

**BANGLADESH UNIVERSITY OF PROFESSIONALS  
(BUP)**



**ACADEMIC GUIDELINE  
for  
M.Sc./MASTERS IN ENVIRONMENTAL SCIENCE (MES)**



Existence Through Knowledge

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**Department of Environmental Science (DES)  
Faculty of Science and Technology (FST)  
Mirpur Cantonment, Dhaka-1216  
Website: [www.bup.edu.bd](http://www.bup.edu.bd)**

## PART ONE: BUP AT A GLANCE

### 1. Introduction.

Bangladesh University of Professionals (BUP), which is one of the public universities of Bangladesh, was established on June 5, 2008. The aim was to facilitate professional degrees and to run under-graduate, graduate and post graduate degrees through its faculties, affiliated and embodied colleges, institutes, academies or organizations. Bangladesh University of Professionals (BUP), with its own unique features, is set up in a green landscape of Mirpur Cantonment located in Dhaka Metropolitan City. The university provides a tranquil, pollution free and secured campus life and above all, a congenial academic atmosphere.

Bangladesh University of Professionals (BUP) deals with not only the education of the Armed Forces personnel but also the students of civilian community from home and abroad. It welcomes those students who intend to dedicate their total attention and devotion to serious academic pursuits to build up better tomorrow for the nation. Bangladesh University of Professionals (BUP) is dedicated to provide high quality education that delivers real benefits for the students. Thus, Bangladesh University of Professionals (BUP) is the unique academic entity in the country, where blending between the civilian and the Armed Forces students of diverse skills, experience, exposure and attitude is possible.

#### 1.1 Motto.

The motto of Bangladesh University of Professionals (BUP) is “**Excellence through Knowledge**”.

#### 1.2 Mission.

The mission of this University is to develop human capital of the military and civilian resources to respond to the knowledge based society of the present world.

#### 1.3 Vision.

The vision of the University is oriented towards enhancing professionalism in both military and civilian environments, through a need-based and time-sensitive education and training. The University envisions the responsibility of graduating intellectually enlightened, technologically advanced, academically competent, ideologically liberal and inspiring research-oriented resourceful citizens who are prepared to lead, promote and preserve the virtues of our great civilization. The University commits itself and all the resources to the accomplishment of this global trust and responsibility.

#### 1.4 Core Values

1. **Integrity** : Highest ethical and moral uprightness.
2. **Discipline** : Strict discipline in all activities.
3. **Creativity** : Creativity in all spheres.
4. **Commitment** : High quality academic standards.
5. **Wisdom** : Enhanced education and research.

#### 1.5 Objectives

1. To become a leading public university in Bangladesh and in the region.
2. To promote knowledge in the field of science and technology, business, medicine, social science, strategy and security.
3. To promote leadership and civil-military relationship.
4. To develop intellectual and practical skills.
5. To provide the best possible academic atmosphere.
6. To preserve the spirit of national culture, heritage and traditions.
7. To facilitate higher education in the Armed Forces.
8. To prepare the faculty and staff with necessary competencies.
9. To deliver competent professionals relevant to the demands of the society.
10. To sustain collaborative relationships with communities and educational partners.
11. To provide efficient services to support programs, campus community and quality of life.

## 1.6 Location and Campus

BUP is located at Mirpur Cantonment and a short walk from the MIST. The campus is easily accessible by road either from Mirpur-10 round-about or Hotel Radisson Dhaka turning point. Faculties and administrative buildings are adjacent which facilitates supportive academic atmosphere. The green landscape includes a natural lake providing an obligatory space to breathe fresh air. The charming scenario of the campus attracts the visitors round the year.

## 1.7 Academic Environment

The academic environment is developed based on systematic thoughts which encourage student learning. The university provides a tranquil, pollution free and secured campus life leading to a congenial academic atmosphere. Our esteemed faculty members provide an excellent opportunity for close personalized caring instruction and take the participants as far as their imagination allows. Faculty also committed to render devoted attention that pushes the students to excel and nurture.

## 1.8 Embodied Faculties

The BUP offers and regulates degrees in multi-disciplinary dimensions in the field of science, technology, strategy, liberal education, business and social sciences, medical science, war and security studies and other fields of knowledge through its following 5 faculties:

- Faculty of Business Studies (FBS).
- Faculty of Arts and Social Science (FASS).
- Faculty of Security and Strategic Studies (FSSS).
- Faculty of Science and Technology (FST).
- Faculty of Medical Studies (FMS).

## 1.9 Regulatory Bodies

There are different regulatory bodies and committees, which regulate the faculty and the university as a whole. These are:

**1.9.1 Senate:** The highest policy and decision-making body of the university.

**1.9.2 Syndicate:** The key executive body for general management and supervision.

**1.9.3 Academic Council:** The key executive body on academic affairs of the university.

## 1.10 Administration

1.10.1 The administrative matters in general are centrally dealt basically by the Registrar and the Treasurer's branch of BUP.

1.10.2 Academic affairs of FST are controlled by Dean FST under the supervision of Vice Chancellor of BUP.

1.10.3 Dean FST plans and executes the academic affairs through Academic Committee composed of a group of dedicated faculty members.

1.10.4 The course will be conducted by the well-reputed teaching faculty members who are expert on their respective subject, supported by the competent management and administrative staffs.

## 1.11 BUP Library

Central Library serves all individuals, comprising of faculty members, students, researchers, staffs and selected members of other academic communities. Now, the library contains 2000 volumes of books and bound journals. It includes electronic copies of books and journals. Every year, lots of books are added to the present stocks. CDs and DVDs containing 3000 e Articles, 2000 e-Journals are available for the inquisitive readers. BUP Library circulation system is fully automated.

### **1.12 Cafeteria**

BUP maintains a well decorated air-conditioned cafeteria 'VISTA' housed at the ground floor of the academic building for all kinds of usage. It offers healthy environment providing highly attractive ambience and remains open for the students, academic and management staffs. Every effort is made to ensure that food items remain fresh while delivery. Cafeteria projects itself as a central attraction for relaxation and enjoying delicious snacks. In addition, it sells stationary, confectionary and gift items.

### **1.13 Auditorium**

BUP auditorium named as 'BIJOY AUDITORIUM' with 500 capacities in a favorite venue for intimate musical performance. Splendid classical design provides multi-purpose facilities for holding academic programs like seminar, workshop, central lecture and presentation.

### **1.14 Prayer Room**

Separate prayer room for both male and female is located at the ground floor of the academic building. Well-furnished rooms with necessary facilities are kept open to value the religious sentiment of the Muslims.

### **1.15 Medical Centre**

Medical centre is established at ground floor to provide primary medical care who don't need admission in to a hospital. Staffed with qualified and experienced physician and compassionate paramedics it offers emergency treatment for the minor illness and injuries. Service remains open to all concern working in BUP.

## **1.9 Address**

Bangladesh University of Professionals (BUP)  
Mirpur Cantonment, Dhaka-1216  
Tel: 88-02-8000368, PABX 8000261-4  
Fax: 8000443  
E-mail: info@bup.edu.bd  
Website: www.bup.edu.bd

## **2. Student Services.**

### **2.1 Guidance and Counseling**

The guidance and counseling service are available to students on academic and other matters of interest. A faculty member is assigned as Faculty Adviser for each section of a batch, which, as a routine matter, meets the students at least once a week and also attends them whenever the students feel necessary. The faculty adviser keeps close contact with the students in understanding and solving the problems relating to their academic program, facilities and other issues, if any.

### **2.3 Thesis/Project**

Students have to complete Thesis/Project for the fulfillment of the degree. The Department will set the criteria to get the thesis or project.

### **2.7 Admission Procedure**

Faculty/ Department will follow their own procedure as per requirements.

#### **2.7.1 Eligibility for Admission**

Faculty/ Department will follow their own procedure as per requirements.

## 2.7.2 Selection Process

**Written Admission Test:** Admission test will be conducted by Faculty/Department on the basis of the syllabus of B.Sc. in Environmental Science Program and General Knowledge. Admission test will be in MCQ and/or Subjective written test.

**Communication Test (Interview/Viva-voce):** The candidates are selected for communication test based on their written test result. Panels of faculty members will take the communication test/interview.

**Final Selection:** Final selection of all candidates will be made on the basis of merit with their combined marks in the written admission test for 100 marks and interview / viva-voce for 25 marks.

## 2.8 Admission in the Program

After final selection, the candidates are asked to go through a medical checkup at BUP Medical Centre to ascertain their medical fitness. The selected candidates must collect Admission Form from Admission Section of Registrar Office and complete admission and registration formalities within the given time frame with respective BUP Admission Section and Faculty by paying required fees. The following rules will apply in this regard:

- (i) Candidate failing to complete admission formalities within the prescribed date and time, his/ her selection will be considered as cancelled.
- (ii) Student who fails to attend the class within two weeks of the commencement of 1st semester class, his/her admission will be considered as cancelled.

In case, If the prescribed vacancies are not filled up by the candidates in the first merit list, other merit list(s) will be published from the waiting candidates for admission, who will have to follow the same procedure for admission.

## 2.9 Tuition and other Fees

### 1<sup>ST</sup> SEMESTER

**Theory Courses** : 4 (Credits:  $4 \times 3 = 12$ ) + 1 (Credits:  $1 \times 2 = 2$ ) = Total Credits: 14

**Viva-Voce** : 1 (Credits:  $1 \times 1 = 1$ ) = Total Credits: 1

**Grand Total Credits** :  $4 \times 3 + 1 \times 2 + 1 \times 1 = 15$

Serial	Category of Fees / Charges	Amount (Tk.)
1	Admission Fee (Once)	5,000.00
2	Semester Registration Fee	500.00
3	Library Fee	500.00
4	Computer Lab and Training Aid Fee	500.00
5	Security Money	10,000.00
6	Tuition Fee	9,000.00
7	Course Registration Fee (1350.00/Credit)	18,900.00
8	Viva-Voce	1,500.00
9	Grade Sheet Fee	500.00
10	Student Welfare Fee	2,000.00
11	Education Enhancement Fee	2,000.00
12	Center Fee	1,000.00
13	Transport Fee	500.00
14	ID Card Fee (Once)	100.00
15	Tie/Scarf (Once)	650.00
Grand Total =		52,650.00
<b>In Word: Fifty Two Thousand Six Hundred and Fifty Taka Only</b>		

**2<sup>ND</sup> SEMESTER**

Theory Courses : 4 (Credits:  $4 \times 3 = 12$ ) = Total Credits: 12  
 Thesis/Project : 1 (Credits:  $1 \times 3 = 3$ ) = Total Credits: 3  
 Grand Total Credits :  $4 \times 3 + 1 \times 3 = 15$

Serial	Category of Fees / Charges	Amount (Tk.)
1	Semester Registration Fee	500.00
2	Project (2600.00/Credit)	7,800.00
3	Library Fee	500.00
4	Computer Lab and Training Aid Fee	500.00
5	Tuition Fee	18,000.00
6	Course Registration Fee (1350.00/Credit)	16,200.00
7	Grade Sheet Fee	500.00
8	Student Welfare Fee	2,000.00
9	Education Enhancement Fee	2,000.00
10	Center Fee	1,000.00
11	Transport Fee	500.00
<b>Grand Total =</b>		<b>49,500.00</b>
<b>In Word: Forty Eight Thousand Six Hundred Taka Only</b>		

**3<sup>RD</sup> SEMESTER (M.SC. IN ENVIRONMENTAL SCIENCE PROGRAM)**

Theory Courses : 3 (Credits:  $3 \times 3 = 9$ ) = Total Credits: 9  
 Thesis : 1 (Credits:  $1 \times 9 = 9$ ) = Total Credits: 9  
 Grand Total Credits :  $3 \times 3 + 1 \times 9 = 18$

Serial	Category of Fees / Charges	Amount (Tk.)
1	Semester Registration Fee	500.00
2	Thesis (2300.00/Credit)	20,700.00
3	Library Fee	500.00
4	Computer Lab and Training Aid Fee	500.00
5	Tuition Fee	18,000.00
6	Course Registration Fee (1350.00/Credit)	12,150.00
7	Grade Sheet Fee	500.00
8	Student Welfare Fee	2,000.00
9	Education Enhancement Fee	2,000.00
10	Center Fee	1,000.00
11	Transport Fee	500.00
12	Provisional Certificate Fee	1,050.00
<b>Grand Total =</b>		<b>59,400.00</b>
<b>In Word: Fifty Nine Thousand Four Hundred Taka Only</b>		

**3<sup>RD</sup> SEMESTER (MASTERS IN ENVIRONMENTAL SCIENCE PROGRAM)**

Theory Courses : 3 (Credits:  $3 \times 3 = 9$ ) = Total Credits: 9  
 Project : 1 (Credits:  $1 \times 6 = 6$ ) = Total Credits: 6  
 Grand Total Credits :  $3 \times 3 + 1 \times 6 = 15$

Serial	Category of Fees / Charges	Amount (Tk.)
1	Semester Registration Fee	500.00
2	Project (2600.00/Credit)	15,600.00
3	Library Fee	500.00

4	Computer Lab and Training Aid Fee	500.00
5	Tuition Fee	18,000.00
6	Course Registration Fee (1350.00/Credit)	12,150.00
7	Grade Sheet Fee	500.00
8	Student Welfare Fee	2,000.00
9	Education Enhancement Fee	2,000.00
10	Center Fee	1,000.00
11	Transport Fee	500.00
12	Provisional Certificate Fee	1,050.00
<b>Grand Total =</b>		<b>54,300.00</b>
<b>In Word: Fifty Four Thousand Three Hundred Taka Only</b>		

### SUMMARY

M.Sc. in Environmental Science Program						
SL	SEM	THEORY	VIVA	THESIS/PROJECT	TOTAL CREDITS	AMOUNT (TK.)
1	1 <sup>st</sup>	14	1	-	15	52,650.00
2	2 <sup>nd</sup>	12	-	3	15	48,600.00
3	3 <sup>rd</sup>	09	-	9	18	59,400.00
<b>Total Credits</b>					<b>48</b>	<b>1,60,650.00</b>
<b>Security/Caution Money (Refundable)</b>						<b>(-) 10,000.00</b>
<b>Total =</b>						<b>1,50,650.00</b>
<b>In Word: One Lac Fifty Thousand Six Hundred and Fifty Taka Only</b>						

Masters in Environmental Science Program						
SL	SEM	THEORY	VIVA	THESIS/PROJECT	TOTAL CREDITS	AMOUNT (TK.)
1	1 <sup>st</sup>	14	1	-	15	52,650.00
2	2 <sup>nd</sup>	12	-	3	15	49,500.00
3	3 <sup>rd</sup>	09	-	6	15	54,300.00
<b>Total Credits</b>					<b>45</b>	<b>1,56,450.00</b>
<b>Security/Caution Money (Refundable)</b>						<b>(-) 10,000.00</b>
<b>Total =</b>						<b>1,46,450.00</b>
<b>In Word: One Lac Forty Five Thousand Five Hundred and Fifty Taka Only</b>						

#### Additional Fees/Payments (As Required):

SER	CATEGORIES OF FEES/CHARGES	AMOUNT (TK)
1.	Re-admission Fee	5000.00
2.	Migration Certificate Fee	750.00
3.	Supplementary Final Examination Fee	5000.00
4.	Non-Collegiate Fee (Per Course)	5000.00

**\*Disclaimer:** The university authority reserves the right to modify/change the tuition fee as per requirement. Students/University has to pay their own cost during field study in each year.

#### 2.10 Review of Fee Structure

All fees mentioned in the above table will be reviewed as and when necessary by the university authority and the students will be liable to pay the fees as per changed/reviewed fees.

### **2.11 Deadline for Submission of Fees/Dues**

The admitted students will have to clear all the fees during the admission process after publication of result. For subsequent semesters, the payment of all fees/dues must be maintained semester wise and the following rules will apply in this regard:

- The semester fees can be paid within 15 days after commencement of each semester without any penalty.
- The students may pay their fees after 1st 15 days within one-month time by paying a penalty of Tk. 500.00 for each 15 days.
- If a student fails to pay the semester fees within one and a half month, his/her name will be dropped and the student will have to apply for re-admission, should he/she desire to continue his/her study. If approved, he/she may take re-admission paying required re-admission fee.

### **2.12 Course Load to Student**

As a general rule, students are not given more than 5 courses in a semester. However, maximum seven courses will be allowed, when a student is repeating course/courses because of obtaining 'F' grade or 'I' grade or if they want to improve their previous grades. This will be allowed only once for a particular course and the students have to take the course/courses with the batch that comes immediately after them. A student will be allowed to retake only 2 courses in each semester. He/she must complete all the courses of under graduation within 3 years of his or her registration period. A student must register for minimum 03 courses in a semester.

### **2.13 Conduct of Courses**

Generally, a single teacher is assigned to plan and teach a particular course in a semester. The following guidelines will be followed for conducting different courses:

- At the beginning of the semester, the course teacher will prepare a course kit with course outline according to the approved course curriculum, performance evaluation and grading system (as laid down in the policy), list of suggested text books/references, and a tentative schedule of classes, examinations and events. He/she will distribute a copy of the same course outline to each student registered for the course and will submit a copy to the Department Office.
- At least 1 (one) class per week, consisting of 180 minutes respectively, should be planned for each batch.
- The students must appear 1 (one) Mid Term examinations in a semester as per given schedule. As a rule, retake of Mid Term Examination is not allowed, except for sickness, hospitalization or other unavoidable circumstances, provided the student has valid supporting documents and he/she has been permitted by the course teacher and the program office before the examination commences. In such cases, 10% of total weight assigned against Mid Term examination may be deducted.
- The course teachers are expected to ensure that n+1 class tests are conducted in a semester for each course and credit hours will be counted.
- An individual term paper/Project paper/Assignment will be assigned to the students that will be followed by a presentation.
- Assignments (individual and group), case studies etc. should be allotted to students which will be followed by presentations, as per the course requirements. The presentations must be short. For that purpose, miscellaneous periods or 15-30 minutes in each day's class may be utilized.
- One analytical group assignment and individual presentation should be included in a course. As per the requirements of the course(s), field trips may be organized.



- Any fraction in the marks obtained is to be rounded up to the advantage of student i.e. any fraction is to be rounded up to the next number.

#### 2.14 Class Attendance

Attendance in all classes is mandatory. A certain percentage of the total marks for each course is allotted for class attendance. If a student is to appear in the final examination, she/he must fulfill the criteria of being Collegiate (having more than 75% attendance). In case a student becomes Non-collegiate (having attendance from 65% to below 75%) his/her guardian must apply to the chairman of the respective department followed by the payment of BDT 5000 as fine for each course to be allowed to sit for the final exam. Students who become Dis-collegiate (having attendance below 65% attendance) will not be allowed to sit for the final examination. A student must obtain permission from the Chairman of the Department for any kind of absence due to valid reason and must inform the course teacher and program coordinator. The marks distribution for attendance is given below:

Attendance	Marks
90% and Above	10.0
85% to < 90%	9.0
80% to < 85%	8
75% to < 80%	7
65% to < 75%	6 (Non-Collegiate, with payment @ 5000/- per course)
Less than 65%	Dis-collegiate

#### 2.15 Examination and Assessment System

BUP follows a single examiner system and continuous assessment is done to evaluate a student in a semester. The following rules will apply for all tests and examinations:

- All tests, assignments, term paper/Project paper, presentations, class performance will be evaluated by the course teacher. He/she will show the scripts, assignments, term papers, etc. to the students in the classroom within the following week. However, the scripts of final examination will not be shown to them.
- The course teacher is required to submit all scripts, assignments, etc. with a compiled up-to-date result summary for all the tests/performance evaluated prior to semester final examination to the Department and Controller of Examination of BUP. However, the course teachers will be responsible for making his/her in course marks available to students before final exam.
- The questions for the semester final examination will be set by the course teacher, and submitted to the Moderation Committee of the respective faculty. More than one teacher can take a single course in different section of a batch. In that case, a combined set of question/s will have to be prepared through the Moderation Committee. However, a course teacher must give more 03 questions than that of his requirements.
- The course teacher alone will evaluate the scripts and submit the marks obtained by the students through online and also submit hard copy to the chairman and Controller of Examination. However, course teacher must take need approval respective chairman of the department.

#### 2.16 Supplementary Final Examination

As a general rule, supplementary examinations of any kind are not allowed. However, if a student fails to appear for the scheduled semester final examination for unavoidable and valid reasons, he/she may be allowed to appear for this examination on case by case basis according to the following guidelines:

- In case of a student's extreme compassionate ground or any other reason that is approved by the Chairman of the Department, he/she must appear the supplementary within 45 days of publishing the result of the semester final.

- Students should apply to the concerned Dean (through the respective department) within seven days from the last examination with the required supporting documents describing the reasons for his/her inability to appear for the scheduled semester final examination. The Dean, if convinced, will forward the same to the office of the Controller of Examination duly recommended for approval and thereby making arrangements to conduct the respective subject examination.
- Students will have to pay the required fees as per the university policy for appearing for the supplementary examination and completing other examination formalities for the course(s) so appeared.
- No more than 'B' grade will be awarded to the students for supplementary examinations. However, special cases may be considered with prior approval of the VC.
- The existing rules of semester final examination will apply to the conduct of supplementary examinations e.g. question setting, moderation, evaluation, and result publication etc.

### 3. Performance Evaluation System.

Distribution of Marks for Evaluation to be followed as per the Faculty/Department

#### 3.1 Distribution of Marks for the Evaluation of Theory Courses

Letter grades are used to evaluate the performance of a student in a course. The following grading system is currently followed for performance evaluation of the students:

Remarks	Distribution
Final Exam	50%
One Mid-term	20%
Class Tests (Four)	10%
Term Paper (Individual) including Presentation	10%
Class attendance	10%
<b>Total =</b>	<b>100%</b>

The BUP authority reserves the right to review/revise the above grading system. However, depending on the nature of course, minor modifications can be made by respective course teacher, provided it is incorporated in the course outline.

#### 3.4 Grading System

Numerical Grade	Letter Grade		Grade Point
80% and above	A+	(A Plus)	4.00
75% to < 80%	A	(A Regular)	3.75
70% to < 75%	A-	(A Minus)	3.50
65% to < 70%	B+	(B Plus)	3.25
60% to < 65%	B	(B Regular)	3.00
55% to < 60%	B-	(B Minus)	2.75
50% to < 55%	C+	(C Plus)	2.50
45% to < 50%	C	(C Regular)	2.25
40% to < 45%	D	-	2.00
< 40%	F	-	0.00
-	I	-	Incomplete
-	W	-	Withdrawal/Withdrawn

- 'F' grade is indicative of an unacceptable 'failing' performance overall by a student, earning a grade point of 0.00.

- 'I' grade is indicative of a situation where a student, due to nonacademic reasons beyond his/her control, is incapable of completing the full requirements of the course for being unable to sit for the semester final examination. With the submission of valid and authenticated evidence of such reason(s), and the recommendation of the course teacher and the Chairman of the respective department (to be reported to the Chairperson of the Examination Committee), that particular student will be allowed to complete the course within the valid registration period. Meanwhile, the student concerned will be promoted to the next semester. A maximum of two 'I' grades will be allowed to a student in one semester.
- 'W' grade will be awarded when a student is permitted to withdraw/drop a course/semester without penalty within four weeks from the commencement of the semester. Withdrawals are not permitted after the mid-semester examination. A student may re-registration in the semester concerned with the available batch by paying the fees for the whole year.

### 3.5 Calculation of GPA (Grade Point Average) and CGPA (Cumulative Grade Point Average)

Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses passed/completed by a student. CGPA (Cumulative Grade Point Average) will be computed after each semester to determine the academic standing of the student in the program. The four-step procedure that will be followed to calculate the CGPA of a student is given below:

1. Grade points earned in each course will be computed based on credit hours in that course and the individual grade earned in that course by multiplying both.
2. All subject grade points (determined at step 1) will be added to determine the total grade points earned.
3. Credits of all registered courses (except Incomplete grade 'I') will be added together to determine the total number of credits.
4. GPA will be determined by dividing the results of step 2 by the result of step 3.

For example, if a student passes/ completes five courses in a semester having credits C1, C2, C3, C4, C5 and his/her grade points in these courses are G1, G2, G3, G4, G5 respectively, then

$$\text{GPA} = \frac{\text{Total Grade Point earned in particular Semester}}{\text{Number of Courses taken in the particular Semester}}$$

$$\text{GPA} = \frac{\sum C_i G_i}{\sum C_i}$$

- A numerical example, Suppose, a student has completed five courses in a term obtained the following grades:

Course	Credits	Grade	Grade Points
ENV 5101	3	A+	4.00
ENV 5102	3	B	3.00
ENV 5103	3	A	3.75
ENV 5104	2	B+	3.25
ENV 5105	1	A-	3.50

Then his/her GPA for the term will be computed as follows:

$$\text{Grade Point Average (GPA) Calculation} = \frac{3 \times 4.00 + 3 \times 3.00 + 3 \times 3.75 + 2 \times 3.25 + 1 \times 3.50}{3 + 3 + 3 + 2 + 1} = 3.50$$

- When a course is repeated for improvement, the last result grade shall be counted for calculation of GPA and CGPA.
- Performance in all the subjects including all the 'F' grades shall be reflected in the transcript.

#### Cumulative Grade Point Average (CGPA) Calculation: CGPA

Total credits in a semester X semester GPA + total credits in a semester X semester GPA+...

$$= \frac{15 \times 3.75 + 15 \times 3.5 + 16 \times 3.6}{15 + 15 + 16} = 3.62$$

### 3.6 Promotion Policy

Students must obtain the following minimum CGPA in each semester/year for being promoted to the next semester.

Serial	Postgraduate Program	
	Semester	Required Minimum CGPA
1	1 <sup>st</sup> – 2 <sup>nd</sup>	2.00
2	2 <sup>nd</sup> – 3 <sup>rd</sup>	2.50

If a student gets 'I' or 'F' grade in maximum two courses, prior to the condition of retaking the courses, he/she will be promoted to the next semester. He/she must complete all the retake courses of under graduation within 3 years of his or her registration period.

If a student gets 'I' or 'F' grade in minimum three courses in a semester/ year, he/she will not be promoted to the next semester/year. In such case a student will have more two chances for clearing I or F grades.

### 3.7 Degree Requirement

Students must complete all the requirements of the degree within six years of valid registration period for the undergraduate program. The requirements are as follow

- No 'F' or 'I' grades
- Minimum CGPA of 2.5
- Thesis/Project minimum grade 'C' (as applicable)

### 3.8 Incomplete Grade

- Incomplete grade is indicative of a situation where a student, due to nonacademic reasons beyond his/her control, is incapable of completing the full requirements of the course for being unable to sit for the semester final examination. With the submission of valid and authenticated evidence of such reason(s), and the recommendation of the course teacher and the Chairman of the respective department (to be reported to the Chairperson of the Examination Committee), that particular student will be allowed to complete the course with the immediate next batch. Meanwhile, the student concerned will be promoted to the next semester. If an 'Incomplete' grade is not cleared with the next batch, the 'I' grade will automatically be changed to an 'F' grade. A maximum of two 'I' grades will be allowed to a student in one semester. In such cases, the maximum letter grade will be "B" of the respective subject.

### 3.9 Retaking/Improvement of Grade(s)

Improvement of grade(s) will be guided by the following rules:

- A student earning an 'F' grade in any course shall be required to improve the grade by retaking the course offered in the subsequent semester(s), since achieving a passing grade in all courses individually is a degree requirement.
- A student will be allowed to retake only 2 courses in each semester. He/she must sit for all in-course and final examinations. To appear examination, his/her class attendance is a matter of concern for the respective chairman of that department.

- Any student earning a GPA '**Below B grade**' may choose to improve the grade by retaking a course, when offered to the immediate batch. The following rules will apply in this regard:
  - In order to retake a course, the student must apply to the Dean of the Faculty through respective departments within first week the commencement of a semester.
  - The grade earned on the retaken course will be shown in the transcript by '**R**' symbol meaning '**Retake**'. The grade earned on such course(s) would be used for computing the final CGPA.
- If any student gets grade '**less than 'B**' she/he can sit for an **Improvement examination** with the next batch. However, in that case, the previous result of that course will be nullified and the GPA obtained in the improvement examination result will be considered as the final one for that particular course. Such scope for a specific course will be given only once.
- He/she will be allowed to retake/improve a course only once with the immediate next batch.
- Failing in a course twice will warrant a student to be permanently withdrawn from the programme/university.
- Improvement examination for a course is not allowed after the graduation.
- Obtained grades in retake courses should be highlighted in the grade sheet by '**R**'.
- He/she must complete all the retaking or improvement courses of under graduation within 6 years of his or her registration period.

### 3.10 The Rules on Batch Dropout

- In a semester, students obtaining "**F**" Grade in three or more courses will automatically be relegated to the next batch. Such relegation for more than twice will warrant withdrawal of the student from the program.

### 3.11 The Rules on Withdrawal

- **Temporary Withdrawal:** The term Temporary Withdrawal means that the student has been allowed by the Academic Council, BUP to discontinue temporarily. The student, so withdrawn, may re-enter the course as per terms and conditions set by the authority.
- **Permanent Withdrawal:** The term "permanent withdrawal" means a permanent, voluntary discontinuation from the program. The implication of permanent withdrawal includes cancellation of admission and expiry of registration. Once a student is permanently withdrawn, he/she will require a readmission and fresh registration to re-enter the program.
- **Withdrawal on Poor Performance:** Students failing in any course shall retake the whole course with the immediate next batch and this is allowed only once. However, in that case, the previous result of that course will be nullified and the GPA obtained in the improvement examination result will be considered as the final one for that particular course. Failing in such case will warrant him/her to be withdrawn from the program permanently.

### 3.12 Dismissal on Disciplinary Grounds

A student may be dismissed or expelled from the program for adopting unfair means (Copying in examinations/trying to influence grades); unruly behavior, or any other breach of discipline. The implication of dismissal may include cancellation of admission and termination of registration. Once a student is dismissed, he/she will require a readmission and fresh registration to re-participate in the program except moral aptitude.

#### 4. **Discipline and Code of Conduct.**

Adherence to strict discipline is considered to be a core concept of building future leaders. The students must abide by the rules, regulations and code of conduct of the university. Students are forbidden either to be a member of or to organize students' organization, club, society etc. other than those set up by the University authority. They must maintain a quiet and congenial atmosphere in the academic building particularly adjacent to the classroom, library, faculty rooms etc. The students will not be allowed to enter the classroom, if he/she is in contrary to the following rules:

- Arriving late in the class
- Not wearing appropriate dress/attire as per the dress code

The Students' Discipline Rules are available in BUP website.

#### 5. **Other Breach of Discipline.**

Academic council may dismiss any student on disciplinary ground if any form of in discipline or unruly behavior is observed in him/ her which may disrupt the academic environment or program or is considered detrimental to BUP's image. Discipline Committee will process the matter. Zero tolerance to drug, violence, and sexual exploitation and abuse (SEA).

#### 6. **Students' Grievance Procedure.**

The Controller of Examination reserves the right to arrange re-scrutiny of a student's script or re-evaluation of grading, if a student submits a grievance application to Controller of Examination within one week of publication of provisional results.

Disclaimer: The university authority reserves the right to cancel/ modify/ change any information given in this prospectus.

#### 7. **Conclusion.**

BUP academic guideline is to be followed for the best use of student's evaluation, assessment including admission system. It is the guide for the faculty members too for assessing overall evaluation system of a student as well as to know BUP rules and regulations.

## PART TWO: RULES

### DEPARTMENT OF ENVIRONMENTAL SCIENCE

#### 1. Introduction - Faculty of Science and Technology (FST):

The Faculty of Science and Technology (FST) under BUP started its activity in full swing from the early 2012. We are now in a brief hinge of history when the human society is struggling to enter in a sustainable equilibrium. Unfortunately unsustainable development by ruining the precious environment is the major barrier behind that. In such circumstance, holism and interconnectedness of science and management should come into signify the guiding principles to develop trained personnel with strong need-based academic knowledge, skills and competencies who can understand and manage the pollution of water, sediments, soil, air and bio species with a goal to obtaining their mitigation, proper monitoring of the impacts, management and to lead the nation towards the summit of Sustainable Development.

Environmental Science comprises a multidisciplinary endeavor to seek knowledge for the wellbeing of the society. This discipline plays vital and in fact indispensable role in all fields of traditional and modern human activities. Hence Faculty of Science and Technology (FST) of Bangladesh University of Professionals (BUP) took initiative to promote the subject like Environmental Science to create the indispensable human resource, experts of the field and contribute to the nation building.

#### To achieve the desired level of excellence, the FST emphasizes on the followings:

A meticulous admission and selection process for best possible screening.

- Interactive sessions in the classroom and uninterrupted curriculum.
- Effective teaching through innovative methods blended with latest trends and developments in the world and with its state of the art facilities.
- Competent internal faculties with flexibility to outsourcing expert resource persons.
- Regular guest lectures and visits to organizations.
- Well thought-out and continuous feedback and assessment system.
- A culture of discipline, punctuality and commitment.
- Emphasis on Code of Conduct and Dress Code.
- Focus to develop students as a good human being with all possible attributes of a successful business leader.
- A tranquil, external turbulence free secured campus life.

#### 2. Current Programs:

The faculty is running following programs:

- a. B.Sc. (Hons) in Information and Communication Technology (BICT).
- b. Master in Information and Communication Technology (MICT).
- c. Master (M.Sc. Engr. /M Engr.) in Information and System Security (MISS).
- d. B.Sc. (Hons) in Environmental Science.
- e. Masters of Environmental Science.
- f. M.Sc. in Environmental Science.
- g. Certificate Course on Energy Management and Conservation.
- h. Certificate Course on Renewable Energy and the Environment.

#### 3. Dean:

Lt Col Md Lutfar Rahman  
Dean (Acting)  
Faculty of Science & Technology (FST)  
Bangladesh University of Professionals (BUP)

#### 4. Chairman:

Lt Col Md Lutfar Rahman  
Chairman

Department of Environmental Science  
Bangladesh University of Professionals (BUP)

5. **Mailing Address:**

Department of Environmental Science  
Faculty of Science & Technology (FST)  
Bangladesh University of Professionals (BUP)  
Mirpur Cantonment, Dhaka-1216  
Phone: 02-8000439, Fax: 88-02-8000443  
Website: [www.bup.edu.bd](http://www.bup.edu.bd)

6. **Department of Environmental Science:**

Bachelor of Science (B.Sc.) in Environmental Science program is designed to produce graduates with solid foundation and knowledge in all the spheres of earth including air, water, soil and human being. It focuses on creating skilled human resources in the field of environmental science. Students gain extensive experience in developing effective formulation to mitigate and manage environmental pollution and how to build a sustainable environment.

The program includes basic knowledge about the environment, the causes behind its exploitation, probable mitigation and management.

Organizational orientation, project management and communication skills are developed in addition to exploration of the technical and human aspects of Environmental Science.

7. **Admission Rule**

7.1 **Introduction:**

Admission in Masters in Environmental Science program run by Department of Environmental Science off Bangladesh University of Professionals (BUP) is open to all Bangladeshi male and female citizen provided they meet admission requirements. The program is also open to limited number of foreign students (male/female) in compliance with government rules on the subject. Any candidate having required qualification can apply for admission. The department announces admission circular in different dailies and through websites for the convenience of potential candidates.

7.2 **Overview of Admission:**

BUP seeks applications from candidates desiring admission in Masters in Environmental Science programs by circulating and advertising in Bengali and English national daily newspapers, websites and through electronic media. Candidates will be required to apply through website/SMS with a prefixed amount of money (the amount will be decided by the Department every year and which is non-refundable). All eligible candidates will be called for written admission test and the list of eligible candidates will be posted on BUP notice board and in website ([www.bup.edu.bd](http://www.bup.edu.bd)) minimum 07 (seven) days before the written admission test. Subsequently, basing on written test result a list of Eligible Candidates for Viva-Voce will be displayed at BUP Notice Board as well as in BUP website on a specified date along with the date of interview/ viva voce. Every year the Department will take decision regarding the number of candidates to be called for viva voce. After the completion of viva voce, the final merit list of candidates selected for the program will be displayed at BUP Notice Board as well as in BUP website with necessary instructions for completing admission procedures.

7.3 **Vacancy:**

Number of batches in each academic year and the number of students in each batch will be decided by the Department considering available facilities, demand for program and the quality of available students.



#### 7.4 Eligibility for Admission:

To be eligible for admission in Masters in Environmental Science program of BUP, a candidate must have B.Sc. or Equivalent degree from any discipline.

#### 7.5 Review of Minimum Requirement:

Depending upon the requirement and prevailing circumstances in each academic year, the Department may review the minimum requirements of candidates prior to approval of admission policy of each year.

#### 7.6 Selection Process Detail:

Selection of candidates is made basing on their standing in the combined merit list. The selection process that is followed in BUP is:

- 1) Written Admission Test. All candidates are required to attend a written admission test of 100 marks, where he/she will have to qualify. The test is conducted on the relevant subject matter and General Knowledge.
- 2) Communication Test (Interview/Viva-Voce). The candidates are selected for communication test based on their written test result. Panels of faculty members take the communication test/interview, which carry 25 marks.

#### 7.7 Final Selection:

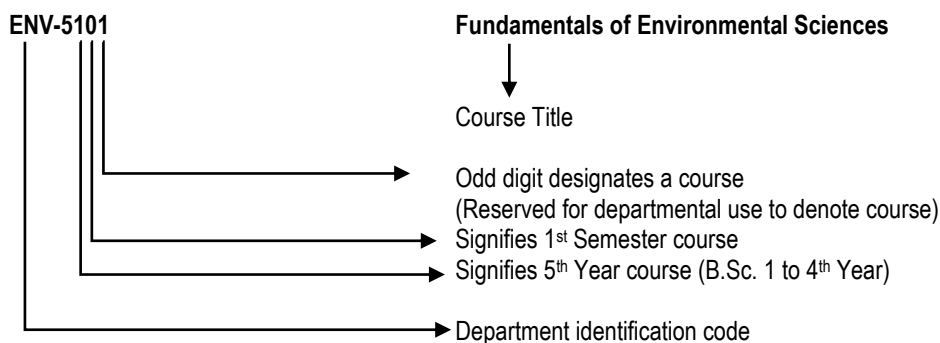
Final Selection will be made on the basis of merit with their combined marks in the written admission test (80% weightage), interview/ viva voce (20% weightage).

### 8. Course Designation System:

Each course is designated by a maximum of four letter code identifying the department offering the course followed by a three-digit number having the following interpretation:

- The first digit corresponds to the year/level in which the course is normally taken by the students.
- The second digit corresponds to the semester/ term in which the course is normally taken by the students.
- The last two digits denote various courses, where an odd number is used for theoretical courses and an even number for Laboratory courses.

The course designation system is illustrated as Follows:



9. **Detail Course Curriculum: semester-wise course distribution:**

<b>1st Semester</b>		
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>
ENV-5101	Fundamentals of Environmental Sciences	3
ENV-5102	Environmental Pollution	3
ENV-5103	Land and Water Resources Management	3
ENV-5104	Ecosystem and Biodiversity	3
ENV-5105	Environment, Health and Safety(EHS)	2
ENV-5106	Viva-voce	1
<b>Total =</b>		<b>15</b>

<b>2nd Semester</b>		
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>
ENV-5201	Global Climate Change and Disaster Management	3
ENV-5202	Industrial waste treatment and Management	3
ENV-5203	Environmental Issues, Policies and Legislation	3
ENV-5204	Research Methodology	3
ENV-5305	Thesis/Project	3
<b>Total =</b>		<b>15</b>

<b>3rd Semester</b>		
<b>Course Code</b>	<b>Course Title</b>	<b>Credit Hours</b>
ENV-5301	Environmental Management System (EMS)	3
ENV-5302	Integrated Environmental Impact Assessment	3
ENV-5303	GIS and RS for Environmental Management	3
ENV-5305	Thesis/Project	9/6
<b>Total =</b>		<b>18/15</b>

<b>M.Sc. in Environmental Science</b>	<b>Masters in Environmental Science</b>
Thesis Group : 48 Credits	Non Thesis Group : 45 Credits

Sl.	Semester	Theory	Viva-voce	Project / Thesis	Total	Remarks
1.	Sem-1	14	1	-	15	4 × 3 (Theory), 1 × 2 (Theory), 1 × 1 (Viva-Voce)
2.	Sem-2	12	-	3	15	4 × 3 (Theory), 1 × 3 (Project / Thesis)
3.	Sem-3	9	-	6/9	15/18	4 × 3 (Theory), 1 × 6 (Project)/ 1 × 9 (Thesis)
<b>Grand Total</b>		<b>35</b>	<b>1</b>	<b>9/12</b>	<b>45/48</b>	

**Note:** The distribution of courses may be changed by the authority, if necessary.

1st Semester		
Course Code	Course Title	Credit Hours
ENV-5101	Fundamentals of Environmental Sciences	3
ENV-5102	Environmental Pollution	3
ENV-5103	Land and Water Resources Management	3
ENV-5104	Ecosystem and Biodiversity	3
ENV-5105	Environment, Health and Safety(EHS)	2
ENV-5106	Viva-voce	1
<b>Total =</b>		<b>15</b>

### **ENV- 5101 Fundamentals of Environmental Sciences**

1. Definition, scope and goal of environmental sciences, its relation to other disciplines of science, environmental issues in Bangladesh and role of environmental science, state of environmental awareness, environmental communication and action-oriented programs in Bangladesh and South Asia.
2. Multidisciplinary nature of environmental Sciences: Historical and philosophical basis, concept of Gaia: the interconnectedness of lithosphere, hydrosphere, atmosphere and biosphere.
3. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems, Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.
4. Biogeochemical Cycles of some important elements: Carbon, Nitrogen, Sulfur; their implication for global environmental changes.
5. Environmental Pollution: Definition, causes, effects and control measures of Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards; Solid waste (Causes, effects and control measures of urban and industrial wastes), Role of an individual in prevention of pollution, Concept of Disaster (Floods, earthquakes, cyclones and landslides).
6. Social Issues and the Environment: From unsustainable to sustainable development, urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concern, Environmental ethics
7. Human Population and the Environment: Population growth, variation among nations, Population Explosion-Family Welfare Programme, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health.
8. Environmental Issues and possible solutions: Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation.
9. Environmental Ethics: Definition and scope, Approach of environmental ethics, Environmental attitude, Individual, social, corporate and global ethics, Environmental justice, Legal system of Bangladesh

#### **References:**

1. Textbook of Environmental Studies by Erach harucha, Universities Press, India, 2005.
3. Environmental science earth as a living planet by Arms, K., Aaunders college publishing, 1990.
4. Environmental science an introduction by Miller.Jr., G.T..
5. Environmental science earth as a living planet by Daniel B.Botkin, E.A.K., John Wiley and sons inc., 1998.

### **ENV-5102 Environmental Pollution**

1. Water Pollution: Nature and types of water pollutants, elemental pollution and their determination, heavy metals, Cd, Hg, Cr etc., metalloids e.g. Arsenic in groundwater of Bangladesh, organic pollutants, pesticides in water, polychlorinated biphenyls.
2. Water Treatment: Treated water use, municipal water treatment, treatment of water for industrial use, removal of organic, removal of heavy metals and metalloids (arsenic), removal of phosphorus and nitrogen compounds.

3. Adsorption-filtration: Definition, types of adsorption, adsorption isotherm, adsorption of solutes by solids, hysteresis curves, thermodynamic properties, modes of adsorption by natural and synthetic adsorbents, application of adsorption-filtration process, desorption of solute particles, Mesoporous materials: Porous solids, classification of pore sizes, development of mesoporous supports, preparation of mesoporous materials.
4. Atmospheric Chemistry: Importance of the Atmosphere, Evolution of atmosphere, Inversions and Air pollution, Global climate and Microclimate, Carbon Cycle and Atmospheric Carbon dioxide, Reactions of Atmospheric oxygen and Nitrogen, Aerosols, their direct and indirect effects: Aerosol properties, sources and production mechanisms of atmospheric aerosols, direct and indirect forcing associated with aerosols.
5. Air Pollution: Atmospheric pollutants, Inorganic gasses, Organic and organic sulfites and particulate oxides of sulfur and sulfur cycle, Nitrogen Oxides and Nitrogen cycle, Urban air pollution, Mitigation of urban air pollution.
6. Environmental Soil Chemistry: Soil and agriculture, Nature and composition of soil, Acid-base and Ion-exchange reactions in soils, Wastes and pollutants in soil, Soil loss and degradation.
7. Ocean pollution: Sewage - source and effects of some marine pollution, toxic pollutants - antifouling paints, DDT, dioxins, PCBs; oil on water, marine debris - fishing gears, plastics.

#### **References:**

1. Environmental Chemistry, S.E. Manahan, 7<sup>th</sup> Edn, Lewis Publishers, 2000.
2. Environmental Chemistry of Soil, M. McBride.
3. A Guide to the study of Environmental Pollution, William Andrews (Edn).
4. Advanced Inorganic Chemistry, S.Z Haider.

### **ENV-5103 Land and Water Resources Management**

#### **Section-A: Land Resources Management**

1. Incidence and Effects of Land Degradation: Changing Land Use: Its Causes and Implications, Global Environmental Change
2. Challenges to Sustainable Land Management: Appropriate Land Management Systems, Improved Water Management, Adapting to Climate Change, Knowledge Dissemination and Land Policy Constraints
3. SLM Interventions: An Agri-technical Perspective: Protecting the Land Resource: Agricultural Intensification and Integrated Farming Systems, Soil Fertility Management, Market Opportunities Linked to Erosion Control Practices: A Key to Adoption?, Protecting and Managing Watersheds, Exploiting the Production and Environmental Service Functions of Land
4. The Bank's Evolving SLM Portfolio: Past and Current Investments for SLM and Related Interventions, The Pattern of Bank Group Investments in SLM, NRM, BioCarbon, and Watershed Management Programs
5. Strategic Options: Policy and Sector Work, Research and Technology Development, Knowledge Sharing and Extension, Providing Incentives, Expenditure Priorities, and Modes of Financing, Recommended Approach and the Role of the World Bank Group,
6. Case Study on Land Management and water resources management and a Useful Plant Diversity

#### **Section-B: Water Resources Management**

1. Introduction: Hydrologic Cycle, Importance of Hydrology, Water Balance, Energy Budget. Groundwater (Definition, origin and depth of GW, springs and wells, Aquifers and Aquifers properties, Water yield, Groundwater flow, Groundwater investigations, Well tests, Steady state well Hydraulics, Methods of Groundwater exploration).
2. Hydrological Environments: Hydrogeological environments of Bangladesh, Sea-water intrusion in coastal aquifers, Hydrogeological models and their use in resource assessments.

3. Water Resources planning & management: Water, and its impurities, criteria of water quality, Sources of fresh water, characteristics of domestic industrial & Irrigation water. Estimation & Collection system of surface & ground water, Effluent disposal, reuse & misuse of water, Basic concept of water resource planning & management, Wetlands & water resources, Soil water relationship, Human impact on water resources: Irrigation & flood control system strategic planning: conceptual frame work & models: Watershed management of urban ( Municipal ) & Rural area emphasis on drinking water (urban) & Irrigation water (Rural), Economic considerations, Business response, Water and Conflict
4. Water resources of Bangladesh: Importance and properties of water, sources and worldwide supply and national consumption, the water cycle, water supply problems, building dams and water diversion projects, groundwater use, water conservation, flooding- problems and solution and adaptation, water shortage-issue and solutions, irrigation-issues and solution, groundwater pollution in Bangladesh-a detrimental threat to the safe drinking water supply, navigation and flood control, Water resources and power generation, Regional conflicts on Water resources, Planning for water resources development.
5. IWRM: Development, Implementation, IWRM in Bangladesh, Case Study

#### **References:**

1. Sustainable Land Management: Challenges, Opportunities, and Trade-offs, 2006, The International Bank for Reconstruction and Development/The World Bank, NW, Washington DC
2. Kiely, G., 1998, Environmental Engineering, McGraw-Hill.
3. Raghunath, H.M., Hydrology: Principles, Analysis and Design.
4. Abdel-Aziz, I.K., 1986; Groundwater Engineering. McGraw-Hill Book Co., New York.
5. Lioyd, J.W. & Heathcote, J.A., 1985, Natural Inorganic Hydrochemistry in relation to Ground Water: An Introduction; Claredon Press.
6. UNITED NATIONS, 1982, The Hydrogeological Condition of Bangladesh; United Nations Ground Water Survey Technical Report, New York.

#### **ENV-5104 Ecosystem and Biodiversity**

1. Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystems (Forest ecosystems, Grassland ecosystems, Desert ecosystems, Aquatic ecosystems).
2. Basic Concepts of Biodiversity: Definition, significance of Biodiversity and natural resources, Benefits from Biodiversity, Types of Biodiversity, Biodiversity and species concept, Status of biodiversity in Bangladesh.
3. Threats and Conservation of Biodiversity: Depletion of Biodiversity, Causes of threatening Biodiversity, IUCN categories of endangered species, Red data book, Measures for Biodiversity conservation, Protected area and biosphere serves Role of Zoos, Botanical gardens and captive breeding programme. Forest Ecosystems of Bangladesh: Role of forest dwellers for ecosystem sustainability; Hill forest and Sal forest of Bangladesh as potential resources, The Sundarbans biodiversity conservation, Wildlife of Bangladesh as a resource and their protection.
4. Wetlands of Bangladesh: History and heritage of wetlands, Importance of wetlands for Bangladesh, Resources of wetlands, Haor basins of Bangladesh as resource base - Haor systems of international importance; Socioeconomic values of wetlands - Over fishing and the vanishing of fish species, impact of flood control and irrigation project on fish species; Marine and estuarine ecosystem of Bangladesh; Coral reef - St. Martin island and its significance; Impact of development activities on wetlands, Management and regulations of wetlands - National and global importance of coastal and wetland biodiversity, Coastal wetlands biodiversity management, Mangrove of the Chokoria Sundarbans; Aquaculture and mangrove forestry, International collaboration for management of wetlands.

5. Coastal Afforestation and Environment: Plantation in coastal areas of Bangladesh; Windbreaks and Shelterbelts: Wind and vegetation, functions of windbreaks and shelterbelts, types of windbreaks and shelterbelts for coastal regions.
6. Participatory Forestry: Agro-forestry and Social Forestry.
7. Restoration Ecology: Theory, forest restoration, Urban greening and green spaces, Importance of urban forestry and aquatic urban habitat for urban landscape developments and environment.
8. Wastelands: Wasteland as a dormant resource base for sustainable development; Development of wastelands - Technology for development of wastelands - coastal sands, dry and rocky areas, wet lands, denuded and eroded hill slopes, land slips and mined areas.
9. Impact of artificial trans-boundary barrages on different ecosystems of Bangladesh.
10. National conservation strategies for ecosystem sustainability of Bangladesh.

### **References:**

1. Najma Heptulla. 1993. Environment protection in developing countries, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
2. A.P. Dwivedi. 1992. Agroforestry Principles and Practices, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
3. L. DeVere Burton. 2000. Introduction to Forestry Science. Delmar Publishers, New York.
4. C. Philip Wheater. 1999. Urban habitats, Routledge Publication Ltd., London.
5. Neaz Ahmad Siddiqi. 2001. Mangrove Forestry in Bangladesh. Institute of Forestry and Environmental Sciences, University of Chittagong.
6. M. Sitaram Rao. 1979. Introduction to Social Forestry. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
7. M. Z. Abedin, C.K. Lai and M. Omar Ali. 1990. Homestead Plantation and Agroforestry in Bangladesh. Published by Bangladesh Agricultural Research Institute.
8. P.K.R. Nair. 1994. Agroforestry Systems in the Tropics, Kluwer Academic Publishers in co-operation with ICRAF, USA.
9. H.L. Gholz, 1987. Agroforestry: Realities, Possibilities and Potentials, Martinus Nijhoff Publishers, The Netherlands.
10. M. S. Khan, E. Haq, S. Huq, A. A. Rahman, S. M. A. Rashid and H. Ahmed. 1994. Wetlands of Bangladesh, BCAS, Dhaka, Bangladesh.
11. K. C. Misra, 1989. Manual of Plant Ecology, 3<sup>rd</sup> edition, Oxford and IBH Publishing Co. Pvt. Ltd., India.

### **ENV-5105 Environment, Health and Safety (EHS)**

1. Introduction: Need for integration of safety, health and environment; Fundamentals of safety; overview of industrial safety management; role of top management and Government in safety management, Legal aspects of safety.
2. Steps of industrial safety management: Security Management of Industrial plants; Safe working practices; Personal protective equipments; Storage and handling of Material and equipment; Safety in transportation and automotive equipments; Electrical safety; Mechanical Hazards; Chemical Hazards; Building design and Fire protection; Radiation Hazards; Safety in Hazardous area, safety in power plants etc.
3. Occupational Health and Safety Assessment Series (OHSAS), Scope of OHSAS 18001.
4. Industrial safety analysis: Introduction, locating and defining injury sources, causes of injury, sources of data, safety analysis techniques, fault tree calculations, risk tolerability.
5. Implementation and operation, Structure and responsibility, Training, awareness and competence, Consultation and communication, Documentation, Operational control, Emergency preparedness and response, Social security inside the industries, Insurance.

## **References:**

1. "Occupational health and safety management systems-Specification", Occupational health and safety assessment series, OHSAS 18001:1999.
2. Bangladesh Labor Law, 2006.
3. "American national Standard, Quality Management Systems-Requirements" published by American Society for Quality, December, 2000.
4. R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environmental Management Systems, Khanna Publishers.
5. Kabata-Pendias A, Pendias H. Trace Elements in Soils and Plants, CRC press, Boca Raton, Florida.
6. Salomons W., Forstner U., and Mader P. Heavy Metals (Problems and Solution), Springer- Verlag Berlin Heidelberg, 1995.
7. Alshawabkeh A. N., Acar Y.B. Removal of contaminants from soils by electrokinetics: A theoretical treatise. J. Environ. Sci. Health A27/7, 1835-1861, 1992.
8. Brown G.A., Elliott H.A. Influence of electrolytes on EDTA extraction of Pb from polluted soil. Wat. Air. Soil. Pollution 62, 157-165, 1992.

## **ENV-5201 Global Climate Change and Disaster Management**

### **Section-A: Global Climate Change**

1. Current knowledge about observed and future impacts of climate change on the natural and human environment: Freshwater resources and their management, Ecosystems, their properties, goods and services, Food, fibre and forest products, Coastal systems and low-lying areas, Industry, settlement and society, Human health.
2. Future impacts of climate change in Africa, Asia, Australia and New Zealand, Europe, Latin America, North America, Polar Regions (Arctic and Antarctic) and Small islands.
3. Impact on Public Health: Quantitative health impact assessment, Disasters: Floods and windstorms, vector borne diseases, waterborne and floodborne diarrheal diseases, Food security, vulnerable populations.
4. Assessment of adaptation practices, options, constraints and capacity.
5. Inter-relationships between adaptation and mitigation.
6. Assessing key vulnerabilities and the risk from climate change.
7. Perspectives on climate change and sustainability.
8. Issues related to mitigation in the long term context: Energy supply, Transport and its infrastructure, Residential and commercial buildings, Industry, Agriculture, Forestry, Waste management.
9. Mitigation from a cross sectoral perspective.
10. Sustainable Development and mitigation.
11. Policies, instruments and co-operative agreements.
12. Case studies.

### **Section-B: Disaster Management**

1. Disaster Concepts, Regulatory and Institution Framework in Bangladesh: Terms and concepts used in disaster management, Disaster risk situation in Bangladesh and global scenarios, Comprehensive disaster management (CDM) approach, Cross cutting themes such as, Gender, Ethnic minorities, Globalization, global insecurities & its linkages to disasters and food Security, Bangladesh Disaster management models and approaches, Regulatory framework of Bangladesh DM system, Institutional Framework of Bangladesh DM system, Standing Orders on Disasters and roles of DMC(s).
2. Disaster Risk Management and Sustainable Development: Methodologies for undertaking disaster risk management and provide tools for understanding and assessing: Hazards and its classification, Community risk assessment, vulnerability and institution profiling, Vulnerability factors, Coping capacities and mechanisms,

Community empowerment, Evolution of disaster risk management, Relation between disaster and sustainable development, Climate change impact and livelihood adaptation to climate change.

3. Disaster Prevention and Mitigation: Framework for prevention and mitigation, Structural and non-structural mitigation, Hazards prevented by structural mitigation, Risk treatment and application of insurance, Community based disaster management, Institutional and legal mechanisms for risk reduction, Advocacy and role of public awareness, National prevention & mitigation strategies preparation.
4. Disaster Preparedness for Effective Response: Preparedness planning and contingency planning key preparedness considerations: Vulnerability assessment, Coordination aspect, Organization/Institutional Frameworks, Information system, Response mechanism, Resource Base, Public education and training, Early warning systems, Rehearsal/drills, Community preparedness.
5. Disaster Response : Key steps for emergency response, Warning information/message dissemination, warning signals in Bangladesh, Evacuation and evacuation equipments, Search and rescue of vulnerable communities, Transitional shelter and shelter management, Public critical services restoration, Damage, loss and needs assessment, Other sectoral support during emergencies e.g food, health, Nutrition, water & sanitation, and education, Working with the media and information management, Resource management, The emergency coordination centre and role of incident manager.
6. Disaster, Recovery, Rehabilitation and Reconstruction: Concepts and principles early recovery, Concepts of development relief, Build back better, Stakeholder, community involvement and participation, Recovery interventions.
7. Disaster Management Plan and Implementation Aspect: Preparation of disaster management plan, Relief management, coordination and distribution through DMC, Accountability in disaster management projects, Monitoring of risk reduction interventions and evaluation, Development and implementation of sectoral / personal action plans.
8. Case Studies in Disaster Prevention and Mitigation, Disaster Preparedness for Effective Response, Disaster Response, Disaster, Recovery, Rehabilitation and Reconstruction.

### **References:**

1. IPCC, 2007: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp.
2. IPCC, 2007: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
3. GOB 1999. Standing orders on Disaster, Min of DM & RDMB, Dhaka.
4. Carter, W. Nick. 1999. Disaster management; a disaster manager's handbook, ADB, Manila, Philippines.
5. UNDRO, 1991. Mitigating Natural Disasters Phenomena, Effects & Options a manual for policy makers and planners, United Nations, New York.

### **ENV 5202-Industrial Waste Treatment and Management**

1. Basic concept of pollution and pollutants
2. Treatment Plant Design and Maintenance: The planning process, Treatment costs, Plant setting, Construction staging and Process design, Mechanization, Instrumentation and Automation, Plant layout, Building design, Example of design information, Other significant design features, Maintenance of treatment plant, Health and safety issues of treatment plant.
3. Treatment Technologies for Industrial wastes: Physical treatment technologies: Screening, Grit removal, Flocculation, Gravity separation theory, Primary sedimentation, High rate clarification, Process application, Flotation, Design considerations for dissolved – Air flotation systems.



4. Chemical Treatment Technologies: Role of chemicals unit processes in wastewater treatment, Application of chemical unit processes, Fundamentals of Chemical coagulation, Chemical precipitation for improved plant performance, Chemical precipitation for removal of heavy metals and dissolved inorganic substances, Chemical oxidation, Applications, chemical oxidation of BOD and COD, Electrochemical wastewater treatment, Chemical neutralization.
5. Biological Treatment Technologies: Overview of biological wastewater treatment, Objectives of biological treatment, Microremediation technology and Phytoremediation Technology, Role of Microorganisms in wastewater treatment, Types of biological processes for wastewater treatment, Suspended growth biological treatment processes, Attached Growth and combined biological treatment Processes, Biological removal of toxic and recalcitrant organic compound, Biological removal of heavy metals.
6. Advanced Treatment Technologies: Need for advanced treatment, Technologies used for advanced treatment, Selection of filtration technology, Effluent filtration with chemical addition, Membrane filtration Processes, Membrane process classification and configurations, Application of membrane electrodialysis, Fundamentals of adsorption, Design of stripping towers, application, Ion exchange chemistry, Theory of advanced oxidation technologies, applications and operational problems, Performance expectations of distillation in reclamation applications.
7. Disinfection Processes: Regulatory requirements for wastewater disinfection, Disinfection theory, Methods and mechanism of disinfectants, Disinfection with Chlorine, Ozone, Ultraviolet radiation, Disinfection systems, Environmental impact of Disinfection systems, Comparison of alternative disinfection technologies, Advantages and disadvantages.
8. Issues Related to Treatment Plant Performance: Upgrading wastewater treatment Plant performance, Process optimization, Upgrading existing wastewater treatment facilities, Treatment process reliability and selection design values, Development of input-and output data.
9. The 3R's Golden rule (Reduction, Reuse & Recycling) of Industrial Waste Management: Concepts of Sustainable Industrialization, Reducing the waste or zero waste discharge and environmental costs of industrial production by 3R's approach, Reducing solid waste by dematerialisation technology, waste reduction by water conservation in industrial production, Industrial complexing to reuse waste of one industry as raw material by another, Recycling of industrial waste to recover useful by-products, Global waste trade and exchange for non-hazardous industrial waste recycling, environmental significance of recycling, Economic benefits of recycling.
10. Preventing Industrial Wastes and Pollution through Cleaner Production: The concept of cleaner production, Strategies to prevent and reduce the generation of toxic waste at source, Changing production process in industries to reduce toxicity and achieve cleaner production, Equipment modification for cleaner production, Material change and substitution to reduce hazardous waste and achieve cleaner production in industries, Clean and safe alternative to conventional plastic, Cleaner agriculture and food production by reducing dependence on agro chemicals, Cleaner energy production.
10. Case analysis and presentation.
11. Effluent Treatment Plant/ Recycling Plant visit.

### **References:**

1. Wastewater Engineering: Treatment and Reuse (4th Edition), Metcalf & Eddy Inc., Tata Mc Graw-Hill Publishing Company Limited
2. Water and Wastewater Engineering, Water Purification and Wastewater Treatment and Disposal (Volume 2) Gordon M. Fair, John C. Geyen, Daniel A. okun, John Wiley and Sons Inc., New York
3. Industrial Waste Treatment, Edmund B. Bessliever, Mc Graw- Hill Book Company Inc.
4. Industrial Waste Treatment Handbook (2nd Edition) By: Woodard & Curran, Inc. © 2006 Elsevier.
5. Waste Treatment in the Process Industries: Lawrence K. Wang, Yung-Tse Hung, Howard H. Inc. © 2006 Elsevier
6. Industrial and Hazardous Wastes: Health Implication and Management Plans: Dr. Rajiv K. Sinha and Dr. Sunil Herat, 2004 Pointer Publishers.

## **ENV-5203 Environmental Issues, Policies and Legislation**

1. Characterization of environmental issues and overview of global sustainability around the world.
2. Key environmental issues for global sustainability: Population and demographic transition, Food production, urbanization, Oil production, electricity generation, greenhouse gas production, climate change, sea level rise and the renewable transition, Deforestation and biodiversity, desertification, water use, and waste production, war and terrorism.
3. Environmental Issues related to Bangladesh: Environmental health and Population dynamic, Human Rights and scenario in Bangladesh, Human Rights and Legal system of Bangladesh, State of Environment in Bangladesh (Forest sector, Agriculture, Rivers, wetlands, Industrialization, Legislation for development), Arsenic Pollution, Shrimp Movement, Greenhouse gases and their impact, trends and projection of future emissions, global warming, acid rain, ozone layer depletion, climate change and sustainable development.
4. SDGs: goals, objectives, details of each goal, target group
5. Basic principles for institutional, legal, and regulatory framework for environmental policies, local and global strategies, regulations and governance.
6. State of the environment and policy retrospective: Our common future, Earth Summit, Kyoto protocol, and Johannesburg Earth Summit; CDM and Carbon credit, Convention of biological diversity, Ramsar convention, Innovation and networking for environmental policy for sustainable environmental management since Rio (Earth Summit): Guidelines for environmental policies of World Bank, UNEP, WHO, OECD, and other international and UN organizations.
7. Legal System of Bangladesh: Environmental law regime in Bangladesh, constitutional provision, role of BELA in the legal activism in Bangladesh, Bangladesh position on ICTPs; ECA 1995, ECR 1997, EC 2000 and other recent laws, Environmental policy: National and international, laws regarding Biodiversity conservation, Forestry, Fishery, Mineral exploration, Groundwater management etc.
8. Market-based environmental policies and actions for achieving the Millennium Development goals and related outcomes; Analysis of environmental policies between developed and developing countries.
9. Case study of environmental policies and natural resource management in South-East Asia.

### **References:**

1. Newman, P. and Kenworthy, J (1999): Sustainability and Cities : Overcoming Automobile Dependence, Island Press, Washington, D.C
2. Newman, P. (2000): Global Environmental Issues. N212/N412, Unit Reader, 2000 Environmental Science, Division of Science and Engineering Murdoch University, Perth, Western Australia.
3. Hanaki, K. (1995): 716-92 Management of Global and Urban Environment, Research Center for Advanced Science & Technology, Tokyo University, Japan.
4. Jurma C. (2002): The Global Sustainability Challenge: From agreement to action. International Journal of Global Environmental Issues, 2(1/2): 1-14
5. Millennium Goals, United Nations Development Programme; <http://www.undp.org/mdg/> Accessed 21/01/2004.

## **ENV-5204 Research Methodology**

1. Introduction – need and importance of research methodology: Approach – methodology and limitation of research:
2. Research design – features of good design, concept and development of research plan: Sampling design – sampling strategy, methodology and types of design of the program,
3. Census and sample survey: Measurement and scaling techniques. Introduction (Meaning and nature of research), Classification of research, Identifying and analysis of research problem,
4. Basic statistical concepts and techniques; Describing data probability, data distributions, testing differences between means, correlation & regressions, Non-linear relationship, Participatory research and its methodology development with practical explanation.

5. Methods of data collection – primary data, secondary data, selection of appropriate data, guidelines for interviewing, questionnaire and schedule:
6. Social and participatory methodologies in peoples’ participation: Data processing and analysis – problems, types, statistics, interpretation of results, graphical representation and tabulation, manuscript preparation, rules of quotation and bibliography:
7. Report writing: Case studies, Statistical tools and SPSS, social research methods – survey, interview, ethical issues in social research, quantitative environmental research: field- and/or laboratory based research, safety issues in environmental research design, modeling and simulation, techniques for disseminating research outcome: thesis, articles and presentation, writing research proposals.

### **Reference**

1. Wilson: Introduction to Research Methodology. McGraw-Hill Book Co, NY.
2. Cochran, W. G. and Cox, G. M. (1957): Experimental Designs; John Wiley and Sons Inc., London.
3. Blalock, H.M.Jr.(1979): Social Statistics, MacGraw Hill Book Company , New Delhi.
4. Bishop, (1992) ON.19. Statistics for Biology, A practical guides for the experimental Bilogists , Longman, , UK.
5. Cochran, W. G. (1963). Sampling Techniques (second edition), John Wiley & Sons, NY
6. \*Students will select specific topic of research and will do exercise

### **ENV-5301 Environmental Management System (EMS)**

1. Definition of EMS (Environmental Management System). Scope and objectives of EMS, Key Concepts of Industrial Environmental Management, Environmental Management Approaches.
2. Terminology: Auditor, continual improvement, corrective action, document, environment, environmental aspect, Environmental Balance, environmental impact, environmental objective, environmental performance, environmental policy, environmental target, interested party, internal audit, nonconformity, organization, preventive action, prevention of pollution, procedure, record.
3. General requirements of EMS, Applicability of environmental policy, Environmental aspects; legal and other requirements; objectives, targets and program(s).
4. Implementation and operation: Resources, roles, responsibility and authority; competence, training and awareness; communication; documentation; control of documents; operational control; emergency preparedness and response.
5. Checking: Monitoring and measurement; evaluation of compliance; nonconformity, corrective action and preventive action; control of records; internal audit.
6. Relationships among ISO 9000 (QMS), ISO 14000 (EMS) and OSHAS 18000 (Occupational health, safety and environment).

#### **Recommended References:**

1. Environmental Management Systems- Requirements with guidance for use” Published by International Organization for Standardization, 2004.
2. Environmental Laws in Bangladesh” Published by Environment & Development Alliance, June 1999.
3. Application for certification to ISO 14001:2004” by Bureau Veritas (Bangladesh) Private Limited, July 2007.
4. Descriptive Law on Pollution & Environment by Akalank Kumar Jain, 9th ed, June 2000.

### **ENV-5302 Integrated Environmental Impact Assessment (IEA)**

1. Basic Concepts: overview of EA, EIA, SIA, SEA, Analytical Frameworks: DPSIR, Social, Political and economic context
2. EA: Definition, Concepts, Scope and design, tools and method, Application (Planning, communication, evaluation), Case Study
3. EIA: Definition, Concepts, Scope and design, tools and method, Application (Planning, communication, evaluation), Case Study
4. SIA: Definition, Concepts, Scope and design, tools and method, Application (Planning, communication, evaluation), Case Study
5. SEA: Definition, Concepts, Scope and design, tools and method, Application (Planning, communication, evaluation), Case Study

#### **References:**

1. UNEP Geo manuals

### **ENV-5303 GIS and RS for Environmental Management**

1. Introduction to Geographic Information System (GIS); definition, purpose, scope and nature of GIS, basic concepts, components of a geographic based information system: Data input to spatial information: Geographical data types and methods of representation; data base concepts, points, line arc and continuous surface: GIS data structure; nature of geographic data, spatial data models, raster data models, vector data model, comparison, format conversion, data structure conversions, data medium conversion; Concepts, systems and methods of image transformation and information extraction from primary data. Global Positioning System (GPS): Concepts, system, methods, types, data acquisition and applications.
2. Preprocessing; data reduction and generalization, error detecting editing, merging, edge matching, rectification and registration, coordinate systems and geo-referencing: Manipulation, Analysis and Spatial Modeling; reclassification and aggregation: Overlay Operations; topological overlay: 3D GIS: Management and implementation of GIS.
3. Remote sensing in environmental management: Importance, application to biodiversity, coastal zones, fishing zones, forest cover, natural resources, wastelands, natural disasters, weather analysis and forecasting, global climatology, landforms, rock and mineral resources, crops and land use, ecology, urban settlement.
4. Conceptual model for spatial and non-spatial information of GIS, Map projection: Methods and types, importance, and applications, Decision Support System (DSS): Concepts, systems and techniques, object Oriented GIS; Internet GIS; and Open GIS/online GIS.
5. Fundamentals of remote sensing – definition, energy source and radiation principles, spectral bands and structure, interaction of light with atmosphere and surface, characteristic of energy with different media, data acquisition and interpretation, applications: Remote sensing satellites, sensors and their characteristics – history, types of satellites and their specialization, orbit characteristics, sensor characteristics, application: Remote sensing images – preprocessing and processing techniques, enhancement techniques, filtering: Digital image classification – supervised and unsupervised classifications, area measurement from classified image, temporal change detection: Image interpretation with GIS data: Microwave remote sensing: SAR techniques
6. Aerial photograph – introduction, basic photo interpretation techniques, photo scale and stereoscopic parallax, color concept, flight planning, ground control: Photogrammetry and Air-photo interpretation – image parallax, aerial stereograms, methods of height determination, counting objects, area measurement: AP application in environmental sciences and case studies.

### **References:**

1. Bonham-Carter GF (1994) Geographical Information System for Geoscientists – Modeling with GIS. Pergamon
2. Burrough PA (1986) Principles of Geographical Information Systems for Land Resource Assessment. Clarendon
3. DeMers MN (1997) Fundamentals of Geographical Information Systems. Wiley
4. Lillesand TM and Kiefer RW (1994) Remote Sensing and Image Interpretation. John Wiley & Sons
5. Schowengerdt RA (1983) Techniques for Image Processing and Classification in Remote Sensing. Academic Press
6. Bonham-Carter, G.F. (1994) Geographical Information System for Geoscientists modeling with GIS Program.
7. Burrough, P.A. (2001) Principles of Geographical Information Systems, Clarendon.
8. Curran, P.J. (1985) Principles of Remote Sensing, ELBS.
9. DeMers, M.N. (1997) Fundamentals of Geographical Information System. Willy & Sons.
10. Ferguson, M. (1998) GPS Land Navigation. Glassland.
11. Jesson, J.R. (1996) Introductory Digital Processing: A Remote Sensing Perspective. Pentice Hall, Englewood Cliffs.
12. Konecny, G. (2003) Geoinformation: Remote Sensing, Photogrammetry and Geographic Information System, Taylor & Francis, London and New York.

13. Lillesand, T.M. and Kiefer, R.W. (1994) Remote Sensing and Image Interpretation. John Wiley & Sons.
14. Lucas, I.F.J. (2000) Principles of Remote Sensing. ITC Education Textbook Science-2. ITC, Enschede, The Netherlands.
15. Maguire, D.; Goodchild, M. and Rhind, D.W. (1991) Geographical Information systems: Principles and Applications. Longman.
16. Martin, D. (1996) Geographic Information System. Routledge.
17. Sabins, F.F. (1996) Remote Sensing: Principles and Interpretation, Freeman.
18. Schwengerdt, R.A. (1983) Techniques for Image Processing and Classification in Remote Sensing, Academic Press.

### **ENV- 5101 Fundamentals of Environmental Sciences**

1. Definition, scope and goal of environmental sciences, its relation to other disciplines of science, environmental issues in Bangladesh and role of environmental science, state of environmental awareness, environmental communication and action oriented programs in Bangladesh and South Asia. Multidisciplinary nature of environmental Sciences: Historical and philosophical basis, concept of Gaia: the interconnectedness of lithosphere, hydrosphere, atmosphere and biosphere. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems, Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles. Biogeochemical Cycles of some important elements: Carbon, Nitrogen, Sulfur; their implication for global environmental changes. Environmental Pollution: Definition, causes, effects and control measures of Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards; Solid waste (Causes, effects and control measures of urban and industrial wastes), Role of an individual in prevention of pollution, Concept of Disaster (Floods, earthquakes, cyclones and landslides). Social Issues and the Environment: From unsustainable to sustainable development, urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concern, Environmental ethics.
2. Human Population and the Environment: Population growth, variation among nations, Population explosion-Family Welfare Program, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health. Environmental Issues and possible solutions: Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation. Environmental Ethics: Definition and scope, Approach of environmental ethics, Environmental attitude, Individual, social, corporate and global ethics, Environmental justice, Legal system of Bangladesh

### **References:**

1. Textbook of Environmental Studies by Erach harucha, Universities Press, India, 2005.
3. Environmental science earth as a living planet by Arms, K., Aaunders college publishing, 1990.
4. Environmental science an introduction by Miller.Jr., G.T..
5. Environmental science earth as a living planet by Daniel B.Botkin, E.A.K., John Wiley and sons inc., 1998.

### **ENV-5102 Environmental Pollution**

1. Water Pollution: Nature and types of water pollutants, elemental pollution and their determination, heavy metals, Cd, Hg, Cr etc., metalloids e.g. Arsenic in groundwater of Bangladesh, organic pollutants, pesticides in water, polychlorinated biphenyls.
2. Water Treatment: Treated water use, municipal water treatment and treatment of water for industrial use, removal of organic, removal of heavy metals and metalloids (arsenic), removal of phosphorus and nitrogen compounds.
3. Adsorption-filtration: Definition, types of adsorption, adsorption isotherm, adsorption of solutes by solids, hysteresis curves, thermodynamic properties, modes of adsorption by natural and synthetic adsorbents, application of adsorption-filtration process, desorption of solute particles.
4. Mesoporous materials: Porous solids, classification of pore sizes, development of mesoporous supports, preparation of mesoporous materials.
5. Atmospheric Chemistry: Importance of the Atmosphere, Evolution of atmosphere, Inversions and Air pollution, Global climate and Microclimate, Carbon Cycle and Atmospheric Carbon dioxide, Reactions of Atmospheric oxygen and Nitrogen, Aerosols, their direct and indirect effects: Aerosol properties, sources and production mechanisms of atmospheric aerosols, direct and indirect forcing associated with aerosols.
6. Air Pollution: Atmospheric pollutants, Inorganic gasses, Organic and organic sulphites and particulate oxides of sulphur and sulphur cycle, Nitrogen Oxides and Nitrogen cycle, urban air pollution, Mitigation of urban air pollution.
7. Environmental Soil Chemistry: Soil and agriculture, Nature and composition of soil, Acid-base and Ion-exchange reactions in soils, Wastes and pollutants in soil, Soil loss and degradation.
8. Ocean pollution: Sewage - source and effects of some marine pollution, toxic pollutants - antifouling paints, DDT, dioxins, PCBs; oil on water, marine debris - fishing gears, plastics.

#### **References:**

1. Environmental Chemistry, S.E. Manahan, 7th Edn, Lewis Publishers, 2000.
2. Environmental Chemistry of Soil, M. McBride.
3. A Guide to the study of Environmental Pollution, William Andrews (Edn).
4. Advanced Inorganic Chemistry, S.Z Haider.

#### **ENV-5103 Land and Water Resources Management**

##### **Section-A: Land Resources Management**

1. Incidence and Effects of Land Degradation: Changing Land Use: Its Causes and Implications, Global Environmental Change Challenges to Sustainable Land Management: Appropriate Land Management Systems, Improved Water Management, Adapting to Climate Change, Knowledge Dissemination and Land Policy Constraints
2. SLM Interventions: An Agri-technical Perspective: Protecting the Land Resource: Agricultural Intensification and Integrated Farming Systems, Soil Fertility Management, Market Opportunities Linked to Erosion Control Practices: A Key to Adoption?, Protecting and Managing Watersheds, Exploiting the Production and Environmental Service Functions of Land.
3. The Bank's Evolving SLM Portfolio: Past and Current Investments for SLM and Related Interventions, The Pattern of Bank Group Investments in SLM, NRM, Bio Carbon, and Watershed Management Programs.
4. Strategic Options: Policy and Sector Work, Research and Technology Development, Knowledge Sharing and Extension, Providing Incentives, Expenditure Priorities, and Modes of Financing, Recommended Approach and the Role of the World Bank Group.

## 5. Case Study on Land Management and water resources management and a Useful Plant Diversity

### **Section-B: Water Resources Management**

1. Introduction: Hydrologic Cycle, Importance of Hydrology, Water Balance, Energy Budget. Groundwater (Definition, origin and depth of GW, springs and wells, Aquifers and Aquifers properties, Water yield, Groundwater flow, Groundwater investigations, Well tests, Steady state well Hydraulics, Methods of Groundwater exploration).
2. Hydrological Environments: Hydrogeological environments of Bangladesh, Sea-water intrusion in coastal aquifers, Hydrogeological models and their use in resource assessments.
3. Water Resources planning & management: Water, and its impurities, criteria of water quality, Sources of fresh water, characteristics of domestic industrial & Irrigation water. Estimation & Collection system of surface & ground water, Effluent disposal, reuse & misuse of water, Basic concept of water resource planning & management, Wetlands & water resources, Soil water relationship, Human impact on water resources: Irrigation & flood control system strategic planning: conceptual frame work & models: Watershed management of urban ( Municipal ) & Rural area emphasis on drinking water (urban) & Irrigation water (Rural), Economic considerations, Business response, Water and Conflict.
4. Water resources of Bangladesh: Importance and properties of water, sources and worldwide supply and national consumption, the water cycle, water supply problems, building dams and water diversion projects, groundwater use, water conservation, flooding- problems and solution and adaptation, water shortage-issue and solutions, irrigation-issues and solution, groundwater pollution in Bangladesh-a detrimental threat to the safe drinking water supply, navigation and flood control, Water resources and power generation, Regional conflicts on Water resources, Planning for water resources development.
5. IWRM: Development, Implementation, IWRM in Bangladesh, Case Study

### **References:**

1. Sustainable Land Management: Challenges, Opportunities, and Trade-offs, 2006, The International Bank for Reconstruction and Development/The World Bank, NW, Washington DC
2. Kiely, G., 1998, Environmental Engineering, McGraw-Hill.
3. Raghunath, H.M., Hydrology: Principles, Analysis and Design.
4. Abdel-Aziz, I.K., 1986; Groundwater Engineering, McGraw-Hill Book Co., New York.
5. Lioyd, J.W. & Heathcote, J.A., 1985, Natural Inorganic Hydrochemistry in relation to Ground Water: An Introduction; Clarendon Press. UNITED NATIONS, 1982, The Hydrogeological Condition of Bangladesh; United Nations Ground Water Survey Technical Report, New York.

### **ENV-5104 Ecosystem and Biodiversity**

1. Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystems (Forest ecosystems, Grassland ecosystems, Desert ecosystems, Aquatic ecosystems).
2. Basic Concepts of Biodiversity: Definition, significance of Biodiversity and natural resources, Benefits from Biodiversity, Types of Biodiversity and Biodiversity and species concept, Status of biodiversity in Bangladesh.
3. Threats and Conservation of Biodiversity: Depletion of Biodiversity, Causes of threatening Biodiversity, IUCN categories of endangered species, Red data book, Measures for Biodiversity conservation, protected area and biosphere serves Role of Zoos, Botanical gardens and captive breeding programme. Forest Ecosystems of Bangladesh: Role of forest dwellers for ecosystem sustainability; Hill forest and Sal forest



of Bangladesh as potential resources, The Sundarbans biodiversity conservation, Wildlife of Bangladesh as a resource and their protection.

4. Wetlands of Bangladesh: History and heritage of wetlands, Importance of wetlands for Bangladesh, Resources of wetlands, Haor basins of Bangladesh as resource base - Haor systems of international importance; Socioeconomic values of wetlands - Over fishing and the vanishing of fish species, impact of flood control and irrigation project on fish species; Marine and estuarine ecosystem of Bangladesh; Coral reef - St. Martin island and its significance; Impact of development activities on wetlands, Management and regulations of wetlands - National and global importance of coastal and wetland biodiversity, Coastal wetlands biodiversity management, Mangrove of the Chokoria Sundarbans; Aquaculture and mangrove forestry, International collaboration for management of wetlands.
5. Coastal Afforestation and Environment: Plantation in coastal areas of Bangladesh; Windbreaks and Shelterbelts: Wind and vegetation, functions of windbreaks and shelterbelts, types of windbreaks and shelterbelts for coastal regions.
6. Participatory Forestry: Agro-forestry and Social Forestry.
7. Restoration Ecology: Theory, forest restoration, urban greening and green spaces, Importance of urban forestry and aquatic urban habitat for urban landscape developments and environment.
8. Wastelands: Wasteland as a dormant resource base for sustainable development; Development of wastelands -Technology for development of wastelands - coastal sands, dry and rocky areas, wet lands, denuded and eroded hill slopes, land slips and mined areas. Impact of artificial trans-boundary barrages on different ecosystems of Bangladesh. National conservation strategies for ecosystem sustainability of Bangladesh.

#### **References:**

1. Najma Heptulla. 1993. Environment protection in developing countries, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
2. A.P. Dwivedi. 1992. Agroforestry Principles and Practices, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
3. L. DeVere Burton. 2000. Introduction to Forestry Science. Delmar Publishers, New York.
4. C. Philip Wheater. 1999. Urban habitats, Routledge Publication Ltd., London.
5. Neaz Ahmad Siddiqi. 2001. Mangrove Forestry in Bangladesh. Institute of Forestry and Environmental Sciences, University of Chittagong.
6. M. Sitaram Rao. 1979. Introduction to Social Forestry. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
7. M. Z. Abedin, C.K. Lai and M. Omar Ali. 1990. Homestead Plantation and Agroforestry in Bangladesh. Published by Bangladesh Agricultural Research Institute.
8. P.K.R. Nair. 1994. Agroforestry Systems in the Tropics, Kluwer Academic Publishers in co-operation with ICRAF, USA.
9. H.L. Gholz, 1987. Agroforestry: Realities, Possibilities and Potentials, Martinus Nijhoff Publishers, The Netherlands.
10. M. S. Khan, E. Haq, S. Huq, A. A. Rahman, S. M. A. Rashid and H. Ahmed. 1994. Wetlands of Bangladesh, BCAS, Dhaka, Bangladesh.
11. K. C. Misra, 1989. Manual of Plant Ecology, 3rd edition, Oxford and IBH Publishing Co. Pvt. Ltd., India.

#### **ENV-5105 Environment, Health and Safety (EHS)**

1. Introduction: Need for integration of safety, health and environment; Fundamentals of safety; overview of industrial safety management; role of top management and Government in safety management, Legal aspects of safety.
2. Steps of industrial safety management: Security Management of Industrial plants; Safe working practices; Personal protective Equipments; Storage and handling of Material and equipment; Safety in transportation

and automotive Equipments; Electrical safety; Mechanical Hazards; Chemical Hazards; Building design and Fire protection; Radiation Hazards; Safety in Hazardous area, safety in power plants etc.

3. Occupational Health and Safety Assessment Series (OHSAS), Scope of OHSAS 18001.
4. Industrial safety analysis: Introduction, locating and defining injury sources, causes of injury, sources of data, safety analysis techniques, fault tree calculations, risk tolerability.
5. Implementation and operation, Structure and responsibility, Training, awareness and competence, Consultation and communication, Documentation, Operational control, Emergency preparedness and response, Social security inside the industries, Insurance.

### **References:**

1. "Occupational health and safety management systems-Specification", Occupational health and safety assessment series, OHSAS 18001:1999.
2. Bangladesh Labour Law, 2006.
3. "American national Standard, Quality Management Systems-Requirements" published by American Society for Quality, December, 2000.
4. R. K. Jain and Sunil S. Rao, Industrial Safety, Health and Environmental Management Systems, Khanna Publishers.
5. Kabata-Pendias A, Pendias H. Trace Elements in Soils and Plants, CRC press, Boca Raton, Florida.
6. Salomons W., Forstner U., and Mader P. Heavy Metals (Problems and Solution), Springer- Verlag Berlin Heidelberg, 1995.
7. Alshwabkeh A. N., Acar Y.B. Removal of contaminants from soils by electrokinetics: A theoretical treatise. J. Environ. Sci. Health A27/7, 1835-1861, 1992.
8. Brown G.A., Elliott H.A. Influence of electrolytes on EDTA extraction of Pb from polluted soil. Wat. Air. Soil. Pollution 62, 157-165, 1992.

## **ENV-5201 Global Climate Change and Disaster Management**

### **Section-A: Global Climate Change**

1. Current knowledge about observed and future impacts of climate change on the natural and human environment: Freshwater resources and their management, Ecosystems, their properties, goods and services, Food, fiber and forest products, Coastal systems and low-lying areas, Industry, settlement and society, Human health.
2. Future impacts of climate change in Africa, Asia, Australia and New Zealand, Europe, Latin America, North America, Polar Regions (Arctic and Antarctic) and Small islands.
3. Impact on Public Health: Quantitative health impact assessment, Disasters: Floods and windstorms, vector borne diseases, waterborne and foodborne diarrheal diseases, Food security, vulnerable populations.
4. Assessment of adaptation practices, options, constraints and capacity.
5. Inter-relationships between adaptation and mitigation.
6. Assessing key vulnerabilities and the risk from climate change.
7. Perspectives on climate change and sustainability.
8. Issues related to mitigation in the long term context: Energy supply, Transport and its infrastructure, Residential and commercial buildings, Industry, Agriculture, Forestry, Waste management.
9. Mitigation from a cross sectoral perspective.
10. Sustainable Development and mitigation.
11. Policies, instruments and co-operative agreements.
12. Case studies.

### **Section-B: Disaster Management**

1. Disaster Concepts, Regulatory and Institution Framework in Bangladesh: Terms and concepts used in disaster management, Disaster risk situation in Bangladesh and global scenarios, Comprehensive disaster management (CDM) approach, Cross cutting themes such as, Gender, Ethnic minorities, Globalization, global insecurities & its linkages to disasters and food Security, Bangladesh Disaster management models

and approaches, Regulatory framework of Bangladesh DM system, Institutional Framework of Bangladesh DM system, Standing Orders on Disasters and roles of DMC(s).

2. Disaster Risk Management and Sustainable Development: Methodologies for undertaking disaster risk management and provide tools for understanding and assessing: Hazards and its classification, Community risk assessment, vulnerability and institution profiling, Vulnerability factors, Coping capacities and mechanisms, Community empowerment, Evolution of disaster risk management, Relation between disaster and sustainable development, Climate change impact and livelihood adaptation to climate change.
3. Disaster Prevention and Mitigation: Framework for prevention and mitigation, Structural and non-structural mitigation, Hazards prevented by structural mitigation, Risk treatment and application of insurance, Community based disaster management, Institutional and legal mechanisms for risk reduction, Advocacy and role of public awareness, National prevention & mitigation strategies preparation.
4. Disaster Preparedness for Effective Response: Preparedness planning and contingency planning key preparedness considerations: Vulnerability assessment, Coordination aspect, Organization/Institutional Frameworks, Information system, Response mechanism, Resource Base, Public education and training, Early warning systems, Rehearsal/drills, Community preparedness.
5. Disaster Response : Key steps for emergency response, Warning information/message dissemination, warning signals in Bangladesh, Evacuation and evacuation equipment's, Search and rescue of vulnerable communities, Transitional shelter and shelter management, Public critical services restoration, Damage, loss and needs assessment, Other sectoral support during emergencies e.g. food, health, Nutrition, water & sanitation, and education, Working with the media and information management, Resource management, The emergency coordination centre and role of incident manager.
6. Disaster, Recovery, Rehabilitation and Reconstruction: Concepts and principles early recovery, Concepts of development relief, Build back better, Stakeholder, community involvement and participation, Recovery interventions.
7. Disaster Management Plan and Implementation Aspect: Preparation of disaster management plan, Relief management, coordination and distribution through DMC, Accountability in disaster management projects, Monitoring of risk reduction interventions and evaluation, Development and implementation of sectoral / personal action plans.
8. Case Studies in Disaster Prevention and Mitigation, Disaster Preparedness for Effective Response, Disaster Response, Disaster, Recovery, Rehabilitation and Reconstruction.

#### References:

1. IPCC, 2007: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp.
2. IPCC, 2007: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
3. GOB 1999. Standing orders on Disaster, Min of DM & RDMB, Dhaka.
4. Carter, W. Nick. 1999. Disaster management; a disaster manager's handbook, ADB, Manila, Philippines.
5. UNDRO, 1991. Mitigating Natural Disasters Phenomena, Effects & Options a manual for policy makers and planners, United Nations, New York.

## ENV 5202-Industrial Waste Treatment and Management

1. Basic concept of pollution and pollutants
2. Treatment Plant Design and Maintenance: The planning process, Treatment costs, Plant setting, Construction staging and Process design, Mechanization, Instrumentation and Automation, Plant layout, Building design, Example of design information, Other significant design features, Maintenance of treatment plant, Health and safety issues of treatment plant.
3. Treatment Technologies for Industrial wastes: Physical treatment technologies: Screening, Grit removal, Flocculation, Gravity separation theory, Primary sedimentation, High rate clarification, Process application, Flotation, Design considerations for dissolved – Air flotation systems.
4. Chemical Treatment Technologies: Role of chemicals unit processes in wastewater treatment, Application of chemical unit processes, Fundamentals of Chemical coagulation, Chemical precipitation for improved plant performance, Chemical precipitation for removal of heavy metals and dissolved inorganic substances, Chemical oxidation, Applications, chemical oxidation of BOD and COD, Electrochemical wastewater treatment, Chemical neutralization.
5. Biological Treatment Technologies: Overview of biological wastewater treatment, Objectives of biological treatment, Micro remediation technology and Phytoremediation Technology, Role of Microorganisms in wastewater treatment, Types of biological processes for wastewater treatment, Suspended growth biological treatment processes, Attached Growth and combined biological treatment Processes, Biological removal of toxic and recalcitrant organic compound, Biological removal of heavy metals.
6. Advanced Treatment Technologies: Need for advanced treatment, Technologies used for advanced treatment, Selection of filtration technology, Effluent filtration with chemical addition, Membrane filtration Processes, Membrane process classification and configurations, Application of membrane electro dialysis, Fundamentals of adsorption, Design of stripping towers, application, Ion exchange chemistry, Theory of advanced oxidation technologies, applications and operational problems, Performance expectations of distillation in reclamation applications.
7. Disinfection Processes: Regulatory requirements for wastewater disinfection, Disinfection theory, Methods and mechanism of disinfectants, Disinfection with Chlorine, Ozone, Ultraviolet radiation, Disinfection systems, Environmental impact of Disinfection systems, Comparison of alternative disinfection technologies, Advantages and disadvantages.
8. Issues Related to Treatment Plant Performance: Upgrading wastewater treatment Plant performance, Process optimization, Upgrading existing wastewater treatment facilities, Treatment process reliability and selection design values, Development of input-and output data.
9. The 3R's Golden rule (Reduction, Reuse & Recycling) of Industrial Waste Management: Concepts of Sustainable Industrialization, Reducing the waste or zero waste discharge and environmental costs of industrial production by 3R's approach, Reducing solid waste by dematerialization technology, waste reduction by water conservation in industrial production, Industrial complexions to reuse waste of one industry as raw material by another, Recycling of industrial waste to recover useful by-products, Global waste trade and exchange for non-hazardous industrial waste recycling, environmental significance of recycling, Economic benefits of recycling.
10. Preventing Industrial Wastes and Pollution through Cleaner Production: The concept of cleaner production, Strategies to prevent and reduce the generation of toxic waste at source, Changing production process in industries to reduce toxicity and achieve cleaner production, Equipment modification for cleaner production, Material change and substitution to reduce hazardous waste and achieve cleaner production in industries, Clean and safe alternative to conventional plastic, Cleaner agriculture and food production by reducing dependence on agro chemicals, Cleaner energy production.

11. Case analysis and presentation.
12. Effluent Treatment Plant/ Recycling Plant visit.

**References:**

1. Wastewater Engineering: Treatment and Reuse (4th Edition), Metcalf & Eddy Inc., Tata Mc Graw-Hill Publishing Company Limited
2. Water and Wastewater Engineering, Water Purification and Wastewater Treatment and Disposal (Volume 2) Gordon M. Fair, John C. Geyen, Daniel A. okun, John Wiley and Sons Inc., New York
3. Industrial Waste Treatment, Edmund B. Bessliever, Mc Graw- Hill Book Company Inc.
4. Industrial Waste Treatment Handbook (2nd Edition) By: Woodard & Curran, Inc. © 2006 Elsevier.
5. Waste Treatment in the Process Industries: Lawrence K. Wang, Yung-Tse Hung,Howard H. Inc. © 2006 Elsevier
6. Industrial and Hazardous Wastes: Health Implication and Management Plans: Dr. Rajiv K. Sinha and Dr. Sunil Herat, 2004 Pointer Publishers.

**ENV-5203 Environmental Issues, Policies and Legislation**

1. Characterization of environmental issues and overview of global sustainability around the world. Key environmental issues for global sustainability: Population and demographic transition, Food production, urbanization, Oil production, electricity generation, greenhouse gas production, climate change, sea level rise and the renewable transition, Deforestation and biodiversity, desertification, water use, and waste production, war and terrorism.
2. Environmental Issues related to Bangladesh: Environmental health and Population dynamic, Human Rights and scenario in Bangladesh, Human Rights and Legal system of Bangladesh, State of Environment in Bangladesh (Forest sector, Agriculture, Rivers, wetlands, Industrialization, Legislation for development), Arsenic Pollution, Shrimp Movement, Greenhouse gases and their impact, trends and projection of future emissions, global warming, acid rain, ozone layer depletion, climate change and sustainable development.
3. SDGs: goals, objectives, details of each goal, target group
4. Basic principles for institutional, legal, and regulatory framework for environmental policies, local and global strategies, regulations and governance.
5. State of the environment and policy retrospective: Our common future, Earth Summit, Kyoto protocol, and Johannesburg Earth Summit; CDM and Carbon credit, Convention of biological diversity, Ramsar convention, Innovation and networking for environmental policy for sustainable environmental management since Rio (Earth Summit): Guidelines for environmental policies of World Bank, UNEP, WHO, OECD, and other international and UN organizations.
6. Legal System of Bangladesh: Environmental law regime in Bangladesh, constitutional provision, role of BELA in the legal activism in Bangladesh, Bangladesh position on ICTPs; ECA 1995, ECR 1997, EC 2000 and other recent laws, Environmental policy: National and international, laws regarding Biodiversity conservation, Forestry, Fishery, Mineral exploration, Groundwater management etc.
7. Market-based environmental policies and actions for achieving the Millennium Development goals and related outcomes; Analysis of environmental policies between developed and developing countries.
8. Case study of environmental policies and natural resource management in South-East Asia.

**References:**

1. Newman, P. and Kenworthy, J (1999): Sustainability and Cities: Overcoming Automobile Dependence, Island Press, Washington, D.C
2. Newman, P. (2000): Global Environmental Issues. N212/N412, Unit Reader, 2000 Environmental Science, Division of Science and Engineering Murdoch University, Perth, Western Australia.

3. Hanaki, K. (1995): 716-92 Management of Global and Urban Environment, Research Center for Advanced Science & Technology, Tokyo University, Japan.
4. Jurma C. (2002): The Global Sustainability Challenge: From agreement to action. International Journal of Global Environmental Issues, 2(1/2): 1-14
5. Millennium Goals, United Nations Development Programme; <http://www.undp.org/mdg/> Accessed 21/01/2004.

### **ENV-5204 Research Methodology**

1. Introduction – need and importance of research methodology: Approach – methodology and limitation of research:
2. Research design – features of good design, concept and development of research plan: Sampling design – sampling strategy, methodology and types of design of the program.
3. Census and sample survey: Measurement and scaling techniques. Introduction (Meaning and nature of research), Classification of research, Identifying and analysis of research problem,
4. Basic statistical concepts and techniques; Describing data probability, data distributions, testing differences between means, correction & regressions, Non-linear relationship, Participatory research and its methodology development with practical explanation.
5. Methods of data collection – primary data, secondary data, selection of appropriate data, guidelines for interviewing, questionnaire and schedule:
6. Social and participatory methodologies in peoples’ participation: Data processing and analysis – problems, types, statistics, interpretation of results, graphical representation and tabulation, manuscript preparation, rules of quotation and bibliography:
7. Report writing: Case studies, Statistical tools and SPSS, social research methods – survey, interview, ethical issues in social research, quantitative environmental research: field- and/or laboratory-based research, safety issues in environmental research design, modeling and simulation, techniques for disseminating research outcome: thesis, articles and presentation, writing research proposals.

### **Reference:**

1. Wilson: Introduction to Research Methodology. McGraw-Hill Book Co, NY.
2. Cochran, W. G. and Cox, G. M. (1957): Experimental Designs; John Wiley and Sons Inc., London.
3. Blalock, H.M.Jr.(1979): Social Statistics, MacGraw Hill Book Company , New Delhi.
4. Bishop, (1992) ON.19. Statistics for Biology, A practical guides for the experimental Biologists , Longman, , UK.
5. Cochran, W. G. (1963). Sampling Techniques (second edition), John Wiley & Sons, NY
6. \*Students will select specific topic of research and will do exercise

### **ENV-5301 Environmental Management System (EMS)**

1. Definition of EMS (Environmental Management System). Scope and objectives of EMS, Key Concepts of Industrial Environmental Management, Environmental Management Approaches.
2. Terminology: Auditor, continual improvement, corrective action, document, environment, environmental aspect, Environmental Balance, environmental impact, environmental objective, environmental performance, environmental policy, environmental target, interested party, internal audit, nonconformity, organization, preventive action, prevention of pollution, procedure, record.
3. General requirements of EMS, Applicability of environmental policy, Environmental aspects; legal and other requirements; objectives, targets and program(s).
4. Implementation and operation: Resources, roles, responsibility and authority; competence, training and awareness; communication; documentation; control of documents; operational control; emergency preparedness and response.
5. Checking: Monitoring and measurement; evaluation of compliance; nonconformity, corrective action and preventive action; control of records; internal audit.
6. Relationships among ISO 9000 (QMS), ISO 14000 (EMS) and OSHAS 18000 (Occupational health, safety and environment).

### **Recommended References:**

1. Environmental Management Systems- Requirements with guidance for use” Published by International Organization for Standardization, 2004.
2. Environmental Laws in Bangladesh” Published by Environment & Development Alliance, June 1999.
3. Application for certification to ISO 14001:2004” by Bureau Veritas (Bangladesh) Private Limited, July 2007.
4. Descriptive Law on Pollution & Environment by Akalank Kumar Jain, 9th ed, June 2000.

### **ENV-5302 Integrated Environmental Impact Assessment (IEA)**

1. Basic Concepts: overview of EA, EIA, SIA, SEA, Analytical Frameworks: DPSIR, Social, Political and economic context
2. EA: Definition, Concepts, Scope and design, tools and method, Application (Planning, communication, evaluation), Case Study
3. EIA: Definition, Concepts, Scope and design, tools and method, Application (Planning, communication, evaluation), Case Study
4. SIA: Definition, Concepts, Scope and design, tools and method, Application (Planning, communication, evaluation), Case Study
5. SEA: Definition, Concepts, Scope and design, tools and method, Application (Planning, communication, evaluation), Case Study

### **References:**

UNEP Geo manuals

### **ENV-5303 GIS and RS for Environmental Management**

1. Introduction to Geographic Information System (GIS); definition, purpose, scope and nature of GIS, basic concepts, components of a geographic based information system: Data input to spatial information: Geographical data types and methods of representation; data base concepts, points, line arc and continuous surface: GIS data structure; nature of geographic data, spatial data models, raster data models, vector data model, comparison, format conversion, data structure conversions, data medium conversion; Concepts, systems and methods of image transformation and information extraction from primary data. Global Positioning System (GPS): Concepts, system, methods, types, data acquisition and applications.
2. Preprocessing; data reduction and generalization, error detecting editing, merging, edge matching, rectification and registration, coordinate systems and geo-referencing: Manipulation, Analysis and Spatial Modeling; reclassification and aggregation: Overlay Operations; topological overlay: 3D GIS: Management and implementation of GIS.
3. Remote sensing in environmental management: Importance, application to biodiversity, coastal zones, fishing zones, forest cover, natural resources, wastelands, natural disasters, weather analysis and forecasting, global climatology, landforms, rock and mineral resources, crops and land use, ecology, urban settlement.
4. Conceptual model for spatial and non-spatial information of GIS, Map projection: Methods and types, importance, and applications, Decision Support System (DSS): Concepts, systems and techniques, object Oriented GIS; Internet GIS; and Open GIS/online GIS.
5. Fundamentals of remote sensing – definition, energy source and radiation principles, spectral bands and structure, interaction of light with atmosphere and surface, characteristic of energy with different media, data acquisition and interpretation, applications: Remote sensing satellites, sensors and their characteristics – history, types of satellites and their specialization, orbit characteristics, sensor characteristics, application: Remote sensing images – preprocessing and processing techniques, enhancement techniques, filtering: Digital image classification – supervised and unsupervised classifications, area measurement from

classified image, temporal change detection: Image interpretation with GIS data: Microwave remote sensing: SAR techniques

6. Aerial photograph – introduction, basic photo interpretation techniques, photo scale and stereoscopic parallax, color concept, flight planning, ground control: Photogrammetry and Air-photo interpretation – image parallax, aerial stereograms, methods of height determination, counting objects, area measurement: AP application in environmental sciences and case studies.

### **References:**

1. Bonham-Carter GF (1994) Geographical Information System for Geoscientists – Modeling with GIS. Pergamon
2. Burrough PA (1986) Principles of Geographical Information Systems for Land Resource Assessment. Clarendon
3. DeMers MN (1997) Fundamentals of Geographical Information Systems. Wiley
4. Lillesand TM and Kiefer RW (1994) Remote Sensing and Image Interpretation. John Wiley & Sons
5. Schowengerdt RA (1983) Techniques for Image Processing and Classification in Remote Sensing. Academic Press
6. Bonham-Carter, G.F. (1994) Geographical Information System for Geoscientists modeling with GIS Program.
7. Burrough, P.A. (2001) Principles of Geographical Information Systems, Clarendon.
8. Curran, P.J. (1985) Principles of Remote Sensing, ELBS.
9. DeMers, M.N. (1997) Fundamentals of Geographical Information System. Wiley & Sons.
10. Ferguson, M. (1998) GPS Land Navigation. Glassland.
11. Jesson, J.R. (1996) Introductory Digital Processing: A Remote Sensing Perspective. Pentice Hall, Englewood Cliffs.
12. Konecny, G. (2003) Geoinformation: Remote Sensing, Photogrammetry and Geographic Information System, Taylor & Francis, London and New York.
13. Lillesand, T.M. and Kiefer, R.W. (1994) Remote Sensing and Image Interpretation. John Wiley & Sons.
14. Lucas, I.F.J. (2000) Principles of Remote Sensing. ITC Education Textbook Science-2. ITC, Enschede, The Netherlands.
15. Maguire, D.; Goodchild, M. and Rhind, D.W. (1991) Geographical Information systems: Principles and Applications. Longman.
16. Martin, D. (1996) Geographic Information System. Routledge.
17. Sabins, F.F. (1996) Remote Sensing: Principles and Interpretation, Freeman.
18. Schowengerdt, R.A. (1983) Techniques for Image Processing and Classification in Remote Sensing, Academic Press.