ltd., New Delhi 2. Dr. R.R. Khan, Entrepreneurial Management, School Of Management Studies, Mumbai 3. M.B. Shukla, Entrepreneurship And Small Business Management, Kitab Mahal, Allahabad
2	**Reference books**	1. Raj Shankar – "Entrepreneurship: Theory and Practice" – Vijay Nicole Imprints Pvt. Ltd., 2. D. F. Kuratko, T. V. Rao – "Entrepreneurship: A South Asian Perspective" – Cengage Learning 3. David H. Holt, "Entrepreneurship – New Venture Creation", Prentice Hall, New Delhi

3	**Websites**	1. www.startupindia.gov.in 2. www.india.gov.in 3. https://www.sidbi.in/ 4. https://www.nstebd.com/ 5. https://www.nsic.co.in/ 6. https://www.makeinindia.com/
4	**Journals**	1. The Journal of Entrepreneurship | Sage India 2. AMC Indian Journal of Entrepreneurship 3. Entrepreneurship Journal - Publishing India 4. https://www.Ediindia.org/the_journal_of_entrepreneurship 5. Journal Of Entrepreneurship, Management And Innovation
5	**Supplementary Reading**	1. https://articles.bplans.com/a-standard-business-plan-outline/ 2. http://yie.in/ 3. http://tie.org/
6	**Practical Component**	1. Interview a local entrepreneur and understand attributes behind his/her success 2. Visit to DIC to understand the Government Support 3. Visiting NGOs to understand the concept of Social Entrepreneurship. 4. Interview a local Woman Entrepreneur to understand the challenges faced by her.

Semester	III	Total Credit	4
Course Code	GE 301- B	Credit Pattern	L-24, T-06, P-00
Course Title	E-Commerce		

Course Objectives	
1	To explain the nature and different models of E-commerce
2	To explain the technologies required to make e-Commerce viable.
3	To discuss the current drivers and inhibitors facing the business world in adopting and using e-commerce and
4	To discuss the trends in e-Commerce and the use of the Internet.
5	To discuss e-commerce from an enterprise point of view.
6	To demonstrate the concepts of security in e-commerce applications.
Course Outcomes	
After completion of this course the student will be able to:	
1	Recognize the business impact and potential of e-commerce
2	Develop a holistic perspective on the role of IT in organizations.
3	Identify target market based on numerous parameters.
4	Select appropriate e-commerce models for any organization.
5	Follow security measures while dealing with e-commerce applications.

Unit Number	Contents	Number of Sessions	
1	History of e-commerce and Indian business context, www, advantages and disadvantages of e-commerce, e-commerce in India, various Indian case studies. Business models for e-commerce, different type of e-commerce, brokerage model, aggregator model, info-mediary model, community model, value chain model, manufacturer model, advertising model, subscription model, affiliate model.	**L=12**	
		T=03	**P=00**
2	Technologies of the www & e-security, internet client-server applications, networks and internets, URL, software agents, internet service providers, html, java script and xml, e-security, security on the internet, hacking, various security risks, e-business risk management issues, firewall. E-marketing, identifying web presence goals, the browsing behavior model, online marketing, e-advertising, internet marketing trends, target markets, e-branding, marketing strategies. Legal and ethical issues, IT Law, phishing, copy right.	**L=12**	
		T=03	**P=00**

References		
1	**Text books**	a. E-commerce - An Indian Perspective by P.T. Joseph, S.J , PHI publication
2	**Reference books**	1. The unofficial guide to starting an e-commerce business by Jason R.Rich, IDG books India. 2. E-Commerce (Pearson Custom Business Resources) by Kenneth C. Laudon 3. Electronic Commerce by Gary P. Schneider
3	**Websites**	1. http://notes4learners.blogspot.com 2. https://www.academia.edu/8099032/e_commerce_notes 3. https://examupdates.in/e-commerce-full-notes/ 4. https://www.javatpoint.com/html-tutorial 5. http://www.echoecho.com/html.htm
4	**Journals**	1. "Electronic Commerce Research", ISSN: 1389-5753 (Print) 1572-9362 (Online), https://link.springer.com/journal/10660 2. "E - Commerce for future & Trends", eISSN: 2454–9347, http://stmjournals.com/E-Commerce-for-future-and-Trends.html 3. "Journal of Web Development and Web Designing", http://matjournals.com/Journal-of-Web-Development-and-Web-Designing.html
5	**Supplementary Reading**	1. geeksforgeeks 2. tutorialspoint 3. w3Schools
6	**Practical Components**	----------
1	**Text books**	b. E-commerce - An Indian Perspective by P.T. Joseph, S.J , PHI publication
2	**Reference books**	4. The unofficial guide to starting an e-commerce business by Jason R.Rich, IDG books India. 5. E-Commerce (Pearson Custom Business Resources) by Kenneth C. Laudon 6. Electronic Commerce by Gary P. Schneider

Semester	**III**	**Total Credit**	**2**
Course Code	**GE 301-C**	**Credit Pattern**	**L-20, T-5, P-5**
Course Title	**CORPORATE SOCIAL RESPONSIBILITY**		

Course Objectives	
1	To understand the scope and complexity of corporate social responsibility.
2	To gain knowledge of the impact of CSR implementation on societies
3	To acquire skills to frame and design CSR policies and practices appropriate to the Indian workplace.

Course Outcomes: Students will be able to	
1	know the Corporate Social Responsibility of different sector.
2	use the acquired skill for proper sustainable Corporate Social responsibility.

Syllabus:

Unit Number	**Contents**	**Number of Sessions**	
1	Introduction to CSR: Meaning & Definition of CSR, History & evolution of CSR. International framework for corporate social Responsibility, Millennium Development goals, Sustainable development goals, Relationship between CSR and MDGs.United Nations (UN) Global Compact 2011. UN guiding principles on business and human rights.– Globalization and CSR.	**L= 10**	
		T= 3	**P= 2**
2	Indian perspectives and approaches: Models of CSR in India,. Initiatives in India. Corporate Governance and CSR , CSR Policy and guidelines , Legal frame work, rules and regulations, Company Act 2013 - relevant provisions of CSR. Role of Government and NGO in CSR. Business Benefits of CSR.	**L=10**	
		T=2	**P=3**

Learning Resources		
1	**Text Books**	1. Benn & Bolton, (2011). Key concepts in corporate social responsibility. Australia: Sage Publications Ltd. 2. Bradshaw, T. and D. Vogel. (1981). Corporations and their critics: Issues and answers to the problems of corporate social responsibility. New York: McGraw Hill Book Company 3. Brummer, J.J. (1991). Corporate Responsibility and Legitimacy: An interdisciplinary analysis. Westport, CT: Greenwood Press. 4. Cannon, T. (1992). Corporate responsibility (1st ed.) London: Pitman Publishing.

		5. Crane, A. et al., (2008). The Oxford handbook of corporate social responsibility. New York: Oxford University Press Inc.
2	**Reference books**	1. Lourdes Poobala Rayen- Corporate Social responsibility. 2. Ellington. J. (1998).Cannibals with forks: The triple bottom line of 21st century business. New Society Publishers 3. Baxi C.V and Ajit P, Corporate Social Responsibility, Concept & Cases: "The Indian Experience, Excel Books. 4. Reddy S and Stefan S (2004). Corporate Social Responsibility: Sustainable Supply Chains. Hyderabad: ICFAI University Press. 5. Werther, W. B. & Chandler, D. (2011). Strategic corporate social responsibility. Thousand Oaks, CA: Sage
3	**Websites**	www.forbes.com www.referenceforbusiness.com www.justmeans.com www.corporatesocialresponsibility.org
4	**Journals**	International Journal of Corporate Social Responsibility | Home https://jcsr.springeropen.com Sustainability Accounting, Management and Policy Journal, Emerald, 2010- -World Review of Entrepreneurship, Management and Sustainable Development, Inderscience Publishers, 2005-
5	**Supplementary Reading**	1. http://www.diegdi.de/CMSHomepage/openwebcms3.nsf/%28ynDK_contentByKey%29/ENTR- 7BMDUB/$FILE/Studies%2026.pdf 2. Modi P.K., Corporate Social Capital Liability. Arise Publishers & Distributors. First editions - 2009 3. Sharma, J.P., Corporate Governance, Business Ethics & CSR, Ane Books Pvt Ltd, New Delhi.
6	**Practical Component**	Visit to industries to study and record various CSR activities and discuss the same with students and teachers to know the merits and demerits od CSR.

Semester	III	Total Credit	2
Course Code	GE 301D	Credit Pattern	L-22, T- 04, P-04
Course Title	Basics of Indian Economy		

Course Outcomes: Students will be able to	
1	Identify the main issues in Indian economic development
2	Critically analyse the Indian economic policy environment

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**UNIT-1: Indian Economic Environment:** Meaning of underdevelopment, Basic characteristics of India as a developing economy, Major issues of development: Poverty, Unemployment and Inequality, National Income of India: Trends, Growth and Structure. Features and importance, Green Revolution, Low productivity of agriculture and government measures Role of Industrialization, Industries and Five-year plans, Industrial Policy(1991), Services sector Role & Importance	**L= 11**	
		T= 2	**P= 2**
		T=2	**P=2**
2	**UNIT-2: Indian Economic Planning and Reforms:** Objectives of Economic Planning, Redefining the role of the State, Brief review of Five-Year Plans, New Economic Reforms: Liberalization, Privatization and Globalization, NITI Ayog, Balanced Regional Development.	**L= 11**	
		T= 2	**P= 2**

Learning Resources		
1	**Text Books**	• Agarwal A N (2016), Indian Economy, Vikas Publishing House Pvt. Ltd., New Delhi • Gaurav Datt& Ashwini Mahajan (2016), Indian Economy, S. Chand and Company Pvt. Ltd., New Delhi • Misra and Puri (2013), Indian Economy, Himalaya Publishing House Pvt. Ltd., New Delhi.
2	**Reference books**	• Deepashree (2011), Indian Economy, Ane Books Ovt. Ltd., New Delhi • Uma Kapila (2017), Indian Economy: Performance and Policies, Academic Foundation, New Delhi

3	**Websites**	• **www.rbi.org.in** • www.mygov.gov.in • www.cmie.com
4	**Journals**	• Arth Samwad • Economic and Political Weekly • Indian-Economic-Journal • Journal-of Indian-School-of-Political-Economy • Southern Economist • The Economist • Journal of Applied Economics • Indian-Economic-Journal • International Journal of the Economics of Business • Journal-of Indian-School-of-Political-Economy • Agricultural-Economic-Research-Review
5	**Supplementary Reading**	• Economics Survey • Union Budget of India • Niti Ayog Reports • Economics Times Daily • Business Standard Daily • Business Today Daily • Latest Monetary Policy • Latest Fiscal Policy
6	**Practical Component**	• Collect Economic Survey of India of last five years and prepare a report on trends in major macro-economic variables of the country • Establish the relationship between sectoral growth patterns and business environment by collecting data on three major sectors of the economy

Semester	III	Total Credit	2
Course Code	GE 301 E	Credit Pattern	L-23, T-07, P-0
Course Title	DISASTER MANAGEMENT		

Course Objectives	
1	Understand the concept and impact of disasters.
2	Describe the causes, effects and control measures of disasters.

Course Outcomes: After completion of this course students will have capacity to	
1.	Recognize the various global and regional environmental concerns/hazards due to natural causes and/or human activities, and the impact of these on various forms of life .
2.	Obtain and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios
3.	Describe and evaluate the environmental, social, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.
4.	Relate theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery)

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Introduction to Disaster Management :** Hazard and Disaster, Classification of Disasters. Hydrological Disasters - Flood, Drought, Geological Disasters- Earthquakes, Landslides, Volcanic Eruptions. Wind Related Disasters- Cyclone, Biological Disasters Man Made Disasters : Fire – Industrial, Domestic and wild fire Technological Disasters- Bhopal Gas Tragedy Road, Chernobyl and Fukushima. Marine and Social Disasters	L= 11 T= 4	P= 0
2	**Disaster Management :** Risk assessment, Disaster Management Act 2005, National Disaster Management Framework, Role of various organisations- National Disaster Management Authority (NDMA), State Disaster Management Authority (SDMA), District Disaster Management Authority (DDMA), Financial Arrangements for Disaster Management, Disaster management cycle , NDRF. Non-Governmental Organisations, community participation, Education, training for public in emergency preparedness plan, Rescue & rehabilitation programmes.	L= 12 T= 3	P= 0

Learning Resources		
1	Text Books	• Textbook Of Environmental Science And Technology by REDDY, BSP publishers, 2019 • A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018

		• A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017 • A Text Book of Ecology, Tyler Miller, Cengage Learning • A Text Book Environmental Studies, Chatawal & Sharma, HPH • A Text Book Environmental Science, Joshi & Joshi, APH • A Text Book of Environmatal Studies, Nambiar, STP
2	**Reference books**	• Nuclear Accidents (Man Made Disasters) Mark Mayell Publisher: Lucent Books • Management of Man-made Disasters, S. L. Goel, Motilal Banarsidass Publishers Private Limited, New Delhi, ISBN: 8176297151 • Handbook of Pollution Control Processes By: Robert Noyes. Jaico Publishing House, Mumbai (2003) • Fire & Explosion Hazards Handbook of Industrial Chemicals By: TA Davletshina & NP Cheremisinhoff, Noyes Publications, Mumbai (2003) • Environmental Geology by K. Valdiya, Tata McGraw Hill Publishing Co. • Perspectives on Environment by I.R. Manners, M.W. Micksell • Our Planet, Our Health by WHO (1992) • Report of the Panel on Industry by WHO (1992) • Natural Disasters, Author: Claire Watts / Trevor DayPublisher: Dk Publishing, ISBN: 9781465438096 • Environmental Biology by K.C. Agarwal • Resource Book on Chemical (Industrial) Disaster Management, http://nidm.gov.in/PDF/pubs/chemical_mdc.pdf • Directory of Institutions and Resource Persons for Landslide Management In India • http://nidm.gov.in/PDF/pubs/directory%20landslide.pdf
3	**Websites**	• Directory of Institutions and Resource Persons for Landslide Management In India • http://nidm.gov.in/PDF/pubs/directory%20landslide.pdf • https://www.ifrc.org/en/what-we-do/disaster-management/about-disaster-management/ • https://en.wikipedia.org/wiki/Disaster_management_in_India
4	**Journals**	• Current Science, ISSN No. 0011-3891 • Down to Earth • Journal of Biosciences, ISSN No. 0250-5991 • Journal of Environmental Biology, ISSN No. 0254-8704 • Resonance, ISSN No. 0971-8044 • Journal of Earth System Science, ISSN No .2253-4126 • Industrial Safety Chronicle • International Journal of Environmental Engineering Science, ISSN No .2229-3094
5	**Supplementary Reading**	• Demonstration of Fire & Water Safety.
6	**Practical Components**	• Mock drill for various disaster • Disaster Management Action Plan

Semester	III	Total Credit	2
Course Code	AEC 301-A	Credit Pattern	L-23, T-7, P-0
Course Title	ENVIRONMENTAL LEGISLATION		

Course Objectives	
1	Understand the Government policies and their application in the context of environmental protection.
2	Make use of the present legal provisions in current practices of his job and business.

Course Outcomes: The students will able to	
1.	Classify the various environmental policies, laws and institutions involved in the protection and conservation of environment.
2.	Infer various strategies practiced across the globe for environmental conservation.
3.	Evaluate the environmental provisions and acts regarding environmental protection.
4.	Know environmental acts.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Environmental Acts-I:** Constitutional provisions regarding environment protection: Article 47 (Directive principles of State Policies), Article 48A (1942 Amendment), Article 51A(g) (Fundamental duties) The Wild Life (Protection) Act, 1972 The Water (Prevention and Control of Pollution) Act, 1974. The Air (Prevention and Control of Pollution) Act, 1981. Forest (Conservation) Act, 1980.	L= 12 T=4	P=0
2	**Environmental Acts-II:** The environment (Protection) Act, 1986. Public Liability Insurance Act, 1991. Industrial Wastes and Law, Sec. 12 of Factories Act, (1948) and rules framed there under. Hazardous waste (Management & Handling) Rule, 1989 Noise Pollution and Law, Sec. 119 and 120 of the Motor Vehicles Act (1989) and rules framed there under. Note: any amendment to the act impinged time to time is to be covered.	L= 11 T= 3	P= 0

Learning Resources		
1	Text Books	• Environmental Protection and the Laws by CN Mehta, 1991 • India's Forests, Myth and Reality by J.B. Lal 1989 • Legal aspects of Environmental Pollution and its Management by Ed. S.M. Ali, 1992 • Man – Nature and Environmental Law by GS Nathawal, S. Shastri and JP Vyyar, 1988

2	**Reference books**	• International Environmental Policy: Emergence and Dimensions by LK Caldwell, 1990 • Lal's Commenteries on Water, Air Pollution Laws along with the Environmental (Protection) Act and Rules, 1986, 3rd Ed., 1992 Law Publisher – India • The Wildlife (Protection) Act, 1972 (with amendment-1991) • Our Common Future – WCED, 1991 • Universal's Environment and Pollution Law Manual by SK Mohanty, 1998. • Ecology and Environment by P.D. Sharma,2012, Rastogi Publications, Meerut, India.
3	**Websites**	• http://mpcb.gov.in/ • https://www.cseindia.org/tag/state-pollution-control-board--(spcb) • https://www.iaia.org/wiki-details.php?ID=23
4	**Journals**	• Current Science, ISSN No. 0011-3891 • Every Thing About Water • Down to Earth • Industrial Safety Chronicle • International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842 • Resonance, ISSN No. 0971-8044 Journal of Earth System Science, ISSN No .2253-4126
5	**Supplementary Reading**	• Down to Earth, CSE
6	**Practical Components**	• Relevant Case Studies.

Semester	III	Total Credit	2
Course Code	AEC 301- B	Credit Pattern	L-24, T-7, P-0
Course Title	REMOTE SENSING AND GIS		

Course Objectives	
1	Understand basic concepts of Remote Sensing and GIS
2	Describe applications of GIS in the field of Environmental Science.

Course Outcomes: The students will able	
1.	Define remote sensing and GIS.
2.	Explain EMR, Energy interactions and types of Aerial photographs.
3.	Elaborate applications of GIS in Environmental science.
4.	Make use of GIS for various applications.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Remote Sensing :** Definition and Scope of Remote Sensing, Indian Space programme. In situ and Remote sensing, Electromagnetic spectrum, Transmission, Absorption, Reflection, Energy interaction with earth surface and atmosphere, Aerial photography- Classification Of Aerial Photographs , Types of aerial photographs Applications of Aerial Photographs. Satellite imageries-Scanners, pixels, grey levels, bands . Introduction of Remote Sensing Satellites, Meteorological Remote Sensing Satellite, (Polar and Geostationary Satellites), Non Meteorological RS Satellites (Landsat, Spot, IRS), Resolution (Spectral, Spatial and Frequency of Coverage). Satellite data products and selection of satellite data, Applications of Remote Sensing in Environmental Studies.	**L= 12** **T=4**	**P=0**
2	**Geographical Information System (GIS):** Definition of GIS, Capabilities and advantages of GIS, Sources of data, types of data, hardware requirement, Components of GIS., Data structure, Raster and Vector data models, Advantages and disadvantages of vector data and raster data. GIS packages and Application of GIS in Environmental Management. **GIS Analysis :** Topology: Error and editing; GIS data quality, errors, policies. Vector data analysis: Buffering, Overlay analysis (point in polygon, line in polygon, polygon in polygon etc.); Network analysis; Terrain analysis: DEM, DTM and TIN. Interpolation techniques in GIS, Raster data analysis, Non-spatial data, Database Management system (DBMS).	**L= 12** **T=3**	**P=0**

Learning Resources		
1	**Text Books**	• Textbook Of Remote Sensing & Geographical Inform. Systems by KALI CHARAN, Atlantic Publisiers, 2018
2	**Reference books**	• Principles of Photo geology by Singh • Principles of Remote Sensing by Currain • Fundamentals of Photo geology by SN Pandey • Remote Sensing and Image Interpretation:-Tomas M.Lillesand and Ralph W.Keifer john Wiley and sons Inc.New Yark. • Introduction to Remote sensing:-James B. Campbell, Tylor and Franeis Ltd.Londan. • Fundamentals of GISN:-Michael N.Demers.. • Remote Sensing application in applied geosciences:-Sumitra Mukherjee, Milton Book Company. • Principles of Remote Sensing:-A.N.Gatel and S.Singh, Scientific Publishers (India). Jodhpur (1999Edition). • Remote Sensing for Environment and Forest Management:-A.Mehrotra and R.K.Suri. Indus Publishing Co.New.Dehli(1994 Edition) • Remote sensing for large wildfires:-E.Chuvieco, Springer, New York (1999 Edition). • Remote Sensing in Geoscience:-Tripathi N.K. • DeMers, Michael N.,2000. Fundamentals of Geographic Information System (2nd Ed.) (Wiley Student Edition). New York: Jhon Wiley & Sons, Inc. • Foreseman, T. (Ed) 1998. The History of Geographic Information System- Perspectives from the Pioneers. Upper Saddle River. NJ : Prantice Hall. • Heywood, Ian: Cornelius, Sarah: Carver, Steve.2000. An Introduction to Geographic Information System(Pearson Education Asia Low Priced Edition). Longman. • Kraak, Menno-Jan and Ormeling, Ferjan. 2004. Cartography – Visualization of Geospatial Data (2n d Ed.) (Pearson Education Low Price Edition). Pearson Education. • Schuurman, Nadine. 2000. "Trouble in the Heart land: GIS and its Critics in the 1990s." Progress in Human Geography, vol. 24, no. 4, pp.569-590. • Schuurman, Nadine and G. Pratt. 2002. "Care of the Subject: Feminism and Critiques of GIS." Gender, Place and Culture, vol. 9, no. 3, pp. 291-299.
3	**Websites**	• https://oceanservice.noaa.gov/facts/remotesensing.html • https://gisgeography.com/what-gis-geographic-information-systems/ • https://www.esri.com/en-us/what-is-gis/overview

4	**Journals**	• Current Science, ISSN No. 0011-3891 • Down to Earth • Journal of Earth System Science, ISSN No .2253-4126 • Journal of Biosciences, ISSN No. 0250-5991
5	**Supplementary Reading**	• Down to Earth
6	**Practical Components**	• Geo Referencing • Practical Based on Paper (Practical III & IV)

Semester	IV	Total Credit	2
Course Code	AECC-301	Credit Pattern	L-22, T-8
Course Title	Employability Skills		

Course Objectives	
1	Develop effective communication skills
3	Develop broad career plans

Course Outcomes	
After completion of this course the student will be able to:	
1	Match the job requirements and skill sets.
3	Evaluate the employment market.

Unit Number	Contents
1	**Personality**, **Interpersonal and employability skills and Emotional Intelligence: (15)** Basic Interaction Skills –Within family, Society. Interpersonal and intrapersonal skills. Types of skills; Decision Making, Articulation Skills, Emotional Intelligence Human relations examples through role – play and cases
2	**Leadership Skills, Team work, Conflict Management ,Interview Skills, Time Management and Stress Management: (15)** **Leadership skills** – Leadership in groups, coaching, strategic management **Team work & Team building** - Characteristics of an effective team, Essentials of an effective team, Evolution Team. Activities – Team trust, team shape up. **Conflict Management** – Types of conflicts, how to cope with them Small cases including role – plays will be used as teaching methodology. **Interview skills –** Preparation pre-during and post interview Resume writing, self grooming for the interviews. Introduction, Types of interviews, process of interview, Preparation of the candidate, preparation of the interviewer, common interview questions. **Time Management –** Importance, Prioritizing tasks, Personal Goal Setting – SMART goals, delegation, Time management in meetings, barriers to time management, identifying and handling time consuming tasks. Activity – Games, role-play, case studies. **Stress Management** – Understanding stress, Types of stress, symptoms, causes of stress. Managing stress, Techniques of managing stress. Activity – questionnaire to find out the level of stress.

Learning Resources		
1	Reference Books	Business Communication – UrmilaRai& S M. Rai, 12/e, Himalaya Publishing House, 2010. Enhancing Soft Skills – Prof.Dipali Biswas, 1/e, Shroff Publishers & Distributors Pvt. Ltd., 2009. The ACE of Soft Skills – Gopalaswamy Ramesh &Mahadevan Ramesh, 3/e, Pearson Eductaion, 2012.Successful Career, Soft Skills and Business English – Varanasi Bhaskara Rao & Y. Kameswari, 1/e, BS Publications, 2010. Perrsonality Development and Soft Skills - Barun K. Mitra Emotional Intelligence by Daniel Goleman

SEMESTER-IV

Semester	**IV**	**Total Credit**	**4**
Course Code	**CC 401**	**Credit Pattern**	**L-45, T-8, P-7**
Course Title	**ENVIRONMENTAL MICROBIOLOGY, BIOTECHNOLOGY AND TOXICOLOGY**		

Course Objectives :	
1	To study the world of Microbes & use Biotechnological Approaches in Environmental Pollution Management, Energy Resource Management, Forest Management.
2	To study the concept and significance of environmental toxicology.

Course Outcomes: After completion of this course students will have capacity to	
1.	Describe the importance of microbial diversity, benefits and harms of MOs with potential applications in the innovative environmental management technologies.
2.	Describe and apply existing and emerging technologies like *in- situ, ex-situ,* & engineered bioremediation, phyto-remediation for environmental clean up and environmental pollution management. Appreciate the scientific, ethical and social issues associated with certain applications of biotechnology in agriculture and forest management.
3.	Demonstrate an awareness about emerging concerns of reductions in fossil fuels through new biotechnological interventions in the harnessing renewable biomass energy. Describe and apply biotechnological solutions like bio-plastics, bio-fertilizers, bio-pesticides, bio-mining, biosensors to address present environmental concerns.
4.	Identify and evaluate the toxic chemicals, mutagens, carcinogens and their relationships between exposure and dose-response relationships. Evaluate effects on living/physiological systems like neurotoxicity, nephro-toxicity, hepato-toxicity, and reproductive toxicity.

Syllabus:

Unit Number	**Contents**	**Number of Sessions**	
1	**Introduction to Environmental Microbiology** Types of Microbes, Harms & Benefits of MOs with their Environmental Significance.Modern Environmental Microbiology, Microbial Diversity Microbial Nutrition, Media components & Media Preparations,Methods of Sterilizations, Maintenance of Aseptic Conditions,Classification of microorganisms according to Nutrition,Enrichment culture technique for the isolation of desired types of microorganism, Microbial growth in closed and open environments,Binary Fission, Generation Time, Growth Curve,Factors Affecting Microbial Growth-: Nutrients, pH, Temperature, Salinity, Moisture Content, Radiation, Heavy Metals, Toxic chemicals etc,Concept & Methods of Isolation of Pure Culture,Enumeration of MOs in Environmental Samples by Direct and Indirect Methods.	**L= 11**	
		T=2	**P=2**
2	**Fundamentals of Environmental Biotechnology** Concept and Terminologies in Environmental Biotechnology Biotechnological approach of environmental pollution abatement - Bioremediation of contaminated sites, organic and inorganic xenobiotics, *in situ* and *ex situ* and engineered ,Phytoremediation, Biotechnology and Energy management- Biofuels (Liquid fules, Biogas and Biodiesel) Biotechnology and forest management, Industrial Biotechnology,	**L= 11**	
		T= 2	**P= 2**

	Principles of Green chemistry		
3	**Advanced Environmental Biotechnology** Novel applications of biotechnology,Integrated Pest Management & Bio-pesticides, Integrated Plant Nutrient Management & Bio-fertilizers, Biopolymers And Bioplastics, Bioleaching and biomining (Biohydrometallurgy)Biosensors, biofilms, biosurfactants Biosafety of GMOs	**L= 11** **T= 2**	**P= 2**
4	**Environmental Toxicology** Toxicology – Scope, Definition. Evaluation of toxicity –Types and routes of entry of toxicants. Acute, sub acute, chronic toxicity;Dose and Response- LC50/LD50/ concepts and significance, their estimation ,Toxic effects at cell, tissue, organ level, Some organ specific toxicity studies – Neurotoxicity, Nephrotoxicity, Hepatotoxicity, reproductive toxicity; Carcinogenesis – Relation between mutagenesis and carcinogenesis,Environmental carcinogens; Toxic agents in environment-Agrochemicals, industrial chemicals, drugs, food additives, Safety Regulations & Legal control.	**L=12** **T=2**	**P= 1**

Learning Resources

1	**Text Books**	• Environmental Biotechnology, Buddolla, Narosa • Environmental Biotechnology, Allen, CBS • Environmental Biotechnology, Fulekar,CRC • Environmental Biotechnology, Scragg, Oxford • Essentials of Biotechnology, Michael Chrichton,MEDTEC • Biotechnology, Smith,Cambdridge
2	**Reference books**	• Microbiology By: Michael J Pelczar, Jr; ECS Chan & NR Krieg. Tata McGraw-Hill Edition, New Delhi (1998) • Principles of Microbiology By: Ronald M Atlas 2nd Edn, WCB McGraw-Hill, Boston (1997) • General Microbiology By: RY Stanier, JL Ingraham, ML Wheelis & PR Painter. 5th Edn Macmillan Press Ltd., London (1995) • Microbial Ecology – Fundamentals and Application By: Ronald M Atlas & Richard Bartha. 4th Edn. An Imprint of Addison Wesley Longman, Inc. California (1998) • Microbiology: Fundamentals and Applications By: SS Purohit. 6th Edn. Agro Botanica (1997-98) • General Microbiology By: SB Sullia & S Shantharam. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi (1998) • Microbiology – Diversity, Disease & Environment By: Abigail A Salyers & Dixie D Whitt. Fitzgerald Science Press, Maryland (2001) • Industrial Microbiology – An Introduction y: Michael J Waites, Neil L Morgan, John S Rockey & Gary Higton. Blackwell Science, London (2002) • Microbiology – A Laboratory Manual (International Students Edition) By: James G Cappuccina & Natalie Sherman. Addison – Wesley Longman, Inc. California (1990) • Environmental Microbiology – A Laboratory Manual By: Ian L Pepper, CP Gerba & JW Brendecke, Academic Press, New York (1995) • Harish Kumar, 2001: Environmental Health Hazards, Ivy Publishing House,

		Delhi • Chermisinoff, N. P. and Graffia, M. L. 2003: Environmental Health and Safety Management, Jaico Publishing House, Mumbai • Hoffman, D. J. *et al*., Eds. 1995: Hand Book of Ecotoxicology, Lewis, London • de Vries, J. Ed. 1997: Food Safety and Toxicology, CRC Press, London • Rose, J. Ed. 1998: Environmental Toxicology, Gordon and Breach Science Publishers, Australia • Klaassen, C. D. Ed. 1996: Casarett & Doull's Toxicology V Ed., McGraw-Hill, New York • Dell'Omo, G. Ed. 2002: Behavioral Ecotoxicology, John Wiley & Sons Ltd., U. K. • Santra, S.C. (2007) Environment Science, New Central Book Agency, Calcutta.
3	**Websites**	• https://www.britannica.com/technology/biotechnology • https://en.wikipedia.org/wiki/History_of_biotechnology
4	**Journals**	• International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842 • Journal of Biosciences, ISSN No. 0250-5991 • Journal of Environmental Biology, ISSN No. 0254-8704 • Resonance, ISSN No. 0971-8044 • Current Science, ISSN No. 0011-3891
5	**Supplementary Reading**	• Down to Earth • National Geographic.
6	**Practical Components**	• Practicals based on this paper will be conducted under Paper No. Practical VII & VIII.

Semester	IV	Total Credit	4
Course Code	CC 402	Credit Pattern	L-45, T-8, P-7
Course Title	MANAGEMENT OF INDUSTRIAL AND CIVIC WASTE		

Course Objectives	
1	Understand the current Solid Waste Management practices and thus environmental and health issues associated with it.
2	Develop the appropriate strategies and approach for Solid Waste Management resulting into a best public functionary.

Course Outcomes: The students will able to	
1.	Justify the concept like Waste-to-Energy and 5R Principles of Solid Waste Management.
2.	Select suitable method for sludge management at ETP and CETP.
3.	Formulate the technologies for management of Hazardous waste including Biomedical & E-waste.
4.	Interpret the hazards related to radioactivity & manage the Radioactive wastes as per regulations.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Solid Waste Management:** Need of solid waste management; Introduction, Sources, Types, Composition of solid waste and its determination; Solid waste generation from Industries, Agriculture and Domestic sector; Segregation, Collection Storage and Safe handling, Transportation of Hazardous waste. Solid waste treatment: Compaction, dewatering, briquetting, size reduction, separation of organic and inorganic; Solid waste disposal methods – 5R Principle Solid waste energy recovering, incineration, Pyrolysis, Biogas generation Solid waste as source of raw material- Light weight bricks from fly ash, composting etc	**L= 11** **T=2**	**P=2**
2	**Sludge Management:** Organic and inorganic, sewage sludge, industrial sludge, primary and secondary sludge. Dewatering of sludge, conditioning, Compressible and non-compressible sludge, filtration, filtration aids, Dewatering aids, thickening, centrifugation, drying	**L= 11** **T= 2**	**P= 2**
3	**Unit III: Hazardous Waste Management:** Definition, identification and classification of hazardous solid waste. Characteristics of Hazardous waste: toxicity, reactivity, flammability, radioactivity, corrosivity, genetic activity, explosivity. Transboundary movement and Management of wastes, Impact of Hazardous waste on the surrounding environment. Waste avoidance and Waste minimization, Adopting the green process. **Bio-medical:** Definition, sources of generation, Need of separation. Catagories, Colour coding System. Storage, transportation, Treatment methods and Disposal. **E-Waste:** Sources of generation, categories.	**L= 11** **T= 2**	**P= 2**

	Seggrigation, Transportation, Treatment methods and Disposal. Constituents of E-wastes, recycling of e-waste and its environmental consequences,		
4	**Radioactive Waste:** Types of nuclear radiations, Natural and manmade sources of radiations, Radiation hazards and safety; internal and external radiation hazards, Biological effects of radiations : The interaction of radiations with biological cells, various stages, somatic and genetic effects, maximum permissible dose-ICRP Recommendations, safe handling methods, personal dosimetry, nuclear reactor safety, radiation protecting materials. Chernobyl, Threemile & Fukushima nuclear reactor accidents as case studies. **Management of radioactive waste**- High level and Low level wastes, liquids, solids and gases,	**L=12** **T=2**	**P= 1**

Learning Resources		
1	**Text Books**	• Vogel's Textbook of Quantitative Chemical Analysis, 5th edition, J H Basett, J. Nendham and Denny, R.C. • Textbook Of Environmental Science And Technology by REDDY, BSP publishers, 2019 • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017 • Textbook On Biotechnology by H D Kumar, Affiliated East-West Press Pvt Ltd, 2003 • A Text Book of Environmental Chemistry & Pollution Control, Dara, Chand • A Text Book of Green Chemistry, Ahluwalia, Narosa • A Text Book of Engineering Chemistry, Dara, Chand
2	**Reference books**	• Integrated Solid Waste Management – Engineering Principles & Management By: Issues by George Tchobanoglous, Hilary Theisen & Samuel A Vigil. McGraw-Hill International Editions, New York (1993) • Solid Waste Management in Developing Countries By: AD Bhide & BB Sunderesan. Indian National Scientific Documentation Centre, New Delhi (1983) • Solid Waste Engineering By: PA Vesilind, William Worrell & R. Thomas Brooks/Cole, Australia (2002) • Infectious Waste Management By: Frank L Cross Jr, Howard E Hesketh, P Kay Rykowski. Technomic Publishing Co Inc. Lancaster, Basel (1990) • Hazardous Waste Chemistry, Toxicology & Treatment By: S.E Manahan, Lewis Publishers, USA (1990) • Basics of Solid and Hazardous Waste Management Technology By: K.L Shah. Prentice Hall, Ohio (2000) • Industrial and Hazardous Wastes – Health Impacts & Management Plans By: Rajiv K Sinha & Sunil Heart. Pointer Publishers, Jaipur (2004) • Hazardous Waste Management By: MD LaGrega, PL Buckingham, JC Evans &Environmental Resources Management, McGraw-Hill International Edn. Boston (2001) • Matter Hazardous (Laws explained) By: AK Mhaskar. Media Enviro, Pune.

		• D.Bhide and B.B.Sundaresan, "Solid Waste Management– Collection, Processing and isposal" Mudrashilpa Offset Printers, Nagpur, 2001.
3	**Websites**	• http://mpcb.gov.in/images/pdf/part.pdf • https://www.britannica.com/technology/solid-waste-management • https://nptel.ac.in/courses/120108005/module9/lecture9.pdf • https://iwa-network.org/groups/sludge-management/ • http://mimoza.marmara.edu.tr/~orhan.gokyay/enve425/ch1.pdf
4	**Journals**	• Current Science, ISSN No. 0011-3891 • Every Thing About Water • Industrial Safety Chronicle • International Journal of Environmental Engineering Science, ISSN No .2229-3094 • International Journal of Environmental Pollution Control & Management , ISSN No .0975-3842
5	**Supplementary Reading**	• Industrial Safety Chronicle. Published by National Safety Council., Mumbai
6	**Practical Components**	• Practicals based of this paper conducted in (Practical paperVII & VIII)

Semester	IV	Total Credit	2
Course Code	CC 403	Credit Pattern	L-0, T-15, P-45
Course Title	PROJECT (Lab/Survey)		

Course Objectives	
1	As a part of Academic curriculum it is mandatory for the students of M. Sc. (Environmental Science) students to undergo Lab Based/ Survey Research Project during tenure of Sem. IV, in the various areas of Environmental Science, Safety & Environmental Management.

Course Outcomes: After completion of this course students will be capable to	
1	Develop Competence in scientific research designing, identifying environmental issues, planning accordingly and developing problem solving skills.
2	Choose methodology to collect samples/data, analyze and critically evaluate different technical solutions.
3	Perceive skills for project management and writing a scientific report critically and systematically.
4	Compile, interpret and presentation and explanation of their research findings to the audience effectively Contributing to team and group work for scientific investigation and reporting.

Syllabus:

	Contents	Number of Sessions	
		L= 0	
		T=15	P=45
1	Areas - 1.Waste Water Treatment — 2. Solid Waste Management 3. Characterization of Effluent Technologies — 4. Air Pollution & Control 5. Noise Pollution & Control — 6. Toxicological Study 7. Industrial Safety — 8. Disaster Management 9. Environmental Auditing — 10. ISO 14000 11. OSHAS-18001 — 12. Energy Management 13. Composting — 14. Vermicomposting 15. Bioremediation — 16. Phyto-remediation 17. Water Budget — 18. Energy Audit 19. Carbon Footprint — 20. Biomedical Waste Management		

Semester	IV	Total Credit	4
Course Code	CC 404	Credit Pattern	L-15, T-0, P-45
Course Title	PRACTICAL-VII		

Course Objectives	
1	Understand the experimental procedures for analysis of environmental samples.

Course Outcomes: After completion of this course students will be capable of	
1	Applying standard Plate Count method for the enumeration of micro-organisms in the environmental samples.
2	Demonstrating Grams Staining and motility study to differentiate microbes.
3	Evaluating the enrichment culture technique for isolation of desired microbes.
4	Proposing cell/enzyme immobilization technique in industrial pollution management .

Syllabus:

Sr.No.	Title of the Experiment	Paper No.	Number of Sessions	
1	Standard Plate Count (SPC)	CC 404	L= 15	
2	Determination of Inorganic Phosphorus	CC 404	T=0	P=45
3	Demonstration of Starch hydrolysis by microbial Cultures(Two days)	CC 404		
4	Determination of Gram Character of bacterial Culture	CC 404		
5	Demonstration of Motility in bacteria	CC 404		
6	Determination of Irrigation Water Quality by pH, EC & Carbonate-bicarbonates	CC 404		
7	Wildlife Census by Block count Method	CC 404		
8	Determination of Irrigation Water Quality by SAR method	CC 404		
9	Determination of Hexavalent Chromium	CC 404		
10	Immobilization of Micro-organisms (Two days)	CC 404		
11	Determination of Total Kjeldahl Nitrogen (TKN)	CC 404		
12	Zooplanktons	CC 404		
13	Phytoplanktons	CC 404		
14	Isolation of P Solubilizing MOs	CC 404		
15	Determination of Ammonical Nitrogen	CC 404		
16	Backlog/Remedial Practicals	CC 404		
17	Repeation Practicals	CC 404		

Learning Resources

1	Reference books	• Water & WasteWater analysis : Dr. R.K. Trivedy & Dr. P.K.Goel • Standard Methods of water & Waste water analysis: APHA • Hand book of Methods in Environmental Studies (Vol.I) : S.K.Maiti • Hand book of Methods in Environmental Studies (Vol.II) : S.K.Maiti • A text book of Soil analysis : Baruah & Barthakur

Semester	**IV**	**Total Credit**	**4**
Course Code	**CC 405**	**Credit Pattern**	**L-15, T-0, P-45**
Course Title	**PRACTICAL-VIII**		

Course Objectives	
1	Understand the experimental procedures for analysis of environmental samples.

Course Outcomes: After completion of this course students will be capable of	
1	Demonstrating Isolation, segregation, characterization and proper utilization of Municipal Solid Waste.
2	Determining quality of irrigation water for optimal utilization to avoid further environmental consequences.
3	Recommend gypsum requirement for the preparation of reclamation plans for saline alkali soils.
4	Propose dose of lime for reclamation of an acid soil, by performing laboratory experiments and computing results.

Syllabus:

Sr. No.	**Title of the Experiment**	**Paper No.**	**Number of Sessions**	
1	Determination of Gypsum Requirement	CC 405	**L= 15**	
2	Soil Rating & Fertilizer Dose Recommendation	CC 405	**T=0**	**P=45**
3	Determination of Wilting Point	CC 405		
4	Determination of P content of fertilizer	CC 405		
5	Determination of K content of fertilizer	CC 405		
6	Determination of N content of fertilizer	CC 405		
7	Determination of Cation Exchange Capacity(CEC) of Soil (Two days)	CC 405		
8	Determination of Lime Requirement	CC 405		
9	Determination of Fluorides by SPADNS	CC 405		
10	Paper Chromatography	CC 405		
11	Thin Layer Chromatography	CC 405		
12	Geophysical Sounding for Groundwater Exploration	CC 405		
13	Determination of Physical Characteristics of MSW	CC 405		
14	Determination of Chemical Characteristics of MSW	CC 405		
15	Detrmination of Water Quality Index	CC 405		
16	Backlog/Remedial Practicals	CC 405		
17	Repeation Practicals	CC 405		

Learning Resources		
1	**Reference books**	• Water & WasteWater analysis : Dr. R.K. Trivedy & Dr. P.K.Goel • Standard Methods of water & Waste water analysis: APHA • Hand book of Methods in Environmental Studies (Vol.I) : S.K.Maiti • Hand book of Methods in Environmental Studies (Vol.II) : S.K.Maiti • A text book of Soil analysis : Baruah & Barthakur

Semester	IV	Total Credit	4
Course Code	DSE 401 (A)	Credit Pattern	L-45, T-8, P-7
Course Title	LAND AND WATER MANAGEMENT		

Course Objectives	
1	Prevention of Land & Water Resource Degradation.
2	Optimal Use of Land & Water Resources.
3	Sustainable Land & Water Management.

Course Outcomes: After completion of this course students will be capable of	
1	Identifying concept of optimal land use planning based on capabilities to prevent further degradation and relate these to appropriate methodologies of sustainable land management.
2	Discovering challenges and give suggestions to manage accelerated soil erosion, ground water recharging and water logging conditions, with the emphasis on prevention, control and reclamation of saline-alkali soils. Prepare a plan for reclamation of degraded area.
3	Demonstrating an understanding of the hydrology of streams and lake systems and concept of water shed management, and describing the processes of and importance of groundwater flow and aquifer systems.
4	Describing the challenges of maintaining surface and ground water quality, apply their knowledge base and research skills to current issues pertaining to water resource management, and remediation, with emphasis on related economic, social, and public policy dimensions.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Soil Pollution:** Importance of Soil resources, Physical, Chemical and Biological Properties of soil. Definition, causes/ sources of soil pollution: agro-chemicals, heavy metals, disposal of city refuse, waste water, soil salinity and water logging. Fate of pollutants in Soil, Methods of Soil sampling, Effect of Soil pollution on Flora and Fauna, Control Of Soil Pollution**:** Prevention & Elimination, Concept of Soil health, Soil pollution control through Soil health management	**L= 11**	
		T=2	**P=2**
2	Land classification on the basis of topography, climate, and utilization; Land use patterns in India, Need of Land Management Spheres of Land Management, Land Productivity, Capability and Capacity Land Capability Classification as a Guide for Soil Conservation Desertification with special reference to India, Degradation of Land: causes, effects & control, Acid Soil management, Saline & Alkali Soil Management, Soil Erosion, Methods of Soil Conservation, Wetlands & Water Logged areas	**L= 11**	
		T= 2	**P= 2**
3	**Water Resources and Sustainable Development** Classification and sources of surface and groundwater; Exploration and exploitation of water resources; Quality of Irrigation Water; Consequences of unskilled irrigation	**L= 11**	
		T= 2	**P= 2**

	practices,Planning, execution and after effects of man-made reservoirs;Utilization of water resources for energy production, sanitation, drinking,Navigation, industries and agriculture; National Water Policy		
4	Water management strategies and problems Watershed- concept and Classification;Watershed characteristics, Watershed Management,Multi-disciplinary water management; Quantitative Techniques of Water Resources Planning and Management; Regional Water Quality Management;Use of remote sensing in land and water management;Integrated approached towards water, soil and land management.	**L=12** **T=2**	**P= 1**

Learning Resources		
1	**Text Books**	• Text Book Of Soil Science by PAL, CBS publishers, 2018 • Textbook Of Environmental Science And Technology by REDDY, BSP publishers, 2019 • A Textbook Of Environmental Studies, Dr D K Asthana, S. Chand Publishers, 2018 • A Text Book Of Environmental Studies by Vijay Tiwari, Himalaya Publishers, 2017 • A Text Book Environmental Studies, Chatawal & Sharma, HPH • A Text Book Environmental Science, Joshi & Joshi, APH • A Text Book of Environmatal Studies, Nambiar, STP
2	**Reference Books**	• Hydrological Measurements for Watershed Research by Wasi Ullah, SK Gupta and SS Dalal • Watershed Management by JVS Murthy, New age International (P) Ltd, New Delhi • Ground water Hydrology by Todd,D.K. Willy India Pvt. Ltd, New Delhi,2011 • Ground water hydrology by Todd, David Keith, 2010 • Principle and Practice of Water Management by S.C.Panda Agrobos (India) • Conservation of Water Resources Problems & Prospects, 2008 • Resource Values & Development, 1999 by Amarthysen, Oxford Uni. Press New Delhi • Soil Geology, Kolay. A. K ., Atlantic Publisher • Soil Pollution, 2009, Mishra S. C. , APH Publications New Delhi • Introduction to Soil & Water Conservation Engineering, 2002, Mal..B.C. Kalyani Publisher, Ludhiyana. • Land Utilization : Theory & Practice, Mandal R. B. , Concept Publishing • Environmental Geography Science landuse & Earth, Marsh Willium. M. Jhon Willy & Sons, New York. • Geochemistry, Groundwater & Pollution, 2005, Appcco C.A.S., A.A. Balkema Publishers.

		• Land Degradation & Desertification, Jha V. C., Rawat Publications , Jaipur. • Hand Book of Ground Water Remediation & Treatment Technology, Cheremisinoff N.P., Crest Publishinh hours, New Delhi • Land Reforms In India- Performance & Challenges in Gujarat & Maharashtra, Shah Ghanshyam, Sage Publications, New Delhi. • Wet lands of India : Ecology & Threats (Volume 1-III), Abbasi S. A. , Discovery Publishing house, New Delhi. • Land Reclamation Maachinary, 1988, T> Barshchou , MIR Publishers Moscow. • Waste Land Development & their Utilization., Shankar Narayan K.A, Scientific Publisher, Jodhpur. • Basic & Applied Soil Mechanics., 1991, Rajan Gopal , Willy Eastern Ltd.,
3	**Websites**	• https://www.sciencedaily.com/terms/sustainable_land_management.htm • http://www.yourarticlelibrary.com/geography/soil-conservation-4-methods-that-must-be-adopted-for-conserving-soil/13910 • https://www.conserve-energy-future.com/methods-of-soil-conservation.php • https://sciencing.com/types-water-resources-5127497.html • https://www.un.org/waterforlifedecade/water_and_sustainable_development.shtml
4	**Journals**	• Current Science, ISSN No. 0011-3891 • Down to Earth • Every Thing About Water • International Journal of Environmental Engineering Science, ISSN No .2229-3094 • Resonance, ISSN No. 0971-8044 • Journal of Earth System Science, ISSN No .2253-4126
5	**Supplementary Reading**	• CPCB Report • MoEF Report
6	**Practical Components**	• Practicals Based on this,-- Practical VII & VIII

Semester	IV	Total Credit	4
Course Code	DSE 401 (B)	Credit Pattern	L-45, T-8, P-7
Course Title	SAFETY ENGINEERING		

Course Objectives	
1	To study safety aspects with respect to Industrial Safety.
2	To understand the Importance and Applications of Safety Engineering in industrial sector.

Course Outcomes: The students will able to	
1.	Examine the safety in use of machinery & importance of guarding.
2.	Choose the safety measures while handling & storage of materials.
3.	Demonstrate the safety aspects when working at height.
4.	Examine the Safety in Industrial Operation like Heat, Stress & Electrical Hazards.

Syllabus:

Unit Number	Contents	Number of Sessions	
1	**Machine Operation and Guarding** Definition of Engineering, safety engineering, machine guarding. Principles in machine guarding. Ergonomics of machine guarding. Type of guards and selection. Built-in-safety devices, maintenance and repairs of guards, incidental safety devices and tools. **Safety in the use of Machines** Safety in the use of 1) power presses ,2) shearing, 3) bending, 4) rolling, 5) drawing, 6) turning, 7) boring, 8) milling, shaping, 9) planning broaching, planting, 10) grinding, 11) CNC Need for selection and care of cutting tools. Preventive maintenance, periodic checks for safe operation.	**L= 11** **T=2**	**P=2**
2	**Material Handling and Storage of Materials** **Manual :** Kinetics of manual handling. Lifting and carrying of objects of different shapes, size and weight. Safe use of accessories for manual handling.. Safety in stacking and unshackling Floor loading conditions. Layout condition for safety in storage.. **Mechanical** : Lifting machinery, lifts and hoists, signaling, inspection and maintenance. Safety in design and construction, operation, inspection and maintenance of industrial trucks, lifting tackles and loose gears, conveyors. Safety features, safe locations, testing, inspection and maintenance of lifting tackles, safe working load for all mechanical material handling equipment. The competent persons in relation to safety legislation - duties and responsibilities.	**L= 11** **T= 2**	**P= 2**

3	**Working at Different Levels** Working at Heights : Ladders of different types, scaffolds of different types, Other safety requirements while working at heights. Working in Confined Spaces & Working Underground Hand Tools and Power Tools Inspection, maintenance and repair of tools. Detectable causes of tool failures. Tempering, Safe use of various types of hand tools used for metal cutting, wood cutting, miscellaneous cutting work, Noise and Vibration: Continued and impulse noise. Noise isolation. Noise absorption techniques, silences. Practical aspects of control of noise.	**L= 11**	
		T= 2	**P= 2**
4	**Safety In Industrial Operation** **Industrial Lighting & Illumination :** Purpose of lighting. Benefits of good illumination, Sources and types of artificial lighting. Principles of good illumination. Recommended optimum standards of illumination. Design of lighting installation. Standards relating to lighting and colour. **Ventilation and Heat Stress :** Natural ventilation, Mechanical ventilation. Air conditioning. Control of heat exposures at source, dilution and local ventilation. Purpose of ventilation. Thermal comfort. Indices of heat stress. Thermal limits for comfort, efficiency and freedom from health risk Recommended values for air changes required for various areas as per Factories Act, 1948 and National Standards. IS: 3103-1975-Code of practice for Industrial Ventilation. **Electrical Hazards**: Hazards of electrical energy. Safe limits of amperages, voltages. Safe distance from lines. Capacity and protection of conductor. Joints and connections. Means of cutting off power. Overload and short circuit protection. No load protection. Earth fault protection. Earth insulation and continuity tests. Protection against surge and voltage fluctuation. Types of protection for electrical equipment in hazardous atmosphere.	**L=12**	
		T=2	**P= 1**

Learning Resources		
1	**Text Books**	• The Handbook of Safety Engineering: Principles and Applications. Frank R. Spellman, 2009 • Current Science, ISSN No. 0011-3891Industrial Safety Management by L.M. Deshmukh, McGraw Hill Education Publication, 1st July, 2017 • Industrial Safety & Environment by Er. A. K. Gupta, ISBN: 9788131804544
2	**Reference Books**	• Reliability, Maintenance and Safety Engineering. V.K. Gupta, 2009 • Engineering a Safer World: Systems Thinking Applied to Safety. Nancy Leveson, 2011 • Safety Engineering: Principles and Practices. Frank R. Spellman and Nancy E. Whiting, 2004 • Engineering Safety: Fundamentals, Techniques, and Applications. B.S. Dhillon, 2003

		• A Guide to Fire Safety Engineering. S. D. Christian, 2003 • Handbook of OSHA Construction Safety and Health. Charles D. Reese, 1999 • Electrical safety handbook. John Cadick,1994 • Principles of Fire Safety Engineering: Understanding Fire and Fire Protection. Akhil Kumar Das, 2014 • Industrial Safety and Human Behaviour Kaila, H.L. • Environmental Health & Safety Auditing Handbook, 1994 • Bacterial Diseases / Kumar, Vijay
3	**Websites**	• www.nsc.org.in • www.osha.gov • www.ilo.org • www.ohsonline.com • www.worldsafety.org
4	**Journals**	• International Journal of Occupational Safety and Ergonomics. **ISSN : 2376-9130** • International Journal of Occupational Safety and Health. ISSN : 2091-0878 • Journal of Industrial Safety Engineering. ISSN : 2395-6674
5	**Supplementary Reading**	• Industrial Safety Chronicle. Published by National Safety Council., Mumbai • Factory Act 1949
6	**Practical Components**	• Visit to Industries to study various safety aspects.

==========XXXXXXX==========