Curriculum

Undergraduate
Session: 2021-2022

Syllabus

Graduate
Session: 2021-2022

Department of Civil and Environmental Engineering

Shahjalal University of Science and Technology
Sylhet, Bangladesh

Published by:
Office of the Registrar
Shahjalal University of Science and Technology (SUST)
Sylhet 3114, Bangladesh

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Ordinance for Semester System for Bachelor's Degree

(This ordinance will replace other ordinances/resolutions etc. on the issues described here. However, it will not affect ordinances/resolutions on issues not mentioned here.)

1. Student Admission

1.1 Undergraduate Admission:

The admission committee of the university will conduct the admission process for the Bachelor's degree as per the rules. The student will enroll in the first semester of an academic year in individual disciplines of different schools. The admission of foreign students will be subjected to the verification of academic records as per the university rule.

1.2 Student Status, Student Level and Level of courses:

Every student has to maintain her/his student status by enrolling, paying tuition fees, and doing the registration for required credits every successive semester following the requirements (Section-4). For smooth operation of semester system and bookkeeping purpose:(1) a student's level will be expressed by her/his year and semester, and (2) courses of 1st year, 2nd Year, 3rd Year and 4th Year will be termed respectively as 100 level, 200 level, 300 level and 400 level courses.

1.3 Re-Admission:

(1) A student will be eligible for re-admission in the first year first semester of the subsequent session if s/he was present in at least 25% of the classes of her/his core and elective courses of the same semester.

(2)A student has to take re-admission if her/his student status is not maintained or one or more semesters have been annulled because of disciplinary action taken against him/her. In the case of semester annulment, the student has to re-admit to the same level of semester. The level (Year and Semester) of re-admitter will be determined by his/ her completed credits.

The re-admitted students will always be assigned the original Registration number.

1.4 Student's Advisor:

After admission, every batch of the students will be assigned to a student advisor nominated by the respective discipline to guide them during their study under the semester system. Advisors will always be accessible to the students and ready to mentor them in academic activities, career planning and if necessary, personal issues. There will be a prescribed guideline for the advisors to follow.

2. Academic Calendar

2.1 Number of Semesters:

There will be two semesters in an academic year. The first semester of the year will start on 1st January and end on 30th June, the Second semester will begin on 1st July and end on 31st December. The roster of the final examination dates and other academic deadlines will be announced at the beginning of each semester.

2.2 Duration of Semesters:

The duration of each semester will be as follows:

Classes	14 weeks
Recess before final Examination	2 weeks
Final Examination	4 weeks
Total	20 weeks

These 20 (twenty) weeks may not be continuous in order to accommodate various holidays and the recess before the final examination. The final grading will be completed within one month of the beginning of the semester.

3. Course Pattern

The entire Bachelor's degree program has covered through a set of theoretical, practical, project, viva and seminar courses. At the beginning of every academic session, a short description of courses will be published by the curriculum committee of each discipline.

3.1 Course Development:

3.1.1 Core, Elective and General Education Courses: The Curriculum Committee of the discipline duly formed by the respective Dean will develop all the courses of the curriculum for every session. These courses include the Core, General Education, and Elective courses needed for the program of the discipline. The General Education courses will be developed with the close cooperation of the respective discipline concerned, considering the necessity of the program. If for any of the disciplines, the needed General Education courses are not running/operating in the University then the Curriculum Committee of that discipline will develop all the necessary/relevant courses for the program. Finally, the curriculum has to be approved by the respective school and the Academic Council.

3.1.2 Curriculum: (a) Core, Elective and General Education Courses: The Curriculum Committee will select and approve the courses from Core/Elective courses of the discipline as well as General Education courses designed/offered by the other disciplines for completing the full curriculum. The Curriculum committee will also select a group of courses as the core courses. In that instance, without completing all of these core courses, a student will not be considered for graduation even if s/he completed the credits required for the degree. Also, the committee may assign a pre-requisite for any course if deemed necessary.

(b) Second Major Courses: The curriculum committee will select a set of courses of 28-36credits from the core and elective courses for a second major degree.

3.1.3 Course Instruction: At the beginning of every semester, the course instructor has to prepare a detailed course plan and submit it to the head of the discipline to make it available for the students. The course plan should have information about the suggested textbooks, topics per week and corresponding course learning outcomes (Cos) covered, teaching and learning strategies, assessment strategies, number and approximate dates of term-test examinations, quizzes, presentations, and mandatory office hours reserved for the students of the course offered. If not otherwise mentioned, the medium of instruction is always English.

3.2 Course Identification System:

Each course is specified/designated by a three-letter symbol for discipline/ school abbreviation (if not otherwise mentioned) followed by a four-digit International Standard Classification of Education (ISCED) code and a four-digit number to characterize that course. To avoid confusion, any new or modified courses should never be specified/designated by reusing a discontinued course number.

3.2.1 Discipline Identification:

The three-letter symbol will identify a discipline/institute/school offering the course as follows. If the same course is offered to more than one discipline/institute, if necessary, an extra letter shown in the list may be used after the four digits to specify the department receiving the General Education course.

		School of Applied Sciences and Technology:	
1.	ARC	Architecture	A
2.	CEP	Chemical Engineering and Polymer Science	B
3.	CEE	Civil and Environmental Engineering	C
4.	CSE	Computer Science and Engineering	D
5.	EEE	Electrical and Electronic Engineering	E
6.	FET	Food Engineering and Tea Technology	F
7.	IPE	Industrial and Production Engineering	G
8.	MEE	Mechanical Engineering	Q
9.	PME	Petroleum and Mining Engineering	H
		School of Life Sciences	
10.	BMB	Biochemistry and Molecular Biology	I
11.	GEB	Genetic Engineering and Biotechnology	J
		School of Physical Sciences:	
12.	CHE	Chemistry	K
13.	GEE	Geography and Environment	L
14.	MAT	Mathematics	M
15.	PHY	Physics	N
16.	STA	Statistics	O
17.	OCG	Oceanography	S
		School of Social Sciences	
18.	ANP	Anthropology	a
19.	BNG	Bangla	b
20.	ECO	Economics	c
21.	ENG	English	d
22.	PSS	Political Studies	e
23.	PAD	Public Administration	f
24.	SCW	Social Work	g
25.	SOC	Sociology	h
		School of Agriculture and Mineral Science	
26.	FES	Forestry and Environmental Science	P
		School of Management and Business Administration	
27.	BUS	Business Administration	i
		Institute of Information and Communication Technology	
28.	SWE	Software Engineering	W

3.2.2 Course Number:
(a) Following the BNQF (Bangladesh National Qualifications Framework) guidelines, an ISCED Code will be assigned to each course (offered by the discipline/institute/school) immediately after the three-letter code of the specified course.
(b) First Digit: The first digit of the four-digit number, after the ISCED Code, will correspond to the year (level) intended for the course recipient.
(c) Second Digit: The second digit of the four-digit number, after the ISCED Code, will correspond to the semester intended for the course recipient.
(d) Third Digit: A discipline should use the numbers 0 and 1 for the third digit to identify allied General Education courses. The digits 2-9 are reserved for Core and Elective courses to identify the different areas within a discipline/institute.
(e) Fourth Digit: The fourth digit of the four-digit numbers (after the ISCED Code) will identify a course within a particular discipline/institute/school. This digit may be sequential to indicate the follow-up courses. If possible, fourth digit may be even for identifying the laboratory/sessional courses of the discipline/institute/school.

3.2.3 Course Title and Credit: Every course will have a short representative course title and a number indicating the total credit as well as reference to prerequisite courses if any.

3.2.4 Theory and Lab/Sessional Course: If a single course has both Theory and Laboratory/sessional part, then the course must be split by Theory and Lab/Sessional courses, and both should have separate course numbers. A student will not be

allowed to register for the Lab/Sessional course without registering or completing the corresponding Theory course. Completion of both the Theory and the corresponding Lab/Sessional courses is mandatory for graduation.

3.3 Assignment of Credits:

3.3.1 Theoretical: One lecture of 1 (One) hour duration per week or 14 (Fourteen)lectures in total per semester will be considered as one credit.

3.3.2 Laboratory/Sessional Classes: Within the (laboratory/sessional) classroom of the discipline/institute minimum two contact hours of a laboratory/sessional class per week (or 28 contact hours in total per semester) will be considered as one credit. The minimum – maximum credits of the lab/sessional courses will be specified by/ limited to 1-3 credits. The other laboratory/sessional courses (like the design studio, field practicum, etc.) will be designed, and the credits will be determined/specified based on the necessity by the discipline/institute.

3.3.3 Seminar, Projects, Fieldwork, Thesis, Viva etc.: Will be assigned by the respective discipline/institute.

3.4 Classification of the Courses:

The Bachelor's degree courses will be classified into several groups, and the curriculum committee will finalize the curriculum by selecting courses from the groups shown below.

3.4.1 Core and Elective Courses: Every student has to take the courses specified/marked as core courses of the program offered by the discipline/institute. The percentage of the core and elective courses shall be at most 75% of the total credits so designed by the respective discipline/institute.

3.4.2 General Education Courses: Every student is required to take General Education courses developed by the Curriculum Committee of the discipline/institute. The General Education courses shall be at least 25% of the total credits offered by the respective discipline/institute. If any General Education course is specified/declared as a mandatory course in the curriculum, a student is required to take that course to graduate.

3.4.3 Non-credit Courses: The credit of these courses will be added to the total credits if passed but will have no effect on the CGPA as there will be no grades for these courses.

3.4.4Non-credit Course for BNCC: The credit of these courses will be added to the total credits if passed and its grade will be separately shown but will have no effect on the CGPA.

4. Admission in semesters and Course Registration

4.1 Requirements for Admission and Course Registration:

For admissions to higher semester (2^{nd} to 10^{th}) and course registration following requisites and steps have to be strictly maintained:

(1) Completion of 100 level courses is mandatory for student's admission in semester of 300 level courses.

(2) Completion of 200 level courses is required for admission in semester of 400 level courses.
(3) A student having incomplete 100 level courses shall be allowed for admission in her/his next available semester of 100-200 level courses until s/he completes all of 100 level courses.
(4) A student having incomplete 200 level courses shall be allowed for admission in her/his next available semester of 200-300 level courses until s/he completes all of 200 level courses.
(5) Once a student reaches to $8^{th}/10^{th}$ semester of 4/5 years' program s/he will be kept at this level, if necessary, till the specified last semester of the undergraduate program for completion of credit requirement of graduation.

Every admission/course registration of a student will be counted and adjusted from the total number of semesters of the program to determine her/his remaining period of study. Student advisors of all disciplines will advise every student about her/his courses for registration and monitor her/his performances. Accordingly, a student has to register for her/his courses and pay necessary dues within the first 4 (Four) weeks of every semester (2 more weeks for late registration).A student will not be allowed to appear in the examination if her/his semester and examination fee is not fully paid off. Foreign student must have valid Visa/residential permit to appear in the examination and that has to be checked by the student advisor and the head of the discipline/institute.

4.2 Minimum and Maximum Credit:

A student, if s/he is not a clearing graduate, will not be allowed to register for more than 30 credits per semester.

4.2.1 Course registration for clearing graduate: For course registration of a clearing graduate ($8^{th}/10^{th}$ and subsequent semesters), however, the condition(s) for maximum and minimum credits is/are relaxed.

4.3Incomplete Courses:

If a student has an incomplete course(s), s/he has to register such an incomplete course(s) from preceding semesters before registering courses from current or successive semesters. If an incomplete course is not available or offered in the running semesters, the student shall take such course(s) when it is available or offered.

4.5Course Withdrawal:

A student can withdraw a course by a written application to the Controller of Examinations through the Head/Director of the discipline/institute two weeks before the examination start. The Controller of Examinations will send the revised registration list(s) to the disciplines before the commencement of semester final examination. There will be no record in transcript if the course is withdrawn.

4.6 Course Repetition:

If a student has to repeat a failed or incomplete course and that course is not available/offered any more, the discipline may allow him/her to take an equivalent course from the current curriculum. For clearing graduates, if any incomplete course

is not available/offered in the running semester, the discipline may suggest a suitable/equivalent course to complete the credit requirement so required for the degree.

5. Graduation Criteria

5.1 Major Degree

5.1.1 Total Credits: For graduation, student must complete all of the offered courses prescribed by the curriculum committee for her/his session. In general, the minimum requirements for graduation from the disciplines of different Schools and Institute areas in the following table:

Schools/Institute	**Disciplines**	**Program duration (in year)**	**Minimum credits**
Physical Sciences	All disciplines	4	140
Social Sciences			
Management and Business Administration			
Applied Sciences and Technology	Architecture	5	200
	Other disciplines	4	160
Institute of Information and Communication Technology	Software Engineering	4	160
Life Sciences	All disciplines	4	160
Agriculture and Mineral Sciences			

Student must complete all the core and prerequisite (if assigned in curriculum) as well as all the registered courses for graduation.

5.1.2 Total Years:

A regular student is expected to complete her/his graduation in 8/10 semesters for 4/5(four/five) years' program of the disciplines/institute. If necessary, s/he will be given 4 (four) extra semesters(in consecutive 2 (two) years) in addition to8/10 (eight/ten) semesters of the program to complete the credit-requirement of the degree. In very special cases, that is, if a student completed her/his 80% or more of the credits and intended through application to complete the remaining credits thenthe discipline may send a detailed report to the respective Dean for further steps. Then, based on the report and Dean's opinion, Academic Council may allow2 (two)extra semesters as the special semesters for completing the credit-requirement of the degree as irregular students. In the case of Institute, the director will send the report through the governing body to the academic council. The regular examination year will be specified/identified by the session and the end-month (June or December) of the semester in which the student graduates.

5.1.3 Break in study:

In very special cases, if a student does not register and remains absent continuously for 2-4 (two to four) semesters within her/his12/14 semesters of 4/5 years 'program, then s/he may apply for re-admission as an irregular student. Her/his application will be considered only once provided that s/he has already completed 80% or more of the credits for which s/he was supposed to register and sit in the examination before the beginning of her/his break of study. The concerned discipline will analyze the application and send its well-judged recommendation to the Dean within the 1st month of the running semester. The Academic council, based on the recommendation of the discipline and the opinion of the Dean, may allow the applicant for admission as an irregular student. Such student has to complete the required credits within her/his remaining number of semesters.

In the certificate, grade sheet and transcript of all irregular students, the word "irregular" will be mentioned.

5.2 Second Major Degree

5.2.1 Total Credits: A student will be eligible for a second major degree if s/he completes an extra 28-36 credits requirement stipulated by the program offering discipline.

5.2.2Total Semesters: A student must complete the credit-requirement of second major degree within her/his8 (eight) regular and 4 (four) extra semesters.

5.2.3Requirement of Second Major Degree: A student will not be given a second major degree if s/he fails to complete her/his regular major degree.

5.2.4Registration Criteria: An offering discipline will decide on the number of seats for the second major, enrollment criteria, and get it approved from the Academic council. Students willing to get a second major have to apply to the offering discipline for enrollment, and the concerned discipline will enroll them as per the admission criteria.

5.2.5 Class routine: After enrollment, a regular student may start taking the second major courses starting from her/his 3rd semester. The class routine will be arranged to accommodate the student's need.

5.2.6 Certificate and Mark sheet: A student completing the requirement will be given an additional standard certificate and mark sheet for her/his second major degree.

6. Examination System

A student will be evaluated continuously under the semester-course system. For theoretical classes, students have to be assessed by class participation, assignments, quizzes, term-test examinations, topic-based report writing/presentation, and semester-end final examination. For laboratory/sessional work, s/he will be assessed by observation at work, viva-voce during laboratory/sessional works, from her/his written reports and grades of examinations designed by the respective course teacher and the examination committee.

6.1 Distribution of Marks:

The marks of a given course will be as follows:

1.	Class Attendance	10%
2.	Class performance (Quizzes, MCQ, fill in the gap, report writing/ presentation / Assignments)	10%
3.	Term-Test Examinations	20%
4.	Final Examination (25%is the pass mark for the final examination)	60%

6.1.1 Class participation: The marks for class participation will be as follows:

Attendance (Percentage)	Marks	Attendance (Percentage)	Marks	Attendance (Percentage)	Marks
≥ 95	10	80 – <85	7	65 – < 70	4
90 – <95	9	75 – < 80	6	60 – <65	3
85 – < 90	8	70 – <75	5	50 – <60	0

A student will not be allowed to appear the final examination of a course if her/his class attendance in that course is less than 50%.

6.1.2 Term-Test:
There should be at least two Term-Tests for every theory course. The course teacher may decide the marks distribution between term-tests. The answer script must be shown to the students as it is essential to their learning process.

6.1.3 Final Examination:
After the 16th week since the beginning of the semester, the final examination will be conducted as per the Semester Examination Ordinance.

(a) Duration of the Final Examination:
There will be a 3-hour final examination for every course of 3-4 (three-four) credits, and the courses less than 3 (three) credits will have a final examination for 2 (two) hours duration.

(b)Evaluation of answer scripts of final examination:
The school of disciplines may follow any one of the following answer script evaluation system.

(1) Single Examiner system, SES: The students will have two answer scripts to answer a separate set of questions during the final examination. Two examiners will grade the two answer scripts separately, and their given marks will be added together (examinee wise)for determining the Final Mark.

(2) Double Examiner system, DES: The students will have a single answer script to answer questions during the final examination. The answer scripts will be evaluated by two examiners separately. For determining the Final Mark: (1) If the difference of two marks of the examiners is less than 20%,then these two marks will be averaged, and (2) If the difference of two marks of the examiners is 20% or more, the corresponding/concerned answer scripts will be examined by a third examiner and then the closer (by smaller difference) otherwise higher two marks of the three examiners will be averaged. Furthermore, if the total marks of two examiners differ by 15% or more in the case of 50% or more answer scripts of a course, then the whole set of answer scripts will be examined by the third examiner.

The examination committee will propose the name for appointing the third examiner(s) (not any member of the examination committee) to the respective Dean. The Dean will authenticate/approve the name and send it to the Controller of Examinations for book-keeping and to take the approval of the Vice-Chancellor.

The system of answer script evaluation of the school has to be approved by the Academic Council.

7. Grading System

7.1 Letter Grade and Grade Point:
Letter Grade and corresponding Grade-Point for a course will be awarded from the roundup marks of individual courses as follows:

Numerical Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	C-	2.00
Less than 40%	F	0.00

7.2 Calculation of Grades

7.2.1 GPA: Grade Point Average (GPA) is the weighted average of the grade points obtained in all the courses completed by a student in a semester.

7.2.2 CGPA: Cumulative Grade Point Average (CGPA) of major andsecond major degrees will be calculated separately by the weighted average of all courses of the previous semesters along with that of the current/present semester. For the calculation of the final CGPA of clearing graduates, if the third digit after the decimal point is nonzero then its previous, that is, the second digit will be incremented by one. A student, if applicable, will also receive a separate CGPA for her/his Second Major courses.

7.2.3 F Grades: A student will be given an "F" grade if s/he fails or remains absent in the final examination of a registered course. If a student obtains an "F" grade, her/his grade will not be counted for GPA and s/he will have to repeat the course.

An "F" grade will be in her/his record, and s/he will not be eligible for distinction, award, and scholarship of the university.

7.2.4 Course Improvement: A student will be allowed only once to improve maximum of 2 (two) theory courses for which s/he has obtained a B- grade or less in the previous level by registering in the semesters of the immediate next level. Such course grade improvement opportunity shall be given only for 100- 300 level courses. If the course grade does not improve then the previous course grade will sustain in grade count. In the case of the course grade improvement, this will be cited/noted in the concerned transcripts beside the grade count as "Improvement."

8. Distinction

8.1 Distinction:

Candidates for 4/5 years' programs will be awarded the degree with Distinction if her/his overall CGPA is 3.75 or above. However, a candidate/student will not be considered for Distinction and any kind of Awards if s/he has any one of the following:

(a) s/he is not a regular student,
(b) s/he has semester drop or incomplete courses in any semester,
(c) s/he has an "F" grade in any course,
(d) s/he has upgraded her/his GPA through improvement,
(e) s/he is addicted to drugs,
(f) disciplinary action(s) is taken against her/him.

9. Certificate of Practical Skill

For extraordinary and remarkable contribution in establishing lab(s)/new lab set ups, instrument making, developing software/ algorithm/apps/ device/ technology/ technique, designing research tools, etc., student (involved) will be awarded a certificate of excellence in practical skill based on the decisions of the discipline by the respective Dean.

Examination Ordinance for the Semester System for the Bachelor's Degree

(This ordinance will replace other ordinances/resolutions etc. on the issues described here; however, it will not affect ordinances/resolutions on issues not mentioned here.)

1. Examinations and Results

University authorities will administer and publish the results of Bachelor's degree examinations. Every examination will be identified by University Semester Number (USN).

2. Final Examination Dates, Rosters, and Registrations

2.1 Data Base Update: At the beginning (within the first 4 weeks) of every semester, the office of the registrar will update the valid list of students who have paid the tuition and got admitted to that semester. They will make necessary corrections to the available list of the teachers. The office of the controller of examinations will update the information of courses offered from the curriculum/syllabus in that semester identified by the USN.

2.2 Examination dates: The period/schedule for the final examination will be fixed/determined by the Academic Council according to the Semester System Ordinance (2.1 and 2.2). The fixed examination period/schedule cannot be changed or shifted without the prior approval of the Academic Council. However, in very special cases, the Vice-Chancellor may make decisions on the examination dates, but such an action must be reported to the next meeting of the Academic Council.

2.3 Examination Rosters: The examination rosters and centers will be prepared and selected by the respective disciplines before 3 (three) weeks of the beginning of the semester examination. The Head of the Discipline will notify the examinees and send the exam routines to the other relevant heads of the disciplines and the Controller of the Examinations.

2.4 Course registration: A student will be allowed to register her/his courses during the first 4 (four) weeks of the semester either by using the internet-based system or by completing the prescribed forms. A student may be allowed to register within the next 2 (two) weeks with a late registration fee. The controller of examinations will make sure the registering students have paid the tuition and the examination fees and send each discipline the detailed registration list along with students admit cards at least 1 (one) week before the start of the semester final examination. The controller of examinations will send an updated list in case of a student register late. In case a student withdraws any course (Semester System Ordinance 4.4) 2 (two) weeks before the examination starts, the controller of examinations will send an updated list to the concerned discipline immediately so that it can be used during the result processing.

3. Examination Committee

3.1 Formation:

A committee consisting of all the teachers headed by the Head of the discipline will propose examination committees for all existing semesters to the respective Dean within 4 (four) weeks of the semester start. It is not necessary to form separate committees for students having incomplete courses at a particular level; the committee of the nearest level of the same year will be responsible to process the result of the students. But, for the clearing graduates, 4th year 2nd semester (5th

year 2nd semester for architecture) committee of immediate past will process the results of left out students of 4th year 2nd semester (5th year 2nd semester for architecture)while 4th year 2nd (5th year 2nd semester for architecture) semester is not running.

3.2 Members:

The examination committees for different semesters will be comprised of the following members:

Chairman: A teacher not below the rank of Professor of the discipline. In absence of Professor of the discipline, an Associate Professor/Head of the discipline. Head of the Discipline will be the Chairman of the terminal semesters.

Internal Members: 4 (four) teachers of the discipline.

External members: One teacher/expert (not below the rank of professor or equivalent) of the Major field from other university/organization and one teacher from each of the disciplines offering the general education courses.

The respective Deans will ratify the list of the examination committees and send to the registrar for approval from the Academic Council.

3.3 Responsibilities:

The Examination Committee will be responsible for the moderation of question papers. External members from the disciplines offering the general education courses will be especially responsible for the moderation of the respective course sand, if necessary, for typing and printing the corresponding question papers. The chairman, internal members, and the external member of the major field will be responsible for conducting the viva-voce examination where applicable.

The Chairman and the internal members of the examination committee will be responsible for the preparation of all question papers, coding and decoding answer scripts (if applicable), detailed results for every course, and the final tabulation.

3.4 Change of Committee Members:

If for some genuine reason either the chairman or a member of the examination committee is needed to be changed, then the committee consisting of all the teachers headed by the Head of the discipline will send the nomination/proposal /recommendation to the respective Dean. The Dean will authenticate/approve the change and send it to the Controller of Examinations for book-keeping and to take the approval of the Vice-Chancellor.

4. Pre-Examination Preparation

The discipline must formulate a uniform policy to ensure equal opportunities to all the existing faculties to maintain the propriety of the participatory examination system. The Head of the Discipline will give that policy to all the examination committees to follow.

4.1 Database Update: The head of the discipline will make sure about the correct status of students, i.e. s/he is in the proper session and semester to write the exam and will also update the database with the information provided by the examination committee.

4.2 The Chairman and the internal members of the examination committee will make the list for:

- Question setters, internal examiners (Course teacher when available) and external examiners (within or outside the university) for the theoretical courses.
- Examiners for the laboratory/sessional courses, seminars, field works, monographs, term papers, theses, projects etc.

- Tabulators and scrutinizers (where applicable) from among the committee members.

The examination committee will send the list to the respective Dean for appointing examiners, tabulators, and scrutinizers (where applicable) before 8 (eight) weeks of the beginning of the semester final examination. The Dean will endorse the said appointment and send the list to the Controller of Examinations. The Controller of Examinations will do the needful for taking administrative approval of the Vice-Chancellor. The Controller of Examinations will then send out the appointment letters to the examiners subject to the approval of the Vice-Chancellor.

4.3 The Chairman of the examination committee will receive all the manuscripts of question papers. If anyone of the manuscript is not received within the stipulated time, the committee will suggest an alternative question setter and send it to the Dean for the appointment. The Dean will ratify the said appointment and send it to the Controller of Examinations. The Controller of Examinations will take approval of the Vice-Chancellor. The Controller of Examinations will then send out the appointment letters to the examiners subject to the approval of the Vice-Chancellor.

4.4 After receiving all the manuscripts of question papers, the examination committee will moderate the questions and will be responsible for security, typing, printing, and photocopying of the question papers. If for unforeseeable reasons, the external member of the Examination Committee is unable to show up during the moderation of the question papers, then the examination committee may recommend a senior teacher of the relevant field outside the discipline to be the external member, and the Controller of Examinations will get it approved by the Vice-Chancellor.

4.5 The Controller of Examinations will be responsible for printing and supplying blank (main and extra) answer scripts, mark-sheets, and other relevant forms to the concerned disciplines.

4.6 The Controller of Examinations will send out the required blank (main and extra) answer scripts, mark sheets, envelopes, blank forms, instruction sheets, etc. as per the requisition of the head of the discipline well before the examination starts.

5. Conducting Final Examination

Discipline will not be allowed to conduct the semester final examination without publishing the results of previous semesters.

5.1 Before the semester final examination, the head of the discipline will assign the duties to the chief invigilator and invigilators. The chief invigilator will collect the question papers from the respective chairman of the examination committee before the examination starts. He will be responsible to conduct the examination with the help of invigilators as per the university rule (155th AC). The conduct of examination involves: (a) the distribution of answer scripts and question papers, (b) collecting signatures of the students on the attendance sheet, (c) collecting the answer scripts after the examination, (d) sorting the answer scripts, (e) completing the course wise top-sheet, and (f) returning the packet of the answer scripts to the chairman (on the same day or within the next working day) of the examination committee.

5.2 As per semester ordinance, the school may follow any one of the following systems:

- Single Examiner System (SES): Students will be answering a separate set of questions in two separates A and B answer scripts.

- Double Examiner System (DES): Students will be answering all questions in one single answer script.

The invigilators, accordingly, will ready separate packets for the regular and drop students.

5.3 Upon receiving the answer script from the chief invigilator, the chairman of the examination committee will deliver

- the two packets of the answer scripts (A and B) to the respective examiners under the single examiner system, SES.
- the packet of single answer scripts to the internal examiner under the double examiner system, DES.

It should be done within the next 3 (three) days since the examination of the concerned course has taken place. The chairman will make sure every packet has (a) top-sheet, (b) question paper, (c) blank mark sheet, (d) special envelopes, and (e) detailed instructions on the grading procedure.

5.4 In case a packet of answer scripts needs to be sent to an examiner outside the university, the chairman will send it to the office of the Controller of Examinations for reaching it to the proper destination. The Controller of Examinations will then send the packet along with the (1) top-sheet. (2) question paper, (3) blank mark sheet, (4) special envelopes, and (5) detailed instructions on the grading procedure to the external examiner within 3 (three) working days requesting the examiner to return the examined scripts within 15 days.

5.5 If any student is apprehended for unfair means during the examination, then (a) the chief invigilator in case of the Final Examination and (b) the course teacher for the term test/practical examination will take the necessary steps to inform the Controller of Examinations as per the examination rule (155th AC). A separate disciplinary committee set up only for examination related misconduct will make a quick decision and inform the student. The Examination disciplinary committee shall be constituted as stated below:

Vice Chancellor	Chairman
All Deans	Member
Director of Institute (offering undergraduate/graduate program)	Member
One member of the Syndicate nominated by the Vice Chancellor	Member
Director of students counselling and guidance (DSCG)	Member
Proctor	Member
Controller of Examinations	Member Secretary

The nominated member shall hold office for a term of two years. The committee will dispose of all the issues within the 15 (fifteen) working days after the last exam of that semester has taken place, and the decision(s) has/have to be reported to the Syndicate.

5.6 If a student comes down with a contagious disease during the Final Examination,then s/he may apply to the Controller of Examination through the Head of the discipline to write the examinations in sickbed/sickbay. The Controller of Examinations will arrange the Examination under the guidance of the physician of the medical center.

6. Processing of the Result

6.1 Theory Courses: (If school follow Single Examiner System, SES)

6.1.1 The processing of the result starts at the end of the classes when the course teacher makes 3 (three) copies of the mark-sheets showing (a) the total number of attendance of each student, (b) the marks from Term-test, and (c) the marks from continuous assessments (assignments, quiz, report writing, and presentation). S/he will display one copy on the noticeboard, send one sealed copy to the Controller of Examinations, and one copy to the Chairman of the Examination Committee responsible for processing the result of that course
before the beginning of the semester examination. The course teacher shall enter the attendance, class performances, and total marks of continuous assessments using the software so approved for result processing.

6.1.2 Two examiners will examine scripts A and B separately, grade the answer scripts properly making legible marks on the answer scripts, and put on the Marks on the mark-sheet within 12 (twelve) working days after the examination of the specified course. S/he will enter all the Marks using the software, send the original mark-sheet in a sealed envelope, and the packet of answer scripts to the Chairman of the Examination Committee and one copy of the same in a sealed envelope to the Controller of Examinations.

6.1.3 If an examiner is from outside the university, s/he will grade the answer scripts within 15 (fifteen) days of receipt of the packet. S/he will send one copy of the mark-sheet in a sealed envelope and the packet of answer scripts to the Controller of Examinations and one copy of the same in a sealed envelope to the chairman of the Examination Committee. Upon receipt of the packet of the answer scripts the controller of examinations will send the packet to the chairman of the examination committee for scrutiny. The chairman and the tabulators of the examination committee will enter the marks of the external examiners using the software for result processing.

6.1.4 Upon receipt of the answer scripts and mark-sheets from the two examiners, the Chairman of the examinations committee will distribute the two packets of answer scripts A and B to the two scrutinizers. The scrutinizers will go through the answer scripts carefully (to see whether each of the answers has properly graded or not) and put on the marks from the answer scripts on a blank mark-sheet and prepare a report whenever discrepancies are visible/or found. S/he will send one copy of the mark-sheet in a sealed envelope along with the report and the packet of the answer scripts to the Chairman of the Examination Committee and one copy of the detailed mark sheet in a sealed envelope to the Controller of Examinations. The committee will tally the mark-sheets received from the examiners, respective scrutinizers, and judge the report. The committee, if discrepancies are reported, will take necessary steps to resolve it. The Chairman and Tabulators will also carefully check the marks so entered by the examiners and duly process the result for publishing.

6.2 Theory Course: (if school follow the Double Examiner System, DES)

6.2.1 The process of attendance, class performance, and continuous assessment is similar to section 6.1.1; however, the process of grading answer scripts shall be done according as in the following.

6.2.2 The internal examiner will examine the scripts thoroughly without making any marks on the answer scripts and put on the Marks on the mark-sheet within 15 (fifteen) days after the examination of that specified course. Then, s/he will send the original detailed mark-sheet in a sealed envelope and the packet of answer scripts to the Chairman of the Examination Committee and one copy of the original mark sheet in a sealed envelope to the Controller of Examinations. S/he will enter the marks using the software so approved for result processing.

6.2.3 In case an examiner is from an outside university, s/he will examine the scripts thoroughly as per the instruction without making any marks on the scripts, put on the Marks on the mark-sheet within 15 (fifteen) days after the receipt of the answer scripts of the specified course. Then s/he will send one copy of the mark-sheet in a sealed envelope and the packet of answer scripts to the Controller of Examinations and the original mark sheet in a sealed envelope to the chairman of the Examination Committee. Upon receipt of the packet of the answer script, the chairman of the Examination Committee will send only the Packet to the Controller of Examinations for evaluation by the (outside) second examiner. The Chairman and Tabulators will do enter the marks of the external examiners using the approved software for result processing.

6.2.4 Upon receipt of the answer scripts and the Marks from the internal examiner, the chairman of the examinations committee will send the packet of the answer scripts along with the (a) the top-sheet. (b) question paper, (c) a blank mark sheet, (d) special envelopes, and (e) the detailed instruction of the grading procedure to the second examiner within the next 3 (three) working days.

6.2.5 The second (internal) examiner will examine the scripts thoroughly without making any marks on the answer script and put on the Marks on the mark-sheet within 15 (fifteen) days after the examination of the specified course. Then, s/he will send the original detailed mark- sheet in a sealed envelope and the packet of answer scripts to the Chairman of the Examination Committee and one copy of the original detailed mark-sheet in a sealed envelope to the Controller of Examinations. S/he will have to enter the marks using the approved software for result processing.

6.2.6 As soon as the chairman of the examination committee receives the envelopes of the mark-sheets from the two examiners of a course, s/he will send those two detailed mark- sheets to two members (not tabulators) of the examination committee for checking the sum of each total marks. The concerned members will check/scrutinize the sum of each total mark of the examiners and return the checked mark-sheets to the chairman within a working day. Then, the chairman and tabulators will tally the total marks of the examiners and the respective members to ensure the obtained marks have been correctly put on and do the needful for any discrepancies.

(1) If the examination committee finds genuinely for any answer script the difference between the two marks of the two examiners is 20% or more, then the committee will propose the name of the third examiner for the concerned course to evaluate such answer script(s) to the Dean for the appointment. The Dean will ratify that appointment and send it to the Controller of Examinations for the approval of the Vice-Chancellor.

The committee will send the answer scripts singled out for third examinations along with the (a) top-sheet, (b) question paper, (c) blank mark-sheet, (d) special envelopes, and (e) detailed instruction of the grading procedure to the third examiner.

(2) If marks of two examiners differ by 15% or more in case of 50% or more answer scripts of a course, then the committee will propose the name of the third examiner for the concerned course to evaluate all the answer scripts to the Dean for the appointment. The Dean will ratify that appointment and send it to the Controller of Examinations for the approval of the Vice-Chancellor.

The third examiner should not be a member of the examination committee. S/he (third examiner) will send the original detailed mark-sheet in a sealed envelope and the packet of answer scripts to the chairman of the examination committee and one copy of the original detailed mark-sheet in a sealed envelope to the Controller of Examinations. S/he will have to enter the marks using the approved software for result processing.

6.2.7 Result processing of the theory courses shall be accomplished as in the following:

- the total marks of the two examiners in which the difference is less than 20% will be averaged.
- In the case of the third examination closer (by smaller difference) two marks, otherwise the higher (for equal differences) two marks of the examiners will be averaged.
- The final letter grades and grade points for the examinees of the specified course will be determined by taking the sum of (a) the marks from class attendance, (b) the marks from class performance and continuous assessment, and (c) average marks.

6.2.8 For every course, the committee (excluding members from the disciplines offering the general education courses) will make at least 3 (three) copies of the final grade points along with marks from the attendance. class performance. continuous assessments, and final examination. The committee has to authenticate them by their signatures, save one copy for the record, send a second copy to the Controller of Examinations, and the other copies to the concerned. disciplines for which the course has been offered. The result must be signed by all the members for publishing. Any changes in the list of members of the examination committee must be stated in the resolution of the committee. The committee will announce only the grade points and letter grades of the students for all the courses on the department notice board.

6.3 Other Courses

6.3.1 For Lab/Sessional courses: (a) In the disciplines for which the evaluation of the lab/sessional examination is a continuous process, the designated teachers will determine the grades of the students for the lab/sessional course through a series of quizzes, assignments, viva, reports, etc. At the end of the semester, one of the assigned the lab/sessional teachers will display one copy of the result on the notice board and send one copy to the Chairman of the Examination Committee and the Controller of Examinations. S/he will also enter the marks using the result processing software.

(b) In the disciplines which conduct the final lab examination, the designated course teacher will be the chief invigilator and as per rule of the examination, invigilators will be assigned to conduct the lab/sessional examination. Invigilators will help the chief invigilator to determine the grades of the examinees. After the end of the lab examination, the lab teachers will display one copy of the result on the notice board and send one copy to the Chairman of the Examination Committee and the

Controller of Examinations. S/he will also enter the marks using the result processing software.
The examination committee will authenticate the result with their signatures, convert into the letter and numeric grades if necessary, and make at least three copies. The committee will save one copy for the record, send one copy to the Controller of Examinations and other copies to the discipline for which the course has been offered.
6.3.2 For Theses/Project reports/assignment (Industrial) reports/monographs, the supervisor will give an overall assessment for the student and on her/his thesis/project, which will count 30% of the total marks. Evaluation of the thesis/project/reports/monographs by the 2 (two) external examiners who are not involved in supervision/co-supervision will count 40% of the total marks, and from the final presentation in the presence of the examination committee, 30% of marks will be counted. The examination committee will enter the aggregated Marks of the examinees using the software and process the result.
6.3.3 The viva-voce examination will be conducted by the Examination Committee (excluding the members of the disciplines offering the general education courses). During the viva-voce, all the members have to be present (full time) and will grade separately/individually. The average of the marks of the members participating will be considered as the final mark for determining the grade. The chairman of the examination committee will enter the mark using the software for result processing.
6.3.4 For BNCC, examination will be administered by the ordinance approved in 99th Academic Council.

6.4 Preparation of final grade
For every course, the examination committee will calculate the Grade Point and corresponding Letter Grade as per the Semester System Ordinance (7.1) using the result processing Software, which will be published through the tabulation sheet.

6.5 Withholding of Results
In some special cases, results of the examinees could be withheld: (a) If the examinee has unpaid dues, (b) an objection from the residential halls; proctor office, (c) other obligations to the university, (d) If the university has taken some form of disciplinary action against the examinee, and (e) If the syndicate decides to withhold the result for some specific reasons.

7. Preparation of Tabulation Sheet and Publication of Result
7.1 Four original tabulation sheets will be prepared by the tabulators and checked by the members. Finally, tabulation sheets have to be signed by the chairman, tabulators, and members of the examination committee. The tabulation sheets will contain the Grade Points of every course and the weighted average of the Grade Points (GPA) for every student at that level. For each of the examinees, CGPA will be calculated according to the process mentioned in the Semester System Ordinance (7.2.2) from the second semester onwards. The examination committee will send the tabulation sheets to the Controller of Examinations for her/his signature, and then for the approval of the Vice- Chancellor.
7.2 For the use and preservation of these four duly signed tabulation sheets: (a) one copy will be kept in the office of the Controller of examinations, (b) one copy will be kept in the Department, (c) one copy will be kept in the office of the respective Dean, and (d) one copy will be kept in the store of the Controller's Office.
7.3 The Controller of Examinations will publish the results taking permission of the Vice- Chancellor, subject to post-facto approval of the syndicate.
7.4 For the final semester, the Examination Committee will send a list of students graduating in that particular semester showing the total credits, CGPA, and state if any student is awarded Distinction. Also, the committee will declare in writing that they have thoroughly checked, scrutinized and correctly prepared the tabulation sheets as per rules. This list will be used as the result notification. Finally, the Controller of Examinations will take the approval for publishing the result.
7.5 The Controller of Examinations will issue the grade sheets and provisional certificates after 7 (seven) days of publication of the result. A student may collect the Provisional Certificate subject to the No Objection Certificate from the Librarian, Proctor, Student's Advisor, Treasurer (student's union), University Medical Officer, Provost, and head of the Discipline.
7.6 The original certificates will be signed by the Vice-Chancellor, Controller of Examinations, and will be issued to the graduates after the convocation. The graduate has to return her/his provisional certificate to collect the original one. If the convocation is not held on time then the Controller of Examinations may issue a student his original certificate in very special cases, subject to the permission of the Vice-Chancellor.
7.7 If a certificate or grade-sheet is lost or destroyed, a student may apply for a duplicate. However, s/he has to file a General Diary in the police station, publish in the newspaper about the loss, and attach a copy of the two documents along with the application to the Controller of examinations. If the certificate or grade-sheet is partly damaged, then the concerned student may have a duplicate by paying the required fee and returning the damaged certificate/grade-sheet to the office of the Controller of Examinations. Every duplicate certificate/mark-sheet has to be signed by the Controller of Examinations.
7.8 If a student has to correct the spelling of her/his own or her/his parent's name consistent with the SSC certificate he has to affidavit through Judicial Magistrate, publish the matter in a newspaper, and apply to Registrar through the Head of the discipline. Registrar will inform the Controller of Examinations after taking permission from the Vice-Chancellor. The Controller of Examinations will exchange his old certificate or mark-sheets with the corrected copies. The documents with affidavit will be signed and dispensed by the Controller.
7.9 The controller of Examinations will preserve the used answer scripts for 1 (one) year after an examination has taken place. The office may dispose of these answer scripts through an auction at the end of this period.

8. Payment of Bills
8.1 The syndicate, according to the recommendation of the Academic Council, will decide all the remunerations related to the examination process.
8.2 The Controller of Examinations will process the bills as per the work-schedule submitted by the chairman of the examination committee, check the authenticity, and submit to the office of the Director of Accounts, which will take the necessary action for payment of the
bills.

9. Examination Ethics

9.1 Everyone involved in the process of the examination shall guard the confidentiality of the question papers, examination grades, and results. The examinee, under any circumstance, cannot try to tamper with the examiners. Such attempts of the examinees shall be brought to the attention of the Controller of Examinations.

9.2A student may never be asked any question that may hurt her/his religious or ethnic background/identity.

9.3 If someone involved in offering a course or in the examination process having the following relatives as examinees, s/he shall inform the head of the discipline and the Controller of Examinations or the controlling authority immediately.

(a) Husband/Wife (b) Son/Daughter (c) Brother in law/Sister in law (d) Son in law/Daughter in law (e) Nephew/Niece (1) Uncle/Aunt (g) First cousins (h) brother/sister.

10. Question Structure

Each discipline must follow one unique question structure for final examinations. For 3.00 (three) or 4.00 (four) credits theory courses: (a) the written (final) examinations will be conducted for 60 marks, (b) there will be six questions for Double Examiner System (three questions in each part of the question paper for Single Examiner System), and the examinees will be asked to answer all of them, and (c) the examination time/duration will be 3 (three) hours. However, for 2.00 (two) credits theory courses: (a) the written (final) examination will be conducted for 60 marks, (b) there will be four questions for Double Examination System (twoquestions in each part of the question paper for Single Examination System), and the examinees will be asked to answer all of them, and (c) the examination time/duration will be 2 (two) hours. For the GPA calculation, 60% of the secured marks of the examinees will be considered in the result processing. Question setters are liable to set questions covering the entire curriculum of the course, and the examination committee shall have the liberty to investigate it and to do other necessary corrections during moderation. Moderated question paper must be printed and supplied to the examinee.

11. Compliance

A student (clearing graduate) may appeal to the Controller of Examinations for the reexamine of his/her answer scripts for a maximum of 2 (two) theory courses within 2 (two) weeks after publishing the result. In this case s/he must pay a fee determined by the AC filling the prescribed form supplied by the office of the Controller of Examinations. Then, based on the appeal, two examiners (except the previous examiners) will be appointed soon by the Grievance Cell, and the Controller of Examinations will take the approval from the Vice- Chancellor. In the case of the single examiner system (SES), two examiners will evaluate two answer scripts A and B (of the appealed course) separately, and their given Marks will be added together for obtaining the total mark. Whereas for the double examiner system (DES). two examiners will evaluate the single answer script (of the appealed course) separately, and then the two Marks will be averaged. If the present total/average mark is at least 10% less or higher than the previous total/average mark, only then, the Grievance Cell will ask the concerned Examination Committee and the Controller of Examinations to revise the grade of the applicant. Otherwise, her/his previous grade shall stand.

11.1. Grievance cell

In each discipline for exam-oriented compliance, a four/five members' committee as in the following will be formed:

Dean of the school	: Convener
Head of the discipline (if not examiner)	: Member
Two senior faculties (not examiners) nominated by the discipline	: Member
The Controller of Examinations	: Member secretary

12. General Instruction

- Disable (only handicapped) and slow learning students will be allowed 5 (five) minutes extra per hour during the examination.
- Disable (blind/without hand only) students will be allowed to take support in writing during the examination. But the writer should be junior and unfamiliar with the course for which the examinee is hiring her/him.
- Application for result correction may be accepted if it is submitted/lodged within the next 3 (three) months since the publication of the result. Chairman of the concerned examination committee/ Head of the discipline and the Controller of Examinations will do the corrections as per rules.
- The result/ tabulation sheet for course improvement will be signed by the examination committee of the present semester of the examinee.

13. Exam Hall structure:

For final examination of theory courses the number of invigilators will be as in the following.

For each exam hall:

- For 1 – 25 examinees, 2 (two) invigilators will be assigned.
- For 26 – 40 examinees, 3 (three) invigilators will be assigned.
- After 40 examinees, 1 (one) invigilator will be increased for each 20 examinees.
- For each course, one chief invigilator will be assigned to conduct the examination.

(b) For Term Test of theory courses, the number of invigilators will be as in the following.

For each exam hall:

- For 1 – 25 examinees, 2 (two) invigilators will be assigned.
- For 26 – 40 examinees, 3 (three) invigilators will be assigned.
- After 40 examinees, 1 (one) invigilator will be increased for each 20 examinees.
- For each course, one chief invigilator will be assigned to conduct the examination.

(c) For continuous assessment, course teacher will do the needful and no other invigilators are required.

Course Code: MSC004	Credits: 03	Semester: 4-2	Year: 4th
Course Title: Military Science (mvgwiK weÁvb)			

Rationale/†hŠw³KZv : evsjv‡`k b¨vkbvj K¨v‡WU †Kvi we Gb wm wm Gi my`xN© HwZ‡n¨i BwZnvm i‡q‡Q| 1923 mv‡j BwÛhvb †Uwi‡Uvwiqvj †dvm© (ITF) G¨v± cvk nevi ci Aw·jvwi †Uwi‡Uvwiqvj †dv‡m©m KwgwUi mycvwikµ‡g XvKv‡Z GKwU BDwbfvwm©wU †Uªwbs †Kvi (UTC) MVb Kiv nq Ges Gi g_¨ w`‡q K¨v‡WU †Kv‡ii hvÎv ïiæ nq| Ávb, k„•Ljv I GKZv GB wZb g~j g‡š¿ DØy× K‡i †`‡k‡i hye mgvR Z_v ¯‹zj, K‡jR I wek¦we`¨vj‡qi QvÎQvÎx‡`i †jLvcovii cvkvcvwk mvgwiK cÖwk¶‡Yi gva¨‡g wØZxq mvwii cÖwZi¶v evwnbx wn‡m‡e M‡o †Zvjv Ges ^bwZK PwiÎ weKvk GB †Kv‡m©i j¶¨|

Course Objectives/j¶¨ I D‡Ïk¨: GB †Kvm©wU cvV¨m~wP‡Z AšÍfy©³ Kivi D‡Ïk¨ nj-
†`‡ki Kv‡R Z¨v‡Mi g‡bvfve Ges wk¶v_©x‡`i g‡a¨ åvZ…Zj‡eva M‡o DV‡e|
wk¶v_©x‡`i ^bwZK Pwi‡Îi DbœwZ mvab Ki‡e|
†`‡ki cÖwZi¶v Kv‡R Drmvn I DÏxcbv †hvMv‡e|
RvZxq Dbœqbg~jK Kg©KvÐ I `y‡h©v‡Mi mgq m„k„•Lj †¯^”Qv‡meK evwnbx wn‡m‡e M‡o Zzj‡e|
ewntkÎæi Avµg‡bi †cÖw¶‡Z wØZxq mvwii cÖwZ‡iva evwnbx wn‡m‡e M‡o Zzj‡e |

Course Learning Outcomes (CLOs)/djvdj :
GB †Kvm©wU Aa¨q‡bi d‡j wk¶v_©xiv †h mKj wel‡q mg¨K Ávb I `¶Zv AR©b Ki‡eÑ
CLO-1: e¨w³¯^v_©, nxbgb¨Zv, ivRbxwZ I ^bwZK c`öjb †_‡K gy³ _vK‡e|
CLO-2: ivóªxq ch©v‡q wewfbœ Kg©Kv‡Ð wbivcËv evwnbx‡K mnqZv cÖ`vb Ki‡Z cvi‡e|
CLO-3: †`k‡cÖwgK I gvbeZvev`x my›`i I fv‡jv g‡bi gvbyl wn‡m‡e M‡o Zzj‡Z mvnvh¨ Ki‡e|
CLO-4: AvZœwek¦v‡m ejxqvb n‡q DV‡e|
CLO-5: myk„•Lj I AvbyMZ¨kxj hye mgvR ^Zwi Ki‡e|

Mapping CLOs to PLOs

CLO/ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10
CLO1	√	√		√		√			√	
CLO2		√	√	√	√	√		√	√	√
CLO3	√	√			√		√	√		√
CLO4	√		√	√	√	√	√		√	
CLO5	√	√			√			√	√	√

Course Contents/cvV¨µg :

cwVZ welq (ZËjxq I e¨envwiK) : we Gb wm wmÕi BwZnvm-HwZn¨, we Gb wm wmÕi mvsMVwbK KvVv‡gv, gnvb ¯^vaxbZv hy‡×i cUf~wg I KviY, ¯^vaxbZv hy‡×i †m±i mg~n, wW ª j, KzPKvIqvR, g¨vc wiwWs, hy‡×i bvbv †KŠkj, hy‡× e¨eüZ A‡¯¿i cwiPq, evsjv‡`‡ki mk¯¿ evwnbxi cwiPq, †bZ…‡Zji ^ewkó¨, kixi PP©v, cÖv_wgK wPwKrmv, mgvR †mev, `y‡h©vM e¨e¯'vcbv, f~wgK¤ú e¨e¯'vcbv, N~wY©So e¨e¯'vcbv, AwMœ wbe©vc‡bi †KŠkj, mvs¯‹…wZK cÖwk¶Y BZ¨vw`|

Recommended Books/mnvqK MÖš' :
we Gb wm wm : mvgwiK weÁvb m`i `ßi KZ©„K wba©vwiZ I cÖKvwkZ|

SHAHJALAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

VISION OF THE UNIVERSITY

To be a leading university of excellence in Science and Technology with a strong national commitment and significant international impact.

MISSION OF THE UNIVERSITY

1) To advance learning and knowledge through teaching and research in science and technology
2) To serve as a center for knowledge creation, technological innovation and transfer among academia, industry, and society
3) To assist in transferring Bangladesh a country with sustainable economic growth and equitable social development

Name of the School: Applied Sciences and Technology
Name of the Department: Civil and Environmental Engineering
Name of the Program: B.Sc. in Civil and Environmental Engineering

Overview of the Department of Civil and Environmental Engineering

The Department of **Civil and Environmental Engineering (CEE)** is one of the most prestigious departments of Shahjalal University of Science and Technology (SUST). This department was formerly known as the Department of Environmental Engineering and Pollution Control and was established in 1995. The Department of CEE currently offers B.Sc. Engineering-, M.Sc. Engineering and PhD- program. Presently 25 faculty members are working in various specialized divisions of CEE.
Specifically, the Environmental and Water Resources Engineering division, with the support of a well-equipped laboratory, has been providing academic services as well as providing testing, design and consultancy services in various areas of environmental engineering. Some of the areas include but not limited to water and wastewater quality assessment along with their treatment, solid and hazardous waste management, air and sound pollution measurement with mitigation techniques, environmental management planning, environmental auditing, and environmental impact assessment and monitoring.
Moreover, the Structural and Construction Engineering division is equipped with the state of the art hardware and software facilities for carrying out testing of various structural materials in the laboratory (i.e. mild steel, concrete, stone, sand, cement, and bricks) and in-field (core cutting and testing, structural health assessment, and nondestructive testing of RCC and masonry structures). Apart from teaching, consultancy services for design and construction of civil structures and infrastructures including but not limited to buildings, bridges, culverts, retaining walls, reservoirs, terminals, steel structures, and other civil structures are also provided. As the quality of soil in construction sites plays a key role, it is needed to identify the physical characteristics of the soil to determine its ability to support the structure. Our Geotechnical Engineering division deals with such matters with honor.
On the other hand, the Transportation Engineering division offers a broad range of specialized transportation services covering laboratory testing (e.g., bitumen, aggregate, soil, full-scale pavement and rail track performance), specialized training

and related consultancy services (e.g., pavement performance evaluation, structural and geometrical design of pavement, management of traffic control system, accident analysis and safety measures, transport modelling and planning and so on).
Additionally, this Department has possessed several collaboration programs both nationally and globally including 'Disaster Engineering' with the University of Kassel, Germany; 'Global Sanitation Graduate School (GSGS) funded by Bill and Melinda Gates Foundation (BMGF)' with IHE Delft, the Netherlands and Khulna University of Engineering and Technology (KUET), Bangladesh; 'Water and Waste Management funded by DANIDA, UNDP, World Bank and CDMP' with Bangladesh University of Engineering and Technology (BUET), Bangladesh as well as others. Moreover, this Department has been working with International Training Network (ITN-BUET), Global Water Partnership (GWP), the Department of Public Health Engineering (DPHE) in capacity building of local government administration and public representative to achieve SDG-6. Furthermore, conferences (national and international), seminars, workshops, training programs, fairs, engineering competitions and other Olympiads related to CEE are regularly organized with pride by this Department.

VISION OF THE DEPARTMENT

To create high-quality engineering professionals who will keep significant role in sustainable infrastructure development and environmental safety with a motto "Build the Earth, Save the Earth"

MISSION OF THE DEPARTMENT

1) Produce world-class engineers with technical competency, analytical thinking ability, ethical standard, life-long learning ability and leadership skill, who can have successful careers as professionals and will contribute to the advancement of knowledge and novelty in civil and environmental engineering and similar fields
2) Educate its students in a modern-dynamic learning environment by providing them in-depth knowledge so that they add value in the wide areas of infrastructure development and environmental safety
3) Promote teaching, research, innovation and maintain an effective industry-academia relationship at national and international level

Program Educational Objectives (PEO)

Graduates obtaining a certified degree in Civil and Environmental Engineering should be well educated in the broad areas of infrastructure development and environmental safety. However to be an effective and productive engineer students need to grab a variety of skills that go beyond their course content. The objectives or learning targets of the curriculum are categorized in the following dimensions:

- Knowledge
- Skill
- Attitude

To achieve these targets, program educational objectives are set as follows:

1) Graduates will become leading researchers and educationalists who create and disseminate new knowledge in the field of sustainable development ensuring environmental safety,
2) Graduates will become key decision makers in the industries associated with civil and environmental engineering applications. They will become recognized experts working in government sector, consulting firms and international organizations around the country and around the world addressing some of the most challenging problems of modern times,
3) Graduates engage themselves toward lifelong learning and the pursuit of post graduate or other professional education including continuous professional development,
4) The graduates demonstrate professionalism, ethics and ability to work in inter and multi-disciplinary team and to adapt the latest trends and technology in the field of Civil and Environmental Engineering.

Mapping between PEO and Mission:

PEO Statement	M1	M2	M3
PEO1	3	2	
PEO2	2	1	3
PEO3		3	2
PEO4	2	3	

Correlation: 3-High, 2-Medium, 1-Low

Program Learning Outcome

1) Ability to **acquire and apply knowledge** of basic mathematics, science, engineering and to formulate or solve Civil and Environmental Engineering problems
2) Ability to **analyze and identify** a relevant problem and reach to valid conclusions using first principles of mathematics, the natural sciences and the engineering sciences
3) An ability to **design** a system, component, or process to meet desired needs while incorporating engineering standards and realistic constraints such as economic, environmental, constructability, social, political, ethical, health and safety, manufacturability and sustainability issues
4) Ability to **design and conduct experiments**, as well as to evaluate the results critically and interpret data in more than one recognized major civil and environmental engineering area
5) Understanding of the **impact** of civil and environmental engineering solutions in a global/political/societal context
6) An ability to function effectively on **multi-disciplinary** team to accomplish a common goal
7) Ability to use the **modern engineering tools, techniques and computational methods** necessary for engineering practice
8) Ability to **communicate** effectively in oral and written forms
9) Understanding of **professional norms and ethical responsibility**
10) Appreciation and knowledge of **current civil and environmental engineering issues** including professional practice such as procurement of work, bidding versus quality selection processes, interactions among design and construction professionals
11) Recognition of the need to engage in **life-long learning including continuing education**

12) Proficiency in all **recognized areas of civil and environmental engineering**, like: structures, geotechnical, transportation, environment, water resource, surveying-materials-construction

Mapping between program education objective and program learning outcome:

PLO / PEO	PEO1	PEO2	PEO3	PEO4
PLO1	2	2	3	2
PLO2	3	3	3	2
PLO3	2	1	-	3
PLO4	2	2	2	2
PLO5	1	2	-	3
PLO6	2	2	1	3
PLO7	2	-	2	3
PLO8	1	-	-	2
PLO9	1	-	-	2
PLO10	2	1	1	-
PLO11	-	3	3	1
PLO12	3	2	2	2

Correlation: 3-High, 2-Medium, 1-Low

First Year: Semester I

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE131	Engineering Mechanics - I	2+0	2.0
CEE181	Introduction to Environmental Engineering	2+0	2.0
CHE101C	Chemistry	3+0	3.0
ECO107C	Principles of Economics	2+0	2.0
ENG101C	Effective communication in English	2+0	2.0
MAT103C	Differential Calculus and Vector Analysis	3+0	3.0
PHY107C	General Physics	3+0	3.0
SSS100	History of the Emergence of Independent Bangladesh	3+0	3.0
CEE132	Engineering Graphics - I	0+2	1.0
ENG102C	English Language Lab - I	0+2	1.0
	Total	**20+4= 24**	**22.0**

First Year: Semester II

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE133	Engineering Mechanics - II	2+0	2.0
CEE135	Engineering Materials	3+0	3.0
CEE137	Numerical Analysis	2+0	2.0
BUS103C	Cost Accounting for Engineers	2+0	2.0
MAT104C	Integral Calculus and Ordinary Differential Equations	3+0	3.0
SCW103C	Social Science for Engineers	2+0	2.0
CEE130	Year Final Viva - I	-	0.5
CEE134	Engineering Graphics - II	0+2	1.0
CHE102C	Chemistry Practical	0+3	1.5
EEE128C	Electrical Services Design	0+3	1.5
IPE104C	Workshop Practice	0+2	1.0
PHY104C	Physics Practical	0+3	1.5
	Total	**14+13=27**	**21.0**

Second Year: Semester I

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE223	Surveying	3+0	3.0
CEE231	Mechanics of Solids - I	2+0	2.0
CEE235	Fluid Mechanics	3+0	3.0
CEE237	Engineering Geology and Geomorphology	2+0	2.0
CSE203C	Introduction to Computer Language	2+0	2.0
MAT207C	Vector Calculus, Matrix, Laplace Transformation and Partial Differential Equations	3+0	3.0
CEE222	Details of Construction	0+2	1.0
CEE234	AutoCAD for Civil and Environmental Engineers	0+2	1.0
CEE238	Engineering Materials Sessional	0+2	1.0
CSE204C	Introduction to Computer Language Lab	0+4	2.0
	Total	**15+10=25**	**20. 0**

Second Year: Semester II

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE221	Hydrology	3+0	3.0
CEE229	Ground Water	2+0	2.0
CEE233	Mechanics of Solids - II	2+0	2.0
CEE271	Water Supply Engineering	2+0	2.0
CEE281	Environmental Sanitation and Solid Waste Management	2+0	2.0
STA211C	Statistics	2+0	2.0
CEE224	Quantity Surveying	0+2	1.0
CEE226	Remote Sensing and GIS Sessional	0+2	1.0
CEE228	Practical Surveying (Field work)	2 weeks	1.0
CEE230	Year Final Viva - II	-	0.5
CEE232	Mechanics of Solids Sessional	0+2	1.0
CEE236	Fluid Mechanics Sessional	0+2	1.0
STA212C	Practical Statistics	0+2	1.0
	Total	**13+10=23**	**19.5**

Third Year: Semester I

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE341	Structural Analysis - I	3+0	3.0
CEE345	Reinforced Concrete Design - I	3+0	3.0
CEE351	Geotechnical Engineering - I	3+0	3.0
CEE371	Open Channel Hydraulics	3+0	3.0
CEE381	Wastewater Engineering	3+0	3.0
CEE383	Environmental Pollution Control Engineering	2+0	2.0
CEE342	Structural Analysis and Design Sessional - I	0+2	1.0
CEE346	Reinforced Concrete Design Sessional - I	0+2	1.0
CEE382	Plumbing for Water Supply and Drainage	0+2	1.0
CEE384	Environmental Engineering Sessional	0+2	1.0
CEE386	Water Supply and Sewerage Engineering Sessional	0+2	1.0
	Total	**17+10 =27**	**22.0**

Third Year: Semester II

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE343	Structural Analysis - II	3+0	3.0
CEE347	Reinforced Concrete Design - II	3+0	3.0
CEE353	Geotechnical Engineering - II	3+0	3.0
CEE361	Transportation Engineering - I	3+0	3.0
CEE373	Hydraulics and Hydraulic Structures	3+0	3.0
ARC301C	Urban and Regional Planning	2+0	2.0
CEE330	Year Final Viva - III		0.5
CEE332	Scientific Research (Tools and Techniques)	0+2	1.0
CEE344	Structural Analysis and Design Sessional - II	0+2	1.0
CEE352	Geotechnical Engineering Sessional - I	0+2	1.0
	Total	**17+06=23**	**20.5**

Fourth Year: Semester I

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE421	Project Planning and Management	2+0	2.0
CEE433	Disaster Management and Earthquake Engineering	3+0	3.0
CEE441	Reinforced Concrete Design - III	2+0	2.0
CEE443	Steel Structure	2+0	2.0
CEE449	Structural Analysis - III	3+0	3.0
CEE451	Geotechnical Engineering - III	2+0	2.0
CEE461	Transportation Engineering - II	3+0	3.0
CEE430*	Thesis/ Project work	0+2	1.0
CEE432	Field Work for Engineers	1 week	1.0
CEE442	Computer aided Structural Analysis and Design	0+2	1.0
CEE446	Reinforced Concrete Design Sessional - II	0+2	1.0
CEE462	Transportation Engineering Sessional - I	0+2	1.0
	Total	**17+08 =25**	**22.0**

Proposal submission, presentation and viva, whose marks will be added with CEE430 in final semester. Therefore, the total credits of 21.0 in this semester is appeared instead of 22.0.*

Fourth Year: Semester II

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE463	Transportation Engineering - III	3+0	3.0
CEE471	Irrigation and River Engineering	3+0	3.0
CEE481	Environmental Impact Assessment	2+0	2.0
CEE455 (Presently offered)	One theory course from thesis related field	2+0	2.0
CEE430**	Thesis/ Project work	0+6	3.0
CEE444	Bridge Design Sessional	0+2	1.0
CEE452	Geotechnical Engineering Sessional - II	0+2	1.0
CEE464	Transportation Engineering Sessional - II	0+2	1.0
CEE472	Design of Hydraulic Structures	0+2	1.0
CEE482	Environmental Design Sessional	0+2	1.0
	Total	**10+16 =26**	**18.0**

***Thesis/project defense, where the marks obtained in CEE430* will be included. Therefore, the total credits in CEE430 will be 4.0 resulting the total credits of 19.0 in this semester instead of 18.0.*

Thesis Related Specialized Courses

1. Environmental Engineering

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE483	Hazardous and Radioactive Waste Management	2+0	2.0
CEE485	Bioenvironmental Engineering	2+0	2.0
CEE487	Environmental Modeling	2+0	2.0
CEE489	Environmental Management and Auditing	2+0	2.0

2. Geotechnical Engineering

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE453	Geotechnical Engineering - IV	2+0	2.0
CEE455	Geoenvironmental Engineering	2+0	2.0

3. Structural Engineering

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE445	Construction Practices and Management	2+0	2.0
CEE447	Theory of Elasticity	2+0	2.0
CEE491	Dynamics of Structures	2+0	2.0

4. Transportation Engineering

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE465	Transports and Traffic Planning	2+0	2.0
CEE467	Transportation Planning and Management	2+0	2.0

5. Water Resources Engineering

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CEE473	Integrated Water Resource Management	2+0	2.0
CEE475	Coastal Engineering	2+0	2.0

Total credits included in all semesters:

Semester	Credits
1/1	22.00
1/2	21.00
2/1	20.00
2/2	19.50
3/1	22.00
3/2	20.50
4/1	22.00
4/2	18.00
Total	**165.00**

NB: Every student has to complete all the cources indicated above for obtaining the B.Sc. Engineering degree in Civil and Environmental Engineering.

First Year: Semester I

1.1	**Course title**	Engineering Mechanics-I
1.2	**Course no**	CEE131
1.3	**Credit value**	2.0
1.4	**Semester**	1st year 1st semester
1.5	**Rationale**	This course facilities for gathering the basic knowledge about the effects of force on solid mass and to develop student's ability to visualize the distribution of forces on a solid body. This knowledge is a prerequisite for many engineering courses offered in the subsequent semesters that capture the detailed analysis and design of engineering structures or structural components.
1.6	**Course objectives**	1) To have an idea about rigid body mechanics. Equivalent force systems: concepts of moment, couple, resultant. Equilibrium: free-body diagram; equations of equilibrium. Structural analysis: trusses by method of sections and method of integration 2) To facilitate necessary knowledge of the center of gravity, center of mass, center of volume and the centroid 3) To develop skills to determine the location of the center of gravity and centroid for a system of discrete particles and a body of arbitrary shape 4) To develop the ability for determining the moment of inertia for areas and masses of different geometric configurations.
1.7	**Course content**	

Statics of particles
This chapter is devoted to the study of forces contained in a single plane, and the analysis of forces in three-dimensional space is also analyzed here.

Rigid bodies: Equivalent systems of forces
In this chapter, the effect of forces exerted on a rigid body, and how to replace a given system of forces by a simpler equivalent system is shown.

Equilibrium of a rigid body
This chapter shows how to solve rigid-body equilibrium problems using the equations of equilibrium.

Structural analysis
The forces in the members of a truss using the method of joints and the method of sections are determined in this chapter.

Centroids
Definitions, Center of gravity, Mass center and Centroid, Centroids of Areas, Centroids of Lines, Principle of Symmetry, Estimating location of Centroid by eye estimation, Integrating for Centroids (Arc of a Circle, Plane Triangle, Sector of Circle, Area without an axis of symmetry, Right circular cone), Composite figures, Theorem of Pappus and Guldinus, Center of pressure

Moment of inertia of areas
Introduction, Rectangular moment of inertia, Polar moment of inertia, Radius of gyration, Determination of moment of inertia (Rectangle, Triangle, Circle), Transfer formula-parallel axes, Choice of differential element, Composite areas, Product of inertia, Moment of inertia about inclined axes, Maximum and minimum moment of inertia.

Moment of inertia of masses
Definition, Moment of inertia about planes and axes, Units, Radius of gyration, Transfer formula-parallel axes, Integrating for moment of inertia of masses (Cylinder, Sphere, Thin disk, Cone, Slender rod), Composite bodies.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Draw complete free-body diagrams and write appropriate equilibrium equations from the free-body diagram, including the support reactions on a structure 2) Analyze various statically determinate systems such as beams, and trusses 3) Locate the centroid of an area, center of mass, center of volume effectively 4) Calculate the moment of inertia of areas and masses for different geometric configurations 5) Relate and apply fundamental sciences for learning the essential engineering concepts and theories of different branches.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	2										
CLO2		3	3										
CLO3		3	3										
CLO4		3	3										
CLO5		3											

Correlation: 3-High, 2-Medium, 1-Low

Reference books:

Andy Ruina and Rudra Pratap, Introduction to Statics and Dynamics, *Oxford University Press*, 2011

F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, *Tata McGraw Hill*, 2011.

H. Shames, Engineering Mechanics: Statics and dynamics, 4th Ed, PHI, 2002.

J. L. Meriam and L. G. Kraige , Engineering Mechanics, Vol I – Statics, Vol II –Dynamics, 6th Ed, *John Wiley*, 2008.

R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, *Pearson Press*, 2006.

R.S. Khurmi, Engineering Mechanics, S.Chand and Co., 2001

V.M. Faires and S.D. Chambers, Analytic Mechanics, 3rd Ed, *The Macmillan Company*, 2001.

1.1	**Course title**	Engineering Graphics I
1.2	**Course no**	CEE132
1.3	**Credit value**	1.0
1.4	**Semester**	1st year 1st semester
1.5	**Rationale**	This course will familiarize the students with the basics of Engineering drawing mainly visualization, design hypothesis, standards & conventions of drawing, the tools of drawing, and the utilize of Drawings in designing applications. Engineering drawing is the graphical dialect to precise considerations, thoughts, and ideas. The expression by drawing is precise, exact, and brief. This information is fundamental for understanding the detailed description of a building/any other structures.
1.6	**Course objectives**	1) Getting ideas about the fundamentals of Engineering drawing 2) To develop skills in using effectively the drawing tools 3) Helping the students to develop ability in drawing orthographic and isometric views and projections of an object/structure 4) To improve imagination power.
1.7	**Course content**	
Fundamentals of Introduction This chapter presents Introduction to different Instruments like set square, T scale, Cardboard Scale, etc. and their uses. Different types of Plane Geometry are described.		
Fundamentals of Multi-view & projection This chapter presents Multi-view & Projection like revolution and auxiliary views, sectional views, isometric, diametric, and oblique projections.		
Fundamentals of Perspectives This chapter presents Perspectives like one point, two-point, and three-point perspectives.		
Fundamentals of Descriptive geometry This chapter presents Descriptive Geometry like points lines and planes, parallelism, and perpendicularly surfaces. Building drawing, Stair drawing.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Understand the basic types of plane geometry 2) Visualize and draw multi-views and projection 3) Interpret the drafting to some extent.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		1											
CLO2								2					
CLO3			2										

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Latifee, E.R. (2005). Beginner's guide to Engineering Drawing. *E.R. Latifee.* ISBN: 984-32-2711-5. Singh, G. and Subash, C. (1997). Civil Engineering Drawing. *Standard publishers distributors.* ISBN: 81-86308-38-5

1.1	**Course title**	Introduction to Environmental Engineering
1.2	**Course no**	CEE181
1.3	**Credit value**	2.0
1.4	**Semester**	1st year 1st semester
1.5	**Rationale**	This course introduces the provision of not only the warnings of danger but lights to lead the way towards a sustainable standard of living to protect human health and the environment. The knowledge of this course is prerequisite to other latter courses such as Water and Wastewater Treatment, Water Supply Engineering, Groundwater, Geoenvironmental Engineering and so on.
1.6	**Course objectives**	1) Identifying and solving environmental problems 2) Introducing to basic concepts of material balances 3) Introducing the fundamental concepts covered in the major areas of environmental engineering.
1.7	**Course content**	
Identifying and Solving Environmental Problems: This chapter describes the Origins of Environmental Engineering, Environmental engineering today, as well as Sustainability and Cradle-to-Cradle Design.		
Engineering Decisions: This chapter is a review of how environmental engineers make decisions, beginning with a short description of technical decisions and followed by a discussion of cost-effectiveness, possibly the second most commonly employed tool in environmental engineering decision making and the second most quantifiable. Next, the use of benefit/cost analysis is described, followed by a discussion of decisions based on risk analysis. Moving even further toward the more subjective forms of decision making, environmental impact analysis as an engineering tool is reviewed.		
Material Balances and Separations: In this chapter the material balance around a black box unit operation is introduced first. Then these black boxes are identified as actual unit operations that perform useful functions. Initially, these black boxes have nothing going on inside them that affects the materials flow.		
Energy Flows and Balances: In this chapter how the energy flows and is put to use, and the efficiencies of such use are discussed.		
Applications of Environmental Engineering: In this chapter, various parameters used to measure water quality, water supply and treatment, wastewater treatment, Air quality assessment and control, solid waste management and noise pollution assessment are briefly discussed.		
1.8	**Course learning outcomes**	***By end of this course, the students will able to*** 1) Identify the major environmental problems 2) Evaluate the possible environmental solutions 3) Outline the procedure of solid waste management

		4) Distinguish between material- and energy balance.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	2			3							
CLO2			2					2					
CLO3			3										
CLO4		2				2							

Correlation: 3-High, 2-Medium, 1-Low

References	Han, D. (2012). Concise environmental engineering. PhD and VentusPublishing Aps.ISBN: 987-87-403-0197-7 Vesilind, P.A., Morgan, S.M. & Heine, L.G. (2010). Introduction to environmental engineering. Cengage Learning. ISBN (13): 978-0-495-29583-9

First Year: Semester II

1.1	**Course title**	Year Final Viva - I
1.2	**Course no**	CEE130
1.3	**Credit value**	0.5
1.4	**Semester**	1st year 2nd semester
1.5	**Rationale**	By this course students will learn how to present themselves in an official forum for viva voce and they may be evaluated based upon the knowledge they achieved from their first year theory and laboratory course.
1.6	**Course objective**	1) To obtain the basic requirements for facing a viva voce exam in a formal platform with a matured attitude 2) To communicate with an examiner and express the knowledge and skills learnt from theory and laboratory courses 3) To recap the knowledge and understandings of the taught courses at the end of the year.
1.7	**Course content**	
All theory and laboratory courses of first year first semester and second semester		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Explain and answer the intellectual and technical questions in front of an examination board 2) Communicate with examiner and express their knowledge in a satisfactory way 3) Review the acquired knowledge from the courses of first year first semester and second semester.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1									2				
CLO2									3	1		1	
CLO3		2										2	

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	As per given reference books for all theory and laboratory courses by course teachers

1.1	**Course title**	Engineering Mechanics-II
1.2	**Course no**	CEE133
1.3	**Credit value**	2.0
1.4	**Semester**	1st year 2nd semester
1.5	**Rationale**	This course introduces the relevant physical properties and fundamental laws governing materials and structures' behavior, and students will learn how to solve various problems of interest to civil and environmental engineers. In this course, the emphasis is on the physical understanding of why a material or structure behaves the way it does in the engineering design of materials and structures.
1.6	**Course objectives**	1) To introduce basic tools and fundamental theories of Engineering Mechanics to analyze real-world engineering structures 2) To introduce the concept of dry friction and analyze the equilibrium of rigid bodies subjected to this force 3) Acquaint students with the theory and analysis of plane motion and relative motion and help them conceptualize fundamental theories in flexible cord and its application in engineering structures 4) To introduce the concepts of position, displacement, velocity and acceleration of a body and to develop knowledge for determining motion in problems involving the concepts of work, energy and power, 5) To provide basic ideas for understanding Impulse and Momentum.
1.7	**Course content**	
Fundamentals of Friction This chapter presents frictional force, limiting frictional force, coefficient of kinetic friction, laws of friction, angle of friction, belt friction, and pivot friction.		
Flexible Cord This chapter presents the parabolic chord, the length of the parabolic curve, the catenary.		
Plane Motion Review of Displacement, Velocity, Acceleration, Constant Acceleration-Rectilinear Motion, Variable Acceleration, Angular Velocity, Relation Between Angular And Linear Speeds, Angular Acceleration, Constant Angular Acceleration, Curvilinear Motion, Tangential And Normal Accelerations.		
Fundamentals of Relative Motion This chapter presents relative displacement, relative velocity, and relative motion of points in a rigid body.		
Force System that Produces Rectilinear Motion Introduction, Newton's Laws of Motion, Component Forces and Accelerations, Motion on an Inclined Planes, Motion of Connected Bodies, Motion of Center of Gravity of a Rigid Body, Location of the Resultant – Body in Rectilinear		

Translation, Inertia Force, Methods of Solving Problems.		
Work, Kinetic Energy and Power Work, Work of a System of Forces Acting on a Rigid Body, Principle of Work and Kinetic Energy, Kinetic Energy of a Rigid Body in Translation, Potential Energy, Work of a Couple, Kinetic Energy of a Rotating Body, Bodies in Plane Motion, Frictional Force in Plane Rolling, Power, Efficiency.		
Fundamentals of Impulse and Momentum This chapter presents impulse and momentum, principle of impulse and momentum, angular impulse and angular momentum, linear momentum and conservation of linear momentum.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply the principles of Engineering Mechanics to analyze real-world engineering structures 2) Understand basic friction concepts and specific applications of frictional force analysis on wedges, screws, belts, and bearings 3) Able to analyze cable support systems and determination of the important criterion for its design 4) Understand and be able to apply Newton's laws of motion and basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts) 5) Realize basic dynamics concepts – work, energy and power 6) Assess the basic principles of Impulse and Momentum.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1		3								
CLO2			3					2		
CLO3			3					2		
CLO4			3					2		
CLO5			3					2		
CLO6			3					2		

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Beer, F., Jhonston, E.R., Mazurek, D. (2010), Vector Mechanics for Engineers: Dynamics. McGraw-Hill Companies. ISBN-10: 0077402324 Faires, V.M., Chambers, S.D. (1958), Analytical Mechanics. Macmillan, New York. Hibbeler, R. C. (2015, Engineering Mechanics: Dynamics. Pearson Education. ISBN-13: 978-0132911276 Khurmi, R. S. (2011), A Textbook of Engineering Mechanics. S Chand & Co Ltd. ISBN-10: 8121931002

1.1	**Course title**	Engineering Graphics - II
1.2	**Course no**	CEE134
1.3	**Credit value**	1.0
1.4	**Semester**	1st year 2nd semester
1.5	**Rationale**	This course will familiarize the students with the building plan and its different components as well. They will also understand different environmental control elements. This practical drawing will help the students to understand the plan of structure designed by an Architect for structural design purposes. This understanding is essential for the execution of the structural design.
1.6	**Course objectives**	1) Help students to conceptualize the complete building drawing and Computer applications (Sweet home 3D) 2) To facilitate necessary knowledge about drawing of different environmental control elements 3) Acquaint students with the AutoCAD.
1.7	**Course content**	
Fundamentals of complete building drawing and computer applications This chapter presents the Complete Building Drawing and Computer applications (Sweet home 3D). Different parts of the building are described and taught to draw. The drawing of a building on a computer is also presented.		
Fundamentals of drawing for environment control elements This chapter presents Drawing for environment control elements i.e. Septic tank, Soak-well, Inspection pits, Sewerage line, Underground water reservoir, Overhead water reservoir, Internal water and sewerage line, Soil and rainwater pipe from the building, Drainage, etc. and their application also described.		
Fundamentals of introduction to AutoCAD This chapter presents an introduction to AutoCAD in a nutshell		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) outline the drawing procedure of building components and plan as well as different environmental control elements 2) Explain the architectural plan of the building to perform the design 3) Able to prepare, predict and show a structural components using AutoCAD.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		2	1					1					
CLO2		2	1						3				
CLO3								1					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Latifee, E.R. (2005), Beginner's guide to Engineering Drawing. *E.R. Latifee.* ISBN: 984-32-2711-5 Singh, G. and Subash, C. (1997). Civil Engineering Drawing. *Standard publishers distributors.* ISBN: 81-86308-38-5

1.1	**Course title**	Engineering Materials
1.2	**Course no**	CEE135
1.3	**Credit value**	3.0
1.4	**Semester**	1st year 2nd semester
1.5	**Rationale**	Engineering materials are important both from a scientific perspective, as well as towards applications. In the race of modern science and technology, to make things stronger, cheaper, lighter, more functional, and more sustainable, the manipulation of materials, their properties and processes are key. So, materials are of the utmost importance for engineers (or other applied fields), as the usage of the appropriate materials is crucial when designing systems. This course will provide the students a comprehensive understanding of the composition, manufacturing, properties and engineering behavior of materials used in various civil engineering applications.
1.6	**Course objectives**	1) To introduce the basic ideas about some most used construction materials, their properties, uses, availability etc. 2) To introduce the factors for selection of the desired engineering materials 3) To learn about the manufacturing process, quality control parameters and field test of bricks, cement and aggregates (fine and coarse) 4) To introduce the basic theories of concrete technology and their functional use in construction works 5) Helping the students in designing the mix ratio of concrete by different method and 6) To develop skills to identify the quality of Timber, Rubber, Plastic, Glass, Paints and Varnish for engineering construction.
1.7	**Course content**	

Introduction
General consideration, Properties of engineering materials, Selection of engineering materials, Commonly used construction materials in Bangladesh.

Bricks
Factors affecting the quality of bricks, constituents of bricks and their function, composition of good brick earth, harmful constituents of brick-clay, process of manufacturing, characteristics of good bricks, field testing of bricks, tests of bricks (laboratory) classification bricks in general, classification bricks according to PWD and BDS 208, special bricks, uses of bricks.

Aggregates
Introduction to aggregates and their uses, classification of aggregates (based on size, source and specific gravity), aggregate characteristics affecting concrete behavior, characteristics controlled by porosity, different moisture condition of aggregate, absorption and surface moisture quantity terms, characteristics dependent on prior exposure and processing factors, influence of aggregate on concrete strength, specification of coarse aggregate, brick aggregate, stone aggregate, availability of stone in Bangladesh, recycled aggregate.

Fine Aggregate/ Sand
Sand/clay/silt, particle size ranges, classification of sand based on source and size, properties of good sand, tests on sand, specification of fine aggregate, standard specification for standard sand, sand characteristics in Bangladesh, availability of sand in Bangladesh, uses of sand, fineness modulus (FM), computation of FM, sieve analysis and gradation, types of grading curves, bulking of sand.

Cement
Introduction, Portland cement, chemical compounds in Portland cement and role of them, functions of various ingredients of cement, manufacturing of cement, properties of cement (hydration, setting, hardening, fineness, soundness, compressive strength, etc.), types of Portland cements and their specifications, field testing of cement, standard physical requirements of Ordinary Portland cement.

Steel
Steel, cast iron, wrought iron, Compositions and typical applications of various carbon steels, TMT steel, Tor-steel, Weathering steel, High performance steel, Prestressing steel, common forms of steel, rebar size and grade, feasibility of steel in reinforced concrete constructions, steel making process (scrap to billet, billet to final products), properties of steel, computation of properties of steel from stress-strain diagram.

Concrete
This chapter discusses about ingredients of concrete; Properties of concrete; Factor controlling properties of concrete; Types of concrete; Light weight concrete; Water cement ratio; Carbonation of concrete; Curing of concrete; Workability of concrete; Creep of concrete; Concreting in cold and hot weather and Design of concrete mix by different method.

Timber
Uses of timber in engineering work, Mechanical properties, Advantages of timber, Structure of tree, Conversion of timber, Seasoning of timber, Defects in timber, Deterioration of timber, Preservation of timber, Making timber as Fire resistant element, and Characteristics of good timbers have been described in this chapter.

Rubber
Types of rubber, Sources of natural rubber, Physical properties of natural rubber, Chemical treatment of latex, Raw materials, Synthetic reactions and properties of synthetic rubber, and vulcanization of rubber.

Plastic
This chapter discusses in detail about characteristics of plastic, classification, some typical examples of plastics and their uses.

Glass
Properties of glasses, Various uses of glass in construction, Major constituents, Manufacture of glass, Basic types of glass and their uses.

Paints and Varnishes
Objectives of paints & varnishes, Characteristics of good paint & varnish, Constituents of Paints & varnishes, Types of paints & varnishes and finally Common defects in painting (causes, prevention, and remedial methods) have been discussed.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Describe the basic properties, manufacturing process and quality control of various construction materials 2) choose proper materials for various construction works 3) Perform field test to determine the quality of various engineering materials 4) Understand the types/classes, functions of different ingredients of cement, bricks, steel, etc. 5) Interpret the type, nature and commonly used materials and recently being used for civil engineering purpose 6) Identify and explain the strength controlling factors of concrete 7) Analyze design requirements and perform cement concrete mix design for realistic civil engineering projects giving proper considerations for special needs and constraints and 8) Select suitable materials to properly use them in engineering construction works.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		2	2										1
CLO2			3			2							2
CLO3					3								1
CLO4								2			2		2
CLO5		3											
CLO6			3										
CLO7				3	2			2					
CLO8		3						1					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Aziz, M. A. (1995), A text book of Engineering materials. Kazi Mahfuzur Rahman, 34/2, Zigatola. Claisse. P. A. (2015), Civil Engineering Materials, Butterworth-Heinemann, ISBN-13: 978-0081002759 Gupta, R. K. (2009), Civil Engineering Materials & Construction Practices. Jain Brothers. ISBN-10: 8183601030 Latifee, E. R. (2007), An Introduction to Properties and Evaluation of Engineering Materials. E. R. Latifee 5B, mallika, Dhaka. ISBN: 984-300-000839-0 Van Amsterdam, E. V. (2000), Construction Materials for Civil Engineering. Juta Academic. ISBN: 0702152137.

Course title	Numerical Analysis
Course no	CEE137
Credit value	2.0
Semester	1st year 2nd semester
Rationale	This course introduces different computational methods to solve a mathematical problem numerically. Based on sound knowledge in computational mathematics, numerical methods will enable the students to develop the ability to solve various complicated mathematical problems associated with different branches of Civil and Environmental Engineering.
Course objectives	1) To acquaint the students with the basic tools and fundamental theories of Numerical Analysis 2) To give an idea about the accuracy of standard numerical methods 3) To facilitate necessary knowledge about different numerical methods for various mathematical operations and tasks, such as Interpolation, differentiation, Integration 4) To provide the knowledge of numerical methods to solve algebraic and transcendental equations, to find the root and to solve a differential equation and to fit a curve 5) Help students to familiarize themselves with the computer application of different numerical methods using MATLAB and Excel.

Course content

Introduction to Numerical Analysis

This chapter presents a brief discussion on the significance of numerical methods, difference between analytical and numerical approach, some simple problems on different civil and environmental engineering fields.

Numerical differentiation

Introduction, Numerical differentiation: Errors in numerical differentiation, The cubic spline method, Maximum and minimum values of a tabulated function.

Numerical integration

Introduction, Trapezoidal rule, Simpson's 1/3-rule, Simpson's 3/8 rule, Weddle's rule, Romberg Integration.

Interpolation

Introduction, Finite differences: Forward differences, Backward differences, Central differences, Newton's formula for Interpolation, Central differences interpolation formula Stirling's formula, Bessel's formula, Everett's formula, Practical Interpolation, Lagrange's Interpolation formula, Divided differences, and their properties, Inverse Interpolation, Interpolation by iteration.

Accuracy and error

This chapter presents different types of error occurring in numerical computation. Difference between accuracy and precision is also discussed with examples. Computation of error in successive iteration involved in the numerical method is also practiced in this section.

Root finding algorithm

This chapter presents different open and bracketing methods for finding the roots of equations with examples. Generally, Bisection, False-position, Newton-Raphson and Secant methods are discussed along with their advantages and limitations.

Ordinary differential equation

This chapter presents the importance of formation and solution of ordinary differential equations (ODE) in the engineering field. A detailed description on Euler's, Midpoint and Heun's method to solve ODE is presented. Moreover, a brief introduction on Runge-Kutta method is also delivered in this section.

Curve fitting This chapter presents the use of curve fitting techniques to find out the interrelationship between variables. Theoretical and practical demonstration is also made on various linear and non-linear relations that exist in different civil and environmental engineering fields.	
Course learning outcomes	***By the end of this course, students will be able to*** 1) Explain the core ideas and concepts of numerical methods for solving complicated Engineering calculations approximately 2) Apply various numerical methods for performing tasks, such as Interpolation, differentiation, integration 3) Explore rigorous, analytic, highly numerate strategy to analyze and solve problems such as finding roots of equations, solving differential equations and curve fitting to a given data set 4) Formulate methods for analyzing error induced from approximate results 5) Evaluate different numerical methods using MATLAB and Excel.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	2										
CLO2			2										
CLO3			2										
CLO4			2										
CLO5			2										

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Chapra, S.C. and Canale, R.P. (6th edition), Numerical Methods for Engineers, ISBN-13: 978-0073401065 Bilal, M.A. and Richard, H.M (2015), Numerical Analysis for Engineers: Methods and Applications, Chapman and Hall/CRC, ISBN 9781482250350 Carl .E. Pearson, C.E (1986), Numerical Methods in Engineering & Science, Chapman and Hall/CRC, ISBN 9780442273446 S.S. Sastry, Introductory methods of numerical analysis, 4th edition, Prentice hall of India, 2007. A.R. Vasishtha and V. Vasishtha, Numerical analysis, Kedar Nath Ram Nath, 2007 E. Ward Cheney and David R. Kincaid, Numerical Mathematics and Computing, 5th Edition, Brooks/Cole Publishers, 2004 R. Burden, and J. D. Faires, Numerical Analysis, PWS Kent Publishers, 1993.

Second Year: Semester I

1.1	**Course title**	Details of Construction
1.2	**Course no**	CEE222
1.3	**Credit value**	1.0
1.4	**Semester**	2nd year 1st semester
1.5	**Rationale**	This course will familiarize the students with the knowledge of supervising a construction project's site, ensuring expected quality and specified compliances. The students will also be introduced to construction site safety and construction laws and regulations. This knowledge is essential for the execution of any civil structure and infrastructure projects.
1.6	**Course objectives**	1) To interpret drawing and specifications and implement them in-field 2) To familiarize with various field tests of construction and building materials and their applications controlling construction quality 3) To understand the procedure of checking construction formwork, steel fabrication, quality of concrete, concrete placement and curing, earth cutting and construction techniques of different types of foundation 4) To comprehend road construction techniques and quality assurance 5) To learn the basic concept of site safety, time and cost management of a project and to introduce with the BNBC provisions for construction
1.7	**Course content**	

Pre-construction

Various methods, tools and techniques applying for site investigation, site survey, and soil testing; checking design and detail working drawing from the constructability point of view; documentation and procedures for the approvals and permissions from different concerned departments for construction initiation.

Procurement

Different approaches of project delivery system including selection of consultants, contractors, project managers, and site engineers for a project; materials and equipment procurement methods and their impacts on construction performances.

Construction

Understanding and interpreting construction design documents, specification, and shop drawings, site preparation methods, setting-out the project on-site; comprehending various earthwork techniques; construction techniques of different types of foundation; formworks, fabrication of rebar for sub-structure and superstructure (column, beam, slab); brickworks; plastering; curing of different construction items (concrete, brickwork, plastering, etc.); tiles fittings, plumbing (water supply and sewerage) fittings and fixtures; primary concepts of electrical wiring and fittings; and demonstrating the functions of different construction equipment including heavy equipment for complex infrastructure constructions; importance of various laboratory and field tests of materials and equipment and their appropriate schedule for ensuring construction quality; response to the request for inspection, giving feedback, and review the feedback for ensuring construction quality. Introducing construction codes and safety provisions mentioned in the Bangladesh National Building Code (BNBC).

Testing and commissioning

The concepts and importance of testing and commissioning of a civil structure or infrastructure; testing of various structural and non-structural items, making the list of defective items during project handover/delivery, handover of spare materials and equipment; understanding liability period and functions of a consultant or contractor in this period.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Understand and analyze engineering drawing and specifications and implement them in-field 2) Do various in-field tests of construction and building materials and their applications controlling construction quality 3) Check construction formwork, examine steel fabrication, quality of concrete 4) Synthesize the basic concept of site safety, time and cost management of a project 5) Understand the roles and responsibilities of a quality assurance engineer for on-site supervision.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		3											
CLO2			3										
CLO3			3					2					
CLO4			2								3		
CLO5										2	3		

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	BNBC, "Bangladesh National Building Code", *Housing and Building Research Institute Dhaka, Bangladesh*, 2006. Latifee, E.R.; "Engineering Materials", 2007. Nilson, A.H., Darwin, D., Dolan, C.W.; "Design of Concrete Structures" *13th Ed.,McGraw-Hill*, 2004. P. Purushothama Raj; "Building Construction Materials and Techniques", Pearson Education India, 2016. ISBN 9789332579118 Edward Allen, and Joseph Iano; "Fundamentals of building construction: materials and methods Sixth edition." Publisher-Wiley, 2014, ISBN: 9781118138915 Branoff, Theodore J., author. "Interpreting engineering drawings Eighth edition." Eighth Edition; Publisher: Cengage Learning, 2016; ISBN: 9781133693598 David Kent Ballast, FAIA, "Architect's Handbook of Construction Detailing." Second Edition. John Wiley & Sons, Inc. 2009. "Preparation of Construction Specifications for Civil Projects." Published by ASCE; ISBN 978-0-7844-7794-6 (ebook); 2013.

1.1	**Course title**	Surveying
1.2	**Course no**	CEE223
1.3	**Credit value**	3.0
1.4	**Semester**	2nd year 1st semester
1.5	**Rationale**	Surveying plays a vital role in the field of Geodesy, Photogrammetry, Cartography, GIS, Digital Mapping, Cadastral Surveying, etc. The planning and design of all Civil Engineering projects such as the construction of highways, bridges, tunnels, dams, state boundaries, coastlines, navigable streams, etc. are based upon surveying measurements. Thus, surveying is a basic requirement for all Engineering projects.
1.6	**Course objectives**	1) To conceptualize the basic principle of surveying and aquatint the students with modern surveying tools/instruments necessary for engineering practice 2) To introduce various methods of Plane Surveying (chain surveying, traverse surveying, tacheometry or stadia surveying, plane table surveying, etc.) to determine the topography, prepare a map 3) Accumulate basis ideas for calculating areas and volumes (cutting and filling) to minimize project cost by different methods 4) To introduce the geometry and methods for setting out of curves in route alignment 5) To facilitate necessary knowledge about photogrammetry surveying and its application in the practical field.
1.7	**Course content**	

Introduction

This chapter presents a brief discussion on the significance of surveying, the scope of this course for civil and environmental engineers, and some basic introduction on some surveying terms. Classification of surveying and the importance of Surveying is also described concisely in this section. Importance of Surveying.

Errors in Surveying

Sources of Errors, Types of Errors, Precision and accuracy, Probability, Calculation of error.

Calculation areas and volumes

This chapter mainly focuses on calculating earthwork (cutting and filling) by different methods.

Chain Surveying

This chapter presents an overview of types of chain surveying, elements of chain surveying, selection criteria for a survey station, types of errors occur in chain surveying, and how to solve the error in the practical field have been discussed in this part.

Traverse Surveying

Introduction to traverse, Types of the traverse, Various types of the meridian and bearing systems, Measurement of angles with compass and theodolite, Procedure of traversing, Plotting of traverse, Closing error, Traverse computation.

Plane Table Surveying

This chapter presents a concise description of plane table surveying, advantages and disadvantages over other surveying methods, instruments used in this survey, the

working procedure in the field, and finally different methods for different geographical situations have been discussed.
Leveling Definitions of terms used in leveling, Leveling instruments, Adjustments of a level, Field procedure of leveling, Methods of calculating R.L. (rise and fall, line of collimation), Curvature and Refraction, Errors in leveling, Contouring, Contour interval, Characteristics of contours, Method of locating contour, Uses of contour maps.
Tacheometry or Stadia Surveying This chapter deals with the theory of stadia surveying, description of instruments, formula derivation for horizontal and vertical distance, determination of tacheometric constant, and finally horizontal distance, inclined distance, and vertical height-based problems are discussed in this section.
Curve and Curve Ranging Classification of curves, simple circular curve, elements of a simple circular curve, degree of curve, and fundamentals of the geometry of simple circular curve, Method of curve ranging (Linear and instrumental method), Field procedure for setting out the curve, Workout examples of the simple circular curve Introduction to transition curve, Characteristics, and function of transition curve, Combined curve, Setting out a combined curve, Workout examples of the combined curve Introduction to vertical curve, Vertical curves by the equation of the parabola.
Photogrammetry Surveying This chapter presents an overview of photogrammetry surveying, types of photogrammetry surveying, advantages, and disadvantages over other survey methods, and how many photographs are required for an aerial survey have been solved.
Project Surveying Introduction to various project surveying, House setting work.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Interpret the basic principle of surveying and use of modern surveying tools/instruments in different civil engineering projects 2) Identify the suitable surveying method for field data collection (chain surveying, traverse surveying, tacheometry or stadia surveying, plane table surveying, etc.) and apply them in the practical field to determine the topography, prepare a map 3) Apply the knowledge for calculating earthwork for different civil engineering projects (cutting and filling) to minimize project cost by different methods 4) Understand the basic theory of curve and set out curve for route project 5) Explain photogrammetry surveying and its application in the practical field.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3						2					
CLO2			3										1
CLO3					2						3		2
CLO4					2			2					
CLO5		3						2					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Aziz, M.A., M. Shajahan, M. (1965), A textbook of surveying. *Hafiz Book Center*. Kahmen, H., Faig, W. (1988), Surveying, *Walter de Gruyter & Co.* ASIN: B01K91A8NS Punmia, B. C., Jain, A. K., Jain, A. K. (2016), Surveying - Vol. 1. *Laxmi Publications*. ISBN-13: 978-8170088530 Punmia, B. C., Jain, A. K., Jain, A. K. (2016), Surveying - Vol. 2. *Laxmi Publications*. ISBN-13: 978-8170088837 Roy. S. K. (2011), Fundamental of Surveying, *Prentice-Hall of India Pvt. Ltd.* ISBN-13: 978-8120341982 Ghilani, C.D., Wolf, P.R. (2012), Elementary Surveying: An Introduction to geomatics. 13th Ed., *Prentice Hall*, ISBN-13: 978-0-13-255434-3

1.1	**Course title**	Mechanics of Solids - I
1.2	**Course no**	CEE231
1.3	**Credit value**	2.0
1.4	**Semester**	2nd year 1stsemester
1.5	**Rationale**	This course will familiarize the students with the knowledge of basics of stress, strain and their application. It also gives them the knowledge of calculating the shear force and bending moment along with shear and bending stresses in determinate beams of different shapes. This knowledge is essential to solve structural engineering problems.
1.6	**Course objectives**	1) To understand the basics and applications of stress, strain, and material properties 2) Helping the students to develop the ability to determine stresses and stain in structures under axial loading 3) To develop the skill of the students for finding out the shear force and bending moment along with shear and bending stresses in determinate beams of different shapes 4) To facilitate necessary knowledge about riveted joints and welded connections and 5) To enhance the skill of formulating and solving structural engineering problems.
1.7	**Course content**	
Stress analysis of axially loaded members Introduction, Analysis of internal forces, Simple stress, Shearing stress, Bearing		

stress		
Strain analysis of axially loaded members Simple strain, Stress-strain diagram, Hokes's law, Strain analysis of statically indeterminate members, Poisson's ratio: Biaxial and triaxial deformations,		
Stresses in thin and thick-walled cylinders and spheres Stresses calculation in thin and thick-walled cylinders and spheres		
Riveted and Welded Connections Rivet, Types of riveted joints, Failure of the riveted joints, Introduction to welded connections		
Shear force and bending moment diagrams Definition, Shear force and bending moment for determinate beams		
Bending stress and shear stress in beams Definition, Shear stress and bending stress for determinate beams of different shapes		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Describe the basics of stress and strain and distinguish normal and shear stress, simple strain, and the corresponding material properties 2) Solve for stresses and strains in a structural component due to axial load 3) Determine the stresses in thin and thick-walled cylinders and spheres 4) Identify different types of Riveted and Welded connections and design them 5) Determine the shear force and bending moment for determinate beams and 6) Determine the shear stress and bending stress of determinate beams of different shapes.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2			2										1
CLO3				2									
CLO4		3											2
CLO5		3	2	3	2			2					2
CLO6		3		3	2			1					1

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Beer, F.P., Jr. Johnston, E.R., Dewolf, J.T., Mazurek, D.F. (2011), Mechanics of materials. 6th Ed., *McGraw-Hill Education,* ISBN 978-0-07-338028-5 Hibbler, R.C. (2014) Mechanics of materials. 9th Ed., *Pearson Prentice Hall*, ISBN 978-0-13-325442-6 Pytel, A., Singer, F.L. (1987), Strength of materials. 4th Ed., *Harper & Row*, ISBN 978-0-06-350599-5 Khurmi, R.S., Gupta, J.K. (2005), A textbook of machine design. 14th Ed., *Eurasia public house (pvt.) Ltd.* ISBN 978-8-12-192537-2

1.1	**Course title**	AutoCAD for Civil and Environmental Engineers
1.2	**Course no**	CEE234
1.3	**Credit value**	1.0
1.4	**Semester**	2nd year 1st semester
1.5	**Rationale**	AutoCAD is the most widely used computer-aided design (CAD) software for producing architectural, engineering, and construction drawing. This course will able to make the students for sketching design projects and analyzing the sketches to find the best solution for the projects
1.6	**Course objectives**	1) Getting ideas about computer-aided drawing 2) Make the students understand the concept and techniques to draw 3) To develop skills on engineering drawing
1.7	**Course content**	
Introduction to AutoCAD for the Civil and Environmental Engineering profession Getting started, Creating basic drawings, Manipulating objects, Drawing organization and inquiry commands, Using drawing aids, Editing entities, Controlling object visibility, Annotating the drawing, Dimensioning, Hatching objects, Creating additional drawing objects, Plotting of drawings		
Methods for a presentable drawing Working with layout, Creating drawing template		
Two-Dimensional drawings by using AutoCAD Draw Plan, Elevation, Section of a Building using AutoCAD		
Complete structural drawing of a five-storied residential building Structural drawing using AutoCAD		
Introduction to 3D model design Getting to Know the 3D Modeling Workspace, Drawing in 3D Using Solids, Creating 3D Forms from 2D Shapes		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Demonstrate basic concepts of the AutoCAD software 2) Apply basic concepts to develop construction (drawing) techniques 3) Create two dimensional (2D) drawings (e.g. floor plan, elevation, etc.) using AutoCAD 4) Apply drawing skill in civil engineering project 5) Evaluate computer-aided design drawings based on critical thinking and problem-solving skills.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1								3					
CLO2		1					2						
CLO3			2				2						2
CLO4					2								
CLO5					3								3

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Autodesk (2010), AutoCAD official training guide essentials. *Autodesk Inc.* Omura, G., Benton, B.C. (2015), Mastering AutoCAD 2016 and AutoCAD LT 2016. *Willey & Sons*. ISBN: 978-1-119-04479-6 (ebk.) Mallik, S. (2011), Mastering AutoCAD. *Systech Publications, Ltd*. ISBN: 978-984-8980-10-1

1.1	**Course title**	Fluid Mechanics
1.2	**Course no**	CEE235
1.3	**Credit value**	3.0
1.4	**Semester**	2nd year 1st semester
1.5	**Rationale**	This course will familiarize the students with the knowledge of fundamental fluid mechanics based upon a sound background in engineering mechanics. This knowledge is essential for the execution of water-related projects (such as pipe flow, sewer flow, open channel flow) and hydraulic engineering works.
1.6	**Course objectives**	1) To facilitate necessary knowledge about the fundamental fluid properties and accumulate basic concepts to determine the pressure exerted by a fluid (compressible and incompressible) on a submerged object, and the location and magnitude of the resultant force of the fluid on the object 2) Understand the basic principles (such as conservation laws of 3) mass, momentum and energy) and equation in fluid mechanics to solve fluid flow problems 4) Help the students to develop ability in computing head loss in the pipe for laminar and turbulent flow 5) To enhance the skill of determining the performance characteristics of fluid machinery.
1.7	**Course content**	

Fluid statics
This chapter introduces Fluid properties related to environmental phenomena, Ideal fluid, Real fluid, Viscosity, Surface tension, Capillarity, Manometry, Forces on the submerged planes and curved surfaces, Buoyancy and Floatation, Energy consideration in steady flow, Cavitation, EGL, HGL and Stagnation point.

Dynamics
This chapter describes Flow characteristics of fluid; Dimensional flow; Equation of continuity; Momentum and forces in fluid flow, Stationary vane, Moving vane.

Flow of fluid in pipes
Bernoulli's equation; Flow through venturimeter; Frictional losses in pipes and fittings, Laminar flow, Turbulent flow, Reynold's number, Pipes in series, parallel and pipe network will be explained in this chapter.

Types of fluid machinery
The final chapter deals with Impulse and reaction turbines; Centrifugal and axial flow pumps.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Analyze and draw the free-body diagrams of fluid elements to show the magnitude and direction of forces acting on submerged surfaces 2) Apply the governing principles of fluid mechanics to solve fluid flow problems 3) Explain how different fluid machineries (such as turbines and pumps) work.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	2										
CLO2			3		2								
CLO3								3					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Daugherty, R.L., Franzini, J.B., and E. John Finnemore, E.J. (1989) Fluid Mechanics with Engineering Application-SI metric. McGraw-Hill Book Co. Khurmi, R.S. (1999), A Textbook of Hydraulics and Fluid Mechanics. S Chand & Co Ltd. ISBN10: 8121916763

1.1	**Course title**	Engineering Geology and Geomorphology
1.2	**Course no**	CEE237
1.3	**Credit value**	2.0
1.4	**Semester**	2nd year 1st semester
1.5	**Rationale**	This course will familiarize the students with the basics of engineering geology and geomorphology in the Bangladesh context which covers the earth and its materials, the structure of these materials, natural forces acting upon them, water patterns, the assessment of landform changes, the impacts of development on the environment, the risks from surface processes, etc. As most of the civil engineering projects involve the earth and its features, the fundamental knowledge of geology and geomorphology is vital for understanding the stability of land to sustain the proposed project/structure. This course also supports students to know the water patterns and determine if a particular site is inclined to flooding.
1.6	**Course objectives**	1) To provide knowledge about the theory and application of engineering geology and geomorphology concerning civil and environmental engineering demand 2) Helping the students to develop ability in drawing, reading, and interpreting the geologic map for analysis and design purposes 3) Accumulate basic ideas about various rock and minerals, geology, and geomorphology of Bangladesh.
1.7	**Course content**	

Introduction to engineering geology and geomorphology The significance of studying engineering geology and geomorphology, the scope of this course for civil and environmental engineers, and basic introduction on geologic terms. Discussion on some historical failure events in the civil engineering field due to misinterpretation of geology.
Mineralogy A concise description of various minerals, its formation, occurrence, properties, use, composition, classification, and identification. Introduction of real samples of some common rocks and minerals in class for identification and classification.
Geomorphology An overview of the characteristics, origin, and development of landforms of the earth. It also deals with the Internal geologic processes of the earth's crust, such as tectonic activity and volcanism that constructs new landforms. This section seeks to understand landform history, its dynamics, and predict future changes by geologic processes like epigenic, endogenic, and extraterrestrial processes. This chapter also deals with a drainage basin, stream order (with example), channel morphology, water and wind erosion of soil, etc.
Geology and geomorphology of Bangladesh This chapter mainly focuses on the geological and geomorphological features of Bangladesh. Different landscape maps, contour maps, and the physiographic map are shown in the class and a short observational study is made.
Structural geology This chapter mainly focuses on the three-dimensional distribution of rock units with respect to their deformational histories and rock mechanics. Computation of strike-dip angle, tectonic plate boundary, structural defects, and fabrics, etc. are also covered in this part.
Geologic mapping This chapter deals with the theory and practice of drawing different geologic maps like contour map, geologic cross-section map, etc. mainly focuses on the three-dimensional distribution of rock units with respect to their deformational histories. Computation of strike-dip angle, tectonic plate boundary, structural defects, and fabrics, etc. are also covered in this part.
Geology and earthquake This chapter presents an overview of geologic features related to earthquake engineering. Different earthquake waves, their propagation, magnitude and epicenter determination, earthquake response of construction site geology, etc. are also covered in this section.
Application of geology in Civil & Environmental Engineering projects: This chapter presents the application scenario of site exploration techniques with different conventional and geophysical methods and different tools for geological measurement. Some case study on important civil and environmental engineering projects such as the Channel tunnel; Karnaphuli tunnel, Padma bridge, etc. are also covered in this chapter.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) To introduce the concepts of geology and geomorphology with civil and environmental engineering demand 2) Draw different geologic maps i.e. contour map, geologic cross-section 3) Apply knowledge on the selection of foundation for different structures within the setting of existing natural geology.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3		2		2			2		2		2
CLO2				2		2	2		2		2		3
CLO3		3	3	2		3	3		3		3		3

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Varghese, P.C (2012). Engineering Geology for Civil Engineers. *PHI Learning*, ISBN: 978-8120344952 Garg, S.K. (2011). Physical and Engineering Geology, *Khanna Publisher,* ISBN: 978-8174090324

1.1	**Course title**	Engineering Material Sessional
1.2	**Course no.**	CEE238
1.3	**Credit value**	1.0
1.4	**Semester**	2nd Year 1st Semester
1.5	**Rational**	Students will determine different properties of engineering materials indicating the quality and strength of the materials.
1.6	**Course objectives**	1) To introduce the strength and properties of cement 2) To classify the properties of fine and coarse aggregate 3) To facilitate necessary knowledge about properties of bricks and timber 4) To acquaint students with the properties of concrete.
1.7	**Course content**	

Determination of normal consistency of cement This experiment determines the amount of water needed for preparation cement mortar.
Determination of initial setting time of cement This experiment describes the beginning of setting time of cement paste i.e., the paste is rigid sufficiently to withstand a definite amount of pressure.
Determination of direct compressive strength of cement mortar The compressive strength of cement mortar at different ages can be determined by this experiment.
Sieve analysis of fine and coarse aggregate This experiment shows the index of coarseness or fineness of the material using sieve analysis.
Sampling and testing of bricks for compressive strength and absorption This test represents the load bearing capacity (compressive characteristics) of bricks and its water holding capacity.

Compressive strength of cylindrical concrete specimen and cubes The compressive strength of concrete (both cylindrical and cubes) at different ages can be determined by this experiment.		
Specific gravity and absorption capacity of coarse and fine aggregate This test determines the water holding capacity (absorption) capacity of coarse and fine aggregates and their specific gravity.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Determine the normal consistency and setting time of cement 2) Experiment of the compressive strength of cement mortar 3) Determine the specific gravity and absorption capacity of fine and coarse aggregate 4) Prepare the gradation curve and the index of coarseness or fineness of aggregate by using sieve analysis 5) Determine the compressive strength of concrete at different ages.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		1			2			3					
CLO2				2	2			3					
CLO3		1			2			3					
CLO4					2			3					
CLO5					2			3					

Correlation: 3-High, 2-Medium, 1-Low

Reference books	Aziz, M. A. (1995), A text book of Engineering materials. *Kazi Mahfuzur Rahman, 34/2, Zigatola*. Claisse. P. A. (2015), Civil Engineering Materials, *Butterworth-Heinemann,* ISBN-13: 978-0081002759 Gupta, R. K. (2009), Civil Engineering Materials & Construction Practices. *Jain Brothers.* ISBN-10: 8183601030 Latifee, E. R. (2007), An Introduction to Properties and Evaluation of Engineering Materials. *E. R. Latifee 5B, mallika, Dhaka.* ISBN: 984-300-000839-0 Van Amsterdam, E. V. (2000), Construction Materials for Civil Engineering. *Juta Academic.* ISBN: 0702152137.

Second Year: Semester II

1.1	**Course title**	Hydrology
1.2	**Course no**	CEE221
1.3	**Credit value**	3.0
1.4	**Semester**	2nd year 2ndsemester
1.5	**Rationale**	This course will familiarize the students with the basics of engineering hydrology which covers the Hydrological cycle, Catchment, Losses, Hydrographs, Hyetographs, Precipitation, Streamflow, Runoff, Floods, and Flood Routing. Design topics such as flood frequency analysis, peak flow estimation, design hydrograph estimation, groundwater process and modeling, and Flood control/yield hydrology are also covered in this course. Knowledge of hydrology is vital for the sustainable management of water sources. This course acquainted students with different information on hydrology which helps them to solve practical problems efficiently.
1.6	**Course objectives**	1) To facilitate necessary knowledge about the occurrence, circulation, distribution of water on Earth 2) Acquaint students with the basic knowledge of hydrological processes, hydrologic cycle on earth and earth's atmosphere and different hydrological events like Precipitation, Streamflow, Runoff, Flood, etc. 3) Accumulate basic ideas to compare and assess (e.g. how they work, what their impediments are) several methods for determining peak flows, flood hydrographs, and flood routing which will help to solve real problems.
1.7	**Course content**	
Introduction to hydrology The hydrologic cycle, Water budget equation, World water balance, History of hydrology, Importance and Role of Hydrology in Environmental Engineering.		
Physics of the airflow Cyclone		
Precipitation Forms of Precipitation, Weather Systems for Precipitation, Characteristics of Precipitation, Measurement of Precipitation, Rain gauge Network, Preparation of Data, Presentation of Rainfall Data, Mean Precipitation over an Area, Depth-Area-Duration Relationships, Intensity-Duration-Frequency-Relationship, Probable Maximum Precipitation.		
Streamflow Measurement of Stage and Velocity, Area Velocity Method, Different Methods of Streamflow Measurement, Stage-Discharge Relationship, Extrapolation of Rating curve.		
Abstractions from precipitation Evaporation Process, Evaporimeters, Empirical Evaporation Equations, Analytical Methods of Evaporation Estimation, Reservoir Evaporation and methods for its Reduction, Transpiration, Evapotranspiration, Measurement of Evapotranspiration, Actual Evapotranspiration (AET), Interception. Infiltration and Soil Moistures, Infiltration Capacity, Modeling Infiltration Capacity, Classification of Infiltration Capacities, Infiltration Indices.		
Runoff Runoff Characteristics of Stream, Yield or Annual Runoff, Flow Duration Curve and Flow Mass Curve, Surface Water Resources in Perspective of Bangladesh.		

Hydrographs Construction of a Flood Hydrograph and Its Different components, Factors Affecting Flood Hydrograph, Effective Rainfall, Base Flow Separation, Unit Hydrograph of Different Durations, Derivation of Unit Hydrograph, Synthetic Unit Hydrograph, Instantaneous Unit Hydrograph, the Distribution graph.		
Floods and flood routing Introducing Different Method of Flood Peak Calculation and Their Practical Applications, Flood-Frequency Studies, Risk, Reliability and safety factor, Basic Equations of Flood Routing, Classification of flood routing, methods of flood routing, flood control, and flood forecasting.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Explain basic theories of the hydrologic cycle, global water balance, water budget equation, etc. 2) Explain the Hydrologic events like precipitation, runoff, streamflow, etc. in detail 3) Construct and analyze flood hydrograph, unit hydrograph, and apply the knowledge for the water resources projects 4) Apply methods of flood peak calculation and flood routing.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1				2			2						1
CLO2				2			2						2
CLO3		3		3			2						2
CLO4		3		3			3						3

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Chow V.T. (Ed), *"Applied Hydrology", The* McGraw'-Hill, New York, NY, 1964. Subramanya K.; "Engineering Hydrology", *The* McGraw'-Hill, 2009.

1.1	**Course title**	Quantity Surveying
1.2	**Course no**	CEE224
1.3	**Credit value**	1.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	This course will familiarize the students with the quantity take-off or bill of quantity (BoQ) of different materials, equipment, and resources for a civil engineering project. This knowledge is essential for the budget preparation, material/resource scheduling, and time and cost management of any civil structure and infrastructure projects.
1.6	**Course objectives**	1) To introduce relevant techniques and tools in the preparation of cost estimates and project budget as well as in the monitoring of project cost performance 2) To enhance the skills on the direct cost and indirect cost of a project, estimate earth-work, rebar, brick, cement, sand, stone/brick-chips required for constructing a structure 3) To develop the skill for calculating man-hour, labor cost, and material cost, and estimating the indirect cost for a project, and understanding contingency cost
1.7	**Course content**	
Fundamentals of quantity surveying Basic theories and concepts of quantity surveying, different tools and techniques of estimation, introduction of the relevant documents required to prepare estimation for a project.		
Estimation of building structure Measurement of materials and works, types of estimates, conceptual and detail estimates of a two-storied building. Estimation of quantities of steel & RCC elements of a multi-storied residential building. Estimation of plumbing and drainage (pipes, fittings, and fixtures) system of a building, water reservoir, and septic tank. Detail estimation of a one-story steel structure.		
Estimation of roadway Computation of earth cutting and filling using various methods, basic estimation of materials required for the rigid and flexible pavements.		
Estimation of a retaining wall and a culvert Introduction to various types of retaining walls and culverts. Estimation of materials required to construct a retaining wall and a culvert.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Demonstrate skills for the budget preparation of a project 2) Prepare the bill of quantity for different work-packages of a project 3) Evaluate the contractor's progress payment.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2			3										
CLO3					3			2			3		

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Abul Faraz Khan. "Estimating", Eight Edition; Shabdik Publisher, 2005 Stephen D. Schuette and Roger W. Liska. "Building Construction Estimating"; McGraw-Hill College; Har/Dis Edition, 1994; ISBN-13 : 978-0079118165 B.N. Dutta. "Estimating and Costing in Civil Engineering", Ubs Publishers & Distributors Pvt. Ltd. 2017; ISSBN-13: 978-8174767707 Martin Brook. "Estimating and Tendering for construction work", Routledge, 2008; ISBN-13 : 978-0750686167 Duncan Cartlidge. "Quantity Surveyor's Pocket Book", Routledge, 2nd Edition, 2012; ISBN-13: 978-0415501101

1.1	**Course title**	Remote Sensing and GIS Sessional
1.2	**Course no**	CEE226
1.3	**Credit value**	1.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	This course will familiarize the students with the basics of remote sensing and GIS. This knowledge will be invariably important in analyzing remote data and to represent those data in graphical form.
1.6	**Course objectives**	1) To provide necessary knowledge about the fundamental of remote sensing and its relation with GIS 2) Help the students to develop ability in analyzing spatial data, using GIS analysis tools 3) To develop the skill of creating maps, images and applications to communicate spatial data in a meaningful way.
1.7	**Course content**	
Introduction to remote sensing and GIS, aerial photography, digital image processing, use of QGIS.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Explain the basics of remote sensing and GIS 2) Analyze the geo-spatial data using QGIS 3) Apply the knowledge of GIS to create maps and images to represent spatial data.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2			3										
CLO3								3					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Bhatta, B. (2011). Remote Sensing and GIS. *Oxford*. ISBN: 978-0198072393

1.1	**Course title**	Practical Surveying (Field Work)
1.2	**Course no**	CEE228
1.3	**Credit value**	1.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	A field survey is a prerequisite task to be done before the planning and development of any civil engineering/mining project. Therefore, this course has great importance and will contribute to the development of qualified engineers. It is a fieldwork-based course through which students will learn about the tools/techniques of surveying and be able to execute the knowledge at the field level. This course will be helpful for the students to conduct the field survey and develop the skill to generate various maps and drawings relevant to engineering projects.
1.6	**Course objectives**	1) To provide the necessary knowledge about different types of surveying, their basic principles, and fieldwork procedure, etc. 2) Acquaint students with practical surveying tools and techniques 3) To develop the skills for conducting survey work at field-level, and preparing maps/drawing for the respective project.
1.7	**Course content**	
Chain survey • Identify the instruments for chain survey • Select convenient stations • Conduct chain survey in the field and record the observations in the field book • Conduct triangulation survey in the field and calculate the area • Conduct cross staff survey and find the area.		
Plane table survey • Identify the accessories of plane table • Set up and orient the plane table • Conduct survey in the field to plot the objects by radiation method and intersection method.		
Traverse/Route/Leveling and Contouring/ Height and Distance problem • Identify the leveling instrument • Perform temporary adjustments for taking observations • Conduct simple leveling and compound levelling • Take fly levels for establishing a bench mark		
Tachometry and Stadia surveying • In this type of surveying in which vertical and horizontal distances are computed from stadia, readings without using chain or tape. This is done with the help of a special type of transit theodolite known as tachometer and a staff known as stadia rod.		
House setting • To mark the excavation lines, • To mark the centerlines of all the columns of the plan of a proposed building on the actual site of work as per plan of the building to facilitate earth cutting.		
Curves and Curve settings. Use of Total Station and Global Position Station (GPS) • Setting out a simple circular curve in the field by a linear method and checking it by an angular method.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply surveying knowledge in real field projects 2) Design and conduct the fieldwork, and generate map/drawing for the respective surveying 3) Use the engineering tools, techniques, and computational methods relevant to field survey.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	2				2						
CLO2				3	3		2				2		2
CLO3		3	3					3					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	A text book of surveying–M.A.Aziz & M.Shajahan, Publisher: Dhaka : Hafiz Book Center, c1965.[Reprinted 2010] Surveying (Volume I, II, III), -Dr BC Punmia, Laxmi Publication, 2005 Surveying (Volume I, II), -SK Duggal, Tata McGraw-Hill Education, ISBN-9332901031, 9789332901032 Surveying & Levelling, -NN Basak, Tata McGraw-Hill Education, Oct 1, 1994 Surveying & Levelling, -SV Kulkarn, Pune Vidyarthi Griha Prakashan, 1988.

1.1	**Course title**	Ground Water
1.2	**Course no**	CEE229
1.3	**Credit value**	2.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	This course will give an insight to the students about the groundwater sources, movement of ground water, ground water exploration techniques, and existing challenges related to ground water extraction. This knowledge is essential for execution of ground water resources management projects including pump and water well design and construction.
1.6	**Course objectives**	1) To understand the basic principles and fundamental equations for ground water flow 2) To facilitate necessary knowledge about the subsurface geology and the aquifer properties 3) Helping the students to develop ability in designing well and pump 4) Accumulate basic ideas about hydraulic conductivity, permeability, and flow rate of confined and unconfined aquifers 5) Familiarize with the existing challenges associated with ground water resources and techniques for the modification of the ground water system.
1.7	**Course content**	

Fundamentals of ground water

Introduction to water on earth; ground water in hydrological cycle; Occurrence of ground water: zone of aeration and zone of saturation; Groundwater sources: Artesian and non-artesian well, infiltration well, infiltration gallery, spring.

Basics of ground water storage and movement

Ground water flow principle: Storage function, conduit function; Aquifer and its properties; Seepage and flow net; fundamentals of well hydraulics: tube well and open well.

Governing equations related to ground water

Governing principles of groundwater flow; Movement of ground water (Darcy's Law) and appropriate continuity principles; Laplace equation for potential ground water flow; Equations related to the yield of wells; Applicability of the equations and related problems.

Ground water development in Bangladesh

Types of well technologies used in Bangladesh including alternative technologies; Design of well (non-gravel pack and gravel pack); Sanitary protection and maintenance of well; Necessity of pumps and types of pumps; Design and installation of pumps.

Challenges of ground water resource

Groundwater table depletion; Salt-water intrusion; Groundwater contamination; Modification of groundwater system.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply the governing principles of ground water flow, ground water movement, and appropriate continuity principles 2) Assess local subsurface geology by using the basic understanding of aquifer properties 3) Estimate hydraulic conductivity, permeability, velocity of ground water at field level and flow rate of confined and unconfined aquifers 4) Identify the challenges associated with ground water resources and understand the engineering techniques for the modification of the ground water system 5) Design the water well (non-gravel pack and gravel pack) and water pump.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2		3	3										
CLO3		3			2			3					
CLO4		3	3					2					2
CLO5				3				3					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Todd, D. K., and Mays, L. W. (2005), Groundwater hydrology Ed (Vol. 1625), Wiley, New Jersey. ISBN-13: 978-8126530038 Aziz, M. A. (1975), Water Supply Engineering. Hafiz Book Center, 167 Ahmed, M. F., and Rahman, M. M. (2000), Water supply and sanitation: Rural and low income urban communities. ITN-Bangladesh, Centre for Water Supply and Waste Management, BUET. Raghunath, H. M. (2007), Groundwater. 3rd Ed., New Age International Pvt Ltd Publishers. ISBN-13: 978-8122419047

1.1	**Course title**	Year Final Viva - II

1.2	**Course no**	CEE230
1.3	**Credit value**	0.5
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	By this course students will learn how to present themselves in an official forum for viva voce and they may be evaluated based upon the knowledge they achieved from their second year theory and laboratory course.
1.6	**Course learning objective**	1) To familiarize a viva voce exam in a formal platform with a matured attitude 2) To express the knowledge and skills learnt from theory and laboratory courses 3) To recap the knowledge and understandings of the taught courses at the end of the year.
1.7	**Course content**	
All theory and laboratory courses of second year first semester and second semester		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Explain and answer the intellectual and technical questions in front of an examination board 2) Communicate with examiner and express their knowledge in a satisfactory way 3) Review the acquired knowledge from the courses of second year first semester and second semester.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1									2				
CLO2									3	1		1	
CLO3		2										2	

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	As per given reference books for all theory and laboratory courses by course teachers

1.1	**Course title**	Mechanics of Solids Sessional
1.2	**Course no**	CEE232
1.3	**Credit value**	1.0
1.4	**Semester**	2nd Year 2nd Semester
1.5	**Rationale**	This course will make the students familiar with various methods to analyze material properties through experiments which will enhance their theoretical knowledge.
1.6	**Course objectives**	1) To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads 2) Helping the students to develop the ability to understand the design for strength and stiffness.

1.7	**Course content**	
	• Tension test of mild steel • Test of helical spring • Static bending test of timber beam • Impact test of metals • Hardness test of metals • Compressive strength test by concrete test hammer • Direct shear test of metal specimen • Buckling test of slender columns	
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Perform tension, shear, torsion, impact, hardness tests for solid materials 2) Determine the impact and hardness of metals 3) Calculate the elastic constants through compression test on springs and deflection test on beams 4) Determine the strength of different materials.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	2					1	2				
CLO2		3	2					1	2				
CLO3		3	2					1	2				
CLO4		3	2					2	1				

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Lab manual-developed by CEE, SUST. Beer, F.P.,Jr. Johnston, E.R., Dewolf, J.T., Mazurek, D.F. (2011), Mechanics of materials.6th Ed., *McGraw-Hill Education,* ISBN 978-0-07-338028-5 Hibbler, R.C. (2014)Mechanics of materials. 9thEd., *Pearson Prentice Hall*, ISBN 978-0-13-325442-6 Pytel, A., Singer, F.L. (1987), Strength of materials. 4th Ed., *Harper & Row*, ISBN 978-0-06-350599-5 Khurmi, R.S. (1968), Strength of materials. *S. Chad & Company Ltd.* ISBN 81-219-2822-2

1.1	**Course title**	Mechanics of Solids−II
1.2	**Course no**	CEE233
1.3	**Credit value**	2.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	This course will familiarize the students with the basic knowledge of torsion, transformation of stress, deflection of beams, analysis of column etc. This knowledge is essential to analyze and design various components of a structure.
1.6	**Course objectives**	1) To conceptualize basic theories of torsion, angle of twist, stresses in circular shafts and helical springs

		2) To provide the knowledge of stress transformation, principal plane and stress, maximum in-plane shear stress, Mohr's circle 3) To comprehend the methods of determining deflections of beams and cantilevers under the different types of loadings using various methods, i.e., double-integration method, moment area method and conjugate beam method.
1.7	**Course content**	
Torsion Torsional deformation of a circular shaft, The torsion formula, Power transmission, Angle of twist.		
Helical spring Types of springs, Uses of helical springs, Stresses in helical spring.		
Principal stresses and strains Stress transformation, principal planes, principal stress, analytical and graphical methods for the stresses on an oblique section of a body, Mohr's circle.		
Deflection of beams Elastic deflections of a beam or cantilever using the method of double integration, the moment-area theorems and the conjugate-beam method.		
Columns Euler's formula to columns with different end conditions, Rankine's formula for long columns and effect of eccentric loading on the Rankine's and Euler's formula for long columns.		
Bending of curved beams Theory and problems related to bending of curved beams with small initial curvature and large initial curvature.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Determine torsional stress in circular shafts and helical springs, design a circular shaft subjected to torsion, design a helical spring 2) Calculate principal stress, maximum shear stress, the orientation of principal plane and plane of maximum shear stress both analytically and using Mohr's circle 3) Determine the slope and deflection of beams under different types of loading 4) Analize both concentrically and eccentrically loaded columns; analyze curved beams.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2				2									
CLO3					2								
CLO4					2								

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Beer, F.P., Jr. Johnston,E.R., Dewolf, J.T., Mazurek, D.F. (2011), Mechanics of materials.6th Ed., *McGraw-Hill Education,* ISBN 978-0-07-338028-5 Hibbler,R.C. (2014)Mechanics of materials. 9thEd., *Pearson Prentice Hall*, ISBN 978-0-13-325442-6 Pytel, A., Singer, F.L. (1987), Strength of materials. 4th Ed., *Harper & Row*, ISBN 978-0-06-350599-5 Khurmi, R.S., Gupta, J.K. (2005), A textbook of machine design. 14th Ed., *Eurasia public house (Pvt.) Ltd.* ISBN 978-8-12-192537-2 Khurmi, R.S. (1968), Strength of materials. *S. Chad & Company Ltd.,* ISBN 81-219-2822-2

1.1	**Course title**	Fluid Mechanics Sessional
1.2	**Course no.**	CEE236
1.3	**Credit value**	1.0
1.4	**Semester**	2nd Year 2nd semester
1.5	**Rationale**	Experiments in fluid mechanics are undoubtedly very important part of investigation. Their significance is dual such as inspirational and proving. Experiments can give an impetus to theoretical studies, modelling of flow fields and flow effects, and preparation of numerical simulations.
1.6	**Course objectives**	1) To introduce the experiments based on various theorem related to fluid mechanics 2) Acquint water flow from various hydraulic weirs.
1.7	**Course content**	
Determination of center of pressure: Center of pressure on partially and fully merged surface has been identified using a torroidal quadrant of rectangular section with an adjustable counter balance.		
Application of Bernoulli's theorem: The energy equation according to Bernoulli's theorem for a horizontal conduit has been introduced. The experimental unit is constructed as a single Perspex fabrication consisting of two cylindrical reservoirs interconnected by a venture of rectangular cross section.		
Determination of flow through venturimeter: Water flow determination using a venturimeter, which has different inner diameter for which water pressure would differ to each other has been introduced. Bernoulli's theorem is applied here basically.		
Determination of flow over a V-notch: A right angled V-shape weir has been introduced through which upstream water is allowed to be flowed, and the volumetric water flow rate is calculated. Theoretical water flow rate is then compared to the actual one to evaluate the coefficient of discharge.		
Determination of flow through an orifice: To measure and control the water flow from a reservoir, an orifice is generally applied as it is simply an opening in the wall of a water reservoir. The actual flow is calculated considering the horizontal and vertical distances of the flow from the orifice. Theoretical water flow rate is then compared to the actual one to evaluate the coefficient of discharge.		

Determination of flow through an external cylindrical mouthpiece:
An external cylindrical mouthpiece is introduced instead of orifice to calculate the actual flow by considering the horizontal and vertical distances of the flow from the mouthpiece. In general, the length of the mouthpiece is considered to be 3 times its inner diameter. Theoretical water flow rate is then compared to the actual one to evaluate the coefficient of discharge.

1.8 Course Learning Outcomes	***By end of this course, the students will able to:*** 1) Conduct the experiments related to flow measurement techniques 2) Compare between theoretical and actual discharges would be distinguished.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		2			3			2					2
CLO2			3					3	1				

Correlation: 3-High, 2-Medium, 1-Low

References	Gupta, V. & Gupta, S. K. (2012). Fluid mechanics and its applications. *New Academic Science Limited*. ISBN (13): 978-1-90-657492-5. Subramanya, K. (2008). Engineering Hydrology. *McGraw-Hill Company*. ISBN (13): 978-0-07-064855-7.

1.1	**Course title**	Water Supply Engineering
1.2	**Course no**	CEE271
1.3	**Credit value**	2.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	This course will give an insight to the students about the water quality, water collection, treatment, and distribution systems, and explain the role of a sustainable water supply system to meet the SDG6. This knowledge is essential for designing water demand, water collection system, water treatment processes, water distribution system, and covers the O & M of the water supply system.
1.6	**Course objectives**	1) Getting an idea about the sustainable water supply system and water safety plan in line with SDG6 2) To understand the fundamentals related to water collection, treatment, and distribution systems 3) To provide the knowledge of water impurities and its effects on health and the environment 4) Familiarize with the rainwater harvesting system and existing challenges regarding the adaptation of the rainwater harvesting system 5) Helping the students to develop ability in estimating water requirements and designing the water treatment systems and water distribution systems.
1.7	**Course content**	

Introduction
History and development of water supply system; Population prediction and water requirements; water sources and availability, water supply system in line with SDG6, JMP ladder for water supply and Bangladesh status.

Water quality
Quality of water based on its source; Types of impurities; Effects of impurities on health and environment, drinking water requirements.

Collection system
Design of collection system and water intake.

Water treatment processes
Introduction to water treatment processes; Sedimentation; Coagulation; Filtration; Disinfection; Arsenic and Iron removal techniques.

Water distribution system
Water pipes and pipe fittings including valves, washouts, hydrants, etc.; Fire hydrant; Maintenance, monitoring and sanitary protection of water distribution systems, Leak detection and unaccounted water or system loss. Water supply system in rural and urban areas.

Rainwater harvesting – an alternative for water supply
Objective; basic components for harvesting system; first-flush; contamination prevention; advantages and disadvantages of rainwater harvesting; rainwater harvesting in Bangladesh and the critical issues for harvesting rainwater.

Water safety plan
Introduction to water safety plan.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Identify the necessity of a sustainable water supply system in line with SDG6 and explain the water safety plan 2) Apply the acquired knowledge for water collection, treatment, and distribution 3) Analyze the quality of water and illustrate the effects of water impurities on health and the environment 4) Describe the rainwater harvesting system and examine the acceptability of the system considering the socio-economic perspective 5) Estimate water requirements and design the water collection systems, water treatment systems and water distribution systems.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	3										
CLO2		3											
CLO3			3			3							
CLO4		3					2						
CLO5				3				2					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Aziz, M. A. (1975), Water Supply Engineering. Hafiz Book Center, 167 Garg, S. K. (1992), Water Supply Engineering: Environmental Engineering. Khanna Ltd. ISBN-13: 978-8174091208 Ahmed, M. F., and Rahman, M. M. (2000), Water supply and sanitation: Rural and low income urban communities. ITN-Bangladesh, Centre for Water Supply and Waste Management, BUET.

1.1	**Course title**	Environmental Sanitation and Solid Waste Management
1.2	**Course no**	CEE281
1.3	**Credit value**	2.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	This course will familiarize the students with the knowledge of sanitation and solid waste management based activities related to social and national level. This knowledge is essential for the execution of proper sanitation practice projects, improved solid waste management projects and improved personal and community-level hygiene practices. This course is closely correlated with wastewater treatment, industrial wastewater treatment, and proper disposal of solid waste in nature.
1.6	**Course objectives**	1) To facilitate necessary knowledge about sanitation and sanitation system, sanitation technology, design of latrine and septic tank in the context of Bangladesh perspective 2) Help them conceptualize about indoor sanitation, hygienic education, communicable diseases, health and hygiene aspects of sanitation, financial and social aspects of sanitation 3) To provide the knowledge of different kinds of solid wastes, solid waste generation, solid waste collection, transfer & transport of solid waste, recycling, treatment of solid waste, etc. 4) Accumulate basic ideas about legal, institutional, and financial aspects of solid wastes management to build awareness about impacts on the environment and health due to solid waste mismanagement.
1.7	**Course contents**	

General concepts of sanitation
This chapter presents a review of primary ideas about sanitation and the sanitation system.

Sanitation technology
This chapter presents a review of Sanitation Technology, Different sanitation options, Sanitation practices in Bangladesh, Design of different types of latrine and septic tank, Sanitation of Community and Public Places. Principles of excreta disposal, Duckweed treatment for waste and bio-gas plant technology.

Indoor sanitation
This chapter presents a review of dwellers sanitation; Code of practice for adequate environmental facilities in an infrastructure, housing and buildings: Space, lighting, air movement and circulation, temperature control, plumbing facilities, ventilation and air conditioning.

Environmental health
Disease description, mode of transmission of diseases, clean water, sanitation, health, nutrition, application of engineering principles to the control of communicable diseases; water borne and water sanitation related diseases; vector borne diseases and vector control; Insecticides and bactericides, occupational health.

Hygiene education and community participation
Scope and methodology for hygiene education; Development of hygiene promotion program; Cost recovery and sustainability of water supply and sanitation services.

General concepts of waste & solid waste
This chapter presents a review of primary ideas about waste and solid waste.

Solid waste generation and solid waste collection
This chapter presents a review of waste & solid waste generation which is the formal practice to the general public.
The techniques of solid waste generation and its impact on the environment are discussed in this chapter.
This chapter presents a review of the solid waste collection system.

Solid waste transfer, transport & treatment
This chapter presents a review of solid waste transfer, transport, volume reduction & treatment. The physical properties of solid waste are also discussed in this part.

Solid waste management
Planning and socio-economic aspects of solid waste management; Community mobilization in solid waste management, hazardous and health-care waste management.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) To ensure safe and sustainable sanitation options 2) Design different types of sanitation systems and technology for family and community 3) Identify diseases related to human excreta, different transmission routes of diseases, and provide measures for the prevention of transmission of diseases through proper sanitation 4) Apply concepts of solid waste management from the source of waste generation to waste disposal in a system of municipality organizational structure 5) Design various technological applications for processing of waste and their disposals in various ways.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1						3							
CLO2				3									
CLO3			3										

CLO4			3		2							
CLO5			2									

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Ahmed, M.F. and Rahman, M.M. (2000), Water supply and sanitation. *ITN Bangladesh,* ISBN−984-31-0936-8. Metcalf & Eddy. (1972). Wastewater engineering: collection, treatment, disposal. *McGraw-Hill*. Chowdhury, M.A.I. (2013). Municipal Solid Waste Management, *University Grant Commission UGC of Bangladesh, Dhaka*, ISBN: 978-984- 8910-14-5

Third Year: Semester I

1.1	**Course title**	Structural Analysis - I
1.2	**Course no**	CEE341
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	This course aims to provide students with a thorough understanding of structural analysis of statically determinate structures by various methods, influence lines and moving concentrated loads, earthquake and wind loads, and structural analysis of statically indeterminate structures by approximate method.
1.6	**Course learning objective**	1) To facilitate necessary knowledge about internal forces in a structure 2) To provide the knowledge of portal frame, mill bent, bridge portal and braced trusses 3) To help conceptualize the basic theories in the analysis of building frames by approximate method both for lateral and vertical loads 4) To understand basic theories of earthquake and wind load on building and calculation procedure as per BNBC.
1.7	**Course content**	

Analysis of statically determinate beams, frames and trusses
This chapter presents a review of internal forces acting on typical structural members and calculate the stability and determinacy of structures, Sign convention and notations for internal forces. It also includes determination of reaction, Axial force, Shear force and Bending moment, obtaining internal forces diagrams in a system.

Analysis of portal frames, mill bent, bridge portal and braced trusses
Introduction to portal frame, analysis of portal frame, bridge portal, mill bent and braced trusses.

Influence line (beam, frame, floor beam, truss) analysis
Introduction to influence line. Generation of influence lines for reaction, shear and moment by using Muller-Breslau Principle.

Moving load analysis
Introduction to moving load. Moving load analysis for reaction, shear and moment considering concentrated loads.

Analysis of building frame for vertical and lateral load
Vertical load analysis of statically indeterminate multistoried building frames by approximate method.
Lateral load analysis of statically indeterminate multistoried building frames by approximate method (*portal method, cantilever method*).

Lateral load (Earthquake and wind effect) calculation as per Bangladesh National Building Code
Earthquake and wind load calculation as per BNBC.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply the principles of mechanics of solids to statically determinate and indeterminate structural members to determine external loads and internal forces and illustrate shear force and bending moments diagrams for beam, frame and truss 2) Identify and analyze portal frame, mill bent, bridge portal and braced trusses 3) Apply the concepts and methodologies of influence line on different structures (beam, frame, floor beam, and truss) to solve real world problems involving structures of different nature. 4) Apply the concepts and methodologies of moving load on structural analysis to solve real world problems 5) Analyze multistoried building frame for vertical and lateral loads by approximate method 6) Calculate earthquake and wind forces as per BNBC.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3			2								
CLO2			2										
CLO3		2							1		2		
CLO4				2									
CLO5				1									3
CLO6								1					3

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	BNBC (2020), Bangladesh National Building Code. *Housing and Building Research Institute Dhaka, Bangladesh*. Hibbler, R.C. (2012), Structural analysis. 8thEd., *Pearson Prentice Hall.* ISBN-13: 978-0-13-257053-4 Kassimali, A. (2014), Structural Analysis, 5th Ed., *Cengage Learning,* ISBN-13: 978-1-133-94389-1 Latifee, E.R. (2007), Analysis of Statically Determinate Structures. ISBN 984-412- 682-7 Schueller, W. (1977), High-rise building structures. *Wiley*. ISBN 0-471-01530-X Shedd, T. C., Vawter, J. (1941), Theory of Simple Structures. 2ndEd., *J. Wiley & Sons, Inc.* Utku, S., Norris C.H., Wilbur, J.B. (2008), Elementary Structural Analysis. 4th Ed.,*McGraw-Hill*. ISBN 0-07-065933-8

1.1	**Course title**	Structural Analysis and Design Sessional - I
1.2	**Course no**	CEE342
1.3	**Credit value**	1.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	The aim of this course is to provide students with a thorough understanding of the analysis and design of steel truss roof system considering wind load. This knowledge is essential for execution of engineering projects such as industrial infrastructures.
1.6	**Course objectives**	1) To introduce the properties, selection, performance and codified requirements of steel for structural steel members/elements 2) To understand the design philosophies and behavior of steel structures 3) To introduce the latest code specifications on the design of steel members 4) To facilitate necessary knowledge about the theories and techniques for the analysis and design of industrial roof truss system 5) To develop skills to analyze and design of welded connections 6) To provide an educational and comprehensive experience in the design of simple steel structures (industrial roof truss system).
1.7	**Course content**	
Introduction Advantages and disadvantages of steel, Elastic and plastic design, Section modulus, Sections used as tension and compression members, section properties, Design philosophy (LRFD, ASD), Assumptions and classification of trusses, Industrial roof truss system.		
Design of Industrial Roof Truss System- Purlin and Sag rod Analysis and design of purlins (dead load analysis, wind load analysis, load combination and design), Analysis and design of sag rod.		
Analysis of Member Forces Dead load analysis, wind load analysis (left to right and right to left), combination of loads.		
Design of Truss members, Bracing System and Connections Design of truss members (top chord, bottom chord and web chord), Design of bracing system (vertical bracing, top chord bracing, bottom chord strut), Design of Welded Connections, Detailing of truss joints.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply knowledge of mathematics, science, and engineering to the analysis and design of steel truss roof system 2) Apply the theory and principles of design of steel structures 3) Perceive, analyze and design industrial steel roof truss system considering wind load 4) Analyze and design welded connections 5) Detail the truss joints to comply with the regulations set out in codes.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2		2	3										2
CLO3			3	2									
CLO4				3	2								2
CLO5							2	2					2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	1. Ambrose, J. (2007). Simplified design of steel structures (Vol. 24). 8th Ed., John Wiley & Sons. ISBN-13: 978-0-470-08631-5 2. Gaylord, E. J., Gaylord, C. N., & Stallmeyer, J. E. (1992). Design of steel structures. 3rd Ed., Mcgraw-Hill. ISBN-13: 978-0-07-023054-5 3. Abu-Saba, E. G. (2012). Design of steel structures. Springer Science & Business Media. ISBN-13: 978-1-4615-2080-1 4. Pytel, A and Singer, F. L (1980), Strength of Materials, 4th Ed., Harpier Collins Publishers, Singapore. ISBN-13: 978-0-06-045313-8

1.1	**Course title**	Reinforced Concrete Design - I
1.2	**Course no**	CEE345
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	The aim of this course is to provide students with a thorough understanding of the design of reinforced concrete structures. This knowledge is essential to realize, understand and design reinforced concrete elements, such as beams and slabs under specific loading and environmental conditions.
1.6	**Course objectives**	1) To introduce the properties, selection, performance and codified requirements of concrete and steel for reinforced concrete structural elements 2) To understand how strength criteria and fundamental principles can be applied to reinforced concrete in a unified way 3) To introduce the basic concepts of mechanics and behavior of reinforced concrete in flexure and shear 4) To facilitate necessary knowledge about the theories and techniques for the analysis and design of reinforced concrete elements, such as beams, slabs etc 5) To develop skills to prepare detailed design and workshop drawings to be execute in the field.
1.7	**Course content**	
Fundamentals of reinforced concrete members: This chapter presents a review of the properties, selection, performance and codified requirements of concrete and steel. It also shows how strength criteria and fundamental principles of the materials can be applied to reinforced concrete members subjected to axial loading.		

Flexural Analysis and Design of singly and doubly reinforced rectangular beams and T- beams according to WSD and USD methods:

This chapter shows the flexural behavior and flexural strength of a beam under gradually increasing load on it. It introduces the WSD and USD methods and shows how to design singly and doubly reinforced rectangular beams and T- beams according to WSD and USD methods. Also describes the practical considerations of beam design.

Shear and diagonal tension in beams:

This chapter describes the shear and diagonal tension in beams, diagonal failure of beams and design of web reinforcement etc.

Bond and anchorage:

This chapter describes the bond force and bond strength in reinforced concrete elements. It also introduces anchorage and development length of reinforcing bars, bar cutoff and bend points in beams, bar splices etc.

Analysis and Design of one-way and two-way slabs:

This chapter describes different types of slabs, analysis and design of one way slab, analysis and design of two way edge supported slabs by Coefficient method.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply knowledge of mathematics, science, and engineering to the analysis and design of reinforced concrete structures 2) Apply the understanding of the theory and principles of design and solution of Reinforced Concrete structures 3) Identify, formulate, and solve engineering problems in the area of reinforced concrete structures 4) Perceive, design and analyze reinforced concrete structures (beams and slabs) for flexure/bending and shear 5) Use new technologies and information systems in the design of civil engineering structures with Reinforced concrete 6) Detail the reinforcement of beam and slab to comply with the regulations set out in codes.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2		2	3										2
CLO3			2	2									
CLO4				3	2								2
CLO5								3			2		
CLO6								2		1			2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:

American Concrete Institute, ACI Codes, 2003

Arthur H. Nilson, David Darwin, Charles W. Dolan (2016), Design of Concrete Structures (15th Edition). *McGraw Hill*. ISBN−007-123260-5

George Winter, Leonard Church, Charles Edward O'Rourke, Arthur H. Nilson (1964), Design of Concrete Structures (7th Edition). *McGraw Hill*. ISBN−007-123260-5

Housing and Building Research Institute, Bangladesh (2006), Bangladesh National Building Code (BNBC- 2006)

Kumar Shushil (2005), Treasures of RCC Designs (14th edition). *Radha press, Gandhi Nagar, Delhi*. ISBN-81-900893-6-6

M. Nadim Hassoun, Akthem Al- Manaseer (2008), Structural Concrete (4th Edition). *John Wiley & Sons, Inc.*, ISBN− 978-0-470-17094-6

Noel J. Everard (1993), Schaum's Outline of Reinforced Concrete Design (3rd Edition). *McGraw Hill*. ISBN-978-0-07-019772-5

P.H. Fargusen, J.E. Breen, J.O. Jirsa (1988). Reinforced Concrete Fundamentals (5th Edition). *McGraw Hill*

Wang C, Salmon C.G. (2006). Reinforced Concrete Design (6th edition). *Addition Wesley Educational Publishers Inc.* ISBN-0-321-98460-9

1.1	**Course title**	Reinforced Concrete Design Sessional - I
1.2	**Course no**	CEE346
1.3	**Credit value**	1.0
1.4	**Semester**	3rd year 2nd semester
1.5	**Rationale**	This course aims to provide students with a thorough understanding of concrete structures' fundamental mechanics, the empirical assumptions, and how they relate to the design. Furthermore, this course focus on the analysis, design of the reinforced concrete beams, column and slabs, emphasizing the guiding principles of the serviceability limit state and the ultimate limit state concepts.
1.6	**Course objectives**	1) To acquaint students with the properties, selection, performance, and codified requirements of concrete and steel, and to show how strength criteria and fundamental principles can be applied to reinforced concrete in a unified way 2) To help them conceptualize fundamental theories of reinforced concrete and techniques for analyzing, designing, and detailing reinforced concrete elements, such as beams, slabs, columns (partial), etc.
1.7	**Course content**	

Share of axial load by Concrete and Steel in a Column

Design of a Singly, Doubly, T shaped Reinforced concrete beam, One-way and Two-way both in WSD and USD and comparison

Field Visit

Visiting a construction sites to show reinforcement of various components of building, construction methods, etc.

Comparison among Singly, Doubly, and T beam both in WSD and USD		
Design of a Cantilever beam in WSD and USD		
Laboratory work Construction of cylindrical molds and singly reinforced beams. Testing of molds for concrete strength; testing of the beam for design capacity and deflection. Comparison of results found from testing and theoretical calculation.		
Laboratory work Determination of concrete Strength of an existing column with concrete hammer and reinforcement with ferro- scanner. Calculation of column's load bearing capacity, calculation of load on the column and comparison the results.		
Design of a Shear Reinforcement of a beam by USD		
Design of a beam for torsion		
Design of Masonry structure as per BNBC		
1.9	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Identify, analyze and design reinforced concrete structures (beams and slabs) for flexure/bending and shear 2) Design the reinforcement detail of beam and slab to comply with the regulations set out in codes 3) Apply the design skills to solve issues in relevant engineering projects.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		2		3				2					
CLO2				3				2					1
CLO3		3						2				3	1

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Arthur H. Nilson, David Darwin, Charles W. Dolan (2010), Design of Concrete Structures (14th Edition). McGraw Hill. ISBN−007-123260-5 George Winter, Leonard Church, Charles Edward O'Rourke, Arthur H. Nilson (1964), Design of Concrete Structures (7th Edition). McGraw Hill. ISBN−007-123260-5 M. Nadim Hassoun, Akthem Al- Manaseer (2008), Structural Concrete (4th Edition). John Wiley & Sons, Inc., ISBN− 978-0-470-17094-6 Housing and Building Research Institute, Bangladesh (2006), Bangladesh National Building Code (BNBC- 2006) American Concrete Institute, ACI Codes, 2003 Noel J. Everard (1993), Schaum's Outline of Reinforced Concrete Design (3rd Edition). McGraw Hill. ISBN-978-0-07-019772-5 Kumar Shushil (2005), Treasures of RCC Designs (14thEdition). Radha press, Gandhi Nagar, Delhi. ISBN-81-900893-6-6 Wang C, Salmon C.G. (2006). Reinforced Concrete Design (6thEdition). Addision Wesley Educational Publishers Inc. ISBN-0-321-98460-9 P.H. Fargusen, J.E. Breen, J.O. Jirsa (1988). Reinforced Concrete Fundamentals (5th Edition). McGraw Hill

1.1	**Course title**	Geotechnical Engineering - I
1.2	**Course no**	CEE351
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	This course will enable the students to understand basic geotechnical properties of soil, such as phase relationships, classification, gradation, and other index properties. The detailed analysis of engineering properties (strength parameters, consolidation, and stress) of geomaterials will provide knowledge on how to present and select strength parameters for designing a geotechnical structure. This course will also teach the effect of permeability, seepage, flow net, soil suction, and lateral earth pressure on the analysis and design of different structures, such as building, embankment, storage facilities, roads, airport.
1.6	**Course objectives**	1) To introduce the fundamental concept of geotechnical engineering and its origin and historical development 2) To acquaint students with the basic formation and structure of soil, their index property and soil classification 3) To understand the effect of permeability, seepage, flow net, soil suction, lateral earth pressure of soil 4) To understand the compaction behavior, total and effective stress, and stress distribution phenomena in different soil layers 5) Make students understand the shear strength testing, behavior and parameters, and consolidation testing and behavior.
1.7	**Course content**	
Fundamentals of geotechnical engineering, formation and structures of soil: This chapter introduces the basics and history of geotechnical engineering along with different geotechnical issues, importance, and application. This also includes the origin, formation and structures of different soils with some uses.		
Index properties and classification of soil: This chapter presents different index properties of soil, such as size and shape of soil particles, particle size distribution (sieve and hydrometer analyses), and Atterberg limits and related indexes. Different soil classification discusses how to arrange various types of soils in specific groups based on their properties with the objective of finding their engineering applications.		
Phase relationships of soil: This chapter discusses the relationships among soil mass, weight, volume, dry mass, water, and air of a soil sample along with different practical and mathematical problems.		

Permeability of soil: This chapter presents the determination process of the coefficient of permeability, seepage and soil suction. This chapter also describes the construction process of the flow net and its applications.
Compaction and consolidation of soil: This chapter differentiates between compaction and consolidation, and when these phenomena occur in the real field. The test procedure and analysis on compaction includes standard and modified proctor test. One-dimensional consolidation behavior and testing (using oedometer) of soil are included in this chapter with the view to analyze coefficient of consolidation, coefficient of volume compressibility, compression index, and induced settlement analysis. The time rate of consolidation discusses at which a soil consolidates and how long it requires to reach a certain degree of consolidation.
Shear strength of soil: This chapter presents the shear strength behavior of soil in both disturbed and undisturbed conditions. Determination of different shear strength parameters (i.e. angle of internal friction, cohesion, etc.) by various shear strength test methods such as direct, unconfined and triaxial shear strength apparatus are also delivered in this section. The selection of different triaxial test conditions, such as CD, CU, UU, based on field soil and loading conditions was also included in this chapter.
Lateral earth pressure of soil: This chapter presents different types of lateral earth pressure theories, such as Rankine's earth pressure theory, Culmann's active pressure, Coulomb's active pressure, and discusses their application in designing a structure.
Stress in soil mass and soil failure criteria: This chapter presents total and effective stress considering the water table. This chapter also includes soil failure criteria using the Mohr Circle theory.
Stress distribution in soil: This chapter presents vertical stress distribution on a vertical plane, due to line load, under a strip load, under a circular load, under the corner of a rectangular area and at any point of a rectangular area.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Understand and analyze the basic properties of soil, soil formation and structures 2) Evaluate the effect of permeability, seepage, flow net, soil suction, lateral earth pressure of soil on the different structures 3) Analyze optimum moisture content and maximum dry density, coefficient of consolidation, coefficient of volume compressibility, compression index, and induced settlement 4) Interpret the values of shear strength and shear strength behavior, such as the angle of internal friction, cohesion in both drained and undrained conditions 5) Examine total and effective stress, and stress distribution in soil layers.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1						2							1
CLO2		2											2
CLO3		1	2		1	1							1
CLO4		2	2		2								2
CLO5		2	2		2								2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Arora, K.R. (1987), Soil mechanics and foundation engineering. *Standard publishers distributors.* ISBN: 81-8014-028-8 Coduto, D.P. (2003), Geotechnical engineering-principles and practices. *Prentice hall of India private limited.* ISBN: 81-203-2137-5 Craig, R.F. (1979), Soil mechanics. *Van nostrand reinhold (Intenational*). ISBN: 0-278-00042-8 Das, B.M. (2013), Principles of geotechnical Engineering. *Cengage learning India private limited.* ISBN-13: 978-81-315-1879-3 Punmia, B.C. (1970), Soil mechanics and foundation. *Laxmi publications (P) LTD.* ISBN: 81-7008-081-9

1.1	**Course title**	Open Channel Hydraulics
1.2	**Course no**	CEE371
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	This course will familiarize the students with the knowledge of free-surface fluid flow or open channel hydraulics based upon a sound background in fluid mechanics. This knowledge is essential for execution of water resources projects, hydraulic engineering works and hydraulic structures.
1.6	**Course objectives**	1) To introduce the basic principles and fundamental equations for open channels 2) Familiarize with various types of flow condition in rivers and open channels and their application 3) Understand the procedure for designing different types of open channels 4) Accumulate basic ideas for calculating surface profile of gradually varied flow 5) To acquint rapidly varied flow like hydraulic jump and its application in water resource project and designing of hydraulic structures.
1.7	**Course content**	

Fundamental concepts of open channel flow:
A review of fluid mechanics as applied to open-channel flow, The conservation laws are revisited, and the equations of continuity, momentum, and energy are derived, Kinds of Open Channel, Types of open channel flow, Channel geometry and section elements, Effects of viscosity and gravity, Velocity and pressure distribution and their coefficients.

Governing equations for Steady One-Dimensional Flow Continuity equation, Energy equation, Momentum equation, Applicability of the equations and related problems.
Specific energy and critical flow Energy Depth Relationships, Specific energy curve, Discharge depth curve, Critical flow: computation of critical depth by analytical method, computation of critical depth by Trial and error method, computation critical depth by Numerical method, hydraulic exponent for critical flow computation, section factor for critical flow computation, Transition problems, Flow measurement.
Energy and momentum principles: The applications of the energy and momentum principles are discussed along with the problem of choking in steady flow. It is also demonstrated that the hydraulic behavior of open-channel flow can be very different under the subcritical and supercritical conditions. Also, the phenomenon of hydraulic jump is introduced.
Normal flow: A brief description of flow resistance formula is first provided in relation to the boundary layer theory, and then the normal flow calculations for uniform, grass-lined, riprap, composite, and compound channels are presented.
Design of open channels: This chapter is devoted to the hydraulic design of different types of open channels. Several charts are provided to facilitate the lengthy trial-and-error procedures we often need.
Gradually varied flow: This chapter deals with water surface profile calculations for gradually varied flow. An attempt is taken to emphasize how to identify the flow controls, predict the profile, and formulate a solution accordingly.
Rapidly varied flow: Hydraulic jump, Jumps in horizontal rectangular channels, Jumps in horizontal non-rectangular channels, Jumps in slopping channels, Stilling basins design.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Assess the basic principles of energy and momentum, continuity principle and critical flow condition theory for open channels 2) Apply the governing equations for analyzing steady one-dimensional flow 3) Design the unlined and lined open channels by using modern computational methods 4) Calculate the surface profile for gradually varied flow and rapidly varied flow 5) Apply the concept of hydraulic jump for designing of hydraulic structures and water resource project.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2			3										
CLO3			3				2						
CLO4													2
CLO5													2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Akan, A.O. (2006), Open channel hydraulics. *Elsevier Ltd*. ISBN-13: 978-0-7506-6857-6 Chow, V.T. (1959), Open channel hydraulics. *McGraw-Hill Company*. ISBN: 07-010776-9 K. Subramanya (1986), Flow in Open Channels, *McGraw-Hill Company*. ISBN: 07-462446-6

1.1	**Course title**	Wastewater Engineering
1.2	**Course no**	CEE381
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	This course will give an insight to the students about the wastewater source and characteristics, sewer material and appurtenances, conventional and decentralized wastewater systems, and different treatment units and disposal methods for industrial wastewater management. This knowledge is essential for selecting and designing the treatment units for the municipal and industrial wastewater treatment plant and covers the design, construction, and operation of the decentralized wastewater treatment system.
1.6	**Course learning objective**	1) To introduce the source and properties of wastewater, different sewerage systems, sewer materials, and appurtenances 2) To understand the fundamentals related to wastewater plumbing systems, municipal wastewater treatment, and decentralized wastewater treatment systems 3) To provide the knowledge of industrial wastewater characteristics, the extent and consequence of industrial wastewater pollution 4) Familiarize with the engineering solutions for the mitigation of industrial waste and its safe disposal techniques 5) Helping the students to develop the ability in selecting and designing different treatment units for the conventional and decentralized wastewater treatment plant.
1.7	**Course content**	

Fundamentals of wastewater and its treatment:
Definition and characteristics of wastewater; types of wastewater; sources of wastewater; quality and quantity of municipal and industrial wastewater, important contaminants in wastewater; objectives of wastewater treatment, level of wastewater treatment; unit operations and processes involved in wastewater treatment.

Basics of wastewater plumbing:
Description of sewage and wastewater plumbing; Conventional sewerage system; Small bore sewerage system; Simplified sewerage system; Sewer and sewer materials; Construction of sewer; Sewer and sewer appurtenances; Maintenance of sewer and sewer appurtenances.

Principles of wastewater treatment processes:
Preliminary or preparatory treatment: screening, comminutors, grit removal, floatation, neutralization, equalization, aeration, skimming tank; Primary treatment: sedimentation, Imhoff tank, septic tank, interceptor tank; Secondary treatment: waste stabilization ponds, trickling filter, activated sludge process, rotating biological contactors.

Fundamentals of decentralized wastewater treatment systems:
Definition, characteristics and importance of decentralized wastewater treatment (DWWT) systems; Application of DWWT; Steps of treatment: septic tank/settler, anaerobic baffled reactor, anaerobic filter, planted gravel filter, polishing ponds; Recycle and reuse of treatment products.

Overview of industrial waste and wastewater treatment:
Use of water in industries / water intensity; Source and characteristics of industrial wastewater; Consequences of industrial wastewater pollution; Waste reduction techniques; Industrial wastewater treatment: definition of effluent treatment plant (ETP), importance of ETP, treatment levels and mechanisms, overview on ETP process design and operation; Wastewater treatment and disposal methods of major industries - such as petroleum industries (gasoline kerosene treatment), textile industries, tannery; cement, fertilizer, paper and pulp, jute processing, dairy, drug and pharmaceutical, food and allied industry; Treatment and disposal of industrial waste sludge; Laws and regulations for industrial wastewater and waste treatment.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to***
		1) Describe wastewater characteristics, major contaminants, importance and level of wastewater/industrial wastewater treatment, different sewerage systems, sewer materials, and sewer appurtenances 2) Differentiate between conventional and decentralized wastewater treatment systems 3) Identify different treatment units and disposal methods for industrial wastewater management 4) Apply fundamental concepts to the plumbing and treatment systems of wastewater/industrial wastewater 5) Analyze the quality of wastewater/industrial wastewater and illustrate the effects of wastewater contamination on health and the environment ***6)*** Estimate wastewater quantity and design conventional and decentralized wastewater treatment systems.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2			3										
CLO3			3										
CLO4		3							2				2
CLO5			3				2						
CLO6				3					3				2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:

Metcalf and Eddy. (1972), Wastewater engineering: collection, treatment, disposal. McGraw-Hill. ISBN-13: 978-0-07-041675-8

Peavy, H.S. (1985), Environmental Engineering. McGraw-Hill Company. ISBN: 0-07-100231-6

Patwardhan, A.D. (2008), Industrial Waste Water Treatment. PHI Learning Pvt. Ltd. ISBN- 8120333500, 9788120333505

Davis, M.L. and Cornwell, D.A. (1991), Introduction to Environmental Engineering. McGraw-Hill Company. ISBN: 0071008284, 9780071008280

Edwards, J.D. (1996), Industrial Wastewater Treatment: A Guidebook. Lewis Publication.

McGhee, T.J. and Steel, E.W. (1991), Water supply and sewerage. New York: McGraw-Hill.

Ranade, V.V. and Bhandari, V.M. (2014), Industrial Wastewater Treatment, Recycling and Reuse. Elsevier Science and Technology. ISBN-9780080999685

Ahmed, M.F., and Rahman, M.M. (2000), Water supply and sanitation: Rural and low-income urban communities. ITN-Bangladesh, Centre for Water Supply and Waste Management, BUET.

1.1	**Course title**	Plumbing for Water Supply and Drainage
1.2	**Course no**	CEE382
1.3	**Credit value**	1.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	This course will demonstrate the design procedure of different components of a plumbing system using the knowledge of water supply engineering and fluid mechanics. This knowledge will be helpful for students to design and analyze the plumbing system of a building.
1.6	**Course learning objective**	1) To provide necessary knowledge about different components of a plumbing system 2) Help the students to develop ability in analyzing a water supply or wastewater plumbing of a building 3) To develop the skill of designing a plumbing system of a building.
1.7	**Course content**	
Water Reservoir and Water tank Design (Ground water reservoir, overhead tank etc.); Pipe size, fire hydrant, fittings, Sewerage and waste water plumbing, water pipe fittings including valves, hydrants pump and pumping machinery.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Explain the hydraulics and design principles associated with plumbing 2) Analyze the plumbing system of a building 3) Apply the knowledge of hydraulics and water supply to design a plumbing system.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2			3										
CLO3				3				2					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Haq, S.A. (2006), Plumbing Practice. Syeda Masuda Khatoon, House no. 18, Road no. 12, Sector 4, Uttora Model Town, Dhaka. ISBN: 984-32-2948-7 L. V. Ripka, L.V. (1978) Plumbing Installation and Design. Sterling Pub Co Inc; Later Printing edition. ISBN-10: 0826906001

1.1	**Course title**	Environmental Pollution Control Engineering
1.2	**Course no**	CEE383
1.3	**Credit value**	2.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	This course will familiarize the students with the environmental pollution and its control technologies. Course content covers air pollution, noise pollution, thermal pollution, radioactive pollution, and advanced pollution control engineering. This knowledge is essential for the students to identify the extent of environmental pollution and formulate a sustainable engineering solution to cope with the challenges.
1.6	**Course learning objective**	1) To provide knowledge on different environmental pollution in detail 2) Accumulate basic ideas about various control technologies of environmental pollution 3) Helping the students to develop the ability in formulating a sustainable solution to environmental pollution related problems.
1.7	**Course content**	

General concepts of environmental pollution:
Definition of environmental pollution; Sources and impacts of environmental pollution: atmospheric sub-systems, aquatic sub-systems and soil sub-systems.

Air pollution
Air pollution and its classification; Air quality (physical and chemical fundamentals), Major air pollutants: characteristics and their effects on health and environment; Air quality index; Air quality model: indoor air quality model, dispersion model; Air pollution control mechanism and instrumentation; Laws and regulation of air pollution control.

Noise Pollution:
Review of the human auditory system, noise pollution detection, noise pollution control mechanism, and acoustic design principle.

Thermal pollution:
Definitation of thermal pollution; Source of thermal pollution; Effects of thermal pollution on environment; Control strategies of thermal pollution.

Radioactive pollution:
Radioactive pollution, its sources and effects on health and environment; Control strategies of radioactive pollution.

Advanced pollution control engineering:
Fundamental of environmental biotechnology, Phytoremediation and bioremediation techniques, Modern technologies in pollution detection, Monitoring and remediation, Application of biomimicry in pollution control engineering.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Explain the general concepts of different environmental pollution, their impacts, and available control methods 2) Predict the air quality status using the concept of air quality model 3) Assess the health of the natural environment by using the basic understanding of environmental pollution 4) Apply the appropriate engineering solution to cope with the existing environmental challenges 5) Correlate multi-disciplinary information and function on a multi-disciplinary team.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3				2							2
CLO2		3	3			2							
CLO3		3	3										
CLO4			3					3					2
CLO5		3					3						2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Peavy, H.S. (1985), Environmental Engineering. McGraw-Hill Company. ISBN: 0-07-100231-6 Davis, M.L. and Cornwell, D.A. (1991), Introduction to Environmental Engineering. McGraw-Hill Company. ISBN: 0071008284, 9780071008280 Abbasi, S.A. (2010), Environmental Pollution and Its Control. Discovery Publishing Pvt. Ltd. ISBN-10 : 8183566545 Rao, C.S. (2007), Environmental pollution control engineering. New Age International. ISBN-13: 978-0-470-21763-4

1.1	**Course title**	Environmental Engineering Sessional
1.2	**Course no**	CEE384
1.3	**Credit value**	1.0
1.4	**Semester**	3rd year 1st semester

1.5	**Rationale**	This course will provide the students hands-on experience of determining optimum coagulant dose, solid removal efficiency through sedimentation, short-term biochemical oxygen demand (SBOD) in biodegradation process, sludge volume index (SVI), self-cleansing velocity in sewer line, bio-uptake coefficient of heavy metals, standard particulate matter (SPM) in air, basic weather forecasting parameters, dispersion coefficient of contaminants through soil and sound level of different traffic environment. This knowledge and practice are very important to safely handle many environmental engineering issues.
1.6	**Course learning objective**	1) To understand the basic mechanisms of determination technique of different parameters widely used in water, air, soil and noise pollution events 2) To build the students' skills for sampling, testing and/or monitoring the samples collected from the above-mentioned water, air, soil and noise sources using both manual and instrumental techniques.
1.7	**Course content**	

Optimum Coagulant Dose:
This experiment deals with the determination of optimum coagulant dose in form of Al_2SO_4 for certain water sample to remove the turbidity of the sample using conventional jar test apparatus.

Settling column test for type II settling (flocculent part)
This experiment deals with the determination of settling behavior of flocculent particles in a wastewater sample using settling column apparatus.

Short-term biochemical oxygen demand (SBOD) in biodegradation process:
This experiment deals with the determination of total consumption of oxygen used by microorganism during short term biodegradation of organic waste using SBOD test apparatus.

Sludge volume index (SVI):
This experiment deals with the determination of sludge volume index for industrial ETP generated sludge to assess the condition of sludge settleability using sludge volume index tester.

Self-cleansing velocity in sewer line:
This experiment deals with the determination of self-cleansing velocity that should be maintained in municipal sewer line considering all types of sewer fittings like as elbow, tee etc.

Bio-uptake coefficient of heavy metal:
This experiment deals with the determination of bio-uptake coefficient of heavy metals for different plants in aquatic environment to assess their phytoremediation capacity.

Standard particulate matter (SPM) in air:
This experiment deals with the determination of standard particulate matter in form of $SP_{2.5}$ and SP_{10} using both vacuum filtration apparatus and air monitoring device in the open roadside environment.

Basic weather forecasting parameters:
This experiment deals with the determination of basic weather forecasting parameters (air temperature, humidity, daylight intensity, wind velocity & direction, rainfall intensity) using mini portable weather station.

One-dimension dispersion coefficient of contaminants through soil media:
This experiment deals with the determination of one-dimension dispersion coefficient of contaminants leached through soil media using leaching column apparatus.

Sound level in different traffic environment:
This experiment deals with the determination of sound level for different traffic environment e.g. classroom, playground, canteen, bus stop, beside highway, congested busy intersection, industrial plant etc. using sound level meter.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Determine some important water/wastewater related parameters like as the optimum coagulant dose, solid removal efficiency through sedimentation, SBOD in biodegradation process, SVI for industrial effluent, self-cleansing velocity in sewer line 2) Test phytoremediation related parameter like as bio-uptake coefficient of heavy metals. 3) Determine contaminant transport related parameter like as dispersion coefficient of contaminants through soil media and 4) Monitor standard particulate matter (SPM) in air, basic weather forecasting parameters, sound level of different traffic environment.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		3	3	2	3	1	1	3					2
CLO2		3	3	2	3	1	1	3					2
CLO3		3	3	2	3	1	1	3					2
CLO4		3	3	2	3	1	1	3					2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Kiely, G. (1997), Environmental Engineering. McGraw-Hill Company. ISBN (13): 978-0071164245. Metcalf, E. (2003), Wastewater engineering: treatment and reuse, 4th Ed., Stensel HD. ISBN-13: 978-0-07-041878-3

1.1	**Course title**	Water Supply and Sewerage Engineering Sessional
1.2	**Course no**	CEE386
1.3	**Credit value**	1.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	This course will familiarize the students with the general characteristics of water and sewage samples. This knowledge will be invariably important in analyzing any kind of water and sewage samples and helpful in designing water and sewage treatment units.
1.6	**Course learning objective**	1) To provide necessary knowledge about the characteristics of water and sewage samples 2) Helping the students to develop the ability in analyzing the quality of water and sewage sample.
1.7	**Course content**	

Determination of pH, Color, Turbidity, Hardness, Solids, Total Alkalinity, Magnesium, Carbon dioxide, Chlorides, Iron, BOD, COD of water; Chemical Coagulation, Break Point Chlorination and Residual Chlorine determination; determination of Total and Fecal Coliform; OUR determination.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Explain the quality of water (surface water/groundwater/rainwater etc.) and identify the water-quality parameters that are significant for public health and the environment 2) Analyze the characteristics of water, wastewater, and sewage through conducting experiments 3) To select the appropriate technique/method for the treatment of water and sewage.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	3										
CLO2		3	3	3	2			2					
CLO3		3									2		2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Laboratory manual, Civil and Environmental Engineering Department, Shahjalal University of Science and Technology. Metcalf and Eddy. (1972), Wastewater engineering: collection, treatment, disposal. McGraw-Hill. ISBN-13: 978-0-07-041675-8. Ahmed, M. F., and Rahman, M. M. (2000), Water supply and sanitation: Rural and low income urban communities. ITN-Bangladesh, Centre for Water Supply and Waste Management, BUET. McGhee, T.J. and Steel, E.W. (1991), Water supply and sewerage. New York: McGraw-Hill.

Third Year: Semester II

1.1	**Course title**	Year Final Viva - III
1.2	**Course no**	CEE330
1.3	**Credit value**	0.5
1.4	**Semester**	3rd year 2nd semester
1.5	**Rationale**	By this course students will learn how to present themselves in an official forum for viva voce and they may be evaluated based upon the knowledge they achieved from their third year theory and laboratory course.
1.6	**Course learning objective**	1) To introduce a viva voce exam in a formal platform with a matured attitude 2) To communicate with an examiner and express the knowledge and skills learnt from theory and laboratory courses 3) To recap the knowledge and understandings of the taught courses at the end of the year.
1.7	**Course content**	
All theory and laboratory courses of third year first semester and second semester		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Explain and answer the intellectual and technical questions in front of an examination board 2) Communicate with examiner and express their knowledge in a satisfactory way 3) To aaply the skills developed from the courses of third year first semester and second semester.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1									2				
CLO2									3	1		1	
CLO3		2										2	

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	As per given reference books for all theory and laboratory courses by course teachers.

1.1	**Course title**	Scientific Research (Tools and Techniques)
1.2	**Course no**	CEE332
1.3	**Credit value**	1.0
1.4	**Semester**	3rd year 2nd semester
1.5	**Rationale**	This course will provide necessary knowledge on basic tools and techniques used in scientific study and research. It will give a clear understanding of how to design and conduct scientific research, how to compile research proposal and dissertation and how to publish and present them. It also gives an introductory knowledge of compiling patent document and its submission.
1.6	**Course objectives**	1) To enhance the skill on conducting an innovative scientific research 2) To provide the knowledge of preparing a research proposal and patent document 3) Helping the students to develop the ability of writing and publishing scientific articles in peer reviewed journals and conferences, and 4) To build the student capacity to deliver scientific talk and present different scientific poster.
1.7	**Course content**	

Review on basic tools and techniques in scientific study and research:
This module presents the brief review on different scientific study and management tools e.g. note taking, SQ3R reading system, mind mapping, flow charting, 5S system, PDCA, Kaizen theory, etc. Major innovations and scientific contributions specially in civil and environmental engineering field are also covered in this part.

Review on engineering research and its methods:
This module presents a detailed overview on scientific and engineering research, their types, significance, methods of conduction etc.

Preparation of research proposal with budgeting:
This module presents a complete description on how to prepare research proposal with budgeting.

Compilation of thesis paper:
This module presents how to compile a thesis paper including introduction, literature review, materials and methods, data analysis and discussion, conclusion, references, contents, abstract, different annexures etc.

Writing and publishing scientific papers for journal and conference:
This module presents how to write, submit and publish scientific papers in different peer reviewed international journals and conferences.

Preparation of theoretical and design patent application:
This module presents how to write, submit and publish theoretical and design patent document for the sealing and protection of different novel intellectual property.

Delivering scientific talk and poster presentation:
This module presents the way of delivering scientific talk in public gathering and how to prepare, display and present scientific poster in seminar or conferences.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) To conduct an innovative structured scientific research 2) To prepare and submit research proposal and patent documents 3) To write and publish scientific articles in peer reviewed journals and conferences and 4) To deliver scientific talks and present different scientific poster.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3			3								
CLO2									3				
CLO3									3	2			
CLO4									3				

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Manktelow, J. (1999). Mind Tools: Powerful Techniques for Improving Your Creativity and Thinking Skills. Kogan Page Ltd. ISBN: 978-0749425371 Thiel, D.V. (2014). Research Methods for Engineers. Cambridge University Press, ISBN-13: 978-1107610194.

1.1	**Course title**	Structural Analysis - II

1.2	**Course no**	CEE343
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 2nd semester
1.5	**Rationale**	The course provides students with the principles of elastic structural analysis and behaviour of indeterminate structures. Classical and modern analysis techniques are introduced to arm the students with the necessary tools to better appreciate the real behaviour of structures.
1.6	**Course objectives**	1) Accumulate basic ideas about the deflection of frames, trusses and beams 2) To facilitate necessary knowledge about the elastic analysis methods (slope-deflection, moment distribution and consistent deformation) for statically indeterminate structures 3) Acquint the methods for analyzing the indeterminate structures to evaluate the response of structures 4) Foster the analytical and critical thinking skill in the civil engineering field.
1.7	**Course content**	

Method of Analysis of Statically Indeterminate Structure
Methods of the analysis for indeterminate structures (Displacement method, Force method), Concept of static and kinematic indeterminacy.

Deflection of Frames and Trusses: Virtual Work Method
Principle of Virtual Work Method. Conservation of energy principle, Deflection of trusses by Virtual Work Method, Deflection and slope of beams and frames by Virtual Work Method.

Force Method of Analysis: Consistent Deformation Method
General principle and Definitions, Consistent deformation method for Beams, Consistent deformation method for Frames, Consistent deformation method for Trusses.

Displacement Method of Analysis: Slope-Deflection Equation
Derivation of slope-deflection equation, Modified SDE for pin supported end span, Analysis of Beams, Analysis of frames without sidesway, Analysis of frames with sidesway.

Displacement Method of Analysis: Moment Distribution
General principle and Definitions, Moment Distribution for Beams, Stiffness modification factor, Moment Distribution for Frames without sidesway, Moment Distribution for Frames with sidesway.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Identify indeterminate structure and methods of analysis 2) Apply the concepts and methodologies of deflection calculation on different structures to solve real-world problems involving structures of different nature 3) Understand the analysis process of indeterminate structures and adopt an appropriate structural analysis technique, possess an understanding of the physical response of structures to various loads

		4) Perform the calculation to analyse indeterminate beams, frames and trusses by elastic analysis 5) Solve practical issues and the importance of lifelong learning in structural engineering.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			2					3					
CLO2					2			3					3
CLO3					2			3					3
CLO4								3					3
CLO5											1	3	

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Hibbler, R.C. (2012), Structural analysis. 8th Ed., *Pearson Prentice Hall.* ISBN-13: 978-0-13-257053-4 Kassimali, A. (2014), Structural Analysis, 5th Ed., *Cengage Learning,* ISBN-13: 978-1-133-94389-1 Leet, K.M., Uang, Chia-Ming, Lanning, J.T., Gilbert, A.M., (2017), Fundamentals of Structural Analysis. 5th Ed., *McGraw-Hill Education*, ISBN: 978-0-07-339800-6 Wang, C.K. (2008), Intermediate Structural Analysis. *7th Ed., McGraw-Hill*. ISBN 0-07-068135-X

1.1	**Course title**	Structural Analysis and Design Sessional - II
1.2	**Course no**	CEE344
1.3	**Credit value**	1.0
1.4	**Semester**	3rd year 2nd semester
1.5	**Rationale**	This course will enable the students to build-up the capacity in order to investigate the stability, strength and rigidity of different types of structures. This knowledge is essential for designing various structures (pile foundation, septic tank, underground reservoir, overhead water tank, shear wall etc.).
1.6	**Course learning objective**	1) To acquaint the students with the fundamental theories for analyzing the strength against external forces of a structural component 2) To introduce, analyze and design pile foundation 3) To design underground reservoir, septic tank, overhead water tank 4) To analyze and design shear wall.
1.7	**Course content**	
Analysis and Design of Pile Foundation Introduction, design of pile cap, design of pile.		
Analysis and Design of Septic Tank Introduction, volume of tank design (length, width and depth design), soak field and soak pit design.		
Analysis and Design of Underground Reservoir Introduction, design of side wall, base slab and roof slab.		
Analysis and Design of Overhead Water Tank Introduction, determination of tank dimension, design of side wall, and base slab.		

Analysis and Design of Shear Wall Introduction, load calculation, design considering shear forces, design considering moment.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply the analysis and design tools to solve practical problems related to Civil Engineering structures 2) Understand and be able to design important structures like pile foundation, underground reservoir, septic tank, overhead water tank and shear wall 3) Evaluate and check whether the assumed design has the required capacity or strength and re-design if necessary.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		3	1		3			1					
CLO2		2	1		3			3					
CLO3		1	2		3								

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	BNBC (2006), Bangladesh National Building Code. *Housing and Building Research Institute Dhaka, Bangladesh*. Nilson, A.H.; Darwin, D. & Dolan, C.W. (2004), Design of Concrete Structures. *13th Ed., McGraw-Hill*. ISBN 007-248305-9 Kumar, S. (1990). Treasure of RCC Designs. *14th Ed., Standard Book detp.* Ferguson, P. M. (1958). Reinforced Concrete Fundamentals. *5th Ed., Wiley.* Rahman, S. & Khan, A.F. (2004), Reinforced Concrete Manual and Building Plan. *2nd Ed*. Schueller, W. (1977), High-rise building structures. *Wiley*. ISBN 0-471-01530-X

1.1	**Course title**	Reinforced Concrete Design - II
1.2	**Course no**	CEE347
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 2nd semester
1.5	**Rationale**	This course will familiarize the students with the analysis, design and detailing of reinforced concrete elements, such as slabs, columns, footings, stairs, and retaining walls, joint reinforcement. It also introduces them with serviceability design of the reinforced concrete structures.
1.6	**Course objectives**	1) To introduce the basic principles, fundamental equations and analysis of reinforced concrete elements 2) To facilitate necessary knowledge about the theories and techniques for the analysis and design of slabs, columns, footings, stairs, and retaining walls, joint reinforcement 3) To familiarize the procedure for detailing of RCC elements 4) To introduce serviceability design of the reinforced

		concrete structures 5) To give idea about the seismic design.
1.7	**Course content**	
Analysis and Design of two-way column supported slabs: This chapter describes the analysis and design procedure of two way column supported slabs by Direct design method and Equivalent frame method. It also covers the deflection calculation of slabs.		
Analysis and Design of Columns: This part is dedicated for analysis and design of concentric, eccentric, short, long, sway and non-sway columns.		
Analysis and Design of Footings and foundations: This part is dedicated for analysis and design of different types of footings and foundations, such as wall footings, column footings, combined footings, mat foundations, pile and pile caps etc.		
Analysis and Design of retaining walls: This chapter describes the types of retaining walls, loads on retaining wall, its analysis and design. Three types of retaining wall are considered here: gravity retaining wall, cantilever retaining wall and underground retaining wall.		
Analysis and Design of stairs: This chapter describes the types of stairs, their advantages and disadvantages, loading condition, analysis and design. Two types of stairs are considered here: cantilever stair and double flight stair.		
Serviceability: This part includes cracking and deflection in members, crack control, control of deflection, moment vs. curvature of RC sections etc.		
Analysis and Design of Reinforcement at joint: This chapter deals with design, detailing, analysis of Reinforcement at beam-column joint.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply the tools for critical understanding of the theory and principles of design and solution of Reinforced Concrete structures, since they could use new technologies and information systems in the design of civil engineering structures with reinforced concrete 2) Perceive, design and analyze reinforced concrete structures (frames, slabs, columns, footings, stairs, and retaining walls) subjected to flexure/bending and shear 3) Compose, solve and evaluate the internal forces, the deformations, the stresses and reinforcements in various structures made of reinforced Concrete 4) Analyze reinforced concrete member for serviceability response and calculate and evaluate deflections and crack control in accordance with the relevant codes 5) Apply analysis and design skills to unfamiliar structural elements and applications.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CL	PL	PL	PL	PL	PL	PL	PL	PL	PL	PL	PLO	PLO	PLO
CLO1	3												
CLO2			3	2									2
CLO3					3				2				
CLO4			2				2						
CLO5			1										2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	American Concrete Institute, ACI Codes, 2003 Arthur H. Nilson, David Darwin, Charles W. Dolan (2014), Design of Concrete Structures (14th Edition). *McGraw Hill*. ISBN−007-123260-5 George Winter, Leonard Church, Charles Edward O'Rourke, Arthur H. Nilson (1964), Design of Concrete Structures (7th Edition). *McGraw Hill*. ISBN−007-123260-5 Housing and Building Research Institute, Bangladesh (2006), Bangladesh National Building Code (BNBC- 2006) Kumar Shushil (2005), Treasures of RCC Designs (14th edition). *Radha press, Gandhi Nagar, Delhi*. ISBN-81-900893-6-6 M. Nadim Hassoun, Akthem Al- Manaseer (2008), Structural Concrete (4th Edition). *John Wiley & Sons, Inc.*, ISBN− 978-0-470-17094-6 P.H. Fargusen, J.E. Breen, J.O. Jirsa (1988). Reinforced Concrete Fundamentals (5th Edition). *McGraw Hill.*

1.1	**Course title**	Geotechnical Engineering Sessional - I
1.2	**Course no**	CEE352
1.3	**Credit value**	1.0
1.4	**Semester**	3rd year 2nd semester
1.5	**Rationale**	This course will provide the students with the hands on experience of testing different soil in standard laboratory and field test apparatus. The students will learn the basic property, behavior and parameters of soil for applying them in designing different structures based on soil and solving geotechnical issues.
1.6	**Course objectives**	1) To acquaint the student with the basic concept of soil as engineering material, and the properties (physical, engineering) and methods used to characterize soil for geotechnical analysis and design 2) To facilitate necessary knowledge about the common terminology and parameters used to characterize and classify the soil 3) Acquint the factors affecting soil strength and stress-strain behavior, seepage and water flow through soils and their effects on soil stresses and strength 4) Make the students understand the fundamental differences between behaviors of sands and clays 5) To generate the skills to analyze deformation and settlement characteristics of soils, bearing capacity and slope stability concepts.

1.7	Course content
	Visual classification of soils: This chapter presents the procedures for visually identifying the soil in terms of their color, sizes, shape and stiffness.
	Specific gravity determination: This chapter discusses in detail the procedure of determining the specific gravity of soil using a pycnometer.
	Grain size distribution: This chapter presents the procedure and analysis to determine the grain size determination of soil using different standard sieves and hydrometer.
	Atterberg limits determination: This chapter deals with the liquid limit, plastic limit, shrinkage limit, and plasticity index of fine-grained soil. Atterberg limits are used to classify fine-grained soil according to the Unified Soil Classification System (USCS) or AASHTO system.
	Field density determination: A brief description of the procedure for determining the field density of soil by using sand replacement method is discussed in this chapter. The field density of soil is used to determine various indexes and engineering properties of soil.
	Compaction test (Proctor/ modified proctor): These laboratory tests will enable to determine the relationship between the moisture content and the dry density of soil under a specified compaction effort.
	Unconfined compression test: This chapter deals with the theory and determination of unconfined compressive strength of clay soil. The undrained shear strength (s_u) of soil is necessary for the determination of the bearing capacity of foundations, dams etc.
	Direct shear test: This chapter presents a concise description and determination of shear strength parameters (angle of internal friction and cohesion - most important geotechnical parameters of soil) of soil in a direct shear device.
	Consolidation test: This chapter presents a brief description and procedure for determining the magnitude of consolidation settlement that a laterally confined soil specimen undergoes when subjected to different vertical stresses. The obtained data can be used to determine the compression index, recompression index, preconsolidation stress, coefficient of consolidation, and coefficient of secondary compression of the soil.
	Vane shear test: The chapter discusses the procedure of a vane shear test on clay soil, which provides undrained shear strength of soft clays.
	Permeability test: This chapter presents the procedure of permeability test to determine the coefficient of permeability.
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Understand the procedure of soil classification, soil compaction, flow of water through soil, consolidation, and shear strength of soils 2) Distinguish between fundamental behaviors of cohesive and cohesionless soil 3) Explain and apply the knowledge of dry density, optimum moisture content, strength, compressibility, and permeability of soil in real geotechnical analysis and design 4) Calculate the deformation and settlement of soil under any specific load.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1			1		2	2		2					1
CLO2			2		2			2					1
CLO3		2	2	2	2			3			2		3
CLO4		2	2	2	2	2		2			2		3

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Craig, R.F. (2004), Craig's Soil Mechanics. 7th ed., Spon Press: London Das, B. M. and Sobhan K. (2014), Principles of Geotechnical Engineering. 8th ed., Cengage Learning: Stamford, CT, USA Das, B. M. (2002), Soil Mechanics Laboratory Manual. 6th ed., Oxford University Press Soil mechanics Laboratory - CEE, SUST.

1.1	**Course title**	Geotechnical Engineering - II
1.2	**Course no**	CEE353
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 2nd semester
1.5	**Rationale**	This course will allow the students to perform the subsoil investigation and determine the bearing capacity of soil for the foundation of any structure. They will get the knowledge of how to design the shallow and deep foundations. This course will facilitate them to determine the settlement and possibilities of liquefaction hazards. They also get the fundamental knowledge on analysis of the safety factor of slope.
1.6	**Course objectives**	1) To provide detail procedure for conducting the subsoil exploration program along with the preparation of subsoil condition report 2) To develop skills on the methods of calculating the bearing capacity of the soil and designing different types of shallow and deep foundations 3) Accumulate basic ideas about the theoretical concept of foundation settlement and failure and to determine settlement values for different soil profiles 4) To facilitate necessary knowledge about the technique of assessing the vulnerability of different natural and man-made slope and soil liquefaction hazard in earthquake-prone areas.
1.7	**Course content**	

Subsoil investigation:
This chapter presents an elaborate discussion on different subsoil boring methods, e.g. auger, rotatory, percussion, wash boring, etc., disturbed and undisturbed sample collection. A detailed procedure of field tests, such as standard penetration test (SPT) including N-value corrections, cone penetration test (CPT), field vane shear test, non-destructive test, including water table monitoring are also discussed. Finally, a brief idea of preparing a subsoil investigation report is presented here.

Fundamentals of bearing capacities of shallow and deep foundations:
This chapter presents bearing capacity determination of shallow foundation using Terzaghi's, Meyerhof's, Hansen's and Vesic's method in dry and submerged conditions. The bearing capacity of deep foundation (pile) in drained and undrained cases including single and group capacity are also determined.

Design of foundations:
This chapter presents different types of foundation and their design procedure, such as footings (isolated and strip footing), mat (raft) foundations, pile foundations, caisson and coffer dams.

Compressibility and settlement of foundations:
This chapter presents a different theoretical and mathematical analysis of the compression and settlement behavior of foundation soil. Moreover, the estimation of gross and net settlement in case of both shallow and deep foundation is also discussed, including the permissible limit.

Slope stability analysis:
This chapter presents different safety factors of the slope, types of slope failure and different methods, such as Swedish, Bishop's simplified method, etc. to identify the slope factors.

Fundamentals of soil liquefaction:
This chapter presents a brief overview of soil liquefaction phenomena, its impact and mitigation technology. Theoretical and mathematical analysis of liquefaction hazard and some exercise problems in relation to liquefaction vulnerability assessment of underlying soil profile have also been discussed in this section.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Investigate the subsoil for geotechnical purposes 2) Design the different types of shallow and deep foundations 3) Calculate the Settlement of foundations 4) Evaluate the vulnerability of different natural and man-made slope and soil liquefaction hazards.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		1			2			3					1
CLO2			1	3									2
CLO3				2	2								1
CLO4			3		1								1

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Arora, K.R. (1987), Soil mechanics and foundation engineering. *Standard publishers distributors.* ISBN: 81-8014-028-8 Som, N.N., and Das, S.C. (2009), Theory and practice of foundation design. *PHI learning private limited*. ISBN: 978-81-203-2190-8 Das, B.M. (2013), Principles of foundation Engineering. *Cengage learning India private limited.* ISBN-13: 978-81-315-1878-6 Teng, W.C. (1979), Foundation design. *Prentice hall of India private limited.* ISBN:0-87692-033-4 Peck, R.B., Hanson, W.E, and Thornburn, T.H. (1974), *Foundation engineering. John wiley & sons.* ISBN: 978-0-471-67585-3 Bowles, J.E. (1997), Foundation analysis and design. *McGraw-Hill Company*. ISBN: 0-07-118844-4

1.1	**Course title**	Transportation Engineering - I
1.2	**Course no**	CEE361
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 2nd semester
1.5	**Rationale**	This course will help the students to understand the basic principles of transportation engineering and to use modern techniques for the improvement of existing transport facilities. This course will also develop student's capacity to perform traffic analysis, designing of transport system components, and to identify the more appropriate techniques for transport related problem solving.
1.6	**Course objectives**	1) To introduce the students to the basic tool and technique of the vast field of modern Transportation Engineering at an introductory level 2) To familiarize with the basic principle of traffic and transportation engineering i.e. planning, design, operation, and management system 3) To facilitate the necessary knowledge about traffic characteristics and traffic flow characteristics 4) To develop skills for transport problem identifying, necessary data collection, data analysis and designing transport system components such as designing of roadway geometry, parking area, traffic signal, street lighting, etc. 5) To introduce the student with the intelligent transport system.
1.7	**Course content**	

Introduction:
This chapter presents an overview of the basic tool and technique of the vast field of modern Transportation Engineering at an introductory level. This also includes the principles of transportations, transportation functionality, transportation in logistics, importance of transportation system, advantages and disadvantages of different mode of transportation, current problems in transportation sector and finally factors Influencing Transportation Costs and Pricing.

Transportation system status:
Status of existing Transportation System, Systems Approach to Transport Planning, Interdependence of the Land use and Traffic, Stages in Transportation Planning, Transport Systems and Planning Considerations.

Road Transportation System
This chapter presents a brief discussion on basic components of the road transport system and also describes roadway type according to different parameters i.e. geographical location, functional classification, standard wise classification, use wise and urban wise classification.

Transport & highway planning:
Road classification, type of road patterns, road planning survey, master plan its phasing etc. are discussed in this chapter.

Highway alignment and Survey:
Highway alignment and its various factors as well as considerations during construction are discussed in this chapter.

Traffic characteristics:
This chapter presents a concise description of road users (physical, physiological, mental) and vehicular characteristics (static and dynamic), and their impacts on transportation system.

Traffic flow characteristics:
This chapter discusses on fundamentals of Traffic Flow, Flow Parameters, Nature of traffic flow, Categories of Traffic Flow, Approaches to Traffic Flow − Spacing, Gap and Headway Characteristics. It also describes relationships among the three main characteristics -flow, density, and velocity for understanding better traffic flow.

Surveys and studies in traffic engineering:
Conventional and Modern Methods of Traffic Survey and Studies − Volume and Capacity − Headway concepts and applications − Speed and Delay − Origin and Destination, Parking, Accident − Level of Services (LoS).

Design of transport infrastructure (Geometric Design):
This chapter discusses in detail the geometric elements of highway i.e. cross-section, sight distance, horizontal alignment, vertical alignment. It also describes the factors influencing the geometry of highway and problems on the above discussion.

Intersection & Traffic Signal Design:
This chapter presents an overview of the principles and type of at grade and grade-separated intersection; Types and features of channelizing Island and interchange, and basic elements that are considered for designing the intersection. Types and Design, Traffic Signal Control, Signal Co-ordination.

Traffic operation and management:
Traffic Sign, Road Markings, Traffic Control Aids, Street furniture, Road Arboriculture - Traffic Regulation, Cost Effective Management Measures − Traffic Systems Management and Travel Demand Management - Congestion Management, Traffic Calming and Pricing.

Parking studies and Street Lighting:
This chapter deals with the parking characteristics, parking types, parking demand and supply relation, survey techniques for parking studies, ill effects of parking on transportation systems, and design of parking. This chapter also presents an overview of the objectives, types, and design procedures of street lighting.

Intelligent transportation systems:
A broad range of wireless and wireline communications-based information, control and electronics technologies systems are discussed in this chapter.

1.8 Course learning outcomes

By the end of this course, students will be able to

1) Understand the basic principle of traffic and transportation engineering and use of modern tools and techniques in different transportation engineering projects
2) Identify the potential factors that affect traffic characteristics and traffic flow characteristics that help to develop an efficient transport system
3) Analyze the requirements for designing transport system components such as the geometry of highway, signal design, parking design, etc. and to take realistic engineering decision based on the analysis
4) Collect and analyze the transport data for assessing the roadway performance (e.g. LOS) and designing necessary transport system elements.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		3	1					2					
CLO2			3										
CLO3			3	2	2			1					
CLO4			2	3	2								

Correlation: 3-High, 2-Medium, 1-Low

Reference books:

James L.Pline (Edr), "Traffic Engineering Hand Book", Institute of Transportation Engineers, Washington DC, USA, 1999.

Kadiyali, L.R., "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2002

Khanna, S.K. & Justo, C.E.G., "Highway Engineering, Nem Chand & Bros, 2001.

Nicholas T.Garber, Lester A Hoel, "Traffic and Highway Engineering", Revised Second Edition, ITP, California, USA, 1999

Singh, G., "Highway Engineering", Standard Publishers, 2001.

Thomas Curinan, "An Introduction to Traffic Engineering − A Manual for Data Collection and Analysis", Books Cole, UK, 2001

Wolfgang S. Homburger et.al, "Fundamentals of Traffic Engineering", 15th Edition, Institute of Transportation Studies, University of California, Berkely, 2001

1.1	**Course title**	Hydraulics and Hydraulic Structure
1.2	**Course no**	CEE373
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 2nd semester
1.5	**Rational**	Students will learn about sediment hydraulics and various types of hydraulic structures along with their design procedure and design consideration using knowledge of fluid mechanics and open channel hydraulics.
1.6	**Course objectives**	1) To provide the knowledge of sediment transport and design of channels with consideration of sediment transport 2) To acquaint students with the various types of hydraulic structures and their components in detail, purpose and function of the structures and to select the most appropriate structure and location for a specific problem 3) To develop understanding of the basic principles and concepts of analysis and design of hydraulic structures 4) Foster the analytical and critical ability to study the impacts of hydraulic structure on river or canal hydraulics and morphology.
1.7	**Course content**	

Types of Hydraulic Structure:
Introduction, Classification of Hydraulic Structure, their function and application. Common types of hydraulic structures in Bangladesh and their uses.

Theories of Seepage and Design of Weirs and Barrages:
Failure of Hydraulic Structures Founded on Pervious Foundations, Bligh's Creep Theory for Seepage Flow, Lane's Weighted Creep Theory, Khoshla's Theory and Concept of Flow nets, Design of a Vertical Drop Weir on Bligh's Theory, Design of Modern Weirs and Barrages Founded on Permeable Foundations on The Basis of Khoshla's Theory.

Dams and Types of Dam:
Dams, Various kinds of dam, problems associated with dam construction, selection of the type of dam and their classification, factors governing selection of dams, selection of site for a dam.

Design of Gravity Dam:
Forces acting on gravity dam, mode of failure and criteria for structural stability of gravity dam, stability analysis of gravity dam, design of gravity dam.

Spillways and Energy Dissipaters:
Introduction, types of spillways, energy dissipation below spillways.

Diversion Head work:
Components of diversion headwork and their function, weir and barrage, canal head regulator, design of canal head sluice.

Flood Control Reservoir:
Definition and types of reservoir, types of flood control reservoir, Capacity-elevation and Area-Elevation curve of a reservoir site, computation of reservoir capacity, storage zones of reservoir, storage capacity and yield, computation of dependable catchment yield, calculation of reservoir capacity from mass inflow curve.

Cross drainage works:
Types of cross drainage works, Aqueduct and Syphon Aqueduct, design considerations for cross drainage works.

Sediment Transport and Calculation of Sediment Load:
Sediment Transport Mechanism, Shield's Method for Non-scouring Channel Design, Regime Channel, Kennedy's Theory, Estimation Sediment Load by Empirical Formula.

Rivers, Their Behaviour, Control and Training:
Types of Rivers and Their Characteristics, Sub-continental Rivers and Their Classification, Behaviour of Rivers, Control and Training of Rivers, Design of Guide Bank

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Calculate and analyze sediment transport phenomenon and sediment load 2) Design of non-scouring and non-silting canals considering sediment load 3) Design different types of hydraulic structures considering their suitability and functions 4) To analyze the impacts of hydraulic structures on river or canal regime.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		2						1					
CLO2			2	3				2					
CLO3			3	2				2					
CLO4						2							

Correlation: 3-High, 2-Medium, 1-Low

Reference books	Punmia, B.C., Dr. P. B. B. Lal, A. K. J., A. K. J.; "Irrigation and Water Power Engineering", *Laxmi Publications Pvt. Ltd.*, 1992. Garg, S. K.; "Irrigation Engineering and Hydraulic Structures", *Khanna Publishers*, 2009. M.M. Grishin, "Hydraulic Structures", Amazon Publisher Sir Issac Pitman. S. Leliavsky "Irrigation and Hydraulic Design", Amazon Publisher.

Fourth Year: Semester I

1.1	**Course title**	Project Planning and Management
1.2	**Course no**	CEE421
1.3	**Credit value**	2.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	This course will guide the students to discover new and

		established project management tools and techniques and help them gain an understanding of a project life cycle. Students will learn how to handle more projects with budget constraints effectively, efficiently and timely.
1.6	**Course learning objective**	1) To facilitate necessary knowledge about project management, construction of the project, the project scope and goals, the project life-cycle 2) To introduce the construction process, various construction contract types and project delivery methods 3) To develop skills on Project planning and evaluation techniques by feasibility study of the project 4) Make the students understand the problem that may arise during construction and identify project delaying factors 5) To enhance skill on cost volume profit analysis in the areas like product planning decision, profit planning decision, pricing decision etc. 6) Acquaint students with practical, results-driven project management toolkit for immediate use 7) Helping them to manage multiple projects simultaneously with limited resource by knowledge of resource management.
1.7	**Course content**	

Introduction:
This chapter presents an overview of the need for project management, the construction of project, the project scope and goals, the project life-cycle and major types of construction projects.

Contract strategy:
This chapter discusses in detail of contract, selection of contract type, project delivery methods, types of contracts, contract administration and problem on the above topic.

Project planning:
This chapter presents a concise description of project planning steps, work breakdown structure, activities relationships and drawing project network. It describes in detail the duration of the activity, direct cost of the project and problem on above.

Project scheduling:
This chapter discusses on critical path method, calculations for the critical path method, Program Evaluation and Review Technique (PERT), time-scaled diagrams, and criticisms to network techniques.

Resources management:
This chapter deals with resource management, resource allocation, resource aggregation (loading), resource leveling (smoothing) and scheduling with limited resource. It also includes case study and problem on above topic.

Project finance and evaluation:
This chapter presents a brief description of contract cash flow, project cash flow, discounted cash flow, finalizing a tender price, pricing policy and problem on above. Payback period and feasibility study of the project are described in this section.

Project control:
This chapter presents an overview of problems that may arise during construction, schedule updating, delays analysis and earned value management.

Simplex method:
This chapter focuses mainly with capital budgeting, establishing optimum transfer prices and cost volume profit analysis (product planning decision, profit planning decision, pricing decision etc.)

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Supervise construction operations (i.e., project documentation, measurement and progress payments, and project closeout) and project management (i.e., project planning, scheduling, and resource allocations) 2) Explain the construction process, various construction contract types, and project delivery methods 3) To select a suitable project by feasibility study of the project 4) Identify the project delaying factor that may arise during construction period 5) Estimate cost volume profit analysis for decision making in the field of product planning decision, profit planning decision and pricing decision 6) Apply various tools/techniques/methods for the purposes of construction scheduling (e.g., Bar Chart, CPM, PERT), and project performance monitoring and control (EVM, time-cost tradeoff) 7) Manage multiple projects simultaneously with a limited resource by knowledge of resource management.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2										2	3		
CLO3			3										
CLO4			3										
CLO5			3										
CLO6								3					
CLO_7			2				6						

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Kerzner, H. (2013). Project management: a systems approach to planning, scheduling, and controlling: John Wiley & Sons. ISBN: 978-1118022276 Lewis, P. (2000). Project planning, scheduling and control. McGraw-Hill, ISBN: 978-0071360500.

1.1	**Course title**	Thesis/Project
1.2	**Course no**	CEE430
1.3	**Credit value**	1.0
1.4	**Semester**	4^{th} year 1^{st} semester
1.5	**Rationale**	Thesis in undergraduate level will enable a student to learn

		how to conduct a research by problem identification, objective determination and methodology development, conduct experiments and analysis and finally interpret the result.
1.6	**Course objectives**	1) Integrate science and engineering principles for analysis and solution of problems in the field of civil and environmental engineering 2) Formulate the thesis research project. Identify the critical research questions and define the scope and objectives of the project. Design experiments, analysis, or observation plan 3) To make the students introduced with information technology resources to find background information and data pertinent to the thesis topic 4) Develop writing skills and presentation skills needed to effectively communicate the purpose, scope and conclusions of the project.

1.7 Course content

Thesis is an individual inquiry conducted by the students under the general guidance of an academic advisor.

This inquiry can take one of the following forms in any branches of civil engineering (structure, geotechnical, water, environment and transportation):

(a) An original theoretical and/or experimental investigation;

(b) Design of an engineering product or development of computer program;

(c) Compilation and critical analysis of information on a specific engineering topic; or

(d) Investigation of a substantive engineering problem for an external sponsor.

The thesis work will be carried out throughout the whole period of the final year.

4th year 1st semester:

- Selection of thesis topic
- Preparation of project proposal comprising an overview, aims of the project/thesis, methodology, timeline and expected outcomes.
- Setting of experimental set-up (if needed).
- Preparation of proposal defense

1.8 Assessment strategy

Semester	Criteria	Marks (%)
4th year 1st semester	Literature Review, Research Question & Objectives	15
	Research Proposal	15
	Proposal Presentation	10

1.9 Course learning outcomes

By the end of this course, students will be able to

1) Identify a research hypothesis or research question, develop methodology to conduct the study, design an experiment process or system and after completion of all experiment and analysis, write the thesis
2) Able to prepare research proposals for submission and presentation for various purposes
3) Collect relevant data (primary or secondary) and by analyzing the collected data reach to an acceptable solution
4) Understand of the research work conducted and applied it as the theoretical framework to the research process
5) Prepare a supervised and defended research project as a thesis to the department.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			3		2				2		1	2	1
CLO2									1			3	
CLO3			2				1		2				
CLO4		2										2	1
CLO5											2	1	

Correlation: 3-High, 2-Medium, 1-Low

Reference books

Manktelow, J. (1999). Mind Tools:Powerful Techniques for Improving Your Creativity and Thinking Skills. *Kogan Page Ltd*. ISBN: 978-0749425371

Thiel, D.V. (2014). Research Methods for Engineers, *Cambridge University Press*, ISBN-13: 978-1107610194.

1.1	**Course title**	Field Work for Engineers (Sessional)
1.2	**Course no**	CEE432
1.3	**Credit value**	1.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	By studying this course students can be benefited more since engineering courses are taught relating both academic and practical experience. This approach may motivate students, enable them to relate what was learned in the class with the real world, and allow them to start developing their own engineering judgment, which is essential for the successful practice of civil and environmental engineering
1.6	**Course objectives**	1) Introduce with the different construction sites and treatment plants 2) To relate theoretical knowledge with practical field 3) Acquint with construction practical process 4) Familiarize with professional and contemporary issues 5) To broaden skills in team work, communication and planning through small projects 6) Prepare the student for future Engineering positions.

1.7 Course content

Field Work in Civil Engineering Projects

Trip to different construction sites such as, bridge site, flyover and underpass sites, river protection sites, dam sites, road construction sites etc.

Trip to the surface water treatment plants, iron and arsenic removal plants, rain water harvesting plants, industrial waste treatment plants etc.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply the skills developed from various engineering projects to real field 2) Relate theoretical knowledge with the practical work 3) Supervise construction projects and use this knowledge in job life 4) Use the professional and ethical issues and the importance of lifelong learning in civil engineering 5) Communicate effectively orally and written 6) Carry out and finalize a civil engineering project by showing professional ethics.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											2
CLO2			1					1					
CLO3		2						2					
CLO4										2	2	3	
CLO5									3				
CLO6										3	2		

Correlation: 3-High, 2-Medium, 1-Low

Reference books	As per requirement

1.1	**Course title**	Disaster Management and Earthquake Engineering
1.2	**Course no**	CEE433
1.3	**Credit value**	3.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	This course familiarizes the students with fundamental knowledge of disaster management and earthquake engineering. This knowledge is essential for the students to understand common natural disasters in Bangladesh and the strategy/policy/national plan of the Bangladesh government for disaster management. Besides, this course will enable the students to understand the seismic behavior of structures and apply current codified requirements and design specifications for seismic-resistant buildings.
1.6	**Course learning objective**	1) To introduce the basic knowledge, terminology, and principles of disaster management, engineering seismology, and earthquake engineering 2) Acquint the sources of disasters, their effects, and probable remedial measures 3) Familiarize with the disaster management system in Bangladesh along with disaster management acts, policies, and plans 4) To introduce the design philosophies and code specified requirements for earthquake resistant building design 5) To provide the knowledge of the architectural and structural measures for reducing earthquake vulnerability and estimation of EQ induced losses.
1.7	**Course content**	

Disaster Management: Basic concepts Definition and basic components of disaster management; Important terminologies, their significance and inter-relation: disaster, hazard, vulnerability, risk, preparedness, prevention, mitigation, rehabilitation, retrofitting etc.; History of natural disasters; Classification of natural disasters; Impact of disasters on SDGs; Natural disasters in Bangladesh.
Sources of disasters, their effects and probable remedial measures: Bangladesh perspective Sources, effects on public health and environment, and probable remedial measures: Flood, Cyclone, Tsunami, River bank erosion, Structural collapse, Arsenic contamination etc.
Disaster Management System in Bangladesh: Conceptualizing disaster management in Bangladesh; Disaster management system in Bangladesh: National level, Sub-national levels, Disaster Management Institutions in Bangladesh; Disaster management regulatory framework: Disaster management act, National disaster management policy, Disaster management plans, Standing orders on disaster, Guidelines for government at all levels; Disaster management plans: National plan for disaster management, District disaster management plan, Upazila disaster management plan, Union disaster management plan, Paurashava/City Corporation disaster management plan, Sectoral development plans incorporating disaster risk reduction, Hazard specific multi-sectoral disaster management plans etc.
Earthquake Engineering: Basic concepts Earthquake − definition; Causes of EQ, Intraplate EQ & Volcanic EQ; Foreshock & Aftershock; EQ terminology; Determination of EQ focus, EQ intensity & magnitude, Intensity scale, Iso-seismal lines, Magnitude scale, EQ Energy, Magnitude vs. Intensity.
Causes of EQ and Theory of Plate Tectonics Layers of earth, Causes of EQ, Sequence of EQ events, Continental drift, Theory of plate tectonics, Plate boundaries and their formation.
Seismic Waves and Faults Types of seismic waves, Wave motion and propagation, Movement of earth, Wave Parameters, Detection of Seismic Waves, Nature of Seismic Waves, Locating EQ Epicenter by Three-Circle Method, Classification of Faults, Fault Terminology, Elastic Rebound Theory.
Effect of EQ Primary and Secondary Effects, Shaking Hazard on Structures, Inertia Force and deformation in Structural Components, Horizontal and Vertical Shaking, Liquefaction and Its Physical Consequences, Landslides, Tsunamis, Sand blow, etc.
Seismic Vulnerability Reduction: Architectural and Structural Measures Code and Specifications, Set-back Rule, Size of Buildings, Horizontal and Vertical layout of Buildings, Adjacency of Buildings and Seismic separation Gap, Twisting of Buildings and Effect of Torsion, Soft Story Effect and Design Considerations, Short-Column Effect and Its Solution, etc.

Seismic Design of Buildings

Seismic Design Philosophies, EQ-Resistant Buildings, Damage in Buildings and Ductility, Earthquake Ground Motion and Response Spectra, Behaviour of Masonry Structures in EQ, Box Action, Influence of Openings, EQ-Resistant Features, Construction Details of EQ-Resistant RCC Buildings, Effect of EQ on Structural Members of RCC Buildings, Code Specified Seismic Reinforcement Requirement for Beam and Column, EQ Behaviour of Beam-Column Joint, Code Specified Seismic Reinforcement Requirement for Beam-Column Joint, Shear Walls in RCC Buildings: Advantages, Architectural Aspects and Geometry, Code Specified Reinforcement Provision, etc.

Loss Estimation

Loss estimation due to damage of buildings (by RVS method: FEMA 154), Estimation of Human Casualty and Injury, Estimation of Economic Loss.

EQ Prediction

EQ Prediction and Forecasting, Prediction Methods, Statistical Approach, Physical and Geophysical Measurement, Seismic Gap Concept, Paleoseismology, EQ Return Period and Probability, Guttenberg-Richter Law, Weibull Method, etc.

Seismicity in Bangladesh

Seismic Sources, Status of EQ, EQ History, Major EQ in Bangladesh, Seismic Zones, Damage Potentialities in Major Cities, etc.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Describe the fundamentals of disaster, sources, types, effects, and the strategy/policy/national plan of the Bangladesh government for disaster management 2) Identify probable remedial measures that comply with the disaster management system of Bangladesh 3) Understand the basics of seismology on generation, propagation, recording, and measurement of earthquakes 4) Apply building code earthquake requirements in the design of structural systems 5) Identify favorable and dangerous conceptual design features, learn the earthquake resistant design philosophy and its application 6) Compute the probable return period of an earthquake in any area and also the probable loss due to an earthquake in terms of human casualty and injury and monetary value.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO / PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3											
CLO2	3	3				2						2
CLO3	3		2	2								
CLO4		3									2	2
CLO5		2	3									2
CLO6	3	2			3		2					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	American Concrete Institute, ACI Codes Arthur H. Nilson, David Darwin, Charles W. Dolan (2010), Design of Concrete Structures (14th Edition). *McGraw Hill*. ISBN−007-123260-5 Carter, W. Nick (1992), Disaster Management: A Disaster Manager's Handbook. 2nd edition *Asian Development Bank, Manila.* **ISBN-** 9715610064 Coppola P. Damon (2015), Introduction to International Disaster Management. 3rd edition. *Elsevier*. **ISBN-** 978-0-12-801477-6 Disaster Management Bureau of the Government of the People's Republic of Bangladesh (2010), National Plan for Disaster Management 2010-2015 Dr. Mehedi Ahmed Ansary, Dr. Munaz Ahmed Noor (2006), Earthquake Resistant Design Manual (a publication of Bangladesh Earthquake Society), *Academic Press & Publishers Library.* ISBN-984 08 0210 0 Housing and Building Research Institute, Bangladesh (2006), Bangladesh National Building Code (BNBC- 2006).

1.1	**Course title**	Reinforced Concrete Design - III
1.2	**Course no**	CEE441
1.3	**Credit value**	2.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	In the race of modern science and technology, to make things stronger, cheaper, lighter, more functional, and more sustainable, prestressed concrete is used extensively in bridges, multistory buildings and many other important parts of modern infrastructure. This course provides students with an opportunity to enhance their skills in prestressed concrete design and applications.
1.6	**Course learning objective**	1) Make the students understand the basic principles of prestressed concrete technology, advantages and disadvantages, and their applications in civil infrastructure 2) Acquint different concepts for determining the beam stress and compare among them 3) To facilitate necessary knowledge about different methods of prestressing system and using advanced construction materials for posttensioning and pretensioning 4) Helping the students to develop ability in analyzing prestressed beam section considering flexure, shear, torsion and deflection.
1.7	**Course content**	

Introduction

This chapter presents an overview on Principles of prestressed concrete, Classification and types of prestressing, comparison between normal reinforced concrete and prestressed concrete. Finally beam stresses are determined by considering different concepts.

Prestressing system and end anchorages

A concise description of different methods for pretensioning and posttensioning, end anchorages for posttensioning and pretensioning, comparison between posttensioning and pretensioning is discussed in this chapter.

Analysis and design of sections for flexure

This chapter discusses in detail about analysis and design of prestressed flexural member, stresses in concrete due to prestress and load, stresses in steel due to load, Cracking moment, Ultimate moment for bonded and un-bonded tendons.

Loss of pre-stress

This chapter deals with loss of pre-stress due to Elastic shortening , Creep, Shrinkage ,steel Relaxation, bend, relaxation, etc.

Analysis and design of pre-stressed compression member and slab

This chapter discusses in detail about analysis and design of prestressed compression member and slab.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Interpret the basic principles of prestressed concrete technology and their applications in civil infrastructure 2) Examine beam stresses using different concepts. 3) Explain different methods of prestressing system and using advanced construction materials for post tensioning and pretensioning 4) Identify design requirements and analysis prestressed beam section considering flexure, shear, torsion and deflection.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2			3										
CLO3		3						2					
CLO4			2	3									

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Collins, M.P., and Mitchell, D., *Prestressed Concrete Structures*, Response Publications, 1998. Lin, T.Y., and Burns, N.H., *Design of Prestressed Concrete Structures*, John Wiley and Sons, Inc., Third Edition, 1993. Modern Prestressed Concrete: Design Principles and Construction Methods, 4th Edition by James R. Libby, 2012. Prestressed Concrete Design, Second Edition by M.K. Hurst – 2002. Reinforced and Prestressed Concrete 3rd edi. By F. K. Kong, R. H. Evans − 2013.

1.1	**Course title**	Computer-Aided Structural Analysis and Design
1.2	**Course no**	CEE442
1.3	**Credit value**	1.0
1.4	**Semester**	4th year 1st semester

1.5	**Rationale**	This course will make the students familiar with various industry-standard software for structural analysis and make them able to apply this knowledge in the professional field.
1.6	**Course learning objective**	1) To provide the knowledge of using industry-standard software proficiently in addition to knowing the theoretical concepts of structural analysis and design 2) To understand the basics of finite element modeling, specification of loads and boundary conditions, performing analysis and interpretation of results for final analysis and design using commercial software 3) To help the students using Excel as a programming tool.
1.7	**Course content**	

Application of the structural software such as GEAR, GRASP to analyze and design different structural system like beam, frame, and truss.

Application of structural software STAAD.Pro/ ETABS/ SAP2000/ SAFE to analyze and design of a multi-storied building frame.

Application of the software ANSYS/ Abaqus FEA to simulate the stress distribution pattern in the beam.

Development of Excel sheets for structural components design.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1. Outline procedures for analysis and design of real 3D structures using the latest commercial software 2. Understand the finite element modeling, specification of loads and boundary conditions, performing analysis and interpret the results for analysis and design of structures using commercial software 3. Use modern tools to meet the demands of the latest technology in the field of structural engineering 4. Apply industry-standard commercial software in professional design state of affairs 5. Use Excel as a programming tool.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	2	2			2	3				2	
CLO2		3	3	2	3		1	3				2	
CLO3			2	2			2	3				2	
CLO4			2	2			2	3				2	
CLO5		3	3	3			3	1					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Manuals prepared by the department BNBC (2020), Bangladesh National Building Code. *Housing and Building Research Institute Dhaka, Bangladesh* Hibbler, R.C. (2012), Structural analysis. 8thEd., *Pearson Prentice Hall.* ISBN-13: 978-0-13-257053-4 Kassimali, A.(2014), Structural Analysis, 5th Ed., *Cengage Learning,* ISBN-13: 978-1-133-94389-1 Leet, K.M., Uang, Chia-Ming, Lanning, J.T., Gilbert, A.M., (2017),

	Fundamentals of Structural Analysis. 5th Ed., *McGraw-Hill Education*, ISBN: 978-0-07-339800-6 Nilson, A.H., Darwin, D. & Dolan, C.W. (2010), Design of Concrete Structures. 14th Ed.,*McGraw-Hill Education*. ISBN:978-0-07-329349-3

1.1	**Course title**	Steel Structure
1.2	**Course no**	CEE443
1.3	**Credit value**	2.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	This course familiarizes students to the behavior and design of structural elements in steel structures using current codified requirements and design specifications. This course will enable the students to realize, understand and design basic elements of simple steel structures.
1.6	**Course learning objective**	1) To introduce the properties, selection, performance and codified requirements for design of structural steel members 2) To introduce the design philosophies and latest code specifications for design of steel structures 3) To facilitate necessary knowledge about the theories and techniques for the analysis and design of tension members, bolted and welded connections 4) To make familiar with the knowledge of analysis and design of steel beam, steel column, steel base plate and composite structures.
1.7	**Course content**	
	Introduction: Design philosophy, Limit states, Design considerations, Elastic and plastic design, Overview of LRFD and ASD methods, Sections used as tension and compression members, section properties, etc.	
	Design of tension members: Design strength of tension member, Gross yield strength, Net section fracture strength, Shear lag, Effective net area of the tension members, Block shear rupture strength, Design of tension member using the AISC-LRFD and ASD manual.	
	Connections: Introductory concepts, Classification of connections based on the connecting medium, type of internal forces and type of members joining, Riveted connection, Riveting process and limitations.	
	Design of bolted connections: Structural bolting, ASTM bolt types, Bolt sizes, Bolt assembly, Bolted joint types, Failure mechanism of bolted connections, Code requirements, Shear strength, bearing strength, and minimum edge distance and spacing requirements for bolted connection, Design of bolted connection and gusset plate for given design forces, Behavior of a slip-critical connection and slip-strength of fully tensioned bolted connection, Design of slip-critical bolted splice connection for tension member.	
	Design of welded connections : Structural welding, Different types of welding procedures, Types of weld based on shape, method of deposition and welding position, Welded joints, Minimum and maximum weld size, Nomenclature of weld, Standard welding symbols, Stresses in weld, Specifications for welded connections, Strength of weld, Balanced welded connection, Design of fillet welded connection in AISC-ASD and LRFD methods.	

	Design of steel beam, steel column, steel base plate and composite structures: This chapter deals with the ASD and LRFD design method of steel beam, steel column, steel base plate and composite structures.	
1.8	Course learning outcomes	*By the end of this course, students will be able to* 1) Apply critical understanding of the theory and principles of design and solution of steel structures. 2) Perceive, design and analyze basic elements of steel structures like tension members 3) Analyze and design simple welded and bolted connections. 4) Design steel beam, steel column, steel base plate and composite structures.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1			3	3									
CLO2		2		3				2					
CLO3		2		3				2					
CLO4		1		3			1				1		2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Gaylord, E. H., Gaylord, C. N., and Stallmeyer, J. E. (1992), Design of steel structures. 3rd Ed., Mcgraw-Hill. ISBN-13: 978-0-07-023054-5 Abu-Saba, E. G. (1995), Design of steel structures. Springer Science and Business Media. ISBN-13: 978-0-412-98491-4 Ambrose, J. (1987), Simplified design of steel structures .6th Ed., John Wiley and Sons., ISBN-13: 978-0-471-50539-6 Englekirk, R. E. (1994), Steel structures: Controlling behavior through design. John Wiley and Sons, Inc. ISBN-13: 978-0-471-58459-9. W.T. Segui (2006), LRFD Steel Design, 4th Ed., Brooks/Cole Publishing Company, Pacific Grove, California. ISBN-13: 978-0-495-24471-4 C.G. Salmon and J.E. Johnson (1996), Steel Structures: Design and Behavior, Emphasizing Load and Resistance Factor Design, 4th Ed, Harper College Publishers, New York, NY. ISBN-13: 978-0-673-99786-9

1.1	**Course title**	Reinforced Concrete Design Sessional - II
1.2	**Course no**	CEE446
1.3	**Credit value**	1.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	This course introduces structural design and analysis of multistoried buildings considering wind and earthquake loads.
1.6	**Course learning objective**	1) To facilitate necessary knowledge about BNBC-2020 2) To provide the knowledge on design and analysis of multistoried buildings 3) Help them conceptualize the basic process in the analysis of building frames by both lateral (wind and earthquake) and vertical loads

		4) To familiarize software for design 5) To provide supportive idea about the related power and plumbing systems.
1.7	**Course content**	
Design of multistoried buildings considering wind and earthquake loads: • Calculation of Environmental Loads (wind and earthquake) • Calculation of slab load • Calculation of beam load • Load analysis using software • Design of slab • Design of beam • Design of column • Design of footing, stair, septic tank, etc • Power supply and Plumbing design • Finishing work • Preparation of Bill of Quality (BOQ) • Preparation of design documents.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Calculate earthquake and wind forces as per BNBC 2) Design multistoried buildings 3) To examine the related power and plumbing systems.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		3		2									1
CLO2				2			1						1
CLO3		3		1					1		2		3

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	BNBC (2020), Bangladesh National Building Code. *Housing and Building Research Institute Dhaka, Bangladesh*. Nilson, A.H.; Darwin, D. and Dolan, C.W. (2004), Design of Concrete Structures. 13th Ed., McGraw-Hill. ISBN 007-248305-9.

1.1	**Course title**	Structural Analysis - III
1.2	**Course no**	CEE449
1.3	**Credit value**	3.0
1.4	**Semester**	4thyear 1st semester
1.5	**Rationale**	This course will familiarize the students with the knowledge of analyzing both structural and nonstructural problems. This knowledge is essential for computing the displacements, stresses and strains in discrete structures involving complicated geometries, loadings and material properties.
1.6	**Course learning objective**	1) To introduce the basic principles of finite element method 2) Familiarize with analysis of statically indeterminate structures by stiffness matrix method and flexibility matrix method.

1.7	**Course content**	
Introduction to Finite Elements Explanation of finite elements, one dimensional stress and strain deformation, time depended flow problems, equation solutions by finite elements.		
Method of Analysis of Statically Indeterminate Structures Brief review on Concept of Static and Kinematic Indeterminacy, Degree of Freedom, Methods of the Analysis for Indeterminate structures (Displacement method, Force method) etc.		
Displacement Method of Analysis: Stiffness Matrix Method General principle and definitions, Member stiffness, Stiffness transformations, Assembly of stiffness matrices and Solution for trusses, beams and frames.		
Force Method of Analysis: Fundamentals of Flexibility Matrix Method General principle and definitions, Flexibility matrices and Solution for beams, frames and trusses.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Evaluate the concepts and methodologies of finite element method on different structures (beam, frame and truss) to solve real world problems involving structures of different nature 2) Identify indeterminate structures and methods of analysis 3) Apply the stiffness matrix method to analyze indeterminate beams, frames and trusses 4) Apply the flexibility matrix method to analyze indeterminate beams, frames and trusses.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		3											
CLO2			3										
CLO3				3				2					2
CLO4				3				2					2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Logan, D.L. (2007), A First Course in the Finite Element Method. *4th Ed., Nelson, a division of Thomson Canada Limited*. ISBN 0-534-92964-8 Chandrupatla, T.R. & Belegundu, A.D. (2002), Introduction to Finite Elements in Engineering. *3rd Ed., Prentice-Hall, Inc*. ISBN 0-13-061591-9 Hibbler, R.C. (2012), Structural analysis. *8th Ed., Pearson Prentice Hall.* ISBN-13: 978-0-13-257053-4 Wang, C.K. (2008), Intermediate Structural Analysis. *7th Ed., McGraw-Hill*. ISBN 0-07-068135-X Utku, S.; Norris C.H. & Wilbur, J.B. (2008), Elementary Structural Analysis. *4th Ed., McGraw-Hill*. ISBN 0-07-065933-8

		Weaver, W.J. & Gere, J.M. (1980), Matrix Analysis of Framed Structures. *2nd Ed., Van Nostrand Reinhold Company Inc*. ISBN: 0-442-25773-2
1.1	**Course title**	Geotechnical Engineering − III
1.2	**Course no**	CEE451
1.3	**Credit value**	2.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	This course will enable the students with the knowledge on how to perform geotechnical analysis and design of different structures such as sheet pile, retaining wall, machine foundation and piles subjected to lateral load. This course will also offer knowledge of different soil improvement and dewatering techniques to make them able to work in different adverse soil conditions to design a sustainable structure.
1.6	**Course learning objective**	1) To introduce and design of sheet pile 2) To familiarize with various types of retaining wall along with the sufficient knowledge to analyze and geotechnical design 3) Accumulate design ideas on machine foundation and piles subjected to lateral load 4) To introduce different soil stabilization, improvement and dewatering techniques with their application and design.
1.7	**Course content**	
Analysis and design of sheet pile: This chapter presents the analysis and design of different sheet piles and their design considering both cohesive and cohesionless soil.		
Analysis and design of retaining wall: This chapter introduces different types of retaining walls, application of lateral earth pressure theories to design, stability of gravity retaining walls, and with metal, geotextile and geogrid reinforcement, and slurry wall construction.		
Fundamentals of soil stabilization: A brief description of soil stabilization methods, such as lime stabilization, cement stabilization, fly ash stabilization and deep mixing method along with their applications have been included in this chapter.		
Soil improvement and dewatering techniques: This chapter presents field compaction, vibroflotation, precompression, sand drain, prefabricated vertical drains, stone columns, sand compaction piles, dynamic compaction.		
Fundamentals of machine foundation and pile subjected to lateral load: This chapter presents the foundation design due to vibration, especially from the machines. This also includes analysis and design of pile due to lateral load using the elastic solution and Brom's method.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Design of sheet piles, machine foundations and subjected to lateral load 2) Analysis and design of retaining wall, 3) Apply different soil stabilization techniques to solve soft soil issues for construction purposes, 4) Apply different ground improvement methods to improve the bearing capacity, strength and stiffness of soil.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		2	2	1	2								2
CLO2		2	3	2	3								2
CLO3		1	2		1								1
CLO4		3	3	2	2								2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Arora, K.R. (1987), Soil mechanics and foundation engineering. *Standard publishers distributors.* ISBN: 81-8014-028-8 Coduto, D.P. (2003), Geotechnical engineering-principles and practices. *Prentice hall of India private limited.* ISBN: 81-203-2137-5 Das, B.M. (2013), Principles of foundation engineering. *Cengage learning India private limited.* ISBN-13: 978-81-315-1878-6 Hausmann, M.R. (1990), Engineering Principles of Ground Modification. *McGraw Hill, NY*. ISBN-13: 978-0070272798

1.1	**Course title**	Transportation Engineering - II
1.2	**Course no**	CEE461
1.3	**Credit value**	3.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	This course will introduce students to the basics of transportation modeling those are important for long-term transport planning and policy recommendation. This course will also develop the student capacity for scientific investigation of the road traffic accident; designing, construction and maintenance techniques of both rigid and flexible pavement.
1.6	**Course learning objective**	1) To make the students understand the basic characteristics of standard highway materials 2) Helping the students to develop skills in designing flexible and rigid pavement 3) To enhance the ability for identifying and analyzing the design requirements for Marshall Mix design 4) To facilitate necessary knowledge about highway construction and maintenance 5) To create the ability of understanding and developing four-step transport demand model 6) To develop the skill for scientific investigation of road

		traffic accidents and transport system management.
1.7	**Course content**	
Highway materials: This chapter presents an overview of the basic properties of subgrade soil, aggregate, bituminous materials, cement concrete. It also describes various methods of testing the highway materials to confirm its specification.		
Fundamentals of flexible pavement: This chapter discusses in detail traffic volume calculation, factors affecting design and performance of flexible pavement, flexible pavement design by AASHTO method, CBR method, RHD method. It also includes the whole procedure of bituminous mix design using Marshall mix method and problem on the above topic.		
Fundamental of rigid pavement: This chapter presents a concise description of the types of rigid pavement, factors affecting design and performance of rigid pavement, types of rigid pavement stresses, factors affecting the concrete stresses, determination process of stresses at different position of rigid pavement using Wasstard method. It describes in detail the design method of rigid pavement by AASHTO method and problem on above.		
Highway construction: This chapter discusses on construction procedures of earth roads, gravel road, water bound macadam road, bituminous pavement, cement concrete pavement and soil stabilized roads. Different types of joints in cement concrete pavements, joint filler, sealer, reinforced and prestressed concrete are described in this section.		
Highway maintenance and Drainage: This chapter deals with pavements failure, methods of measurement of skid resistance, unevenness, ruts and cracks. Pavement surface condition evaluation by physical measurement methods and strengthening of the existing pavement is discussed in this part. This chapter also describes highway maintenance, importance of highway drainage, surface & sub-surface drainage, drainage of slope, erosion control, and road construction in waterlogged areas.		
Accident and Traffic Congestion Causes of accidents − Human factors − Vehicles − Road and its condition − Environmental Studies, types of accident, remedies of accident; hazardous road location identification, road safety strategies, different index of traffic congestion measurement, remedies of traffic congestion		
Transportation modeling Definition of transportation modeling, Advanced travel demand forecasting methods, Four step transport demand modeling − trip generation, trip distribution, modal split, trip assessment, Transportation Management System,		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Investigate the properties and quality of highway materials. 2) Design flexible and rigid pavement using different methods 3) Find out the optimum asphalt content for flexible pavement construction by Marshal Mix design 4) Supervise the construction and maintenance of flexible and rigid pavement 5) Develop a four-step transport demand model for transport planning purposes 6) Identify the driving causes of road accidents and to propose appropriate strategies for accident prevention 7) Explore suitable technique for transport system management for minimizing specific transport related problem.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	2					1					
CLO2			2	3									
CLO3					3								
CLO4				3	2			1			1		
CLO5			3					2					1
CLO6			3										
CLO7			3										

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Garber, N.J. (2014). Traffic and Highway Engineering, CL Engineering. ISBN: 978-1133605157 Khanna, S.K. & Justo, C.E.G., "Highway Engineering", Nem Chand & Bros, 2011. Hay, W.W (1965). An Introduction to Transportation Engineering. Kadiyali, L.R. and Lal, N.B. (2005). Principles And Practices of Highway Engineering: (Including Expressways And Airport Engineering). Khanna Publishers. ISBN: 978-8174091659.

1.1	**Course title**	Transportation Engineering Sessional - I
1.2	**Course no**	CEE462
1.3	**Credit value**	1.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	This course will provide the students with the practical experience of testing aggregate, asphalt, and soil in standard laboratory. The students will learn the basic property, behavior and ensure the quality of these materials by conducting various test.
1.6	**Course learning objective**	1) Acquaint students with the basic concept of highway materials (soil, aggregate, and asphalt) 2) To facilitate necessary knowledge about the common terminology and parameters used to characterize and classify the highway materials based on laboratory experiments to confirm their specifications 3) Helping the students to develop ability in designing the Marshal Mix design to find out optimum bitumen content 4) To develop skills for determining the roadway capacity of a selected segment.
1.7	**Course content**	
Aggregate test This chapter discusses in detail the procedures, standard methods of testing, significances, and applications of different aggregate parameters i.e. the specific gravity and water absorption, Aggregate-Crushing Value, Aggregate Impact Value,		

Ten Percent Fine Value, Elongation index, Flakiness of Coarse Aggregate, Los Angeles abrasion test and Angularity number of aggregates. This test plays an important role in the behavior of the pavement structure because its composition, shape, and size of the aggregate all have significant impact on the workability, durability, strength, weight, and shrinkage of the concrete.		
Asphalt test This chapter presents an overview of the procedures, standard methods of testing, significances, and applications of different asphalt parameters. To ensure the quality of asphalt several tests are conducted which are Specific Gravity, Standard penetration, Ductility Value of Bitumen, Solubility of Bitumen, Loss on Heating, Softening Point, Flash & Fire Point, Marshall Test, Viscosity of asphalt. The primary use (70%) of asphalt is in road construction, where it is used as the glue or binder mixed with aggregate particles to create asphalt concrete. Asphalt has low initial costs, lasts longer, and due to its recyclability, has residual value greater than other pavements.		
Marshal Mix Design This chapter presents a concise description of Marshal Mix design to find out the optimum bitumen content and also identifies the key factors that affect the stability, flow, and specific gravity of asphalt concrete.		
Californian Bearing Ratio (CBR) A brief description of the procedure for determining the Californian Bearing Ratio (CBR) of soil is discussed in this chapter. The Californian Bearing Ratio (CBR) test is a penetration test used to evaluate the subgrade strength of roads and pavements. The results of this test are used with the curves to determine the thickness of pavement and its component layers.		
Roadway capacity analysis This chapter mainly focuses on analyzing roadway capacity using HCM procedures for basic freeway section and relate to "ideal" capacities. It also describes the factors affecting the highway capacity (Lane width, Width of shoulder, Lateral clearance, Commercial vehicles, Road alignment and geometry etc.) and relations between capacity and level-of-service.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Interpret the physical and engineering properties of highway materials 2) Explain the procedure of various laboratory experiments on highway materials to characterize and classify the quality and confirm their specifications 3) Identify the key factors that affect the stability, flow, and specific gravity of asphalt concrete by using the Marshal method to find out optimum bitumen content 4) Calculate and analyze the capacity of a selected road segment for improving existing transportation facilities 5) Apply knowledge of mathematics, science, new technologies, tools, and information systems in analyzing transportation systems and infrastructure design.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2			2	3									
CLO3					3	1							1
CLO4			3			2							
CLO5		2						3					

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Laboratory Testing manual 2000 - The United Republic of TanZania Ministry of work S. K. Khanna, "Highway Material Testing: Laboratory Manual", publisher Nem Chand, 1971 Transportation Sessional Manual- Dept. of CEE, SUST.

Fourth Year: Semester II

1.1	**Course title**	Thesis/Project
1.2	**Course no**	CEE430
1.3	**Credit value**	3.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rationale**	Thesis in undergraduate level will enable a student to learn how to conduct a research by problem identification, objective determination and methodology development, conduct experiments and analysis and finally interpret the result.
1.6	**Course objectives**	1) To introduce science and engineering principles for analysis and solution of problems in the field of civil and environmental engineering. 2) Formulate the thesis research project. Identify the critical research questions, and define the scope and objectives of the project. Design experiments, analysis, or observation plan 3) Acquint information technology resources to find background information and data pertinent to the thesis topic 4) To develop writing skills and presentation skills needed to effectively communicate the purpose, scope and conclusions of the project.
1.7	**Course content**	
Thesis is an individual inquiry conducted by the students under the general guidance of an academic advisor. This inquiry can take one of the following forms in any branches of civil engineering (structure, geotechnical, water, environment and transportation): (a) An original theoretical and/or experimental investigation (b) Design of an engineering product or development of computer program (c) Compilation and critical analysis of information on a specific engineering topic; or		

(d) Investigation of a substantive engineering problem for an external sponsor
The thesis work will be carried out throughout the whole period of the final year.

4th year 2nd semester:

- Conduction of laboratory experiments/ software based analysis
- Data analysis from the outcomes of the experiment/software
- Formulation of research findings and thesis paper writing
- Preparation for final thesis defense

1.8 Assessment strategy

Semester	Criteria	Marks (%)
4th year 2nd semester	Thesis- Final	40
	Thesis Defense	20

1.9 Course learning outcomes

By the end of this course, students will be able to

1) Identify a research hypothesis or research question, develop methodology to conduct the study, design an experiment process or system and after completion of all experiment and analysis, write the thesis
2) Prepare research proposals for submission and presentation for various purposes
3) Collect relevant data (primary or secondary) and by analyzing the collected data reach to an acceptable solution
4) Understand of the research work conducted and applied it as the theoretical framework to the research process
5) Complete and submit a supervised and defended research project as a thesis to the department.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			3		2				2		1	2	1
CLO2									1			3	
CLO3			2				1		2				
CLO4		2										2	1
CLO5											2	1	

Correlation: 3-High, 2-Medium, 1-Low

Reference books

Manktelow, J. (1999). Mind Tools:Powerful Techniques for Improving Your Creativity and Thinking Skills. Kogan Page Ltd. ISBN: 978-0749425371

Thiel, D.V. (2014). Research Methods for Engineers, Cambridge University Press, ISBN-13: 978-1107610194.

1.1	**Course title**	Bridge Design Sessional
1.2	**Course no**	CEE444
1.3	**Credit value**	1.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rationale**	The aim of this course is to equip the students with a thorough understanding of the behavior and design of bridges. The knowledge is essential to realize and understand how different types of loads act on bridges and to analyze and design the elements accordingly.

1.6	**Course learning objective**	1) To facilitate knowledge about different types of bridges and their distinctive features, different components of bridges 2) To provide students understanding how different types of loads, such as truck load, impact, horizontal braking/ centrifugal forces, wind and seismic loads, act on bridges 3) To enable students to analyses and design the main components of a chosen bridge 4) To provide students with fundamental knowledge in a wide range of state-of-the-art practices, including code specifications, in bridge engineering.

1.7 Course content

Introduction to bridges:

This chapter discusses on Historical evolution of bridges, Importance of Bridges, Different types of bridges with their distinctive features, Choice of appropriate bridge type, Components of bridges etc.

Bridge Loadings:

This chapter describe the loading standards (AASHTO, Bridge Design Standards for Roads & Highways Department of Bangladesh), Types and Application of loadings, Distribution of loads on slabs, stringers, Materials properties etc.

Analysis and design of bridge superstructure:

This chapter deals with Analysis and design of Concrete Slab bridge, Concrete Deck- Girder bridge and Concrete Balanced Cantilever bridge.

Introduction to bridge sub-structure:

This chapter introduces with Piers, Abutments, Foundations of bridges, their General features, Materials, Types, Forces, Stability, Design, etc.

1.8 Course learning outcomes

By the end of this course, students will be able to

1) Identify bridge components, different bridge types and appropriate uses for each
2) Determine the appropriate structural system to be used for bridges according to the site topography
3) Perceive, analyze and design reinforced concrete bridge superstructures and foundations
4) Apply knowledge of mathematics, science, and engineering to the analysis and design of bridges.
5) Understand new technologies, tools and information systems in bridge engineering.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			1										1
CLO2		1	2										
CLO3		2	1	3	3			2					1
CLO4		3		2	1								
CLO5								3			1		

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	George Winter, Leonard Church, Charles Edward O'Rourke, Arthur H. Nilson (1964), Design of Concrete Structures (7th Edition). *McGraw Hill* Housing and Building Research Institute, Bangladesh (2006), Bangladesh National Building Code (BNBC- 2006) N. Krishna Raju (2009), Design of bridges (4th Edition). *Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.*ISBN- 978-81-204-1741-0 Richard Barker & Jay Puckett (2013), Design of Highway Bridges (3rd Edition). *John Wiley & Sons, Inc., Hoboken, New Jersey*. ISBN 978-0-470-90066-6 Raina, V.K. (2007), Bridge Practice -Analysis, Design and Economics (3rd Edition). Tata *McGraw Hill, New Delhi.* ISBN- 0-07-462362-1 AASHTO LRFD Bridge Design Specifications (1998), SI Units (2nd Edition). *AASHTO −Washington DC* Bridge Design Standards for Roads & Highways Department of Bangladesh (2004). *Ministry of Communications, Bangladesh*

1.1	**Course title**	Geotechnical Engineering Sessional - II
1.2	**Course no**	CEE452
1.3	**Credit value**	1.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rationale**	This course will provide the students hands on experience of unconsolidated undrained (UU), consolidated undrained (CU), consolidated drained (CD) shear tests, dilatancy test, SPT, CPT and field van shear test. They also learn to prepare the Sub-soil investigation report. In addition, they will acquaint the procedure of the Pile load test and Pile integrity test.
1.6	**Course learning objective**	1) To acquaint triaxial shear test (UU, CU, and CD shear test) and their suitable selection for a certain soil type 2) To provide knowledge on how to explain and use Standard penetration test (SPT), Cone penetration test (CPT), and Field vane shear test data for selecting foundation type, depth and capacity 3) To prepare sub-soil profile, interpret soil report, and design of foundation based on the report 4) To provide the knowledge about pile load and pile integrity tests.
1.7	**Course content**	
UU, CU and CD shear strength test: This chapter presents the whole process of UU, CU and CD shear strength test in Tri-axial machine.		
Dilatancy test: This chapter presents dilatancy test of soil (granular) for soil investigation.		
Cone penetration test (CPT): This chapter presents CPT test for soil investigation.		
Standard penetration test (SPT): This chapter presents SPT test for soil investigation.		
Field van shear test: This chapter presents SPT test for soil investigation.		
Preparation of soil report: This chapter presents preparation of soil at a professional standard.		
Interpretation of soil test result: This chapter presents Interpretation of soil test result for better understanding of soil criteria.		
Establishment of sub-soil profile: This chapter presents establishment of sub-soil profile from bore log.		
Design of foundation: This chapter presents design of both shallow and deep foundation for building structure from subsoil investigation report.		
Pile load test: This chapter presents pile load test for building structure.		
Pile integrity test: This chapter presents pile integrity test for building structure.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Determine the geotechnical (engineering) properties of soil in the laboratory using UU, CU and CD shear tests, and dilatancy test 2) Perform the SPT, CPT and field van shear test 3) Prepare the sub-soil investigation report at a professional standard 4) Design the foundation of the building based on the soil investigation report 5) Interpret the procedure of the pile load test and pile integrity test.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		2			3			3					2
CLO2		2			3			3					2
CLO3		2	1										2
CLO4		1		3									2
CLO5		1			2			3					2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Arora, K.R. (1987), Soil mechanics and foundation engineering. *Standard publishers distributors.* ISBN: 81-8014-028-8 Coduto, D.P. (2003), Geotechnical engineering-principles and practices. *Prentice hall of India private limited.* ISBN: 81-203-2137-5 Som, N.N., and Das, S.C. (2009), Theory and practice of foundation design. *PHI learning private limited*. ISBN: 978-81-203-2190-8 Teng, W.C. (1979), Foundation design. *Prentice hall of India private limited.* ISBN:0-87692-033-4 Holtz, R., Kovacs, W., and Sheahan, T. (2011), An Introduction to

	Geotechnical Engineering. *Pearson Prentice Hall.* ISBN 10: 0132496348 Budhu, M. (2011), Soil Mechanics and Foundations. *Wiley*. ISBN 10: 0470556846

1.1	**Course title**	Geoenvironmental Engineering
1.2	**Course no**	CEE455
1.3	**Credit value**	2.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rationale**	This course will familiarize the students with the knowledge of basics of geoenvironmetal engineering. It gives them the knowledge of formulating contaminant transport models for different geoenvironmetal profile. This knowledge is essential to design and implement various contaminated land management techniques.
1.6	**Course objectives**	1) To understand the basic concept of geoenvironmetal engineering 2) Helping the students to develop the ability of understanding different contaminants transport methods and their modeling techniques 3) To enhance the skill of designing and implementing various contaminated land management techniques.
1.7	**Course content**	
Introduction to Geoenvironmental Engineering: This chapter presents a brief discussion on significance and scope of geoenvironmetal engineering.		
Soil Structure: This chapter focuses on the structure of soil media, their properties, texture etc.		
Soil-Water: This chapter presents water interaction with soil media. Permeability, Darcy's theory etc. are discussed here with some practical example.		
Contaminants and Their Transport Method: This chapter consists of brief discussion on different contaminants and their transport methods such as advection, diffusion; hydrodynamic dispersion etc. It also covers determination of tortuosity of different natural and artificial flow medium.		
Tools and Techniques in Geoenvironmental Engineering: This chapter focuses on the monitoring and determination tools and techniques involved in Geoenvironmental Engineering like as tensiometer, lysimeter etc. tools for soil leaching study and corresponding breakthrough curve preparation are also reviewed in this section.		
Contaminants Transport Models: This chapter presents a basic introduction on different geoenvironmetal contaminant transport models. Some mathematical problems are practiced which are based on convective-diffusive transport modeling.		
Contaminated Land Management Techniques: This chapter presents different techniques for the management of contaminated land. Different physic-chemical and biological approach such as bioventing, bio injecting, biosparging, phytoremediation etc. are reviewed in this part.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Find out the sources and causes of potential geoenvironmetal contamination 2) Conduct leaching experiment for studying the contaminants transport phenomena 3) Develop contaminant migration models for different geoenvironmetal profiles 4) Design and implement different management techniques for recovery of contaminated lands.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		2	2			2							
CLO2			2	3	3								1
CLO3			2	2	3								
CLO4		1	2	2	3			2					2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Oswal, M.C. (1994). Soil Physics. *Oxford & IBH Publishing Company, Pvt. Limited,* ISBN (13)-978-8120408760 Kiely, G. (1997). Environmental Engineering. *McGraw-Hill Company*. ISBN (13): 978-0071164245

1.1	**Course title**	Transportation Engineering - III
1.2	**Course no**	CEE463
1.3	**Credit value**	3.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rationale**	This course will provide comprehensive coverage of the main features of the airport and railway engineering with an understanding of the principles and practices relating to the design and operations. This knowledge is essential to combine theoretical analysis with practical applications to allow students to understand the distinctive features of engineering in the airport and railway context.
1.6	**Course learning objective**	1) To introduce a basic understanding of airport systems planning and operation 2) Familiarize with designing flexible pavement and rigid pavement and design of runways and taxiways 3) Understand the various aspects of the planning and design of rail transportation systems 4) To introduce different components and alignment of railways, geometric design of railway, signaling maintenance, capacity analysis of locomotives.
1.7	**Course content**	

Airport

Airport classification, Planning of airfield components − Runway, Taxiway, Apron, Hanger, Passenger Terminals, Configuration of runway, Design of taxiway, Design of flexible pavement by FAA method and CBR method, Design of rigid pavement by FAA method, Airport marking, signaling, Airport drainage, Airport planning.

Railway

Different components and alignment of railways, Geometric design of railway, Signaling, Maintenance, Stations and yard, Capacity analysis of locomotives.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Design airport runways and taxiways (flexible pavement and rigid pavement) by FAA method 2) Design flexible pavement for Airport by CBR method 3) Understand the elements of railway i.e. rails, sleeper, ballast, station, fastening 4) Design geometric alignment 5) Calculate locomotive capacity for different conditions.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1				3									2
CLO2				3									2
CLO3		3	1			1							
CLO4				3		1							2
CLO5			3										

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Gupta, B. L. and Gupta, A. "Roads, Railways, Bridges, Tunnels and Harbour Dock Engineering", Standard Publishers Distributors, Delhi, 5thedi, 2011 Kadiyali, L. R. "Traffic Engineering and Transport Planning", Khana Publishers, 2003 Norman. J. Ashford, Sakleh. A Mumayiz and Paul. H. Wright, "Airport Engineering Planning Design and Development of 21st Century Airports, John Wiley and sons, New Jersey, 2011. Papacostas, C. S. and Prevedourous, C " Transportation Engineering and Planning", 3rd edition, Prentice Hall of India, 2001 Rangwals, W. "Railway Engineering", Charotamy Publishing House, 2003. Richard De Neufille and Amedeo Odoni, "Airport Systems Planning and Design", McGraw Hill, New York, 2003 Singh, G. and Singh J. " Highway Engineering", Standard Publishers Distributors, 2001 Vukan R.Vuchie, Urban Transit Systems and Technology, John Wiley and Sons, 2007.

1.1	**Course title**	Transportation Engineering Sessional - II
1.2	**Course no**	CEE464
1.3	**Credit value**	1.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rationale**	This course makes the student competent to apply the knowledge acquired from the relevant theoretical course for solving real-world cases such as roadway performance analysis, geometrical and structural design of roadway and airfield.
1.6	**Course learning objective**	1) To develop the skill for designing Flexible and Rigid pavement by AASHTO method 2) To create the ability for designing airfield pavement by the FAA (Federal Aviation Administrator) method 3) To develop the skill for traffic data analysis for roadway performance analysis, problem identification and finding the potential solution 4) To learn the designing of horizontal and vertical alignment of a roadway section.
1.7	**Course content**	

1.Pavement Design

- Rigid pavement for highways- pavement thickness, joint spacing & reinforcement details by AASHTO method
- Flexible Pavement Design- by AASHTO, IRC and RHD method.

2. Airfield pavements

- Basic design principles
- Rigid Pavement Design by **FAA method**: based on the Westergaard analysis of edge loaded slabs.

3. Geometric design

Cross Section Elements, Horizontal and Vertical alignment

Road condition survey- Geometric layout of roadway (road length, width, number of lanes, median height, width, shoulder height, width, etc.)

− Geometric layout intersections (geometric measurement and position of channels/islands, corner radius, dimension and location of pedestrian refuge).

Surface condition

− by skid resistance tester or sand-patch method in several locations (near high speed location, zebra crossing, intersection)

− by qualitative observation of potholes, elevated/depressed manholes, speed breakers etc.

4. Roadway intersection design

At grade and Grade separated junctions−Three legged intersection − Diamond interchange.

5. Roadway capacity calculation

Define capacity and relate to "ideal" capacities, calculating capacity using HCM procedures for basic freeway section, Focus on relations between capacity and level-of-service.

6. Traffic studies and design

Traffic volume study and Traffic speed study (Spot Speed, Time mean speed, Space mean speed)

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Design Flexible and Rigid pavement for roadway and airfield

		2) Analyze traffic data such as roadway capacity analysis, traffic volume calculation, speed data analysis, etc. 3) Design horizontal and vertical alignment of a roadway section.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3						2					
CLO2			3		2								
CLO3		3											

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	James H Banks, 'Introduction to transportation engineering', Tata Mc-Graw Hill, 2004. Kadiyyali L.R., 'Highway Engineering', Khanna Publishers. Khanna S.K and Justo, C.E.O, 'Highway Engineering', Nem Chand and Bros. L R Kadiyali., 'Traffic Engineering and Transport Planning' Khanna Publishers Papacoastas and Prevendours, Transportation Engineering and Planning, Phi, New Delhi.

1.1	**Course title**	Irrigation and River Engineering
1.2	**Course no**	CEE471
1.3	**Credit value**	3.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rationale**	The aim of this course is to understand basic concepts of irrigation and water requirements for plants growth. To know the different methods of irrigation and irrigation structures including design of irrigation structures and hydraulic structures for flood protection.
1.6	**Course objectives**	1) Introducing the basic concepts on irrigation along with its importance, purpose and types 2) Gives idea about water requirements of crop, design of Irrigation canal and irrigation structures 3) Give an idea about river characteristics along with river classification and sediment discharge mechanism of a river 4) Give brief idea on river dredging, river pollution, control of river, flood control and its management.
1.7	**Course content**	

Fundamentals of irrigation engineering:

This chapter represents idea about basic concepts on irrigation importance and demerits of irrigation and its types, Describe the irrigation channel network system, irrigation channel design, design of branch channel, irrigation structure and the water requirements of a crop.

River Engineering:

Ideas about river types, characteristics, uses of river, river morphology, river sediment transportation capacity, control of a river, control of flood and its management.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Design of an irrigation canal 2) Calculate the water requirements of a crop and consumptive use 3) Estimate the sediment transport capacity of a river 4) Analyze and design river training works 5) Select Flood control methods and flood control management.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3											
CLO2			3									2	
CLO3				3				2				2	
CLO4													2
CLO5				3									2

Correlation: 3-High, 2-Medium, 1-Low

Reference Books:	Irrigation Engineering By: N. N. Basak River Mechanics By: Pierre Y. Juliyen River Engineering By: Margaret S. Peterse

1.1	**Course title**	Design of Hydraulic Structures
1.2	**Course no**	CEE472
1.3	**Credit value**	1.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rational**	In order to have a balanced overall development of engineering graduates, it is necessary to integrate theory with practice. This course will let the students to do a hand on design example for a hydraulic structure so that they will know the basic assumption and consideration for designing a hydraulic structure.
1.6	**Course objectives**	1) To introduce application of knowledge of the theory course "Hydraulics and Hydraulic Structures" in detail practical design of a hydraulic structure 2) Acquint detail design procedure of a sample hydraulic structure: a three vent regulator, which includes hydraulic design and structural design, considering the hydrologic design condition 3) To train to make assumption and to justify the assumed values for designing of a hydraulic structure.
1.7	**Course content**	

Design of a three vent regulator (Hydraulic calculation)

Finding of glacis height, determination of transition length, Determination of distance of baffle pier and end sill from the foot of the glacis.

Design of a three vent regulator (Hydraulic calculation) Design of cutoff wall depth, Design of total floor length, selection of crest width.		
Design of a three vent regulator (Hydraulic calculation) Design of safe exit gradient, Design of chute block, Design of baffle pier, design of end sill.		
Design of a three vent regulator (Hydraulic calculation) Design of inverted filter and launching apron, Check of floor thickness.		
Design of a three vent regulator (Structural calculation) Load calculation, Check of factor of safety, Design of distributed load on top slab, Moment distribution, Design of top slab, Design of bottom slab.		
Design of a three vent regulator (Structural calculation) Design of abutment, Foundation design for box part, Check for settlement.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Calculate glacis height, transition length, distance of baffle pier and end sill from the foot of the glacis, design of cutoff wall depth, design of total floor length, selection of crest width 2) Design of safe exit gradient, design of chute block, design of baffle pier, design of end sill, design of inverted filter and launching apron, check of floor thickness 3) Calculate structural load, check factor of safety, moment distribution, design of top slab, design of bottom slab, design of abutment, foundation design for box part, check for settlement.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	1	2				3					1
CLO2		2	2	3									1
CLO3		1	1	3				3					1

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Garg, S. K.; "Irrigation Engineering and Hydraulic Structures", *Khanna Publishers*, 2009. Subramanya K.; "Engineering Hydrology", *The* McGraw'-Hill, 2009.

1.1	**Course title**	Environmental Impact Assessment
1.2	**Course no**	CEE481
1.3	**Credit value**	2.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rationale**	This course presents the methodology of environmental impact assessment (EIA) as an important tool for sustainable environmental management and decision-making. The course covers a gist of the concepts, methods, issues, and various forms and stages of the EIA process. It analyzes the advancement of EIA abroad and in Bangladesh. It mainly focuses on case studies of EIA in Bangladesh but also keens on the EIA process of other countries, including developing countries. Distinctive levels and frameworks of EIA are inspected to highlight the differences of approach and affect of the EIA process.
1.6	**Course learning objective**	1) To facilitate necessary knowledge about the Environmental Impact Assessment comprehensively in relation to civil and environmental engineering demand 2) Helping the students to develop the ability in executing the EIA process for practical cases 3) Acquaint students with the Impact assessment tools, techniques, and computational methods necessary for environmental impact evaluation and interpretation.
1.7	**Course content**	
EIA - important terms in environmental impact assessment; Aims and objectives of EIA; Role of EIA in Environmental Management (EM); EIA Methodology: Different methods of EIA, initial environmental examination, Baselines studies; Rapid environmental impact assessment methods: checklist, matrix methods; Scooping and people's participation in EIA; EIA of development schemes; Economical evaluation of EIA; Cost and Cost/benefit analysis of EIA.		
EIA (State of art) in water resources and industrial projects; Application of EIA in energy and agricultural development; EIA for embankment flood protection measures; EIA of irrigation activities: EIA of the infrastructure development project; Environmental impact of flood in rainy season; EIA of draughts in dry season (specially Farakkah and other upstream barrages); EIA in solid waste management; EIA of gas field and tea garden; EIA in JMB project; EIA of transport system; EIA procedure in the private sector, EIA procedure in govt. sector; Different EIA index calculation.		
Introduction to Environmental Auditing.; Environmental management and ISO 14000.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Explain and understand the major principles, guidelines, rules, and different steps of environmental impact assessment 2) Communicate and analyze both orally and in written form the key aspects of environmental impact assessment 3) Analyze different case studies/examples of EIA in practice and apply the knowledge in practical cases 4) Undertake and analyze an environmental impact assessment case with necessary professional skills and provide an environmental management plan to some extent.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1			2	2		1	3		2				
CLO2							3						
CLO3			3			2			3				
CLO4				3		2	3		3				2

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Canter, L. (1996). Environmental Impact Assessment. 2nd Ed., *MacGraw-Hill. Inc., New York*. ISBN-13: 978-0-07-009767-4 Ahmad, Y., & Sammy, G. (1985). Public Involvement: Guidelines to EIA in Developing Countries. Canter, L. W (1986), EIA in water resources project. *Lewis Publishers*. ISBN-13: 978-0-87371-015-2

1.1	**Course title**	Environmental Design Sessional
1.2	**Course no**	CEE482
1.3	**Credit value**	1.0
1.4	**Semester**	4th year 2nd semester
1.5	**Rationale**	This course will demonstrate the design procedure of different environmental systems (such as water distribution and drainage) and environmental components (such as deep tube well, water, or wastewater treatment units) using the knowledge of environmental engineering. This knowledge will be helpful for students to design and analyze those environmental systems and components by using different open-source software.
1.6	**Course learning objective**	1) To provide the necessary knowledge of EPANET in designing and analyzing a water distribution system 2) Acquaint students with the basics of SWMM to design a simple drainage system 3) To develop the skill of designing different environmental components such as deep tube well, water and wastewater treatment units, etc.
1.7	**Course content**	
Design of transport and distribution system of water supply and or drainage; Environmental design of septic tank, water reservoirs, deep tube well, design of water and wastewater treatment units, Use of software for design.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Design and analyze a water distribution system using EPANET 2) Apply techniques of SWMM to design and analyze a simple drainage system 3) Design different environmental components such as deep tube well, water and wastewater treatment units, etc.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1			2	3	2			3					
CLO2			2	3	2			3					
CLO3		2		3				2			2		

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Rossman, L. A. (2010), Storm water management model user's manual, version 5.0 (p. 276), Cincinnati, OH: National Risk Management Research Laboratory, Office of Research and Development, US Environmental Protection Agency. Rossman, L. A. (2000), EPANET 2: user manual. Metcalf and Eddy. (1972), Wastewater engineering: collection, treatment, disposal. McGraw-Hill. ISBN-13: 978-0-07-041675-8. Ahmed, M. F., and Rahman, M. M. (2000), Water supply and sanitation: Rural and low income urban communities. ITN-Bangladesh, Centre for Water Supply and Waste Management, BUET. McGhee, T.J. and Steel, E.W. (1991), Water supply and sewerage. New York: McGraw-Hill.

Profile for non-major courses offered by CEE department

1.1	**Course title**	Structure I - Basic Mechanics
1.2	**Course no**	CEE201A
1.3	**Credit value**	2.0
1.4	**Semester**	2nd year 1st semester
1.5	**Rationale**	This course facilities for gathering the basic knowledge about the effects of force on solid mass and to develop student's ability to visualize the distribution of forces on a solid body. This course will also offer knowledge of centroids, friction, moment of inertia and flexible chords. This knowledge is a prerequisite for many engineering courses offered in the subsequent semesters that capture the detailed analysis and design of engineering structures or structural components.
1.6	**Course objectives**	1) To introduce rigid body mechanics. Equivalent force systems: concepts of moment, couple, resultant. Equilibrium: free-body diagram; equations of equilibrium. Structural analysis: trusses by method of sections and method of integration 2) To develop skills to determine the location of the center of gravity and centroid for a system of discrete particles and a body of arbitrary shape 3) To develop the ability for determining the moment of inertia for areas of different geometric configurations, and 4) To familiarize with the basic theory of Flexible cords and Flexible chords.
1.7	**Course content**	
Statics of particles This chapter is devoted to the study of forces contained in a single plane. The analysis of forces in three-dimensional space is also analyzed here		
Rigid bodies: Equivalent systems of forces In this chapter, the effect of forces exerted on a rigid body, and how to replace a given system of forces with a simpler equivalent system is shown		

Centroids
Definitions, Center of gravity, Mass center and Centroid, Centroids of Areas, Principle of Symmetry, Integrating for Centroids (Arc of a Circle, Plane Triangle, Sector of Circle, Area without an axis of symmetry, Right circular cone), and Composite figures are discussed and determined in this chapter

Moment of inertia of areas
Introduction, Rectangular moment of inertia, Polar moment of inertia, Radius of gyration, Determination of moment of inertia (Rectangle, Triangle, Circle), Transfer formula-parallel axes, Choice of the differential element, Composite areas, and Product of inertia are discussed and determined in this chapter

Structural analysis
The forces in the members of a simple truss using the method of joints and the method of sections are determined in this chapter

Fundamentals of friction
This chapter presents frictional force, limiting frictional force, coefficient of kinetic friction, laws of friction, angle of friction, and belt friction

Fundamentals of flexible cords
This chapter shows how to solve and analyze the parabolic chord and the catenary

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Draw complete free-body diagrams and write appropriate equilibrium equations from the free-body diagram, including the support reactions on a structure 2) Analyze various statically determinate systems such as beams, and trusses 3) Locate the centroid of an area, center of mass, center of volume effectively 4) Calculate the moment of inertia of areas for different geometric configurations 5) Determine the coefficient of friction and the resultant tension of flexible chords and 6) Relate and apply fundamental sciences for learning the essential engineering concepts and theories of different branches.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO / PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	2							2	
CLO2	2					2		2	
CLO3	2					2		2	
CLO4	2					2		2	
CLO5	2							2	

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Andy Ruina and Rudra Pratap, Introduction to Statics and Dynamics, *Oxford University Press*, 2011 F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, *Tata McGraw Hill*, 2011. H. Shames, Engineering Mechanics: Statics and dynamics, 4th Ed, PHI, 2002. J. L. Meriam and L. G. Kraige , Engineering Mechanics, Vol I – Statics, Vol II –Dynamics, 6th Ed, *John Wiley*, 2008. R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, *Pearson Press*, 2006. R.S. Khurmi, Engineering Mechanics, S.Chand and Co., 2001 V.M. Faires and S.D. Chambers, Analytic Mechanics, 3rd Ed, *The Macmillan Company*, 2001.

1.1	**Course title**	Structure II - Mechanics of Solids
1.2	**Course no**	CEE203A
1.3	**Credit value**	3.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	This course will develop basic knowledge and use the relevant physical properties and fundamental laws governing materials and structures' behavior. Students will learn how to solve various problems of interest in Structural Analysis. In this course, the emphasis is on the physical understanding of mechanisms underlying materials' mechanical and structural behavior.
1.6	**Course learning objective**	1) To understand the concept of stress and strain in the members subjected to tension and compression force 2) Help students conceptualize solid mechanics' fundamental theories to calculate forces, deflections, moments, stresses, and strains in engineering structures 3) To introduce the shear force and bending moment diagrams to properly analyze statically determinate beams and frames 4) To make them able to analyze indeterminate beam and buckling of columns.
1.8	**Course content**	

Fundamental concepts of stress and strain
This chapter presents a review of the fundamental concepts of stress and strain. A brief discussion on axial stress, axial strain, shearing stress, shearing strain, and bearing stress, bearing strain. Stress calculation of thin-walled pressure vessels.

Mechanical properties of materials
This chapter deals with analyzing mechanical properties of materials, stress-strain diagram, Hook's law for axial and shearing deformation, and Poisson's ratio.

Calculate the stress and strain of different members
Calculate stresses and strains in members subjected to tension, compression, shear, and temperature changes. Calculate stresses and strains of statically indeterminate members.

Joints- welded and riveted
Introduction, Types of riveted and welded joints, Strength of a simple Lap Joint: Bearing type connection, Strength of a complex Butt joint: Bearing type connection, Friction type connection, welded connection.

Shear force and bending moment diagrams for statically determinate beams and frames
Definition, determination of Shear force and bending moment for determinate

beams and frames, Relation among load, shear and moment, Shear force, and bending moment diagram.
Flexural and shearing stresses in beams; Principal stresses Introduction, Derivation of flexure formula, Economic section, Shearing stress at a loaded beam, Distribution of shearing stress, principal stress and strain.
Slopes and deflections in statically determinate beams Introduction, Double integration method, Theorem of area moment method, conjugate beam method.
Indeterminate beam analyses Introduction to statically indeterminate structure, Analysis of statically indeterminate beam using moment area and conjugate beam method.
Buckling of columns Introduction, Types of end conditions of the column, Euler's formula to columns with different end conditions, Rankine's formula for long columns, and effect of eccentric loading on the Rankine's and Euler's formula for long columns are also discussed here.

1.9	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Apply the theory of solid mechanics to analyze a wide variety of structural members subjected to tension, compression, shear, and temperature changes to solve real world problems 2) Apply the concepts and methodologies of materials' mechanical properties to solve practical problems related to civil engineering structures 3) Design of a riveted joint, as well as welded joints 4) Present graphical variation of shear force and bending moment diagrams along the member's axis could be shown.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9
CLO1		2				1	2		2	
CLO2		2				1	2		2	
CLO3		2				1	2		2	
CLO4		2				1	2		2	

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Pytel, A. and Singer, F.L. (1987), Strength of materials. Harper and Row, publishers, Inc. ISBN 0-0604531343 Popov, E.P. and Balan, T.A. (1998), Engineering mechanics of solids. Pearson Education, Inc. ISBN 81-7808-535-6 Khurmi, R.S. (1968), Strength of materials. S. Chad and Company Ltd. ISBN 81-219-2822-2 Beer, F.P., Johnston, E.R., Dewolf, J.T. and Mazurek, D.F. (2012) Mechanics of materials. McGraw-Hill Companies, Inc. ISBN 978-0-07-338028-5 Hibbler, R.C. (2012) Structural Analysis. Pearson Prentice Hall.
	ISBN-13: 978-0-13-257053-4

1.1	**Course title**	Structure III-Building Structures
1.2	**Course no**	CEE301A
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	This course familiarizes students to the vertical load calculation for the components of a frame building. It also introduces students with deferent types of structures such as truss, arch, dome, shell, folded plate and shear wall. This course also deals with the fundamental design process of RCC and steel structures.
1.6	**Course objectives**	1) To introduce the vertical load calculation for the components of a building 2) Acquint approximate analysis of multistoried buildings for vertical and lateral loads 3) To introduce students with deferent types of structures such as truss, arch, dome, shell, folded plate and shear wall 4) To make familiar with the knowledge of analysis and design of RCC and steel structures.
1.7	**Course content**	

Vertical load calculation for the components of a building Calculation of the load of wall, slab, beam, column, live load.
Approximate analysis of multistoried buildings for vertical and lateral loads Portal method and cantilever method.
Introducing deferent types of structures Truss, arch, dome, shell, folded plate, shear wall etc.
Fundamental design process of RCC structures Design of beam and slab in WSD and USD considering flexure, shear, torsion and deflection.
Fundamentals and design process of steel structures Design of tension member, beam and column in ASD and LRFD.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Analyze horizontal and vertical loads on building 2) Identify the load of different components of building 3) Perceive, design and analyze RCC beam and slab 4) Apply critical understanding of the theory and principles of design and solution of basic elements of steel structures.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1		2					2		2	
CLO2		2					2		2	
CLO3		2					2		2	

CLO4	2					2		2	

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Khurmi, R. S. (2013), Strength of Material. S. Chand ltd. ISBN-13: 978-81-219-0533-6 Pytel A., and Singer F. L. (1987), Strength of Materials. 4th Ed., Harpercollins College Div. ISBN-13: 978-0-06-045313-8 Arthur H. Nilson, David Darwin, Charles W. Dolan (2010), Design of Concrete Structures.14th Ed., McGraw Hill. ISBN−007-123260-5 George Winter, Leonard Church, Charles Edward O'Rourke, Arthur H. Nilson (1964), Design of Concrete Structures. 7th Ed., McGraw Hill. ISBN−007-123260-5 M. Nadim Hassoun, Akthem Al- Manaseer (2008), Structural Concrete. 4th Ed., John Wiley and Sons, Inc. ISBN− 978-0-470-17094-6. Housing and Building Research Institute, Bangladesh (2006), Bangladesh National Building Code (BNBC- 2006) American Concrete Institute, ACI Codes, 2003

1.1	**Course title**	Construction Workshop and Material Sessional
1.2	**Course no.**	CEE302A
1.3	**Credit value**	3.0
1.4	**Semester**	3rd Year 2nd Semester
1.5	**Rational**	Students will determine different properties of engineering materials indicating the quality and strength of the materials.
1.6	**Course objectives**	1) To introduce the strength and properties of cement 2) To analyze and classify the properties of fine and coarse aggregate 3) To facilitate necessary knowledge about properties of bricks and timber 4) To acquaint students with the properties of concrete.
1.7	**Course content**	

Determination of normal consistency of cement:
This experiment determines the amount of water needed for preparation cement mortar.

Determination of initial setting time of cement:
This experiment describes the beginning of setting time of cement paste i.e. the paste is rigid sufficiently to withstand a definite amount of pressure.

Determination of direct compressive strength of cement mortar:
The compressive strength of cement mortar at different ages can be determined by this experiment.

Sieve analysis of fine and coarse aggregate:
This experiment shows the index of coarseness or fineness of the material using sieve analysis.

Sampling and testing of bricks for compressive strength and absorption:
This test represents the load bearing capacity (compressive characteristics) of bricks and its water holding capacity.

Compressive strength of cylindrical concrete specimen and cubes :
The compressive strength of concrete (both cylindrical and cubes) at different ages can be determined by this experiment.

Specific gravity and absorption capacity of coarse and fine aggregate :
This test determines the water holding capacity (absorption) capacity of coarse and fine aggregates and their specific gravity.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Determine the normal consistency and setting time of cement 2) Experiment the compressive strength of cement mortar 3) Determine the specific gravity and absorption capacity of fine and coarse aggregate 4) Prepare the gradation curve and the index of coarseness or fineness of aggregate by using sieve analysis 5) Determine the compressive strength of concrete at different ages.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO / PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	2	1		1					
CLO2	2	1		1					
CLO3	2	1		1					
CLO4	2	1		1					
CLO5	2	1		1					

Correlation: 3-High, 2-Medium, 1-Low

Reference books	Aziz, M. A. (1995), A text book of Engineering materials. *Kazi Mahfuzur Rahman, 34/2, Zigatola*. Claisse. P. A. (2015), Civil Engineering Materials, *Butterworth-Heinemann,* ISBN-13: 978-0081002759 Gupta, R. K. (2009), Civil Engineering Materials & Construction Practices. *Jain Brothers.* ISBN-10: 8183601030 Latifee, E. R. (2007), An Introduction to Properties and Evaluation of Engineering Materials. *E. R. Latifee 5B, mallika, Dhaka.* ISBN: 984-300-000839-0 Van Amsterdam, E. V. (2000), Construction Materials for Civil Engineering. *Juta Academic.* ISBN: 0702152137.

1.1	**Course title**	Project Management
1.2	**Course no**	CEE401A
1.3	**Credit value**	2.0
1.4	**Semester**	4th year 1st semester
1.5	**Rationale**	This course will familiarize the students with the basic knowledge of developing skills of understanding basic project management principles and practices. This knowledge is essential to manage projects from initiation to commissioning achiving projects' basic objectives such

		as time, cost, quality, and safety.
1.6	**Course objective**	1) To introduce management tools and techniques for successful project completion 2) To acquint with project time, cost, quality, and safety management 3) To make them understand project risks and uncertainties and their management strategies 4) To introduce with the PMBOK and the project management manual
1.7	**Course content**	
Introduction Principles of project management and contruction management, triple constraints (time-cost-quality) to achieve project goals, basic concepts of contract management, project safety and risk management.		
Planning and Scheduling Work Breakdown Structure (WBS), Gantt Chart, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), comparision and applications of CPM and PERT in various projects.		
Project Delivery System and Contract Management Basi concepts of project procurement, Project Delivery Methods: Design-Bid-Buid (DBB), Design and Build, Construction Management Contract (CMC), Alliancing, Public Private Partneship (PPP), Engineering Procurement and Contract (EPC), Build, Operate and Transfer (BOT); Contrat types: Lump Sum, Unit Price, Cost Plus or Cost Reimbursable, guaranteed Maximum Price (GMP).		
ProjectSchedule and Cost Management Cash flow analysis, earn value management (EVM), S-curve, pay back period, cost-benefit ratio, internal rate of return (IRR).		
Project Quality Management Deming's 14 points to achieve project quality, ISO 9000, Cost of Quality (CoQ), seven quality control tools, Total Quality Management (TQM), Quality Management in PMBoK.		
Project Safety and Risk Management Safety management: Safety practices at construction site from BNBC, personal and site safety, Risk management: planning for risk management, risk register, risk evaluation, risk assessment, risk control, risk residual, planning for risk response, monitoring and control risks during project execution phases.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Develop a project's plan and schedule 2) Prepare cosh flow and fininancial report 3) Formulate quality assurance plan and risk response strategy 4) Analyze project performance and report project status to the top management

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1		1					2		1	
CLO2		1					1		1	
CLO3		1					1		1	
CLO4		1						2		1	

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Project Management Body of Knowledge (PMBOK)-PMI Kenzer, H. (2013), Project management: a systems approach to planning, scheduling, and controlling. John Wiley and Sons. ISBN-13:978-1-118-41855 Lewis, J.P. (2005), Project planning, scheduling, and control, 4th Ed., McGraw-Hill Pub. ISBN-13:978-0-07-146037-8 Gitlow, Howard S. "Quality Management" Third Edition, McGrawHill Hinze, J. W., Construction Planning & Scheduling, Essex, UK: Prentice, 3rd Ed., 2008. BNBC − construction safety code chapter

1.1	**Course title**	Mechanics of Solids
1.2	**Course no**	CEE201F
1.3	**Credit value**	3.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	This course will familiarize the students with the knowledge of basics of stress, strain and their application. It also gives them the knowledge of calculating the shear force and bending moment along with shear and bending stresses in determinate beams of different shapes.
1.6	**Course objectives**	1) To introduce the basics and applications of stress, strain, and material properties 2) Helping the students to develop the ability to determine stresses and stain in structures under axial loading 3) To develop the skill of the students for finding out the shear force and bending moment along with shear and bending stresses in determinate beams of different shapes 4) To facilitate necessary knowledge about riveted joints and welded connections 5) Helping the students to conceptualize basic theories of torsion, angle of twist 6) To provide the knowledge of stress transformation, principal plane and stress, maximum in-plane shear stress, Mohr's circle 7) To determine deflections of beams and cantilevers under the different types of loadings using double-integration method and moment area method 8) To analyze vertical members supporting axial compressive loads.
1.7	**Course content**	
Stress and Strain analysis of axially loaded members Introduction, Normal stress, Shearing stress, Bearing stress		
Strain analysis of axially loaded members Normal strain under axial loading, Stress-strain diagram, Hokes's law, Statically indeterminate problems.		
Stresses in thin-walled pressure vessel Stresses calculation in thin-walled cylinders and spheres.		

Riveted Joints Rivet, Types of riveted joints, Failure of the riveted joints.		
Torsion Torsional deformation of a circular shaft, The torsion formula, Angle of twist.		
Shear force and bending moment Shear force and bending moment for statically determinate beams.		
Bending stress and shear stress in beams Definition, Shear stress and bending stress for determinate beams.		
Deflection of beams Elastic deflections of a beam or cantilever using the method of double integration, the moment-area theorems.		
Stress Transformation Plain-stress transformation, Principal stress and maximum in-plane shear stress, Mohr's circle.		
Columns Euler's formula to columns with different end conditions, Intermediate column formula.		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Describe the basics of stress and strain and distinguish normal and shear stress, simple strain, and the corresponding material properties 2) Solve for stresses and strains in a structural component due to axial load 3) Determine the stresses in thin-walled cylinders and spheres 4) Identify different types of Riveted joint and design them 5) Determine the shear force and bending moment for determinate beams 6) Determine the shear stress and bending stress of determinate beams 7) Determine torsional stress in a circular shaft, design a circular shaft subjected to torsion 8) Calculate principal stress, maximum shear stress, orientation of principal plane and plane of maximum shear stress both analytically and using Mohr's circle 9) Determine slope and deflection of beams under different types of loading 10) Design both concentrically and eccentrically loaded columns made of common engineering materials.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO / PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	2							
CLO2					2			
CLO3					1			
CLO4					2			
CLO5					1			
CLO6					1			
CLO7					1			
CLO8					1			
CLO9					1			
CLO10					1			

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Beer, F.P., Jr. Johnston, E.R., Dewolf, J.T., Mazurek, D.F. (2011), Mechanics of materials. 6th Ed., *McGraw-Hill Education,* ISBN 978-0-07-338028-5 Hibbler, R.C. (2014) Mechanics of materials. 9th Ed., *Pearson Prentice Hall*, ISBN 978-0-13-325442-6 Pytel, A., Singer, F.L. (1987), Strength of materials. 4th Ed., *Harper & Row*, ISBN 978-0-06-350599-5 Khurmi, R.S. (1968), Strength of materials. *S. Chad & Company Ltd.,* ISBN 81-219-2822-2

1.1	**Course title**	Mechanics of Solids Sessional
1.2	**Course no**	CEE202F
1.3	**Credit value**	1.0
1.4	**Semester**	2nd Year 2nd Semester
1.5	**Rationale**	This course will make the students familiar with various method to analyze material properties through experiment which will enhance their theoretical knowledge
1.6	**Course objective**	1) To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads 2) Helping the students to develop ability to understand the design for strength and stiffness.
1.7	**Course content**	
Tension test of mild steel		
Test of helical spring		
Static bending test of timber beam		
Impact test of metals		
Hardness test of metals		
Direct shear test of metal specimen		
Buckling test of slender columns		
1.8	**Course learning outcomes**	***By the end of this course, students will be able to*** 1) Perform tension, shear and torsion on solid materials 2) Determine impact and hardness test of metals 3) Calculate the elastic constants through compression test on springs and deflection test on beams 4) Analyze the compression strength of different materials.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO / PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	1			2		2	1	
CLO2	1			3		2	1	
CLO3	1			2		2	1	
CLO4	1			3		2	2	

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Lab manual-developed by CEE, SUST. Beer, F.P., Jr. Johnston, E.R., Dewolf, J.T., Mazurek, D.F. (2011), Mechanics of materials. 6th Ed., *McGraw-Hill Education,* ISBN 978-0-07-338028-5 Hibbler, R.C. (2014) Mechanics of materials. 9th Ed., *Pearson Prentice Hall*, ISBN 978-0-13-325442-6 Pytel, A., Singer, F.L. (1987), Strength of materials. 4th Ed., *Harper & Row*, ISBN 978-0-06-350599-5 Khurmi, R.S. (1968), Strength of materials. *S. Chad & Company Ltd.* ISBN 81-219-2822-2

1.1	**Course title**	Building Materials and Construction
1.2	**Course no**	CEE301F
1.3	**Credit value**	3.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	This course will familiarize the students with the basics of Engineering materials (Brick, Cement, Aggregates, and Steel), differents surveying techniques (e.g. Chain, Traverse, Plane table, Leveling and Tachometry) and Cost estimation of load-bearing structure and RCC building.
1.6	**Course objective**	1) To understand the basic knowledge of some most commonly used Engineering Materials (Brick, Cement, Aggregates, and Steel), their properties, uses, availability, etc. 2) Helping the students to develop the ability to evaluate the material content of reinforced concrete structures 3) To develop skills to estimate construction cost of infra-structure of reinforced concrete structures 4) To facilitate the necessary knowledge about various methods of surveying such as Chain, Traverse, Plane table, Leveling and Tachometry 5) To enhance the skills of the Plotting of contour map and calculating areas and volumes (cutting and filling).
1.7	**Course content**	

Fundamentals of Building materials:
This chapter introduces basic civil engineering materials such as Properties and uses of Bricks, Cement, Stone, and Sand. This chapter also introduces the Nature, forms and types of timber and classification.

Fundamentals of Quantity surveying:
This chapter presents Construction procedures and Estimation of Infra-structure which includes Measurement of Materials & Works, Types of Estimates, Detail & Abstract Estimates of a Two-storied Buildings, Estimation of Quantities of Steel & RCC Elements of a two-storied RCC residential Building. This chapter also describes the procedure of the Collection of Materials.

Fundamentals of Surveying:
This chapter discusses the Calculation of area and volumes. This chapter also introduces different types of surveying such as Chain, Traverse, Plane table, Leveling and Tachometry.

1.8	**Course learning outcomes**	***By the end of this course, students will be able to:*** 1) Identify the basic knowledge about various Engineering Materials and their properties and uses 2) Evaluate the detailed estimation of load-bearing structure and RCC building 3) Calculate the areas and volumes (cutting and filling) of earth 4) Explain the differing surveying techniques and methods (e.g. Chain, Traverse, Plane table, Leveling and Tachometry).

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1		3							
CLO2		1							
CLO3		1			2				
CLO4		1				3	3		

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	Aziz, M. A. (1995), A text book of Engineering materials. *Kazi Mahfuzur Rahman, 34/2, Zigatola*. Latifee, E. R. (2007), An Introduction to Properties and Evaluation of Engineering Materials. *E. R. Latifee 5B, mallika, Dhaka.* ISBN: 984-300-000839-0 Dutta, B. N. (2006), Estimating and Costing in Civil Engineering. *Ubs Publishers' Distributors Pvt. Ltd.* ISBN-13: 978-8185273686 Suresh, B. N. (2006), Estimating & Costing. *Telugu Akademi, Hyderabad on behalf of the State Institution of Vocational Education, Andhra Pradesh, Hyderabad.* Aziz, M.A., M. Shajahan, M. (1965), A text book of surveying. *Hafiz Book Center*. Punmia, B. C., Jain, A. K., Jain, A. K. (2016), Surveying - Vol. 1. *Laxmi Publications*. ISBN-13: 978-8170088530 Punmia, B. C., Jain, A. K., Jain, A. K. (2016), Surveying - Vol. 2. *Laxmi Publications*. ISBN-13: 978-8170088837

1.1	**Course title**	Practical Surveying (Field Work)
1.2	**Course no**	CEE302F
1.3	**Credit value**	1.0
1.4	**Semester**	3rd year 1st semester
1.5	**Rationale**	Before development and planning process for any civil engineering or mining project, at first field survey of that area is carried out and various type of survey maps are prepared. These maps and drawing are used for taking various decisions regarding the planning, designing, estimation, execution and construction process etc.

1.6	**Learning Objectives**	The objective of this course is to teach preparation of maps and plans showing the relative position of existing features by which areas, volumes and other related quantities are determined.
1.7	**Course content**	

Chain survey
- Identify the instruments for chain survey
- Select convenient stations
- Conduct chain survey in the field and record the observations in the field book
- Conduct triangulation survey in the field and to calculate the area.
- Conduct cross staff survey and find the area.

Plane table survey
- Identify the accessories of plane table
- Set up and orient the plane table
- Conduct survey in the field to plot the objects by radiation method and intersection method.

Traverse/Leveling and Contouring/ Height and Distance problem
- Identify the leveling instrument
- Perform temporary adjustments for taking observations
- Conduct simple leveling and compound levelling
- Take fly levels for establishing a bench mark.

House setting
- To mark the excavation lines,
- To mark the centerlines of all the columns of the plan of a proposed building on the actual site of work as per plan of the building to facilitate earth cutting.

1.8	**Course learning outcomes**	1) Upon completion of the course: Students are expected to know how to use surveying camera, tape and how to find the height and distance of each point.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1					3		1	3					

Correlation: 3-High, 2-Medium, 1-Low

References	A text book of surveying–M.A.Aziz & M.Shajahan, Publisher: Dhaka : Hafiz Book Center, c1965.[Reprinted 2010] Surveying (Volume I,II III), -Dr BC Punmia, Laxmi Publication, 2005 Surveying (Volume I,II), -SK Duggal, Tata McGraw-Hill Education, ISBN-9332901031, 9789332901032 Surveying & Levelling, -NN Basak, Tata McGraw-Hill Education, Oct 1, 1994 Surveying & Levelling, -SV Kulkarn, Pune Vidyarthi Griha Prakashan, 1988.

List of non major courses offered by other department for CEE department

First Year: Semester I

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CHE101C	Chemistry	3+0	3.0
ECO107C	Principles of Economics	2+0	2.0
ENG101C	Effective communication in English	2+0	2.0
MAT103C	Differential Calculus and Vector Analysis	3+0	3.0
PHY107C	General Physics	3+0	3.0
SSS100	History of the Emergence Bnagladesh	3+0	3.0
ENG102C	English Language Lab - I	0+3	1.0

First Year: Semester II

Course No.	Course Title	Hours / Week Theory + Lab	Credit
BUS103C	Cost Accounting for Engineers	2+0	2.0
MAT104C	Integral Calculus and Ordinary Differential Equations	3+0	3.0
SCW103C	Social Science for Engineers	2+0	2.0
CHE102C	Chemistry Practical	0+3	1.5
EEE128C	Electrical Services Design	0+3	1.5
IPE104C	Workshop Practice	0+2	1.0
PHY104C	Physics Practical	0+3	1.5

Second Year: Semester I

Course No.	Course Title	Hours / Week Theory + Lab	Credit
CSE203C	Introduction to Computer Language	2+0	2.0
MAT207C	Vector Calculus, Matrix, Laplace Transformation and Partial Differential Equations	3+0	3.0
CSE204C	Introduction to Computer Language Lab	0+4	2.0

Second Year: Semester II

Course No.	Course Title	Hours / Week Theory + Lab	Credit
STA211C	Statistics	2+0	2.0
STA212C	Practical Statistics	0+3	1.0

Third Year: Semester II

Course No.	Course Title	Hours / Week Theory + Lab	Credit
ARC301C	Urban and Regional Planning	2+0	2.0

Profile for non-major courses offered by other departments

Course No: CHE 101C	Credit: 3.0	Year: First	Semester: First
Course Title: Chemistry (For Civil & Environmental Engineering)		Course Status: Theory	

Course Rational: The course will introduce the students to basic concepts of chemistry. The students will be familiar with the fundamental chemical techniques and environmental chemistry terms. The students will be skilled to solve chemistry related issues. The knowledge will be very important to develop building material, industrial products and green environment.

Course Objectives:

The objectives of this course are to

- Familiarize the students with the basic concept of electronic structure
- Acquire the knowledge about the properties of elements on the periodic table
- Acquire the basics of acid-base concepts and apply them to identify different acids and bases
- Understand gaseous state of matter and their properties
- Introduce preliminary ideas of chemical equilibrium and kinetics
- Familiarize the students with the basic chemistry in environment, agriculture, food and industry
- Acquaint students with the fundamentals of organic chemistry

Course Content:

Electronic Structure: The quantum theory, The atomic spectrum of hydrogen and the Bohr model, Quantum numbers, Energy levels and orbital, Electronic configuration, Chemical bonding and molecular structure.

The periodic Table: Electron arrangements and the periodic table, Summarized chemical properties of s-block, p-block, d-block and f-block elements.

Acids and Bases: Theories and Modern definition of acids and bases, Dissociation constant, strength, pH, Buffer solution etc.

Gaseous State: Measurement on gases, the ideal gas law, Volumes of gases involved in reactions, Gas mixtures, Partial pressure, Real gases.

Introduction to Chemical Kinetics: Rate laws, rate constant, order of reaction etc.

Chemical Equilibrium: Equilibrium constant K_P, K_C, ΔS, ΔG, catalyst.

Environmental Chemistry: Environmental aspects of **Energy**—Traditional, Fossil fuel, Nuclear, Solar etc.;

Transportation-Road/Rail, Sea, Air; **Agriculture**: Fertilizers, Pesticides, Insecticides; **Food**: Preservatives, Flavor/ Coloring materials; **Industry**: Building materials, metal industry, detergent, Dye, chemicals related to the agriculture, cement and ceramic industry.

Organic Chemistry: Introduction**,** Classification, Nomenclatures, preparations and Properties (Physical & Chemical) of (i) Aliphatic and aromatic hydrocarbons, (ii) Aldehydes and ketones, (iii) Carboxylic acids and (iv) Alcohol s and phenols.

Course Learning Outcomes:

After the successful completion of the course, students will be able to

CLO1	Classify elements, correlate atomic models, orbit & orbitals, electron distribution & energy level, hydrogen spectral series etc.
CLO2	Apply different principles to determine the configuration for any atom or ion
CLO3	Explain the development of the periodic table of elements, analyze and compare periodic trends in physical and chemical properties of elements in periodic table
CLO4	Identify and explain the metallic and non-metallic characters of elements across the periodic table
CLO5	Define and apply the modern concepts of acids and bases to identify and classify the acids and bases and their strength and explain acidic and basic properties of species
CLO6	Understand the ideal gas laws and its application on real system
CLO7	Calculate volume, pressure, and temperature of gases based on the ideal gas laws
CLO8	Understand the relationship between chemical kinetics and equilibrium
CLO9	Understand the general chemistry involved in renewable energy, agriculture, food and industries
CLO10	Formulate the proper structure, name the molecule, and predict physical and chemical properties of aliphatic and aromatic hydrocarbons, aldehydes, ketones, carboxylic acids, alcohols and phenols

Mapping of CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	2											
CLO2		2										
CLO3			1									
CLO4			2									
CLO5				3								
CLO6					1							
CLO7	1											
CLO8		2										
CLO9					1					1		
CLO 10	1											

Correlation: 3-High, 2-Medium, 1-Low

Books Recommended:

1. S. Z. Haider, *Introduction to Modern Inorganic Chemistry.*

2. Haque and Mollah, *Physical Chemistry*
3. R. T. Morrison and R. N. Boyd, *Organic Chemistry* (6th edition)
4. Raymond Chang, *General Chemistry*
5. A. K. Dey, *Environmental chemistry*
6. J. L. Pyle, Chemistry and the technological black lash.

Course No: ECO107C	Academic Session: 2021-22	Semester: 1st Year 1st
Course Title: Principles of Economics		
Course Type: Theory	Credit: 2.0	Marks: 100
Instructor: TBA		

Part A: Introduction

1.1 Course Description and Objectives

This ECO 105 course provides an introduction to the main ideas and concepts involved in modern economics and attempts to provide students with an understanding of how the economy works, what type of problems economists attempt to solve, and how they set about trying to solve them. The course is primarily concerned with the analysis of individual decision-making agents, the behaviour of firms and industries in the economy (microeconomics), on the economy as a whole (macroeconomics) and the inherent problems facing underdeveloped and developing countries (economic development).

Microeconomics part provides a brief and simple introduction to the subject matter and scope of Economics. This section aims to provide an introduction to microeconomic analysis. It outlines the theory of markets with relevant applications to business, social and individual issues. The course covers the principles and consequences of the "rational" choice by individual economic agents in markets. The course also provides an introductory analysis of the role of governments in seeking to ensure the efficient operation of markets.

Macroeconomics section provides a brief and simple introduction to the subject matter and scope of Macroeconomics. It also aims to provide an introduction to macroeconomic analysis outlining how the national income is measured and determined. It also provides a framework in which the interaction of money and goods and services markets can be developed, allowing students to understand the process by which the levels of economic activity, employment are determined.

Economic development section provides students with an understanding of economic theories and analysis in the field of development economics. The section is designed to deal with a selection of issues and problems facing the developing economies.

1.2 Prerequisites

Basic arithmetic and an ability to learn, to understand, and manipulate simple graphs are required, but it would be difficult to do any job in the private or public sector without these skills.

1.3 Course Learning Outcome (CLO)

Successful completion of this course should enable students to:

CLO1 Understand the analysis of individual decision-making agents, the behaviour of firms and industries in the economy

CLO2 Understand the concept of elasticity quantitatively and qualitatively in economic analysis and know differences between different types of markets ;

CLO3 Explain macroeconomic concepts and use simple economic models to interpret the behaviour of key macroeconomic variables;

CLO4 Understand monetary and fiscal policy and Government budget;

CLO5 Understand the main issues confronting underdeveloped and developing countries.

Part B: Teaching and Assessment

2.1 Teaching Strategies

The course materials are delivered through certain teaching-learning activities such as lectures, reading, assignments, exercise and workshop papers.

2.2 Assessment Strategies

No.	Description	Mark
1	Class attendance	10
2	Midterm test	20
3	Assignments	10
4	Final Exam	60

Note: The coursework consists of at least two tests (one can be substituted by assignment) with a combined weight of 20% of the final mark, 10% as a part of continuous assessment like a class test, quiz, problem-solving, short assignment and 10% of the final mark is reserved for class attendance as per rule of the university. Assignment submission date will be fixed by the course convener.

2.3 Assessment of Course Learning Outcome

Outcome	Test	Assignment	Final Examination
1	X	X	X
2	X	X	X
3	X	X	X
4	X	X	X
5	X		X

2.4 Grading System

The grading system has been detailed in Section 7 "Grading System" in Semester Ordinance

Part C: Course Content

3.1 Course Outline

Course Content	Teaching Strategy
1. Introduction to Microeconomics: Definition and scope; basic concepts and tools−PPF and circular flow model; fundamental economic problems and solution systems; Concepts of demand, supply and equilibrium; Concepts of elasticity, different types of elasticities, their applications; Concepts of total and marginal	Lecture, tutorial and exercise

utility; concepts of production, cost and profit, characteristics of different types of markets.	
2. Introduction to Macroeconomics: Key macroeconomic indicators and their performance measurement - GNP, GDP, inflation, unemployment; money, functions of money, monetary policy; fiscal policy and structure of government budget.	Lecture, tutorial and assignment
3. Development and related issues: Introduction to growth and development; environmental problems and economic efficiency; sustainable development goals (SDG), externalities; cost-benefit analysis, NPV, IRR.	Lecture and discussion

3.2 Alignment of topics of the courses with CLOs

	CLO1	CLO2	CLO3	CLO4	CLO5
Content 1	X	X			
Content 2		X	X		
Content 3					X

Part D: Learning Resources

4.1 Required readings

1. Arnold, R. A. (2014): Economics, South Western Publishing Company, Eleventh Edition
2. Bangladesh Economic Review relevant issues.
3. Mankiw, N. G. (2012): Principles of Economics, Thomson South Western Publishing, Sixth Edition
4. Samuelson, P. A. and Nordhaus,W. D. (2009): Economics, McGraw-Hill USA, Nineteenth Edition.
5. Todaro, M. P. and Smith,S. C. (2012): Economics of Development in the Third World, Longman, Eleventh Edition.

ENG 101C	Year 01	Semester 01	Type:
Effective Communication in English	Credits 02	Theory	Marks 100

1. Course Rationale

This course will develop two basic skills i.e. reading and writing. A variety of reading strategies and texts will be used to effectively develop first year students' academic reading skills thereby facilitating their future study. Also, the course focuses on developing the writing skills of students by familiarizing them with grammar rules, providing them with practice thereby enabling them to demonstrate the accurate use of grammar in their writing.

2. Course Objectives

- To enable students to write with accuracy
- To facilitate effective and comprehensible writing
- To raise awareness of common errors that occur in writing
- To develop student's ability to understand write-ups on issues of general concern.
- To improve the vocabulary of learners for effective communication.

3. Course Content

a) Reading

- Different Reading Strategies
- Guessing Meaning from the Context
- Critical Reading (Analyze)
- Critical Reading (Synthesize)
- Critical Reading (Evaluate)
- Annotation
- Summary Writing

Material

- A selection of 08-10 editorials and reports from newspapers/ magazines /journals, etc
- Reading texts in New Headway Upper Intermediate Student's Book (Current edition)
- Selected passages from recommended books
- A selection of other material may be supplied as handouts as deemed necessary by the instructor.

b) Writing

- Forms and functions of different word categories (Noun, verb, adjective, etc.)
- Aspects and uses of tense
- Subject-verb agreement
- Use of infinitive, gerund, present participle, past participle, modals, causatives, conditionals, subjunctives, modals.
- Use of sentence connectors/ cohesion markers/ punctuation
- Effective combination of sentences (simple, complex, compound)
- Developing a paragraph

4. Course Learning Outcomes

At the end of the course, students will be able to

CLO1 Understand grammar rules

CLO2 Produce grammatically correct meaningful sentences

CLO3 Express oneself correctly by using appropriate words, phrases, sentences or ideas

CLO4 Think critically (reflect on a text, grasp abstract ideas and interpret them effectively arrive at well reasoned conclusions and solutions).

CLO5 Extract information accurately

5. Mapping CLOs to PLOs

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		2											
CLO2		1							2				

CLO3								3				
CLO4				1								
CLO5											1	

Correlation: 3-High, 2-Medium, 1-Low

6. Evaluation

- IELTS, TOEFL and other standardized testing formats for assessing the level of reading skill are to be followed. Test items may be as follows: fill in blanks, true/false, multiple choice/ matching word meanings/ information transfer/matching titles with relevant paragraphs in the text, etc.
- Reading skill will be tested on two reading texts. One reading text will be taken from one of the selections students have already read during the semester. The other reading text will be similar in terms of contents and difficulty but will not have been previously discussed.

7. Books Recommended

Tibbits, E. E. ed. Exercises in Reading Comprehension. Longman

Liz and John Soars. (Current edition). New Headway Upper Intermediate Student's Book. Oxford : Oxford University Press

Cliff's TOEFL

Resources recommended by course instructors

ENG 102C	Year 01	Semester 01	Type:
English Language Lab - 1	Credits 02	LAB	Marks 50

1. Course Rationale

This course is designed to improve the speaking and listening skills of students in the English language. Emphasis is laid on proper pronunciation for accurate articulation and recognition of speech sounds as well as correct stress, intonation and language use in varied situations.

2. Course Objectives

- To enable students' understanding of the variations in pronunciation
- To teach proper pronunciation and accurate articulation.
- To facilitate appropriate stress and intonation in speech.
- To encourage use of English effectively in everyday situations.
- To ensure overall improvement of oral communication through listening and speaking.

3. Course Content

Speaking

- Articulators
- English Phonetic Alphabet (British and American) and International Phonetic Alphabet (IPA)
- Stress rules of English
- Intonation rules and functions of intonation
- Communication Styles and Cultural Context
- Fluency, mistakes, misunderstandings, audience, taboos, self-esteem, confidence
- Activities: dialogue, debate, extempore speech, interview, role-play

Listening

- Basics of listening
- Various types of Pronunciation
- IPA, RP, Transcription
- Different accents and intonation patterns
- Activities for Meaning-focused Listening, Information Transfer Strategies,
- Listening Practice through selection of audio clips.

4. Course Learning Outcomes

At the end of the course, students will be able to

CLO1 Read the symbols of the International Phonetic Alphabet used to represent the sounds of the English language.

CLO2 Understand all that is being said in English in varied accents

CLO3 Determine what is being heard and gather information accurately

CLO4 Apply appropriate intonation and stress patterns in English words and sentences.

CLO5 Produce continuous speech clearly and convincingly.

5. Mapping CLOs to PLOs

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		2											
CLO2		1							2				
CLO3							2		3			2	
CLO4									2				
CLO5									2			1	

Correlation: 3-High, 2-Medium, 1-Low

6. Evaluation

- IELTS, TOEFL and other standardized testing formats for assessing the level of listening skill are to be followed. Test items may be as follows: fill in blanks, true/false, multiple choice/ matching word meanings/ information transfer/matching, etc.
- Speaking skill will be tested through dialogue, debate, extempore speech, presentation, role-play etc.

7. Books Recommended

Anderson, A. & Lynch, T. Listening. Oxford: Oxford University Press. 1988

Hancock, Mark. English Pronunciation in Use. New York: Cambridge University Press. 2004

Anderson, Kenneth, et al. Study Speaking. Cambridge University Press, 2007

Hancock, Mark. English Pronunciation in Use. Cambridge University Press, 2004

Jones, Daniel. Cambridge English Pronunciation Dictionary. Cambridge University Press, 2011

Richards J, et al. Person to Person. Oxford University Press, 2007

Richards, Jack C, and David Bohlke. Speak Now: 1. Oxford University Press, 2013
Roach, Peter. English Phonetics and Phonology. Cambridge University Press, 2009

MAT 103C	Year 01	Semester 01	Full Marks
Differential Calculus and Vector Analysis	Credits 03	Theory	100

Course Content

Differential Calculus: Differentiation of explicit and implicit functions and parametric equations; successive differentiation of various types of functions; Leibnitz's theorem; Rolls theorem; mean value theorem. Taylor's theorem in finite and infinite forms; Maclaurin's theorem in finite and infinite forms; Lagrange's form of remainder; Cauchy's form of remainder; expansion of functions by differentiation and integration; partial differentiation; Euler's theorem; tangent and normal; subtangent and subnormal in Cartesian and polar coordinates; determination of maximum and minimum values of functions; point of inflexion and its applications; evaluation of indeterminate forms by L'Hospital's rule; curvature, radius of curvature, centre of curvature and chord of curvature; evolute and involute; asymptotes; envelopes; curve tracing.

Vectors: Definitions of vectors; equality of vectors; addition and multiplication of vectors; triple products and multiple products.

Recommended Books:

1. Mohammad and Bhattacharjee: Differential Calculus
2. Spiegel, M. R.: Vector Analysis
3. Das and Mukherjee: Differential Calculus
4. J. Edwards: Differential Calculus
5. Rahman and Bhattacharjee: A Text Book on Coordinate Geometry with Vector Analysis

Course No.: SSS 100	Credit: 3.0	Year: First	Semester: First
Course Title: History of the Emergence of Independent Bangladesh (for CEE)			Course Status: Theory

Course objective:

The course aims to offer insight into the historical changes, the long struggle for freedom and above all the War of Independence led by the Father of the Nation Bangabandu Sheikh Mujibur Rahman that have shaped today's Bangladesh.

Course learning outcome:

It is hoped that at the end of the course students will:

1. Have a broader understanding and further curiosity of the rich history, culture and heritage of the country.
2. They should also be able to appreciate the importance and relevance of history as a bridge between the past, present and the future.

Course contents:

This course deals with the following interrelated themes and topics that are essential to understand the emergence of Bangladesh. These themes include land and people, politics, economy, governance, society, religion and culture, global connections as well as the basic topics on the freedom struggle and War of Liberation. Issues under each of the broad themes will be discussed from the perspective of historical evolution and contemporary significance **(3 credits).**

1. Description of the country and its people
   a. Impact of Geographical features
   b. Ethnic composition of Bangladesh
   c. Development of Bengali Language and its impact
   d. Cultural syncretism and religious tolerance
   e. Distinctive identity of Bangladesh in the context of undivided Bangladesh

2. Proposal for undivided sovereign Bengal, the partition of the Subcontinent, 1947 and Foreshadowing Bangladesh
   a. Rise of communalism under the colonial rule, Lahore Resolution 1940
   b. The proposal of Suhrawardi and Sarat Bose for undivided Bengal : consequences
   c. The creation of Pakistan 1947
   d. Foundation of Awami Muslim League and Foreshadowing Bangladesh

3. Pakistan: Structure of the state and disparity
   a. Central and provincial structure
   b. Influence of Military and Civil bureaucracy
   c. Economic , social and cultural disparity

4. Language Movement and quest for Bengali identity
   a. Misrule by Muslim League and Struggle for democratic politics
   b. The Language Movement: context, phases and International Recognition of Bengali Language
   c. United front of Haque – Vasani – Suhrawardi: election of 1954, consequences

5. Military rule: the regimes of Ayub Khan and Yahia Khan (1958-1971)
   a. Definition of military rules and its characteristics
   b. Ayub Khan's rise to power and characteristics of his rule (Political repression, Basic democracy, Islamisation)
   c. Fall of Ayub Khan and Yahia Khan's rule

6. Rise of nationalism and the Movement for self-determination
   1. Resistance against cultural aggression and resurgence of Bengali culture
   2. Sheikh Mujibur Rahman and the 6 points movement
   3. Reactions : Importance and significance

4. The Agortola Case 1968

5. The mass- upsurge of 1969 and 11 point movement
   a. Background
   b. Programme
   c. Significance

6. Election of 1970 and its Inpact
   a. Legal Framework Order (LFO)
   b. Programe of different political parties
   c. Election result and centres refusal to comply

7. Non-cooperation Movement and 7th March Speech, 1971
   a. The non-cooperation movement
   b. Speech of 7th March : Background of the speech, major characteristics of the speech, impact of this speech
   c. International recognition of 7th March Speech as part of world heritage

8. Declaration of Independence of Bangladesh
   a. Operation Searchlight
   b. Declaration of Independence of Bangladesh by Bangobondhu
   c. Beginning of the Liberation War of Bangladesh

The war of Liberation 1971
   a. Genocide, repression of women, refugees
   b. Formation of Bangladesh government and proclamation of Independence
   c. The spontaneous early resistance and subsequent organized resistance (Mukti Fouz, Mukti Bahini, guerillas and the frontal warfare)
   d. Publicity Campaign in the war of Liberation (Shadhin Bangla Betar Kendra, the Campaigns abroad and formation of public opinion)
   e. Contribution of students, women and the masses (Peoples war) and different political parties
   f. The role of Great powers and the United Nations in the Liberation war
   g. The contribution of India in the Liberation War
   h. The Anti-liberation activities of the occupation army, the Peace Committee, Al-Badar, Al-Shams, Rajakars, pro Pakistan political parties and Pakistani Collaborators , killing of the intellectuals
   i. Trial of Bangabandhu and reaction of the World Community
   j. Formation of joint command and the Victory
   k. The overall contribution of Bangabandhu in the Independence struggle

9. The Bangabandhu Regime 1972-1975
   a) Homecoming; Speech of 10 January
   b) Making of the constitution
   c) Reconstruction of the war-ravaged country
   d) Foreign Policy of Bangabandhu; Bangabandhu's First Speech in the United Nations
   e) The murder of Bangabandhu and his family and the ideological turn-around

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		1					1					2	
CLO2				2			1						

Correlation: 3-High, 2-Medium, 1-Low

Recommended texts:

1. Ahmed, Salahuddin and Bazlul Mobin Chowdhury (eds.), *Bangladesh: National Culture and Heritage: An Introductory Reader* (Dhaka: Independent University Bangladesh, 2004)
2. Harun-or-Roshid, *The Foreshadowing of Bangladesh: Bengal Muslim League and Muslim Politics, 1906-194*7 (Dhaka : The University Press Limited, 2012)
3. Jahan Rounaq, *Pakistan: Failure in National Integration,(Dhaka :* The University Press Limited, 1977)
4. Maniruzzaman Talukder, *Radical Politics and the Emergence of Bangladesh, (Dhaka :* Mowla,Brothers, 2003)
5. Muhith, A M A, *History of Bangladesh: A Subcontinental Civilization*, (Dhaka: UPL, 2016)
6. Samad Abdus, *History of Liberation War of Bangladesh*, (Dhaka : Aparajeyo Bangla Prakashani, 2019)
7. Milton Kumar Dev, Md. Abdus Samad, *History of Bangladesh* (Dhaka : Biswabidyalya Prokasoni, 2014)
8. Schendel, Willem van : *A History of Bangladesh* (Cambridge: Cambridge University Press, 2009)
9. †kL gywReyi ingvb : *Amgvß AvZ¥Rxebx, (*XvKv : w` BDwbfvwm©wU †cÖmwjwg‡UW, 2012)
10. bxnviiÄbivq : *evOvjxi BwZnvm, (*KjKvZv : †`Õ R cvewjwks, 1402 mvj)
11. mvjvn& DwÏb Avn‡g` I Ab¨vb¨ (m¤úvw`Z), *evsjv‡`‡ki gyw³ msMÖv‡gi BwZnvm* 1947-1971, (XvKv : AvMvgx cÖKvkbx, 2002)
12. Aveyj gvj Ave`yj gywnZ : *evsjv‡`k: RvwZiv‡ói D™¢e, (XvKv :* mvwnZ¨ cÖKvk, 2000)
13. wmivRyj Bmjvg (m¤úvw`Z), *evsjv‡`‡ki BwZnvm 1704-1971,* 3 LÛ, (XvKv : GwkqvwUK †mvmvBwU Ae evsjv‡`k, 1992)
14. nviæb-Ai-iwk` : *e½xq gymwjg jxM cvwK¯Ívb Av‡›`vjb evOvwji ivóªfvebv I e½eÜz,* (XvKv : Ab¨ cÖKvkb, 2018)
15. nvmvb nvwdRyi ingvb : *evsjv‡`‡gi ¯^vaxbZvhy× `wjcÎ,* (m¤úvw`Z), (XvKv: MYcÖRvZš¿x evsiv‡`k miKvi, 1985)^mq` Av‡bvqvi †nv‡mb : *evsjv‡`‡ki ¯^vaxbZvhy‡× civkw³i f~wgKv,* (XvKv : Wvbv cÖKvkbx, 1982)
16. gybZvmxi gvgyb I Ab¨vb¨, *¯^vaxb evsjv‡`‡ki Afy¨`‡qi BwZnvm*, (XvKv: myeY©, 2017)
17. Avey †gv †`‡jvqvi †nv‡mb, *¯^vaxb evsjv‡`‡ki Afy¨`‡qi BwZnvm*, (XvKv : wek¦we`¨vjq cÖKvkbx, 2014)
18. AvkdvK †nv‡mb, *¯^vaxb evsjv‡`‡ki Afy¨`‡qi BwZnvm*, (XvKv: cÖwZk~Y¨ cÖKvkb, 2019)
19. Avey †gv †`‡jvqvi †nv‡mb, *evsjv‡`‡ki BwZnvm, 1905-1971,*

20. AvkdvK †nv‡mb : *evsjv‡`‡ki gyw³hy× I RvwZmsN*, (XvKv: evsjv GKv‡Wwg, 2003)
21. Avey †gv. †`‡jvqvi †nv‡mb, W. †gvnv¤§` †mwjg (m¤úv`bv) : *evsjv‡`k I ewnwe©‡k¦i, (*XvKv : evsjv‡`k BwZnvm mwgwZ, 2015)
22. AvkdvK †nv‡mb, *evsjv‡`‡ki gyw³hy× I Bw›`ªiv MvÜx* (XvKv : myeY© cÖKvkbx, 2017)

Course Code: PHY 107C	Credits: 3.0	Year: First	Semester: First
Course Title: General Physics (For CEE Major)		Course Type: Theory	

Course Objectives

The objectives of this course are:

- to facilitate necessary knowledge about various crystals and their microscopic structures, microscopic models of various kinds of bond.
- to accumulate basic ideas on the elastic behaviors of materials for their application in engineering purposes.
- to introduce students with various phenomena of electromagnetism, the laws of thermodynamics, Carnot's cycle, entropy and various laws of black body radiation.

Course Content

Structure of Matter: Classification of solids, amorphous, crystalline, binding energy and atomic separation in equilibrium in solid, different types of bond in crystals, lattice, basis, crystal, unit cell, packing fractions of *sc*, *bcc*, *fcc* and *hcp* crystals, Miller indices, Interplanar spacing, X-ray diffraction, Bragg's law, elasticity, distinction between metal, insulator and semiconductor.

Sound Waves: Simple harmonic motion, audible, ultrasonic and infrasonic waves, propagation and velocity of longitudinal waves in gaseous medium, Doppler effect, interference and diffraction, beats.

Electromagnetism: Coulomb's law, electric field, Gauss's law and its applications, electric potential and potential energy, dielectrics and Gauss's Law, magnetic field and field strength, magnetic forces on charge and current, torque on a current loop, Ampere's Law, Biot-Savart law and their applications.

Thermodynamics: First law of thermodynamics, isothermal and adiabatic changes, second law of thermodynamics, reversible and irreversible processes, Carnot's cycle, entropy and change of entropy in reversible and irreversible processes, black body radiation, Planck's law, Wein's law and Rayleigh-Jean's law.

Course Learning Outcomes

After successful completion of the course, students will be able to:

CLO1 Understand the reasons of varieties of crystal structures, and bonds in solids, and realize fact of compactness of atoms in the structure.
CLO2 Become familiar with the fundamental equation of structural analysis, and apply it.
CLO3 Distinguish between elastic and plastic materials, and able to control the applied stress for making a material either elastic or plastic.
CLO4 Identify simple harmonic motion, describe properties of sound waves, determine velocity of sound and understand Doppler effect and distinguish between sound wave and electromagnetic wave.
CLO5 Apply Coulomb's law, Gauss's law to solve problems related to electrostatics.
CLO6 Describe magnetic field for moving charges and steady currents, and apply Biot-Savart and Ampere's laws to solve problems.
CLO7 Explain various thermodynamical phenomena related to numerous thermodynamic processes and confidently understand the principle of operation of a Carnot's engine as well as real engine.
CLO8 Solve various problems relevant to the black body radiation.
CLO9 Motivate themselves for academic integrity.

Mapping of the CLOs with PLOs

CLO /PLO	PL O1	PL O2	PL O3	PL O4	PL O5	PL O6	PL O7	PL O8	PL O9	PL O10	PL O11	PL O12
CLO1	2	2	2									
CLO2	3	2	3									
CLO3	2	1	2									
CLO4	1	1	1									
CLO5	2	2	2									
CLO6	1	1	1									
CLO7	1	1	1									
CLO8	1	1										
CLO9									2			

Correlation: 3-High, 2-Medium, 1-Low

Recommended Books

1. Kittel, C.: *Introduction to Solid State Physics*
2. Beiser, A.: *Perspective of Modern Physics*
3. Halliday, D. and Resnick, R.: *Physics* (Vol. I and II)
4. Halliday, D, Resnick, R and Walker, J: Fundamentals of Physics
5. Sears, Zemansky and Young: *University Physics*
6. Puri, S.P.: *Fundamentals of Vibrations and Waves*
7. Zemansky M W and Dittman R H: *Heat and Thermodynamics*

Subject Code : BUS-103C	
Subject Title: Cost Accounting for Engineers (for CEE)	
Semester 2:	
Type : Core	
Pre-requisite : None	
Course Objectives	1.To describe the cost concepts, cost behaviour , and cost accounting techniques that are applied to manufacturing and service businesses. 2. To be capable to interpret cost accounting statements, 3. To provide the students with the capability to apply theoretical knowledge in decision making. 4. To be able to analyse and evaluate information for cost ascertainment, planning, control of business operations. 5. To discuss the various techniques available to measure managerial performance and to motivate employees toward organizational goals. 6. To identify and analyse both qualitative and quantitative standards to formulate best control methods

Course Learning Outcome	**Upon successful completion of this course the students able to:** 1. know about how cost accounting is used for decision making and performance evaluation. 2. competent to demonstrate how materials, labor and overhead costs are added to a product at each stage of the production cycle. 3. Able to express the place and role of cost accounting in the modern economic environment. 4. Recognize and apply the skills necessary for carrying out effective management decision-making and strategic management planning; 5. Capable to select the costs according to their impact on business and society. 6. Able to interpret the impact of the selected costs method. 7. able to design management control process in different business areas.
Contribution of CLO to PLO	Program Outcome 3: This subject contributes to the program outcome through the lessons of theories and concepts of costing needed to cope up with future business challenges. Program Outcome 4: This subject contributes to the program outcome by expanding students' skill technically through the analysing of different costing method which is preferable for every stakeholder. Program Outcome 6: This subject contributes to the program outcome by developing students'analytical ability of both qualitative and quantitative data to formulate best costing methods.

Mapping of Course Learning Outcomes, Teaching Learning Activities and Assessment

Course learning Outcome	Teaching - Learning	Assessment Methods
Course Learning Outcome -1	Lecture, Discussion and Assignment	Assignment, Q/A,MCQ
Course Learning Outcome -2	Lecture and Assignment	Assignment, Q/A
Course Learning Outcome-3	Lecture, Discussion and Problem Based Exercise	Q/A, MCQ
Course Learning Outcome-4	Lecture, Discussion and Problem Based Exercise Assignment,	Q/A, MCQ
Course Learning Outcome-5	Lecture and Assignment/Presentation	Q/A, Assignment, Presentation
Course Learning Outcome-6	Lecture, Group Discussion and Assignment	Q/A, Assignment, Presentation
Course Learning Outcome-7	Lecture, Group Discussion and Assignment	Q/A, Assignment, Presentation

Mapping of Course LO and Generic Skills

Course Learning Outcome (CLO)	Generic Skills(Appendix-1)									
	Intellectual skill	Values, Ethics and Morality skill	Communication & IT skill	Scientific and Analytical skill	Teamwork and Leadership skill	Practical and Problem solving skill	Professionalism	Social skills and responsibility	Entrepreneurship and innovation skill skill skill	Life-long Learning skill
CLO1	p					p			p	p
CLO2	p					p			p	p
CLO3	p					p			p	p
CLO4	p					p			p	p
CLO5	p					p			p	p
CLO6	p					p			p	p
CLO7	p					p			p	p

Summary of the course:

Contents	CLO
Introduction to Cost Accounting: Definition of Cost Accounting, Comparison of Cost Accounting and Financial Accounting; The role of Cost Accounting; Methods and Techniques of Cost Accounting; Characteristics of an Ideal Cost Accounting System	1
Cost Concepts, Classifications and Statements: Cost Object; Expenditures, Cost, Expense and Loss; Cost Classifications; Cost Data and Uses; The Chart of Accounts; Statement of Cost of Goods Manufactured and Sold; Cost Statement or Cost Sheet	1
Costing and Control of Materials: Classification of Materials; Accounting for Materials; Store ledger(FIFO & WAM) method; Inventory Planning; Ordering Cost, Holding Cost and EOQ; Effect of Quantity Discounts on EOQ; Safety Stock and Reorder Point; Material Control Methods; Materials Requirement Planning System. Practical problem.	1&2
Costing and Control of Labour: Productivity and Labour Costs; Costs included in Labour; Accounting for Labour; Time Keeping, Computation of total payroll and Allocation of Payroll costs; Different incentive plan; Labour cost Control, Labour Turnover and Control of Labour Turnover; Learning Curve Theory. Practical problem & solution	2&3
Costing and Control of Manufacturing Overhead: Manufacturing Overhead Costs; Actual Vs. Normal Costing of Manufacturing Overhead; Production Capacity, Predetermined Overhead Rates; Departmental vs. Plant-wise Overhead Rates; Separating Mixed Costs. Scatter-graph; High-low Method and Regression Analysis; Accounting for Manufacturing Overhead; Analysis and Disposition of Under-applied-and Over-applied Overhead	3
Contract Costing : Determination of profit of completed and incomplete contracts.	2&3
Introduction of Management Accounting :Definition-process of Management Accounting, characteristics of Management Accounting, scope of Management Accounting, purpose and objectives of Management Accounting, Comparison of Management Accounting and Financial Accounting	4
Cost Terms, Concepts and Classifications: Cost Behaviour (Analysis and Use):General cost classifications- product costs versus period costs-cost classifications on Financial Statements. Types of cost behaviour patterns- the Analysis of Mixed Costs, High-low method	5&6
Cost-Volume-Profit Relationships: The basics of CVP analysis- Break - even analysis- Break-even chart- Sales Mix. Business application and	5&6

mathematical problem of CVP analysis	
Budget: Define Budget, Types of Budget, Cash budget, purchase budget, sales budget, flexible budget and Related problems	5&6
Standard Costing: Meaning and Objectives- Types of ratios. Standard Costing and its uses for making business decision. Variance calculation, Decision making process from these calculation.	5&6

Text book: (i) Cost Accounting –Volume-1 by Basu and Das; (2) Managerial Accounting by Ray H. Garrison, Eric W. Noreen
Reference: Cost Accounting by MutzUzry et al

MAT 104C	Year 01	Semester	Full
Integral Calculus and Ordinary Differential Equations	Credits 03	Theory	100

Course Content

Integral Calculus: Definition of integration; integration by the method of substitution; integration by parts; standard integrals; method of successive reduction; definite integrals - its properties and use in summing series; Walli's formulae; improper integrals; Beta and Gamma functions; area under a plane curve in Cartesian and polar coordinates; area of the region enclosed by two curves in Cartesian and polar coordinates; trapezoidal rule; Simpson's rule; arc length of curves in Cartesian and polar coordinates; parametric and pedal equations; intrinsic equation; volumes of solid of revolution; volumes of hollow solid of revolution by shell method; area of surface of revolution.

Differential Equations: Ordinary differential equation and formation of differential equations; solution of first order differential equations with various methods; solutions of general linear equations of second and higher order with constant coefficients; solutions of homogeneous linear equations and applications; solution of differential equations of the higher order when the dependent and independent variables are absent; solutions of differential equations by the method based on factorization of the operators.

Recommended Books:

1. Mohammed and Bhattacharjee: Integral Calculus
2. Ayres, F.: Differential equation
3. Edward, J.: Integral Calculus
4. Das and Mukherjee: Integral Calculus

Course No: SCW 103a (For Dept. of CEE)	**Credit: 3.0**	**Year: Second**	**Semester: Second**
Course Title: Social Science for Engineers		**Course Status: Theory**	

Course Description

This course provides students with an understanding of the societal processes and systems that affects the practice of engineers. The course examines different social systems, culture, power and civilization that are effective in designing, planning working, and implementation in different level of construction. in engineering sciences.

Course Objectives

The objectives of this course are:

- To help the students develop understanding the need for social science knowledge in the practice field of engineers.
- To make them able to examine how to utilize the formal and informal systems of the society in human function.
- To make them understand about organizational culture and its impact on productivity
- To assist them develop different frameworks and strategies to assess and address different social issues in the planned change.

Course content

Some Basic Concept: Family, society, civilization, power structure, class, caste, gender and sex, culture, role and status, association.

Social Psychology: Personality, perception, attitude, motivation, memory and forgetting

Community Participation: Understanding community through PRA tools, role of the community in environmental project, community participation and its challenges.

Organization: Organization culture, technology and organization culture, social change and technology, professionalism, work distribution, value of work, work and productivity, organizational theories and human resource management.

Industrialization and Urbanization: nature, causes and impacts of rural industrialization and urbanization, social and environmental impacts, industrial democracy.

Course Learning Outcomes (CLOs)

After successful completion of the course students will be able to

CLO1 Understand the society and culture

CLO2 Identify the dimensions of human development, cognitive setting and their needs at different levels.

CLO3 Develop understanding about human psychology and behavior

CLO4 Demonstrate an ability to design environment friendly policy and its implementation

CLO5 Understand the need of community participation for successful implementation of the industrial project

CLO6 Evaluate the programs for future improvement

CLO7 Apply professional norms and ethics in service delivery systems

Mapping of Course Learning outcomes (CLO) with Program Learning Outcomes (PLOs)

CLO /PLO	PL O1	PL O2	PL O3	PL O4	PL O5	PL O6	PL O7	PL O8	PL O9	PL O10	PL O11	PL O12
CLO1	1											
CLO2		1										
CLO3			2									
CLO4			2			2						
CLO5					2							
CLO6					2							
CLO7									2			

Correlation: 3-High, 2-Medium, 1-Low

Teaching Strategy
The teaching strategies include lectures, power point presentations, discussion, reading assignments exhibition of audio-visual recordings, and demonstration etc.

Assessment Strategy
Assessment will be made based upon midterm examinations, assignments, presentations, viva, quiz, and final examinations.

Recommended Books

1. Khan. F. R. (2000). Principles of Sociology. Shirin Publication.
2. Maciver, R. M. and Page, C. H. (2001). Society: An introductory Analysis. New Delhi: Macmillan.
3. Richard, T. Schaefler, R. and Lamm, P. (1995). Sociology. USA: MeGrew Hill Inc.
4. Kalat, J. W. (2016). *Introduction to psychology*. Nelson Education.
5. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. (2006). Introduction to Psychology (7th eds.). New Delhi: Tata Mac-Graw Hill Publishing Co. Ltd.

Course No: CHE 102C	Credit: 1.5	Year: First	Semester: First
Course Title: Chemistry Practical		Course Status: Practical	

Course Objectives:
The objectives of this course are to
- Familiarize students with the qualitative analysis of inorganic salts
- Acquaint students with the qualitative analysis of organic functional groups
- Accumulate practical skill on titration

Course Content:
Qualitative analysis of inorganic salts:
- Separation and identification of group I cations
- Separation and identification of group II cations
- Separation and identification of group IIIA and IIIB cations
- Separation and identification of group IV cations

- Separation and identification of group V cations
- Identification of anions

Qualitative analysis of organic salts:
- Analysis of the functional groups of organic compounds

Quantitative analysis:
- Standardization of NaOH solution with standard oxalic acid solution

Course Learning Outcomes:
After the successful completion of the course, students will be able to
CLO1 Identify analytical group cations in the solution of inorganic salt

CLO2 Design an analytical scheme to separate and identify the known ions from a mixture of inorganic salts

CLO3 Apply designed analytical scheme to separate and identify the unknown ions from a mixture of inorganic salts

CLO4 Identify the functional group(s) presence in an organic compound and then perform a confirmatory test

CLO5 Determine the concentration of an unknown solution using a standard solution of known concentration

Mapping of CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO
CLO1	X	X				X				
CLO2	X	X				X				
CLO3			X	X		X				
CLO4	X	X				X				
CLO5	X	X				X				

Books Recommended:

1. Vogel, *Qualitative Inorganic Analysis*
2. A.I. Vogel, *A Text Book of Practical Organic Chemistry*
3. A.I. Vogel, *Elementary Practical Organic Chemistry* (Part 1) Vogel, *Text book of Quantitative Analysis.*

Course Title: Building Service Design	Year/Semester: 1/2	Course Status: Lab
Course Code: EEE 128C (CEE)	Credits: 1.5	Contact hours: 3 hours Lab per week

Rationale:
Electrical services are a vital component in any building, so it is necessary for civil engineers to understand the basic principle of services design. This Course content includes the concepts of wiring system design, various lighting schemes, design of substation layout of equipment and design of security systems. This course will help students of architecture to trouble shoot a design problem on a single/multi-storied building/structure.

Course objectives are:

- To train and equip civil engineers with appropriate knowledge and skills required for the lighting design, power supply design and their installations.
- To familiarize the students with electrical design process.
- To provide enough knowledge to the students of architecture so that they can interpret various components of the service design of the building.

Course Contents:

- Electrical units and standards, Ohm's law, KVL and KCL, Basics of AC circuits.
- Wiring system design, Fitting and Fixture layout, Conduit layout, drafting, and estimation.
- Design for illumination and lighting.
- Electrical installations system design: substation, BBT and protection, heating and lifts.
- Design for intercom, public address systems, telephone system and LAN.
- Design of security systems including CCTV, fire alarm, smoke detector, burglar alarm, and sprinkler system.
- A design problem on a single/multi-storied building/structure.

Course Learning Outcomes:

After the successful completion of the course, the student will be able to-

CLO1 Describe the basic concepts of lighting design, power supply distribution design and installations.
CLO2 Explain advantage of Security & Protection System.
CLO3 Interpret various symbols used in the electrical plan of a building.
CLO4 Design the infrastructure according to the power and load demand of the client.

Mapping of Course Learning Outcomes to Program Learning Outcomes

PLO/ CLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO 1		2				2						
CLO 2	2				2							
CLO 3	3				1	2						
CLO 4	2	2				1				1		1

Correlation: 3-High, 2-Medium, 1-Low

Recommended Books

1. Electrical Wiring Estimating and Costing by S.L. Uppal and G.C. Garg

Course No.: IPE104C	Semester: Second	Year: First
Course Title: Workshop Practice (for CEE)	Credit: 1.0	Course Status: Sessional

Rationale of the Course:

In order to have a balanced overall development of engineering graduates, it is necessary to integrate theory with practice. Workshop practice has been included in the curriculum to provide hands-on experience using different tools and basic manufacturing practices. By studying Workshop Practice, students will learn to explain the function, use, and application of different working tools, equipment, machine tools, and the technique of manufacturing a product from its raw material. This course also aims to develop the dignity of labor, precision, safety at work, teamwork, and the students' right attitude.

Course Objectives:

The objectives of this course are:
-to acquaint students with the hand tools used in practice to fabricate a product;
-to facilitate necessary knowledge about the specification of machine tools used in workshops and manufacturing industries;
-to develop skill in identifying the machine tool components and their respective functions, and performing various machining operations on the machine tools used in practice;
-To help students develop the ability to identify and differentiate the work holding devices used in practice to manufacture a product;
-to encourage the students to provide team effort in product manufacturing.

Course Content:

Introduction to Workshop Tools; Study and operation of an Engine Lathe; Study and operation of the Milling Machine; Study and operation of the Radial Drilling Machine; Study and operation of Surface Grinding Machine; and Preparation of a hexagonal nut.

Course Learning Outcomes, CLO

After the successful completion of the course, students will be able to:

CLO1 sketch, specify and use various work holding tools, marking and measuring tools, cutting tools, finishing tools, and other tools such as hammer, spanner, screwdriver, and wrench, etc.;

CLO2 specify various machine tools such as engine lathe, milling machine, radial drilling machine, and surface grinding machine used in workshops as well as manufacturing industries;

CLO3 identify various components of an engine lathe, milling machine, radial drilling machine, and surface grinding machine and describe their respective functions;

CLO4 identify and differentiate the work holding devices used in an engine lathe, milling machine, radial drilling machine, and surface grinding machine;

CLO5 perform various machining operations on an engine lathe, milling machine, radial drilling machine, and surface grinding machine individually;

CLO6 apply their machining skills to fabricate parts of desired features from a given workpiece as per given drawing;

CLO7 apply their team effort to make the sequence of operations required for manufacturing a hexagonal nut and prepare it from a given cylindrical workpiece as per given drawing.

Mapping of CLOs with PLOs

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		1						2					
CLO2		1						2					
CLO3								2					
CLO4					2								
CLO5					2								
CLO6							3						
CLO7							3						

Correlation: 3-High, 2-Medium, 1-Low

Books Recommended:

1. Rajender Singh, Introduction to Basic Manufacturing and Workshop Technology, New Age International Publishers
2. U.K. Singh and Manish Dwivedi, Manufacturing Processes, New Age International Publishers
3. H.N. Gupta, R.C. Gupta, and Arun Mittal, Manufacturing Processes, New Age International Publishers

Course No: PHY104C	Credit: 1.5	Year: First
Course Title: Basic Physics Sessional (For CEE Major)		Course Type: Practical

Course Objectives:

The objectives of this course are to enable students for carrying out some fundamental experiments to find out the numerical values of some physical parameters based on various laws, principle and theorem of physics.

Course Content:

Mechanics:

1. Determination of moment of inertia of a flywheel.
2. Determination of "*g*" by and moment of inertia of a compound pendulum.

Properties of matter:

1. Determination of Young's Modulus by the method of bending.
2. Determination of Rigidity Modulus by Static method.
3. Using a flat spiral spring: a) Verification of Hooke's Law and determination of stiffness constant; b) Determination of "*g*" and the effective mass of the spring; c) Determination of modulus of rigidity of the material of the spring.

Electricity:

1. Determination of galvanometer resistance by half deflection method.

Course Learning Outcomes:

Upon completion of this course, the student will be able to:

CLO1 Apply the principle of conservation of mechanical energy to analyze system undergoing both rotation and translation and find the moment of inertia of uniformly shaped, rigid body.

CLO2 Interpret load versus strain graphs and perform calculations using elastic moduli.

CLO3 Estimate the elastic deformations of materials needed in our daily life.

CLO4 Apply different techniques to measure the acceleration due to gravity "*g*" by using a compound pendulum from the measured time period and compare the predicted result with the published data.

CLO5 Measure the resistance of a galvanometer, familiar with various electrical components used in the experiment and construct circuits based on the circuit diagram.

CLO6 Calculate experimental errors using the error analysis rules.

Mapping of the CLOs with PLOs

CLO/PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO0	PLO 11	PLO 12
CLO1	2	2	2	2								
CLO2	1	3	2	2								
CLO3	1	2	2	2								
CLO4	1	2	2	2								
CLO5	1	1	1									
CLO6	1											

Correlation: 3-High, 2-Medium, 1-Low

Recommended Books

1. Worsnop, B.L. and Flint, H.T.: *Advanced Practical Physics*
2. Chowdhury, S. A. and Basak, A. K.: *Byaboharik PadarthaBidya*
3. Ahmed, G. and Uddin, M. S.: *Practical Physics*

Course Title: Introduction to Computer Language	Credits: 2.0
Course No.: CSE 203C	Contact hours: 2 hours/week

Rationale:

To familiarize the student with basic concepts of computer programming and developer tools. To present the syntax and semantics of the "C" language as well as data types offered by the language. To allow the students to write their own programs using standard language infrastructure regardless of the hardware or software platform.

Objectives:

- To provide students a basic understanding of computer hardware and how a computer works
- To make students understand the basic terminology used in computer programming
- To facilitate with knowledge of how to write, compile and debug programs in the C language
- To help students write programs involving decision structures, loops, functions, and pointers
- To help students develop skills on standard programming practices and how to build up their own logic and how to implement them.

Course Contents:

Computer Basics: Concept on Computer Hardware, Software, and its classification. **C-Language:** Preliminaries, Program constructs variables and data types in C. Input and output. Character and formatted I/O; Arithmetic Expressions and Assignment statements; Loops and Nested loops; Decision making; Arrays, Functions; Arguments and local variables, Calling Functions and arrays. Recursion and

Recursive functions; Structures within a structure. Files; File functions for sequential and Random I/O. Pointers; Pointers and structures; Pointer and functions; Pointer and arrays; Operation and Pointer; Pointer and memory addresses; Operations on Bits; Bit Operation; Bit field; Advanced features; Standard and library.

Course Learning Outcomes: After the successful completion of the course, the student will be able to-

CLO1 Understand the concepts of computer hardware and how it works
CLO2 Recall the basic terminology used in computer programming
CLO3 Construct, compile and debug programs in the C language
CLO4 Apply control-flow tools such as loop, if-else, etc.
CLO5 Understand the usage of pointers, structures, and some advanced topics
CLO6 Employ standard programming practices

Mapping of Course Learning Outcomes to Program Learning Outcomes

PLO/ CLO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
CLO1			3									
CLO2						2	2				2	
CLO3						2	2				2	
CLO4						2	2				2	
CLO5						2	2				2	
CLO6						2	2				2	

Correlation: 3-High, 2-Medium, 1-Low

Textbook

1. Schaum's Outline of Programming with C by Byron S. Gottfried
2. C: The Complete Reference by Herbert Schildt

Course Title: Introduction to Computer Language Lab	Credits: 2.0
Course No.: CSE 204C	Contact hours: 4 hours/week

Rationale:

To familiarize the student with basic concepts of computer programming and developer tools. To present the syntax and semantics of the "C" language as well as data types offered by the language. To allow the students to write their own programs using standard language infrastructure regardless of the hardware or software platform.

Objectives:

- To help to develop skills to work with C compilers and how to use run programs on the computer
- To foster the analytical and critical knowledge to build up logic and implement them using programming language C
- To facilitate necessary knowledge about how to design programs involving decision structures, loops, functions, and pointers
- To help to develop skills to debug codes by giving an in-depth idea about different syntax errors, exceptions and how to fix them

Course Contents:

Computer Basics: Concept on Computer Hardware, Software, and its classification. **C-Language:** Preliminaries, Program constructs variables and data types in C. Input and output. Character and formatted I/O; Arithmetic Expressions and Assignment statements; Loops and Nested loops; Decision making; Arrays, Functions; Arguments and local variables, Calling Functions and arrays. Recursion and Recursive functions; Structures within a structure. Files; File functions for sequential and Random I/O. Pointers; Pointers and structures; Pointer and functions; Pointer and arrays; Operation and Pointer; Pointer and memory addresses; Operations on Bits; Bit Operation; Bit field; Advanced features; Standard and library. **Problem Solving:** Basic Calculator, Odd/Even Test, Showing Letter Grade from Number, Drawing different shapes using Asterisks (*), GCD, Palindrome, Fibonacci Series, Geometric Mean, Quadratic Formula, Cumulative Sum, Cumulative Product, Weighted Average, Generating Prime Number using Sieve of Eratosthenes, Prime Factorization, Big Mod, SOD, NOD, Permutation, Combination, Finding Areas, Basic Geometry Problems, Factorial, Leap Year, Tower of Hanoi, String Manipulation: Vowel and Consonant Count, Reversing a Word, Matrix Multiplication, Piglatin Generator.

Course Learning Outcomes: After the successful completion of the course, the student will be able to-

CLO1 Recognize C compilers and necessary tools to run programs on the computer
CLO2 Interpret logic and implement them using C
CLO3 Design programs involving decision structures, loops, functions, and pointers
CLO4 Debug codes by using the in-depth idea about different types of errors and exceptions
CLO5 Implement knowledge of programming to solve real-life problems

Mapping of Course Learning Outcomes to Program Learning Outcomes

PLO/ CLO	PLO1	PL O2	PL O3	PL O4	PL O5	PL O6	PL O7	PL O8	PL O9	PL O10	PL O11	PL O12
CLO1							3					
CLO2			3			2						
CLO3			3			2						
CLO4			3			2						
CLO5											3	

Correlation: 3-High, 2-Medium, 1-Low

Textbook

1. Schaum's Outline of Programming with C by Byron S. Gottfried
2. C: The Complete Reference by Herbert Schildt

MAT 207C	Year 02	Semester 01	Full Marks:
Vector Calculus, Matrix, Laplace Transformation and Partial Differential Equations	Credits 03	Theory	100

Course Content

Vector Calculus: Differentiation and integration of vectors together with elementary applications; line, surface and volume integrals; gradient of scalar functions; divergence and curl of vector functions; physical significance of gradient, divergence and curl; Stoke's theorem, Green's theorem and their applications.

Matrix: Types of matrices and algebraic properties; rank and elementary transformations of matrices; solution of system of linear equations by matrix methods; linear dependence and independence of vectors; matrix polynomials; determination of characteristic roots and vectors.

Laplace Transformation: Definition of Laplace transforms; elementary transformations and properties; convolution; solution of differential equations by Laplace transforms; evaluation of integrals by Laplace transforms.

Partial Differential Equation: Introduction; equation of the linear and non-linear first order standard forms; linear equations of higher order; equations of the second order with variable coefficients.

Recommended Books:

1. Spiegel, M.R.: Advanced Calculus
2. Spiegel, M.R.: Vector Analysis and Introduction to Tensor Analysis
3. Lass, H.: Vector and Tensor Analysis
4. Ayres, F: Matrices
5. A G Hamilton: Linear Algebra
6. Spiegel, M. R.: Laplace Transform
7. Khanna, M. L.: Laplace Transforms
8. Khanna, M. L.: Partial Differential Equations

1.1	**Course title**	Statistics
1.2	**Course no**	STA211C
1.3	**Credit value**	2.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	Acquire knowledge to analyze applied data
1.6	**Course learning objective**	To provide knowledge of Statistics in order to analyze the data: descriptive way as well as inferential way.
1.7	**Course content**	
Statistics: definition, nature and scope. Nature of statistical data. Attributes and variables, population and sample, parameter and statistic, tabulation, frequency distribution, graphical representations		
Measures of central tendency: mean, median, mode geometric mean, weighted mean and truncated mean.		
Measures of dispersion: range, standard deviation, variance, coefficient of variation, skewness and kurtosis.		
Probability: definition, statement and interpretation of laws of probability, Bayes' rule, random variables, mathematical expectations.		
Probability distributions: uses, applications and properties of Binomial, Poisson, negative Binolial, Exponential distribution, Normal distribution standard normal distribution. Brief discussion on sampling distributions- χ^2, t and F distributions.		
Test of hypothesis: about mean, variance, proportion, test of independence, contingency tables, test of homogeneity, confidence intervals for mean, variance, proportions, sample size determination.		
Correlation and regression: definition, measure, interpretation and significance, curve fitting by least squares method and related tests, simple linear regression model with underlying assumptions, multiple linear regression.		
Design of Experiments: briefly		
1.10	**Course learning outcomes**	***By the end of this course, students will be able to:*** 1. To learn about the basic tools of statistics 2. To represent the data with interpretation in descriptive way as well as inferential way 3. To make correlation and regression between the variables. They will also be able to know about the design of experiments.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1		3					2						
CLO2							2	2					
CLO3					3		2						

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	**Main texts:** Montgomery, D C and Runger, G C. Applied Statistics and Probability for Engineers, 3rd Ed, John Wily and Sons, 2003. Shill R.N. &DebnathS.C. : An introduction to the theory of Statistics, Dhaka, 2001 Mostafa, M G, Methods of Statistics, Karim press and publication, Dhaka Bangladesh. 1989 Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, 10th ed, Sultan chand and sons, 2000 Hogg R V & Craig A T, Introduction to Mathematical Statistics, 5th Ed, Macmillan, London, 1995 DeCoursey, W J. Statistics and Probability for Engineering Applications, Newnes, Elsiver Science (USA), 2003

1.1	**Course title**	Practical Statistics
1.2	**Course no**	STA212C
1.3	**Credit value**	1.0
1.4	**Semester**	2nd year 2nd semester
1.5	**Rationale**	Acquire practical knowledge to analyze applied data
1.6	**Course learning objective**	To provide knowledge of Statistical tools practically using civil engineering and environment related data
1.7	**Course content**	
Measures of central tendency and dispersion		
Correlation and Regression		
Test of hypothesis: test for population proportion, mean, variance, and test for independence of attributes		

1.11	Course learning outcomes	*By the end of this course, students will be able to:* 1) To analyze their data with proper interpretation 2) To represent the data in descriptive way as well as inferential way.

Mapping between program learning outcome (PLO) and course learning outcome (CLO)

CLO	PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO 10	PLO 11	PLO 12
CLO1		3	2	1									
CLO2					3		2						

Correlation: 3-High, 2-Medium, 1-Low

Reference books:	**Main texts:** Montgomery, D C and Runger, G C. Applied Statistics and Probability for Engineers, 3rd Ed, John Wily and Sons, 2003. Shill R.N. &DebnathS.C. : An introduction to the theory of Statistics, Dhaka, 2001 DeCoursey, W J. Statistics and Probability for Engineering Applications, Newnes, Elsiver Science (USA), 2003 **Reference Books:** Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, 10th ed, Sultan chand and sons, 2000 Hogg R V & Craig A T, Introduction to Mathematical Statistics, 5th Ed, Macmillan, London, 1995

Course Title	**Urban & Regional Planning**		
Course Code	ARC301C	**Module**	8
No. of Credits	2.0	**Course Hour**	2.0

COURSE RATIONALE

The course aims to introduce the basic theory, concept and practices in physical planning through review and examination of city and regional structures since the beginning of the earliest human settlements to the contemporary, for the students of Civil and Environmental Engineering.

COURSE OBJECTIVES

- To provide the knowledge on the chronological development of cities and towns since the beginning of the earliest human settlements to the contemporary megalopolises, and beyond.
- Helping the students to understand the social-cultural and political forces that influenced the growth of the cities throughout centuries.
- Help them conceptualize basic theories in physical planning in relation to the study of built environment.
- Foster the analytical and critical thinking in understanding various physical environments in terms of their social-cultural, environmental and technological correspondents.

COURSE CONTENT

Concepts of Urban Planning: Definition, objective, scopes, trends, methods; Urban planning components: framework, forms and type of Planning; History of urbanization and planning: early to modern; Planning Governance: Legislation, tools, instruments. Urban planning methods: Theories of zoning system.
Planning culture of Bangladesh; History of town planning in Bangladesh; Urban planning system and local level planning; Planning law and governance; Problem and issues of land management system in Bangladesh. Concept of contemporary planning tools and process: Community Planning, Public-Private Partnership, Built Operate Transfer, Transit-Oriented Development.

MAPPING COURSE LEARNING OUTCOMES (CLO) TO PLO		**MAPPING CLO TO PLO**											
	After successful completion of the course, students will be able to	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	distinguish various human settlements and identify their planning process	1	2										
CLO2	develop a solid conceptual framework on their origin and evolution throughout history							2					
CLO3	relate various socio-cultural, political, environmental and technological impacts to the growth of the cities throughout the globe			2		2							
CLO4	communicate concepts in urban history and theory through both verbal and written presentations								2				
CLO5	identify the limitations of planning and land management system in Bangladesh		2										
CLO6	apply critical thinking in a range of corresponding fields of history and theory in regional and urban planning	1					2						

Ordinance for the Graduate Program at SUST

Formation of Graduate Study Committee (GSC) will be the prerequisite to start a Graduate program in any Discipline. The GSC will be headed by the Head of the Discipline/ Institute consisting of all professors/Associate Professors of the discipline concerned with a minimum number of 3 professors/Associate Professors. When Professors and Associate Professors are not available in the discipline, the required number of Professors, Associate Professors will be included from the relevant Discipline/Institute by the proposal of the Board of Advanced Studies (BAS) & the Academic council.

1. Introduction

1.1 The graduate program consists of Masters (General), Masters (Thesis), M.Sc. (Engineering), Masters of Philosophy (M.Phil.) and Ph.D. degrees.
1.2 A graduate program may also be offered by a discipline in some specified field in collaboration with other disciplines.
1.3 Any student with (i) 4 year Bachelors degree (ii) 3-year Bachelor and 1-year Masters Degree or (iii) 5-year Bachelor of Architecture degree from a recognized university is eligible to get admitted into the graduate program at SUST.
1.4 Notification for the admission process will be published every year.
1.5 After admission every student will be assigned to a student advisor/supervisor from among the teachers of his/her discipline to guide him/her throughout the academic program.

2. Qualification

2.1 Masters and M.Phil.
2.1.1 Any student with a Bachelors degree from SUST is eligible for admission to the Masters (General) Program.
2.1.2 Any student with a CGPA of 3.25 or more from SUST is eligible for admission to the Masters (Thesis), M.Phil. (Engineering) or M.Phil. Program.
2.1.3 Four-year Graduates from other recognized universities and institutions with a CGPA of 3.25 or more can apply for admission to the Masters (Thesis), M.Phil. (Engineering) or M.Phil. Program. A candidate who passed under course system and seeks admission to M.Phil program has to have First class in Masters or 50% marks in Masters and at least 2nd division in all public examination.
2.1.4 Any student registered for Masters (General) or Masters (Thesis) may transfer to the M.Phil. program, offered by the relevant discipline, if he/she can maintain a CGPA of 3.25 or more during the first two semesters.
2.1.5 The GSC of a discipline will decide if a student from a related discipline will be allowed to apply to the graduate program of that discipline. In these cases if necessary the GSC may ask the candidate to take extra undergraduate/graduate courses to ensure the basic foundation.

2.2 Ph.D.
2.2.1 Candidates with Masters (Thesis), M.Phil. or M.Sc. (Engineering) Degrees are eligible for application for Ph.D. and will be selected after a written and/or viva voce examination and the proper evaluation of academic records by the GSC. A candidate who passed under course system and seeks admission to Ph.D. program has to have First class in Masters or 50% marks in Masters and at least 2nd division in all public examination.
2.2.2 A Masters (Thesis) an M.Phil. or an M.Sc. (Engineering) student may be transferred to the Ph.D. program after the completion of first two semesters with a CGPA 3.25 and the recommendation of his/her supervisor certifying satisfactory progress of research work and with the approval of the GSC and BAS.
2.2.3 The following candidates are eligible for direct admission to Ph.D. if they have a CGPA of 3.25 or more at Bachelors and Masters Level and 3.00 or equivalent in all public examinations. (i) University teachers with two years teaching experience and one publication in standard academic journals. (ii) Teachers of colleges with three years of teaching experience and one publication in a standard academic journal (iii) Researchers of recognized research organizations with three years of research experience and at least three publications in standard academic journals. (iv) Candidates with an M.Phil degree.

3. Admission

3.1 Masters and M.Phil.
3.1.1 If a SUST graduate has the required qualifications he/she can be admitted to the Masters program (General, Thesis or Engineering) as per the recommendation of the GSC.
3.1.2 The candidates for Masters (Thesis and Engineering) and M.Phil. will be selected for admission after a written and/or viva voce examination conducted by the GSC. Full time teachers of SUST are not required to sit for the admission test. GSC will then recommend the candidates for admission to the academic council through the BAS. During the process of admission each candidate shall be assigned by the appropriate GSC and approved by BAS a supervisor from among the teachers of the relevant discipline/institute not below the rank of an associate professor or an assistant professor with a Ph.D. / M.Phil. / M.S.

3.2 Ph.D.
3.2.1 A candidate for admission to the Ph.D. degree program will apply in the prescribed form to the head of the discipline or the director of institute along with the recommendation from possible supervisor(s). The supervisor must be of the rank of professor or associate professor.
3.2.2 After approval from the GSC, the application will be forwarded to the BAS for the approvals of the supervisor and co-supervisors (if any). Each candidate shall have not more than two co-supervisors; one co-supervisor may be from outside SUST. After careful scrutiny of the research proposal BAS will send it to the Academic Council for final Approval.
3.2.3 If necessary a change of supervisor must also be approved by the BAS and the Academic Council.

4. Registration

4.1 Every selected candidate will be registered with the University and enrolled as a full time or if allowed, part time student with payment of prescribed fees and dues before the commencement of each semester.
4.2 A student has to register for at least 50% or maximum 150% credits of the courses at every semester in the prescribed syllabus. But for attaining degree in the last semester above mentioned restrictions will not be followed.

4.3 A candidate may be admitted or change his status into part time student with prior approval of the university and a written consent from the serving organization. A part time student may be assigned a minimum of 6 credit hours per semester.
4.4 A full time student must register for a minimum of 1(2.0 Credits) hours per semester. A full time student shall not be allowed to be employed as a part time employee in other organizations. However he/she may be employed as teaching/research assistant at the University. A Ph.D. candidate shall have to be a full time student for at least one year during his/her Ph.D. work.
4.5 The registration for the Ph.D. degree will remain valid for a period of four years, and can be renewed for a further period of two years.

5. Academic Regulations

5.1 Duration

5.1.1 The minimum duration for the Masters, M.Sc. (Engineering), M.Phil. and Ph.D. degrees will be as followed:

Degree	Duration of Completion	Required Credits
Masters (General)	2 Semesters	Minimum 24
Masters (Thesis)	3 Semesters	36
M.Phil. / M.Sc. (Engg.)	4 Semesters	48
Ph.D.	6 semesters	72

5.1.2 Minimum duration of M.Phil will be 4 Semesters for students who completed 3 years Bachelors and 1 year Masters degree. Minimum duration of M.Phil will be 2 semesters for students who completed 4 years Bachelors and 1 year Masters degree.

5.2 Credit Requirement

5.2.1 For the graduate program a full time student has to register for at least 1(2.0 Credits) each semester. For course work 1 credit means one hour of contact hour per week and for research or project work 1 credit hour means at least three hours per week. A student will be allowed to take theoretical course and research work simultaneously. Once the course requirement is completed, for the research work a graduate student has to register for "independent study" as credit/no-credit basis to fulfill the 1(2.0 Credits) per semester requirement.

5.3 Course Requirement

5.3.1 Syllabus committee for the graduate program will be comprised of the GSC members and two external members from other universities nominated by the Dean.
5.3.2 Every year the syllabus committee will design the graduate level courses for the respective disciplines and recommend the courses for approval of the Academic Council through the School and BAS. GSC can review the curriculum from time to time and recommend any change to the syllabus committee as may be considered necessary.

Masters and M.Phil.

5.3.3 Every Masters (general, thesis and engineering) and M.Phil. student has to complete at least 16 hours of theory course work during the first two semesters. GSC will propose the required courses to the students with consultation of respective supervisors. The course work for M.Phil Program may be reduced and relaxed according to the recommendation of GSC. In that case the duration may be reduced up to 1 year.

Ph.D.

5.3.4 The GSC may suggest courses, if felt necessary, for the Ph.D. students.

5.4 Research Work Requirement

5.4.1 Research work for thesis shall be carried out under the supervision of the supervisor. Co-supervisors from within or outside the discipline / Institute may be appointed, if necessary. The topic of research proposal shall be approved by the BAS after the completion of the required course credits within six months/one year for M.Phil. / Ph.D. on the recommendation of the Head of the Discipline/Institute. A Ph.D. student must submit a progress report of his work to the supervisor(s) at the end of the every semester who will present it to BAS.
5.4.2 The Ph.D. student will give at least one public seminar talk conducted by GSC at the Discipline / Institute every year on a topic of his own field of research.
5.4.3 The research work must be carried out in this University or at a place approved by the supervisor in consultation with the GSC.

6. Conduct of Examinations

6.1 Course Examination

6.1.1 The examination committee will conduct the course examinations as per the examination ordinance of graduate program.

6.2 Thesis Submission

6.2.1 The title of the thesis has to be approved by the BAS on the recommendation of the Head of the Discipline / Institute. For Masters/M.Phil. it has to be done at least three months and for Ph.D. it has to be done at least six months before submitting.
6.2.2 Every student shall submit to the supervisor required number of type written copies of his thesis in the approved forMATon or before a date to be fixed by the Head of the Discipline/ Institute in the consultation with the supervisor concerned.
6.2.3 The student shall declare that the research work was done by him/her and has not submitted elsewhere for other purpose (except for publication).
6.2.4 The thesis should demonstrate an evidence of satisfactory knowledge in the field of research undertaken by the student.

6.3 Masters Thesis Examination

6.3.1 There is no thesis requirement for Masters (General). The project (if any) and the thesis for Masters (Thesis) and will be evaluated as per the examination ordinance of graduate program.

6.4 M.Phil. / M.Sc. (Engineering) Thesis Examination

Thesis Evaluation

6.4.1 The academic council will, on the basis of the suggestion of the GSC and recommendation of the BAS, appoint for every thesis an examination committee consisting of two examiners of whom at least one shall be from outside this University.
6.4.2 The examiners of thesis will either accept it or reject it for the degree and then individually and separately submit one copy of their reports in sealed covers to the controller of examination and another copy to the GSC Chairman. The majority decision will be considered as the final result.
6.4.3 If a thesis is adjudged inadequate for the award of the degree, the candidate will be allowed to resubmit his thesis within six months. If the candidate fails to resubmit or the thesis is adjudged inadequate again the examiners may recommend Masters (general) degree and the controller of examination will place such recommendation before the BAS for the approval of academic council.

Oral Examination and Open Presentation
6.4.4 The GSC in consultation with the supervisor shall suggest, to the Vice Chancellor through BAS, a committee of three members for oral examination consisting of: (i) Convener: Thesis supervisor (ii) A Professor in relevant field from outside the University (iii) One of the thesis examiners.
6.4.5 If any examiner is unable to accept the appointment or has to relinquish his appointment before/ during the examination, the Vice-Chancellor shall appoint another examiner in his place as per the recommendation of GSC.
6.4.6 After the oral examination the convener will send a consolidated report to the controller of examinations stating clearly whether the award of the degree is recommended, who will in turn place it to BAS for the approval of the Academic Council.
6.4.7 In case a candidate performs unsatisfactorily in oral examination even though the thesis is adjudged adequate the examiners may recommend to the Academic Council that the candidate may be permitted to appear at another oral examination within six months from the first oral examination. No candidate shall be allowed to appear at the oral examination of the same thesis for more than two times.

Recommendation for Degree
6.4.8 After completion for the viva-voce examination, the convener of the viva examination committee will send a consolidated report, stating clearly whether the award of the degree is recommended, to the Controller who will in turn place it to BAS for the approval of the academic council.

6.5 Ph.D. Thesis Examination

Thesis Evaluation
6.5.1 The academic council will, on the basis of the suggestion of the GSC and recommendation of the BAS, appoint for every thesis an examination committee consisting of three examiners of whom one shall be the supervisor and the other two from outside this University and at least one from a university from abroad
6.5.2 One of the three examiners will be appointed by the academic council as the convener of the examination committee.
6.5.3 The examiner of thesis will individually and separately submit one copy of their reports in sealed covers to the controller of examination and another copy to the convener. Every examiner will have to explicitly state whether the award of the Ph.D. degree is recommended or not. The recommendations of all the three examiners must be explicit, unambiguous and unanimous for the award of the degree.
6.5.4 If a thesis is adjudged inadequate for the award of the Ph.D. degree, the candidate will be allowed to resubmit his thesis after six months with proper modification. If the candidate fails to resubmit or the thesis is adjudged inadequate again the examiners may recommend the award of M.Phil. or M. S. degree and the controller of examination will place such recommendation before the BAS for the approval of academic council.

Oral Examination and Open Presentation
6.5.5 On receipt of the unanimous opinions of the examiners, the convener shall fix a date and a venue and suggest, to the Vice Chancellor through BAS, a committee of three members for oral examination consisting of the convener, supervisor/co-supervisor and a thesis examiner. At least one of them has to be from outside the university.
6.5.6 If any examiner is unable to accept the appointment or has to relinquish his appointment before/during the examination, the Vice-Chancellor shall appoint another examiner in his place as per the recommendation of GSC.
6.5.7 In case a candidate is unable to satisfy the viva voice Board even though the thesis is adjudged adequate the Board may recommend to the Academic Council that the candidate may be permitted to appear at another oral examination after a lapse of six months from the first oral examination. No candidate shall be allowed to appear at the oral examination of the same thesis for more than two times.

Recommendation for Degree
6.5.8 After completion of the viva voce examination, the convener will send a consolidated report to the controller of examinations stating clearly whether the award of the degree is recommended, who will in turn place it to BAS for the approval of the Academic Council.

7. Award of the Degree

7.1 Masters
7.1.1 Students will be awarded his/her degree as per the recommendation of GSC chairman after the completion of his required credits.

7.2 M.Phil. and Ph.D.
7.2.1 The vice chancellor shall place the reports of the Oral Examination committee for consideration of the academic council which shall recommend to the Syndicate for the award of the degree.

7.2.2 A hard copy of the thesis accepted by the academic council incorporating any correction and changes suggested by the examination committee shall be preserved in the central library of the university and the corresponding electronic version shall be preserved in the archive.

8. Academic Fee

8.1 To be decided by the Academic Council and the Syndicate.

Ref.: *The clause 4.2 of this Ordinance was approved in the 119th Academic Council.*

Examination Ordinance for the Graduate Program

University authorities will administer and publish the results of Masters, M.Phil. and Ph.D. degree examinations under the graduate program. The graduate program will follow the same academic calendar of the undergraduate program for course delivery, the final examination and publication of results. The graduate courses are comprised of theory and lab courses and where applicable, the thesis for the research works. The evaluation of thesis is conducted as per the Ordinance for the Graduate Program at SUST. The theory and lab courses are conducted by the examination committee.

1. Examination Committee

1.1 The GSC of the Discipline/Institute will form the examination committee as per the rules of the University.

1.2 The examination committee will propose the examination schedule, prepare question papers, help the discipline conducting the examination, prepare results and will resolve the issues that may arise concerning the examination procedure.

2. Examination Dates and Routines

2.1 The examination routines will be designed by the respective disciplines and Head of the disciplines will notify them and send copies to the other relevant disciplines and to the office of the Controller of the Examinations.

3. Theory Courses

3.1 Distribution of Marks

A student will be continuously evaluated during the semester through tests, assignments, mid-semester examinations, viva etc. conducted by the course teachers, and it will contain 30% of total marks. The rest 70% marks will come from the final written examination at the end of that semester.

3.2 Class Performance

After the end of the classes, the course teachers will make three copies of mark-sheets showing the marks from class participation and assignment and mid semester examination. He/she will display one copy in the notice board, send one sealed copy to the chairman of the examination committee and another sealed copy to the controller of examination.

3.3 Question Setting and Moderation

3.3.1 The examination Committee will appoint two question setters for each course at least four weeks before the date of commencement of the examination and inform the Controller of examination. The controller of examination will send the necessary papers to the question setters and the examiners. If a question setter or examiner declines the responsibility, he/she will return all the papers and the examination committee will suggest an alternative question setter or examiner.

3.3.2 The chairman of the examination committee will receive all the manuscript of question papers; if no manuscript is received within the specified time the committee will suggest an alternative question setter.

3.3.3 After receiving all the question papers the examination committee will moderate the question papers. Moderation will not be invalid if any member be absent during moderation. For the disciplines of the school of Applied Sciences and Technology the questions will be divided in two groups in the question paper so that two examiners can evaluate the answer script simultaneously. The examination committee will be responsible for the preparation of the necessary editing and printing of the question papers.

3.4 Final Examination

3.4.1 The controller of examination will be responsible to print the blank answer scripts, mark sheets and other relevant forms and will make necessary arrangements, so that these are available during the conduct of examination in the examination hall in due time .

3.5 Evaluation of Answer Script

3.5.1 The answer scripts from the disciplines of Applied Science and technology will be evaluated by two examiners simultaneously, of whom one should preferably the course teacher. The answer scripts from the disciplines of other school of studies will be evaluated by two examiners separately, of whom one should preferably the course teacher. The examiners will examine the scripts thoroughly, mark the scripts properly and grade legibly within the specified time. The examiners will send a sealed copy of mark-sheet to the controller of examination and one sealed copy to the chairman of the examination committee.

3.5.2 The examination committee will assign members from the committee to scrutinize the answer scripts and if any discrepancy is found the committee will make the necessary arrangements to fix the problem and inform the controller of examination.

3.5.3 If the difference between marks given by two examiners be 20% or more than 20% GSC will recommend a third examiner for approval by the V.C and marks given by 3rd examiner & the marks of the first or 2nd examiner which ever is nearest to this will be considered for the average marks .

4. Lab Courses

4.1 Every lab course will be assigned to at least two course instructors and they will grade the students through continuous evaluation.

4.2 For the projects, Masters (Thesis), Industrial assignments, monographs etc. the supervisor will give an overall assessment which will count as 30% of the total marks. Evaluation of the report by two external examiners, who is not involved in supervision/co-supervision will count as another 30% of the marks. The remaining 40% will come from the presentation and viva voce conducted by the examination committee. During viva-voce examination the supervisor or co-supervisor, if present, will not participate in marking.

5. Publication of Result

5.1 Three original tabulation sheets will be prepared by the tabulators and checked by all the members and signed by the tabulators and members of the examination committee. The tabulation sheets will contain the grade point average obtained in the specific semester. The tabulation sheets will be sent to the Controller of Examinations for his signature and approval by the Vice-Chancellor.

5.2 The Controller of Examination shall keep up to date record of all the grades obtained by the student in individual Academic Record Card. Grades shall be announced by the Controller of Examination at the end of each semester.

Grade and grade points:

5.3 The letter grade and grade point will be awarded as follows:

Numerical Grade	Letter Grade	Grade Points
80% Or above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 80%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	C-	2.00
Less than 40%	F	0.00

6. Security and Ethics

6.1 Everyone involved in the process of examination has to guard the security of the question papers, examination grades and the final results. An examinee can never try to influence the examiners and any such attempt has to be brought to the controller of examination.

6.2 A student may never be asked a question so that he is hurt because of his religious or ethnic background.

6.3 If some one involved in the examination process has the following relatives as examinee he/she should immediately inform in to the authority: (a) Husband/wife, (b) Son/Daughter, (c) Brother/Sister, (d) Brother-in-Law/ Sister-in-Law (e) Son-in-Law/ Daughter-in-Law, (f) Nephew/ Niece, (g) Uncle/ Aunt, (h) First Cousins.

Department of Civil and Environmental Engineering
Graduate Program
Session 2021-2022

Department of Civil and Environmental Engineering (CEE) of Shahjalal University of Science and Technology (SUST) offers different types of post graduate degrees namely i) Masters (General) ii) Masters (Thesis) and iii) M.Sc. (Engg.) (equivalent to M.Phil.) in three different programs: a) Civil and Environmental Engineering (CEE), b) Disaster and Environmental Engineering (DEE) and c) Sanitation.

- To fulfill the M.Sc. (Engg.) in CEE, theory courses of 30 credits in first two semesters and thesis of 18 credits in third and fourth semester totaling 48 credits within four semesters have to be completed.
- To fulfill the M.Sc. (Engg.) in DEE, theory courses of 30 credits in first two semesters and thesis of 18 credits in third and fourth semester totaling 48 credits within four semesters have to be completed.
- Fulfill the Masters (Thesis), theory courses of 24 credits from CEE/DEE/Sanitation program in first two semesters and thesis 12 credits in third semester totaling 36 credits within the three semesters have to be completed.
- To fulfill the Masters (General), only theory courses of 24 credits from any of CEE and DEE programs in first two semesters have to be completed.
- To fulfill the Masters (General) in Sanitation, theory courses of 21 credits from Sanitation program and project course of 3 credits totaling 24 credits within first two semesters have to be completed.

INFORMATION FOR GRADUATE PROGRAMS IN CIVIL AND ENVIRONMENTAL ENGINEERING

Theory courses will be selected by Graduate Studies Committee (GSC) of the CEE department from the following options as per necessary:

- General courses
- Courses of structural and construction engineering
- Courses of geotechnical and geo- environmental engineering
- Courses of water and environmental engineering
- Courses of transportation engineering

Summary of courses for graduate programs in Civil and Environmental Engineering (CEE)

Course No.	Course Title	Hours / Week Theory + Lab	Credit
	THEORY		
CEE531	Advanced Numerical Methods and Modelling	3+0	3.0
CEE533	Advanced Engineering Mechanics	3+0	3.0
CEE535	Environmental Mathematical Modelling	3+0	3.0
CEE537	Project Design and Implementation	3+0	3.0
CEE539	Natural Conservation and Urban Planning	3+0	3.0
CEE541	Seismic Engineering	3+0	3.0
CEE543	Wind Engineering and Structural Safety	3+0	3.0
CEE551	Ground Improvement Techniques and Applications	3+0	3.0
CEE561	Transportation Modeling	3+0	3.0
CEE571	Coastal Engineering	3+0	3.0
CEE573	Integrated Water Resources Management	3+0	3.0
CEE575	Flood Control and River Engineering	3+0	3.0
CEE581	Applied Environmental Impact Assessment	3+0	3.0
CEE583	Industrial Waste Management and Control	3+0	3.0
CEE585	Advanced Environmental Engineering	3+0	3.0
CEE587	Water and Wastewater Management	3+0	3.0
CEE589	Disaster Engineering and Management	3+0	3.0
	THESIS		
CEE520	Thesis.	0+12	12.0
CEE530	Thesis for M.Sc. Engg.	0+18	18.0

Notes:

1. *Students of Masters (General; 2-semester program) in CEE must take 24 credits theory courses approved by GSC.*
2. *Students of Masters (Thesis; 3-semester program) in CEE must take 24 credits theory courses and 12 credits thesis approved by GSC.*
3. *Students of M.Sc. Engineering (Thesis; 4-semester program) in CEE must take 30 credits theory courses and 18 credits thesis approved by GSC.*

CEE520 THESIS
(12 hours/week, 12.0 credits)

Thesis should be carried out on a selected topic that will be completed within 3rd semester. Thesis topic must be approved by board of Graduate studies committee of Civil and Environmental Engineering Department.

CEE530 THESIS FOR M.SC. ENGG.
(18 hours/week, 18.0 credits)

Thesis should be carried out on a selected topic that will be completed within 4th semester especially in 3rd and 4th semesters. Thesis topic must be approved by board of Graduate studies committee of Civil and Environmental Engineering Department.

CEE531 ADVANCED NUMERICAL METHODS AND MODELLING
(3 hours/week, 3.0 credits)

Fundamental concepts:
Mathematical models in engineering problems: Definition of mathematical model, Types of engineering problems and its Modeling, Method to create a model.
Review of numerical methods: Roots finding algorithms, Ordinary and partial differential equations and their solution, Numerical differentiation and integration, Finite difference, Initial and boundary value problems and their solutions.
Basic equations in Engineering Mechanics: Two dimensional elasticity equations, Beam under axial and transverse load, Lateral deflection of thin membrane, Plate under flexural load.
Review of Linear Finite Element Methods (FEM): Basic concept of FEM, FEM for one- dimensional problems, FEM for two-dimensional problems, FEM for three-dimensional problems, Scalar field problems.

Numerical modeling of engineering problems:
i) Application of numerical methods in Environmental Engineering: Population model, Atmospheric dispersion model, Biomass growth model, Contaminant transport model.
ii) Application of numerical methods in Geotechnical Engineering: Pressure isobar model, Slope Stability model.
iii) Application of numerical methods in Transportation Engineering: Traffic congestion model.
iv) Application of numerical methods in Water Resource Engineering: Open channel flow model, Pipe Flow model, Ground water Flow model. Software tools and techniques for different engineering fields;
v) Static non-linear analysis and modeling of structural mechanics:
    1. Basics of non-linear structural mechanics, CTU Material non-linearity, Geometrical non- linearity, Consistent linearization of internal virtual work. Finite element discretization of geometrically non-linear continua; Finite volume elements, Finite truss elements. Solution of non-linear static structural equations: Strategies, Iteration methods, Control of iteration procedures. Stability analysis: Computation of stability points, Direct computation of singular points, Software tools and techniques for Static Non- linear FEM.

Recommended Books:
1. Logan, D.L. (2007), A First Course in the Finite Element Method. 4th Ed., Nelson, a division of Thomson Canada Limited. ISBN: 0-534-55298-6
2. Chandrupatla, T.R. and Belegundu, A.D. (2002), Introduction to Finite Elements in Engineering. 3rd Ed., Prentice-Hall, Inc. ISBN: 0-13-061591-9
3. Hutton, D.V. (2004), Fundamentals of Finite Element Analysis. McGraw-Hill. ISBN: 0-07-239536-2 / ISBN: 0-07-112231-1 (ISE)
4. Weaver, W.J. and Gere, J.M. (1980), Matrix Analysis of Framed Structures. 2nd Ed., Van Nostrand Reinhold Company Inc. ISBN: 0-442-25773-2
5. Chapra, S.C. and Canale, R.P. (2005), Numerical Methods for Engineers. 6th Ed., ISBN-13: 978-0073401065
6. Bilal, M.A. and Richard, H.M (2015), Numerical Analysis for Engineers: Methods and Applications. Chapman and Hall/CRC. ISBN 9781482250350
7. Carl .E. Pearson, C.E (1986), Numerical Methods in Engineering and Science. Chapman and Hall/CRC. ISBN 9780442273446

CEE533 ADVANCED ENGINEERING MECHANICS
(3 hours/week, 3.0 credits)

Fluid Mechanics:
Fluid Systems and their application on pipes and nozzle; Effect of hydrostatic forces on the surfaces of fluid structures; Pipe systems design; Dimensional analysis and physical similarities and their application in fluid structures; Viscous fluid; Governing laws of motion in viscous fluid: Continuity equation, Bernoulli's theorem, Euler's equation, Navier-Stokes equation; laminar and turbulent flow; Incompressible flow; Convection and diffusion; Turbulent diffusion; Mass transport equation; Shear flow dispersion; Mixing in rivers and estuaries; Reservoir dynamics; Computation of environmental flow; Flow in open channels, Specially varied flow, Gradually varied and rapidly varied unsteady flow.

Solid Mechanics:
Differential equation of equilibrium of a deformable body and strain displacement relations in Cartesian and Cylindrical co-ordinates; Generalized Hooke's law; Solution of boundary value, problems in a two dimensional elastic continuum; St Venant's principle; Specialization to problems of infinite domain, Thick cylinders; Stress concentrations around holes; Compaction of contact stresses for two bodies in line contact. Torsion of non-circular cross sections: membrane analogy' Hollow thin all multiply connected torsion members. Plates and shells: Introduction to theory of plates and shells, Fracture mechanics: Introduction to linear elastic fracture mechanics, underlying mechanisms and applications of smart materials and structures; Composite materials and structures: Introduction to Composite materials and structures; Non-linear Mechanics: Geometric non-linearity and material non-linearity.

Recommended Books:

1. Kundu, P. K., Cohen, I. M. (2004), Fluid Mechanics. 3rd Ed., Academic Press. ISBN: 9780080470238
2. White, F.M (1991), Viscous Fluid Flow. 2nd Ed., McGraw-Hill. ISBN 0-07-069712-4
3. Schlichting, H (2000), Boundary-Layer Theory. 8th Ed., Springer. ISBN 3-540-66270-7
4. Timoshenko, S. P., and Goodier, J. N. (1970), Theory of Elasticity. 3rd Ed., McGraw-Hill. New York. ISBN-13: 978-0-07-064720-6
5. Sokolnikoff, I. S., and Specht, R. D. (1956), Mathematical theory of elasticity (Vol. 83), New York: McGraw-Hill. ISBN-13: 978-0-07-059629-0
6. Wang, C.T (1963), Applied Elasticity. McGraw-Hill, Inc. ISBN 10: 0070681252 / ISBN 13: 9780070681255
7. Al-Shemmeri, T. (2012), Engineering Fluid Mechanics. Bookboon.
8. Daugherty, R. L., Finnemore, E. J., and Franzini, J. B. (2001), Fluid mechanics with engineering applications. 10th Ed., Tata McGraw-Hill Education. ISBN-13: 978-0-07-112196-5

CEE535 ENVIRONMENTAL MATHEMATICAL MODELLING

(3 hours/week, 3.0 credits)

Definition of mathematical model, Types of mathematical model, Method to create a model, Finite element and Finite volume method. Water supply characteristics, water supply models: management models, mathematical models, ALIED, FLOW etc. Ground water quality and different parameters, Groundwater models: management models, mathematical models, different types of mathematical models practiced for groundwater management such as MODFLOW, ground water flow problems etc. Pollutants of air, atmospheric dispersion models, Contaminant transport model in geo-environment. Biomass growth model, Population model, ecological model. Surface water quality and different parameters, Surface water models: management models, mathematical models, different types of mathematical models practiced for surface water management such as stochastic models, QUAL etc., DO- BOD model. Wastewater characteristics, Different type of waste water reactors, Waste water models: management models, mathematical models, different types of mathematical models practiced for wastewater management. Drainage pattern, drainage characteristics, and catchment areas, Drainage models: management models, mathematical models, different types of mathematical models practiced for urban drainage.

Recommended Books:

1. Chiang, W. H., and Chiang, W. H. (2001), 3D-groundwater modeling with PMWIN (Vol. 346, pp. 67744-5), Berlin, Heidelberg, New York: Springer-Verlag. ISBN-13: 978-3-540-67744-4
2. .Wainwright, J., and Mulligan, M. (Eds.), (2005), Environmental modelling: finding
   simplicity in complexity. 1st Ed., John Wiley and Sons. ISBN-13: 978-0-471-49618-2

3. Khandan, N. (2001), Modeling tools for environmental engineers and scientists. 1st Ed.,
   CRC Press. ISBN-13: 978-1-56676-995-2
4. Banik, B. K. (2015), Sewer systems management: illicit intrusion identification and optimal sensor placement (Doctoral dissertation, Université Paris-Est),
5. Kiely, G. (1997), Environmental Engineering. McGraw-Hill Company. ISBN (13): 978-0071164245.

CEE537 PROJECT DESIGN AND IMPLEMENTATION

(3 hours/week, 3.0 credits)

Definition of Project, Elements of constitutes of a successful project, Project cycle, Project steps, Project elements, Selecting project confronting uncertainty of the management of risk, Selection of project based on IRR, NPV, Standard Deviation.
Role of project manager, Discussion of project management basis – Planning (logical Framework approach), Method of planning of a project, Discussion of the system and project definition, Method of budgeting, Cost estimating, Budget uncertainty and risk management, Scheduling of project, Project delivery system.
PERT, CMP network, Network analysis, Resource leveling, Project resource scheduling, Leadership, Motivation for the project team, Project human resource, Stakeholder management and project communication, Organizational structures, roles, organizational responsibility and organizational maturity.
Project and project management, Project quality management, Quality project standards, Project performance evaluation, Project selection, Project evaluation factors, Project selection by analytic hierarchy method, Multi-criteria evaluation method, Project risk attitudes, Project conflict and control, Critical success factors in project, Parties involved in a project.

Recommended Books:

1. Mareschal, B., and Brans, J. P. (1986), PROMCALC–The PROMETHEE Software User's Guide. HWPR/034, VUB, Brussels.
2. Berkun, S. (2008), Making Things Happen: Mastering Project Management. O'Reilly. ISBN-13: 978-0-596-51771-7
3. Taylor, P. (2015), The Lazy Project Manager: How to be twice as productive and still leave the office early. Infinite Ideas. ISBN-13: 978-1-906821-67-8
4. Eric, V. (1999), The Fast Forward MBA in Project Management. New York: John Wiley & Sons, Inc, 9(20), 285-286. ISBN-13: 978-0-471-23980-2
5. Kerzner, H. (2013), Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons. ISBN-13: 978-0-471-39553-9

CEE539 NATURAL CONSERVATION AND URBAN PLANNING

(3 hours/week, 3.0 credits)

Natural hazards, Man-made hazards, Green Belt, Brown Block, Issues of Brown Agenda, Industrial Hazards: Green House Gas Emissions, Carbon Issues: Carbon Emission, Carbon Trade, Carbon Tax, Hill-cutting, Deforestation and Afforestation, Blocking Water Flow with Dam and Other Man-made Structure versus Free Flow River, Characteristics of Urban towns and Cities, Different types of Evaluation, Social Interactions on Urban Life, Classification of Cities, Linear Cities, Non-Linear Cities: Square City, Rectangular City, Circular City. Ecological Components,

Human Interactions on Ecosystem, Abiotic and Biotic Components of Ecosystems, Ecological Model for urbanization, Cake model, Natural Conservation, Green Marketing, Theory of Environmental Panning, Sustainable Environmental Planning, Definition of sustainability, Human interactions on Sustainability, Sustainable Development Models.

Recommended Books:

1. Ercoskun, O. C. (2012) Green and Ecological Technologies for Urban Planning: Creating Smart Cities. USA: IGI Global. ISBN13: 9781613504536
2. Selman.P.H. (2000) Environmental Planning: The Conservation and Development of Biophysical Resources (second edition). London: Sage Publications. ISBN-13: 978-0761964605

CEE541 SEISMIC ENGINEERING

(3 hours/week, 3.0 credits)

Seismology: Plate tectonics, Earthquake mechanism, Epicenter, Focus, Magnitude, Intensity, Seismic waves, Hypocenter, Wave propagation in layered bodies, Earthquake motion on, ground surface, Earthquake scales, Seismic zoning map of Bangladesh. Characteristics of seismometers and micro tremor instruments; Earthquake time histories; Fourier and response spectra.

Historical seismicity and earthquake catalogues: Data acquisition, sources, magnitude rescaling, application to hazard analysis.

Site characterization: amplification and responses; Experimental simulation and shaking tables.

Introduction to lifeline engineering: electricity, water, natural gas, telecommunication and transportation systems; Post earthquake damage survey; Mitigation strategies; Case studies of major earthquakes; Deterministic and nondeterministic analysis of earthquake response; Earthquake resistant design of buildings, bridges and dams.

Recommended Books:

1. Chopra, A. K. (1995), Dynamics of structures, a primer (Vol. 2), Earthquake Engineering Research. ISBN- 0-13-855214-2
2. Pankaj, A., & Manish, S. (2009), Earthquake resistant design of structures. 5th Ed., PHI learning private limited, New Delhi. ISBN 10: 8120328922/ ISBN 13: 9788120328921
3. Kramer, S.L. (1996), Geotechnical Earthquake Engineering. Prentice Hall, Upper Saddle River, N.J. ISBN- 9780133749434
4. Lecture materials of SAARC Training Program on Techniques for Earthquake Resistant Structures (2012), SAARC Disaster Management Centre, New Delhi and IIT, Roorkee, India
5. Ansary M. A., and Noor M. A. (2006), Earthquake Resistant Design Manual. Bangladesh Earthquake Society, Academic Press and Publishers Library. ISBN– 984 08 0210 0
6. National Plan for Disaster Management 2010-2015 (2010), Disaster Management Bureau of the Government of the People's Republic of Bangladesh
7. Bangladesh National Building Code (BNBC- 2006), Housing and Building Research Institute, Bangladesh (2006)

8. Building Code Requirements for Structural Concrete (ACI 318M-08) and Commentary (2008), American Concrete Institute. ISBN 978-0-87031-283-0
9. Criteria For Earthquake Resistant Design of Structures (2002), Bureau of Indian Standards, New Delhi, India

CEE543 WIND ENGINEERING AND STRUCTURAL SAFETY

(3 hours/week, 3.0 credits)

Wind, cyclone, wave; difference among them; cyclone, types of cyclones, effect of cyclone, nature of wind due to cyclone, components of wind risks. Nature of wind, wind analysis by rose diagram and its impact assessment, components of related wind risks. Vibration, types of vibration due to wind, equations related to vibration, analysis of forced vibration of damped – single degree of freedom due to wind, criteria of foundation design subjected to vibration and related problems. Different types of exposures of wind on structure, wind load calculation on buildings by different methods-projected methods: BNBC-1993 and 2014(draft), Eurocode System (EN 1991-1-4), Wind load in Australian and New Zealand Code (AS/NZS1170.2 (2002).), ASCE 7-05, NBCC 2005, AIJ-1996, IS-2000, Hong Kong-2004, UBC-97, etc; wind loads calculation in industrial warehouses. Wind storms, damage and guidelines for mitigation measures. Wind induced damage to building and disaster risk reduction. Assessment of vulnerability of building due to winds, consideration of building safety in coastal zone subjected to wind.

Recommended Books:

1. Clough, R.W. and Penzien, J. (2003), Dynamics of Structures. Computers and Structures, Inc. ISBN-13: 978-0-923907-50-1
2. Chopra, A.K. (2001), Dynamics of Structures. 2nd Ed., Prentice-Hall, Inc. ISBN-81-203-2139-1
3. Holmes, J. D. (2002), Effective static load distributions in wind engineering. Journal of Wind Engineering and Industrial Aerodynamics, 90(2), 91-109.
4. Taranath, B. S. (2004), Wind and earthquake resistant buildings: structural analysis and design. CRC press. ISBN-13: 978-0-8247-5934-6
5. Ranjitha, K. P., Khan, K. N., Kumar, N. S., & Raza, S. A. (2014, July), Effect of Wind Pressure on RC Tall Buildings using Gust Factor Method. In International Journal of Engineering Research and Technology (Vol. 3, No. 7 (July-2014)), IJERT.
6. Bull J. W. (2015), Tall building: design advance for construction. Saxe-Coburg Publications. ISBN-13: 978-1874672258

CEE551 GROUND IMPROVEMENT TECHNIQUES AND APPLICATIONS

(3 hours/week, 3.0 credits)

Introduction to ground improvement techniques and some renowned case histories; Densification and compaction – field compaction methods and requirements, vibroflotation, and dynamic compaction; Consolidation techniques and their selection strategy – preconsolidation, sand drain, prefabricated vertical drains, vacuum application, electrokinetics; Physical and chemical stabilization methods and application – cement, lime, fly-ash, bitumen, deep mixing; Thermal modification of soil; Reinforcement inclusions – metal strip reinforcement,

geotextile reinforcement, geogrid reinforcement; Ground anchors and micro-piles; Filtration, drainage and seepage control via geosynthetics application.

Recommended Books:

1. Bergado, D.T., Anderson, L.R., Nimura, N., Balasubramaniam, A.S. 1996. Soft ground improvement – in lowland and other environments. ASCE Press, NY. ISBN: 0-7844-0151-9.
2. Das, B.M. 2011. Principles of foundation engineering, SI. 7th ed, Cengage Learning, Stamfort, CT. ISBN: 978-0-495-66812-1.
3. Hausmann, M.R. 1990. Engineering Principles of Ground Modification, McGraw Hill, NY. ISBN-13: 978-0070272798.
4. Indraratna, B., Chu, J. 2005. Ground improvement – case histories. Elsevier, Oxford. ISBN: 0-080-44633-7.
5. Nicholson, P.G. 2015. Soil improvement and ground modification methods. Butterworth Heinemann, Oxford. ISBN: 978-0-12-408076-8.
6. Number of published articles from prestigious journals like Canadian Geotechnical Journal, Geotechnique, Journal of Geotechnical and Geoenvironmental Engineering (Link and papers will be delivered in the class).

CEE561 TRANSPORTATION MODELING
(3 hours/week, 3.0 credits)

Modeling transport demand; approaches of travel demand modeling: trip-based, tour-based, activity-based; four step transportation demand modeling, discrete choice modelling technique (random utility theory): multinomial logit model, nested logit model, cross-nested logit model, mixed logit model, latent class model; survey techniques: revealed preference (RP), stated preference (SP); SP survey design; integrated land use, transportation and environment (ILUTE) modeling system.

Recommended Books:

1. Train K E (2009). Discrete choice methods with simulation: Cambridge university press.
2. Profillidis V A, Botzoris G N (2018). Modeling of transport demand, 1st Edition, Elsevier.

CEE571 COASTAL ENGINEERING
(3 hours/week, 3.0 credits)

Coastal Engineering works; waves: characteristics, types, theory, refraction, reflection, breaking, diffraction and damping; wind generated waves; wind wave prediction; coastal processes, features and formation; longshore sediment transport; sea level fluctuation: tides, storm surges, tsunami, coastal structures; models of coastal processes; coastal management: Boundaries of the coastal system, natural and socio-economic subsystem, coastal concerns and problems; policy for coastal zone management, legal, institutional, economic and environmental aspects; global changes and trends; examples of coastal zone management activities from different countries.

Recommended Books:

1. Bakker, W. T., Coastal Dynamics, USA, World Scientific
2. Kmphius, J. W., Introduction to Coastal Engineering and Management, Canada, World Scientific

CEE573 INTEGRATED WATER RESOURCES MANAGEMENT
(3 hours/week, 3.0 credits)

Water resources system; concepts and principles of integrated water resources management; planning processes and tasks; project formulation and appraisal; identification and evaluation of water management plans; comprehensive regional planning; water resources planning in Bangladesh; systems analysis, models and decision support system; economic and financial analysis; public involvement in water resources planning; environmental impact assessment; social and institutional aspects; water and environmental law.

Recommended Books:

1. Termar, M. k., (1987), Water Resources and Water Management, USA, Elsevier Science
2. Neil, S., (2016), Integrated Water Resources Management, USA, Macmillan Publications
3. Stepehenson, D., (2003), Water Resources Management

CEE575 FLOOD CONTROL AND RIVER ENGINEERING
(3 hours/week, 3.0 credits)

Flood Control:
Types of flood, calculation of runoff in a catchment, Flood frequency analysis (using Log- Pearson method, Weibull method, Weightage Method etc.), Flood in coastal areas, Governing equation for flood modeling, Flood hazard mapping. Flood risk, Flood risk calculation, Back water effect calculation in river. Various flood control measures, Flood protection techniques, River flood and bank erosion, Construction of dam in seismic zone, Flood control in Bangladesh through best management practices. Flood forecasting, Need for flood forecasting, Technique of flood forecasting

River Engineering:
Overview of River Engineering: Introduction, Stream form and classification, River morphology, Geometry of fluvial channels, River planning and design, River investigations, Hydraulic and geomorphic characteristics of river, Physics of flow. Flow in curved channels, Degradation and aggradations, Scour and Scouring Control: Type of scour, Estimating scour, Erosion control, Bridge crossing, River training, Dredging, Morphological characteristics of Ganges-Brahmaputra-Meghna Delta, Principles of Physical Modeling.

Recommended Books:

1. Ghosh, S. N. (1997), Flood control and drainage engineering. CRC Press. ISBN 9781138026278
2. Howard H. Chang (1988), Fluvial Processes in River Engineering. John Wiley and Sons. ISBN-13: 978-0-471-63139-2
3. Przedwojski, B., Błażejewski, R., and Pilarczyk, K. W. (1995), River training techniques: fundamentals, design and applications. AA Balkema. ISBN-13: 978-90-5410-196-3

4. Freitag, B., Bolton, S., Westerlund, F., & Clark, J. (2012), Floodplain management: a new approach for a new era. Island Press. ISBN-13: 978-1-59726-634-5
5. Rossmiller, R. (2013), Stormwater Design for Sustainable Development. McGraw Hill Professional. ISBN-13: 978-0-07-181652-6
6. Julien, P. Y (2004), River Engineering, Stream Restoration and I-stream Restoration.

CEE581 APPLIED ENVIRONMENTAL IMPACT ASSESSMENT
(3 hours/week, 3.0 credits)

Terms used in EIA; Aims and objectives of EIA; Role of EIA in EM; EIA Methodology: Different methods of EIA, initial environmental examination, Baselines studies; Rapid EIA methods: check list, matrix methods; Scooping and communication and people's participation in EIA; Uncertainties in EIA; Impact prediction, evaluation and mitigation; EIA and risk assessment; EIA of development schemes; Economical evaluation of EIA; Cost and Cost/benefit analysis of EIA; Presentation and review of EIA; Strategic environmental assessment; EIA in developing countries; EIA systems practiced in different countries: Australia, Canada, China, Japan, Netherlands, UK, USA etc.; EIA and international agencies: ADB, EC, NEPA, USAID, World Bank, WHO etc.; EIA (State of art) in industrial projects; Application of EIA in energy and agricultural development; EIA for embankment and flood protection measures; EIA of irrigation activities: EIA of infrastructure development project; Environmental impact of flood in rainy season; EIA of draughts in dry season (specially Farakkah and other upstream barrages); EIA in solid waste management; EIA of gas field and tea garden; EIA in JMB project; EIA of transport system and road projects; EIA procedure in private sector, EIA procedure in govt. sector; Different EIA index calculation.

Recommended Books:

1. Canter, L. (1996). Environmental Impact Assessment. 2nd Ed., MacGraw-Hill. Inc., New York. ISBN-13: 978-0-07-009767-4
2. Momtaz, S. and Kabir, Z. (2018), Evaluating Environmental and Social Impact Assessment in Developing Countries- 2nd Ed., Elsevier. Paperback ISBN: 9780128150405.
3. Petts, J., Handbook of Environmental Impact Assessment 1st Edition, ISBN-13: 978-0632047727
4. Lawrence, D. (2005), Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, Inc. ISBN:9780471457220
5. Charles H. Eccleston, C. (2017), Environmental Impact Assessment: A Guide to Best Professional Practices- 1st Ed., CRC Press, ISBN 9781138074156
6. Itakura, Y. (1999), Integrated Environmental Management: Development, Information, and Education in the Asian-Pacific Region -1st Ed., CRC Press. ISBN 9781566704199

CEE583 INDUSTRIAL WASTE MANAGEMENT AND CONTROL
(3 hours/week, 3.0 credits)

Introduction to waste management, Impact of man on the environment, Waste legislation, Waste Management planning, Waste Management Cycle. Sources and characteristics of Industrial Solid waste, Treatment and disposal of industrial waste sludge.

Requirements of the water for various industries, Quality and treatment of industrial water, Characteristics and volume of industrial waste, Problems associated with industrial waste water, Waste water treatment objectives, Physical, chemical and biological methods of industrial waste water treatment including neutralization, equalization, oil separation, flotation, sour water strippers, heavy metal removal, air stripping, chemical oxidation, Overview of waste reduction techniques in industries, Waste problems of major industries and their methods of treatment and disposal- such as petroleum industries (gasoline kerosene treatment), textile industries, tannery, cement, fertilizer, paper and pulp, jute processing, dairy, drug and pharmaceutical, food and allied industry, Complete design of an Effluent treatment plant, Laws and regulations for industrial wastewater and waste treatment.

Recommended Books:

1. Woodard,F. Industrial Waste Treatment Handbook (2nd Edition).USA: Elsevier. ISBN: 9781493303199
2. Pichtel., J. (2005) Waste Management Practices: Municipal, Hazardous, and Industrial,USA:Taylor & Francis. ISBN 9781466585188

CEE585 ADVANCED ENVIRONMENTAL ENGINEERING
(3 hours/week, 3.0 credits)

General Concept: Challenges for the Environment, Water resources, Energy, Population, Agriculture, Land degradation, Industrialization, Urbanization. Types of challenges: Acid rain, green house effects, Municipal waste water, problems of arsenic contamination, pesticides in agriculture, Fate and transport of environmental contaminations, Design and Modeling of Environmental Systems; Chemical and biochemical reactions: rate of reactions, material balances, mass balance on flows and solids, mass balance on air flow and particulates. Flow regimes and reactors: Completely mixed batch-reactors, design plug flow reactor design. Basic Concept of Environmental Biotechnology: Definition, scopes, significance and advantages of environmental biotechnology. Pollution and Biotechnology for Pollution Control, Phyto remediation and Bioremediation. Energy Balanced: Earth's energy balance and the greenhouse effect. Mass Transport Processes: Advection and dispersion, molecular diffusion, the movement of a particle in a fluid stock's law, flow of water through a porous medium, Darcy's law for ground water. Theory of Water Treatment; Sedimentation: Theories of sedimentation (ideal settling of discrete and flocculent particles and deviation from ideality), Coagulation (Destabilization of colloidal particles), Flocculation: Peri-kinetic and Ortho- kinetic) theories, Granular Media Filtration Theory (Transportation, Attachment, and detachment mechanisms), Mechanisms of physical adsorption and chemi-sorption, Iron, manganese and Arsenic removal, Removal of nitrate and fluoride from water, Disinfection: Mechanisms, factors effectiveness and alternatives to disinfection, Chemical precipitation, Membrane Filtration Technology; Mechanisms of revise osmosis, principle and theory, membrane configuration and type, process variables, Electro-dialysis, Gas Transfer: Henry's law, Dalton's law, rate of solution, and dispersion, two film theory, gas transfer equation, and governing factors, type of aeration and applicability, Causes and Sources of order and taste: Treatment, and removal and prevention and control of aquatic growth, Domestic Waste Water treatment;

Introduction, Wastewater treatment categorization, Secondary waste water treatment, Advanced wastewater treatment, Preliminary treatment, Primary treatment, Secondary treatment, Sludge treatment and disposal, Air Pollution Principles and Control; Sources and effects of air pollution, Control of particulate matter from stationary sources, mechanical separation, electro statistic precipitators. Gas and Vapor Control Technology; Incineration, absorption and gas de-sulfurization, Sustainability and renewable energy; Challenges to sustainable development, concept of sustainability, Environment, development and sustainability, Factors governing sustainable development, the economics of sustainability, Renewable energy; Fossil fuels and climate changes, renewable energy sources, renewable energy in future, The world of hydrogen, Solar energy, Bio-energy: Energy crops, woody crops, agriculture crops, wood residues, animal waste, municipal solid waste, landfill gas, commercial and industrial waste etc., Wind and water energy.

Recommended Books:

1. Salvato, J.A., Nemerow, N.L. & Agardy, F.J. (2003), Environmental Engineering (Fifth edition). John Wiley & Sons, Inc., Hoboken, New Jersey. ISBN 0-471-41813-7
2. Weiner, R.F. & Matthews, R. (2003). Environmental Engineering (Fourth edition). Elsevier Science (USA). ISBN: 0750672943

CEE587 WATER AND WASTEWATER MANAGEMENT

(3 hours/week, 3.0 credits)

Ground Water Sources, Surface Water Sources, Rain Water, Water Sources of Bangladesh, Drinking Water Quality, Waste Water Quality, Water and Waste Water Quality Monitoring, Bio-monitoring, Sedimentation Theory, Coagulation and Flocculation, Filtration, Adsorption, Ion Exchange, Hardness and Softening, Aeration and Gas Transfer, Advanced Waste Treatment, Preparatory or Preliminary Treatment, Primary Treatment: Imhoff tank, Septic Tank, Small Bore Sewer System (SBS), Suspended Growth System, Attached Growth System, Waste Stabilization Pond and Lagoons, Nutrient Removal, Natural Waste Treatment and Reuse of Waste Water, Sludge Treatment, Advanced Wastewater Treatment

Recommended Books:

1. Karia, G. L., & Christian, R. A. (2013). *Wastewater treatment: concepts and design approach*. PHI Learning Pvt. Ltd.
2. Tchobanoglous, G., & Burton, F. L. (1979). *Wastewater engineering: treatment, disposal, and reuse*. New York, NY: McGraw-Hill.
3. Ahmed, M. F., & Rahman, M. M. (2000). *Water supply & sanitation: Rural and low income urban communities*. ITN-Bangladesh, Centre for Water Supply and Waste Management, BUET.
4. Garg, S. K. (2010). *Water supply engineering*. New Delhi: Khanna Publishers.

CEE589 DISASTER ENGINEERING AND MANAGEMENT

(3 hours/week, 3.0 credits)

Disaster, vulnerability, risk; definition of different terms related with disaster assessment; types of disaster- flood, cyclone, earthquake, landslide, soil erosion; drought river erosion. Assessment of hazard, vulnerability and risk of flood, earthquake, landslide, soil erosion; drought: river erosion, salinity. Development of hazard map of an area due to flood, earthquake, landslide, salinity. Coastal vulnerability assessment, development of hazard calendar of an area. Climate risk assessment of an area and climate change adaptation.

Recommended Books:

1. Cannon, T. (1994). Vulnerability analysis and the explanation of 'natural'disasters. Disasters, development and environment, 13-30.
2. Mohammad, N. (2006), Natural Hazards and disaster management. Chandu peers.
3. Anderson, M. B. (1995). Vulnerability to disaster and sustainable development: A general framework for assessing vulnerability. Disaster Prevention for Sustainable Development: Economic and Policy Issues. Washington, DC: World Bank, 41-59.

Summary of courses for graduate programs in Disaster and Environmental Engineering (DEE)

Course No.	Course Title	Hours / Week Theory + Lab	Credit
	THEORY		
	MANDATORY COURSES		
CEE631	Advanced Numerical Modeling	3+0	3.0
CEE633	Advanced Mechanics	3+0	3.0
CEE641	Earthquake Engineering	3+0	3.0
CEE685	Challenges in Environmental Engineering	3+0	3.0
CEE689	Challenges in Disaster Engineering	3+0	3.0
	OPTIONAL COURSES		
CEE635	Advanced Environmental Modelling	3+0	3.0
CEE637	Project Management and Controlling	3+0	3.0
CEE639	Natural Preservation and Human-Nature Interaction	3+0	3.0
CEE643	Wind Engineering	3+0	3.0
CEE671	Coastal Engineering and Management	3+0	3.0
CEE673	Integrated Water Resource Management for Engineers	3+0	3.0
CEE675	Flood Control	3+0	3.0
CEE681	Environmental Impact Assessment and Interaction	3+0	3.0
CEE683	Waste Reduction and Control	3+0	3.0
	THESIS		
CEE620	Thesis	0+12	12.0
CEE630	Thesis for M.Sc. Engg.	0+18	18.0

Notes:

1. *Students of Masters (General; 2-semester program) in DEE must take 24 credits theory courses approved by GSC.*
2. *Students of Masters (Thesis; 3-semester program) in DEE must take 24 credits theory courses and 12 credits thesis approved by GSC.*
3. *Students of M.Sc. Engineering (Thesis; 4-semester program) in DEE must take 30 credits theory courses and 18 credits thesis approved by GSC.*

Detailed Syllabus for graduate program in Disaster and Environmental Engineering (DEE)

CEE620 THESIS
(12 hours/week, 12.0 credits)

Thesis should be carried out on a selected topic that will be completed within 3rd semester. Thesis topic must be approved by board of Graduate studies committee of Civil and Environmental Engineering Department.

CEE630 THESIS FOR M.SC. ENGG.
(18 hours/week, 18.0 credits)

Thesis should be carried out on a selected topic that will be completed within 4th semester especially in 3rd and 4th semesters. Thesis topic must be approved by board of Graduate studies committee of Civil and Environmental Engineering Department.

CEE631 ADVANCED NUMERICAL MODELING
(3 hours /week, 3.0 Credits)

Fundamental Concepts
Mathematical models in engineering problems: Definition of mathematical model, Types of engineering problems and its Modeling, Method to create a model.
Analytical and numerical solutions of mathematical problems: Roots finding algorithms, Ordinary and partial differential equations and their solution, Initial and boundary value problems and their solutions.
Basic equations in Engineering Mechanics: Two dimensional elasticity equations, Beam under axial and transverse load, Lateral deflection of thin membrane, Plate under flexural load.
Review of Linear Finite Element Methods (FEM): Basic concept of FEM**,** FEM for one- dimensional problems**,** FEM for two-dimensional problems**,** FEM for three-dimensional problems**,** Scalar field problems.
Numerical Modeling of Engineering Problems
i) Application of numerical methods in environmental engineering: Population model, Atmospheric dispersion model, Biomass growth model, Contaminant transport model.
ii) Application of numerical methods in geotechnical engineering: Pressure isobar model, Slope Stability model.
iii) Application of numerical methods in Transportation engineering: Traffic congestion model.

iv) Application of numerical methods in water resource engineering: Open channel flow model, Pipe Flow model, Ground water Flow model.
Software tools and techniques for different engineering fields.
v) Static non-linear analysis and modeling of structural mechanics:
Basics of non-linear structural mechanics: Non- linearity of structural mechanics, CTU Material non-linearity, Geometrical non-linearity, Consistent linearization of internal virtual work.
Finite element discretization of geometrically non-linear continua: Finite volume elements, Finite truss elements.
Solution of non-linear static structural equations: Strategies, Iteration methods, Control of iteration procedures.
Stability analysis: Computation of stability points**,** Direct computation of singular points.
Software tools and techniques for Static Non- linear FEM

Recommended Books:

1. Logan, D.L. (2007), A First Course in the Finite Element Method. 4th Ed., Nelson, a division of Thomson Canada Limited. ISBN: 0-534-55298-6
2. Chandrupatla, T.R. and Belegundu, A.D. (2002), Introduction to Finite Elements in Engineering. 3rd Ed., Prentice-Hall, Inc. ISBN: 0-13-061591-9
3. Hutton, D.V. (2004), Fundamentals of Finite Element Analysis. McGraw-Hill. ISBN: 0-07-239536-2 / ISBN: 0-07-112231-1 (ISE)
4. Weaver, W.J. and Gere, J.M. (1980), Matrix Analysis of Framed Structures. 2nd Ed., Van Nostrand Reinhold Company Inc. ISBN: 0-442-25773-2
5. Chapra, S.C. and Canale, R.P. (2005), Numerical Methods for Engineers. 6th Ed., ISBN-13: 978-0073401065
6. Bilal, M.A. and Richard, H.M (2015), Numerical Analysis for Engineers: Methods and Applications. Chapman and Hall/CRC. ISBN 9781482250350
7. Carl .E. Pearson, C.E (1986), Numerical Methods in Engineering and Science. Chapman and Hall/CRC. ISBN 9780442273446

CEE633 ADVANCED MECHANICS
(3 hours /week, 3.0 Credits)

Fluid Mechanics
Fluid Systems and their application on pipes and nozzle; Effect of hydrostatic forces on the surfaces of fluid structures; Pipe systems design; Dimensional analysis and physical similarities and their application in fluid structures; Viscous fluid; Governing laws of motion in viscous fluid: Continuity equation, Bernoulli's theorem, Euler's equation, Navier-Stokes equation; laminar and turbulent flow; Incompressible flow; Convection and diffusion; Turbulent diffusion; Mass transport equation; Shear flow dispersion; Mixing in rivers and estuaries; Reservoir dynamics; Computation of environmental flow; Flow in open channels, Specially varied flow, Gradually varied and rapidly varied unsteady flow.

Solid Mechanics
Differential equation of equilibrium of a deformable body and strain displacement relations in Cartesian and Cylindrical co-ordinates; Generalized Hooke's law; Solution of boundary value, problems in a two dimensional elastic continuum; St

Venant's principle; Specialization to problems of infinite domain, Thick cylinders; Stress concentrations around holes; Compaction of contact stresses for two bodies in line contact. Torsion of non-circular cross sections: membrane analogy' Hollow thin all multiply connected torsion members. Plates and shells: Introduction to theory of plates and shells, Fracture mechanics: Introduction to linear elastic fracture mechanics, underlying mechanisms and applications of smart materials and structures; Composite materials and structures: Introduction to Composite materials and structures; Non-linear Mechanics: Geometric non-linearity and material non-linearity.

Recommended Books:

1. Kundu, P. K., Cohen, I. M. (2004), Fluid Mechanics. 3rd Ed., Academic Press. ISBN: 9780080470238
2. White, F.M (1991), Viscous Fluid Flow. 2nd Ed., McGraw-Hill. ISBN 0-07-069712-4
3. Schlichting, H (2000), Boundary-Layer Theory. 8th Ed., Springer. ISBN 3-540-66270-7
4. Timoshenko, S. P., and Goodier, J. N. (1970), Theory of Elasticity. 3rd Ed., McGraw-Hill. New York. ISBN-13: 978-0-07-064720-6
5. Sokolnikoff, I. S., and Specht, R. D. (1956), Mathematical theory of elasticity (Vol. 83), New York: McGraw-Hill. ISBN-13: 978-0-07-059629-0
6. Wang, C.T (1963), Applied Elasticity. McGraw-Hill, Inc. ISBN 10: 0070681252 / ISBN 13: 9780070681255
7. Al-Shemmeri, T. (2012), Engineering Fluid Mechanics. Bookboon.
8. Daugherty, R. L., Finnemore, E. J., and Franzini, J. B. (2001), Fluid mechanics with engineering applications. 10th Ed., Tata McGraw-Hill Education. ISBN-13: 978-0-07-112196-5

CEE635 ADVANCED ENVIRONMENTAL MODELLING

(3 hours /week, 3.0 Credits)

Definition of mathematical model, Types of mathematical model, Method to create a model, Finite element and Finite volume method. Water supply characteristics, water supply models: management models, mathematical models, ALIED, FLOW etc. Ground water quality and different parameters, Groundwater models: management models, mathematical models, different types of mathematical models practiced for groundwater management such as MODFLOW, ground water flow problems etc. Pollutants of air, atmospheric dispersion models, Contaminant transport model in geo-environment. Biomass growth model, Population model, ecological model, Surface water quality and different parameters, Surface water models: management models, mathematical models, different types of mathematical models practiced for surface water management such as stochastic models, QUAL etc., DO- BOD model. Wastewater characteristics, Different type of waste water reactors, Waste water models: management models, mathematical models, different types of mathematical models practiced for wastewater management. Drainage pattern, drainage characteristics, and catchment areas, Drainage models: management models, mathematical models, different types of mathematical models practiced for urban drainage.

Recommended Books:

1. Chiang, W. H., and Chiang, W. H. (2001), 3D-groundwater modeling with PMWIN (Vol. 346, pp. 67744-5), Berlin, Heidelberg, New York: Springer-Verlag. ISBN-13: 978-3-540-67744-4
2. Wainwright, J., and Mulligan, M. (Eds.), (2005), Environmental modelling: finding simplicity in complexity. John Wiley and Sons. ISBN-13: 978-0-471-49618-2
3. Khandan, N. (2001), Modeling tools for environmental engineers and scientists. CRC Press. ISBN-13: 978-1-56676-995-2,
4. Banik, B. K. (2015), Sewer systems management: illicit intrusion identification and optimal sensor placement (Doctoral dissertation, Université Paris-Est),
5. Kiely, G. (1997), Environmental Engineering. McGraw-Hill Company. ISBN (13): 978-0071164245.

CEE637 PROJECT MANAGEMENT AND CONTROLLING

(3 hours /week, 3.0 Credits)

Fundamentals of Project Management

Definition of project, Types of project, characteristics of different types of project, cycles of project, uncertainty and risk of project, reasons of failure of a project in developing countries. Critical success factors for regional and international project. Project office, roles and responsibilities, Role of project manager, Discussion of three overriding responsibilities- negotiation, conflict resolution and persuasion etc., Organizational structure, matrix structures, roles, responsibility, conflict management and cultural differences in decision making and project safety issues, Empowerment and its advantages.

Project planning, scope, the determination of appropriate project approach, project planning fundamental, Legal framework of a project, elements of a project framework of a project, Project uncertainty, and risk identification of a project---identification of characteristics of risk and opportunities and applying tools and techniques for risk identification, resource constraints, qualitative risk analysis, risk response planning.

Methods of budgeting, cost estimating, improving cost estimation, budget uncertainty, effects of budget risk on organization.

Defining human resource development, function of HRD, need of HR planning, way of HR development, process of HR planning, assessment of HR in the organization-zero budget, ideal approach and realistic approach, work load analysis and skill improvement. Stockholder management- controlling the shareholder-manager conflict, roles of stockholders and their function, and project communication.

Management Aspects of Disaster Reduction Projects

PERT and CPM network of disaster reduction projects, network analysis of project based on cost, time, resource loading, calculating probability activities and time resource optimization used as a management tools in flood, cyclone and earthquake reduction project in developing countries.

Project evaluation- NPV, IRR, project time reduction, response allocation techniques used as controlling techniques in flood, cyclone and earthquake reduction project. Project life cycle, resource scheduling in optimal and sustainable

ways as a controlling tools in these project, Variance analysis, Earned value analysis for controlling the project (EVA) used in these projects in developing countries.
Quality assessment processes, quality assurance, introduction to different quality standard eg. ISO, EFQM BS etc. Process-oriented project quality management (PPQM)- principles and requirement used in the project, Sound quality management principles to project.
Risk monitoring and control of disaster reduction and management project, risk management and vulnerability reduction of a project- community based approached to disaster reduction, focus on vulnerability reduction- ADB`s, WB's, UNDP's role in disaster reduction, mitigation, case studies base on successful projects and failure projects and comparisons.

Management Aspects of Environmental Projects
PERT and CPM network of environmental and water resources management projects, network analysis of project based on cost, time, resource loading, calculating probability activities and time resource optimization used as a management tools in arsenic mitigation project, pure drinking water project, town protection projects, sanitation projects for slum people etc. in developing countries.
Project evaluation- NPV, IRR, project time reduction, response allocation techniques used as controlling techniques in environmental and water resources related projects, Project life cycle, resource scheduling in optimal and sustainable ways as controlling tools in environmental water management and irrigation projects, Variance analysis, Earned value analysis for controlling the project (EVA) in these projects in developing countries.
Quality assessment, quality processes, quality assurance, Process-oriented project quality management (PPQM) - principles and requirement used in the project.
Risk monitoring and control of environmental projects, risk management and vulnerability reduction of those project- community based approached to disaster reduction, focus on vulnerability reduction- NGO's role in environmental projects-case studies.
Field work, Examples of Project network in software, Report writing and controlling, Presentation on different practical problems with postering.

Recommended Books:

1. Mareschal, B., and Brans, J. P. (1986), PROMCALC–The PROMETHEE Software User's Guide. HWPR/034, VUB, Brussels.
2. Berkun, S. (2008), Making Things Happen: Mastering Project Management. O'Reilly. ISBN-13: 978-0-596-51771-7
3. Taylor, P. (2015), The Lazy Project Manager: How to be twice as productive and still leave the office early. Infinite Ideas. ISBN-13: 978-1-906821-67-8
4. Eric, V. (1999), The Fast Forward MBA in Project Management. New York: John Wiley & Sons, Inc, 9(20), 285-286. ISBN-13: 978-0-471-23980-2
5. Kerzner, H. (2013), Project management: a systems approach to planning, scheduling, and controlling. John Wiley & Sons. ISBN-13: 978-0-471-39553-9

CEE639 NATURAL PRESERVATION AND HUMAN-NATURE INTERACTION
(3 hours /week, 3.0 Credits)

Urban Hazard and Brown Agenda: Natural hazards, Man-made hazards, Green Belt, Brown Block, Issues of Brown Agenda
Human Interaction on Nature: Industrial Hazards: Green House Gas Emissions, Carbon Issues: Carbon Emission, Carbon Trade, Carbon Tax, Hill-cutting, Deforestation and Afforestration, Blocking Water Flow with Dam and Other Man-made Structure versus Free Flow River
Evaluation Images of Urbanized Cities: Characteristics of Urban towns and Cities, Different types of Evaluation, Social Interactions on Urban Life
Pattern of Urbanization: Classification of Cities, Linear Cities, And Non-Linear Cities: Square City, Rectangular City, And Circular City.
Ecological Planning: Ecological Components, Human Interactions on Ecosystem, Abiotic and Biotic Components of Ecosystems, Ecological Model for urbanization, Cake model
Environmental Planning For Natural Conservation and Preservation: Natural Conservation, Green Marketing, Theory of Environmental Panning, Sustainable Environmental Planning
Sustainable Development: Definition of sustainability, Human interactions on Sustainability, Sustainable Development Models.

Recommended Books:

1. Salvato, J.A., Nemerow, N.L. & Agardy, F.J. (2003), Environmental Engineering (Fifth edition). John Wiley & Sons, Inc., Hoboken, New Jersey. ISBN 0-471-41813-7
2. Weiner, R.F. & Matthews, R. (2003). Environmental Engineering (Fourth edition). Elsevier Science (USA). ISBN: 0750672943

CEE641 EARTHQUAKE ENGINEERING
(3 hours /week, 3.0 Credits)

Introduction: Earthquake, General causes of Earthquake, Effete of recent Earthquakes **Seismology:** Plate tectonics, Earthquake mechanism, Epicenter, Focus, Magnitude, Intensity, Seismic waves, Hypocenter, Wave propagation in layered bodies, Earthquake motion on ground surface, Earthquake scales, Seismic zoning map of Bangladesh

Earthquake Recording Instruments: Seismograph, Accelerograph
Behavior of Structure under Earthquake: Seismic response analysis of SDOF structure, MDOF structure, Linear and Non-Linear analysis of Structures, Behavior of Reinforced concrete structure, Masonry structure, Timber structure
Seismic Strengthening: REHAB technology, Beam, Column, Column-Beam joint, Nonstructural components, Slab, In filled walls, FRP strips technology
Seismic Design of Structures: Basic design requirements, Basic representation of seismic action, Methods of analysis (Linear and Non-Linear), Lateral Force method, Response Spectrum analysis, Static Push over analysis, Time History analysis

Examples on Design: Earthquake dimensioning and construction of conventional masonry in filled and RC structure, Software demonstration

Modern Seismic Robust Concept: Confined masonry, Reinforced masonry, Seismic controls- Passive, Base isolation, Pagoda system, HYDE system, Tendon system, Semi- Active, Active system

Life Lines: Types of life lines, Critical impact on lifelines, Life line failures, Common features of life line

Urban Seismic Renewal: Challenges for Urban seismic design, Seismic assessment, Street survey, Preliminary investigation, Final investigation, Risk analysis

Recommended Books:

1. Chopra, A. K. (1995), Dynamics of structures, a primer (Vol. 2), Earthquake Engineering Research. ISBN- 0-13-855214-2
2. Pankaj, A., & Manish, S. (2009), Earthquake resistant design of structures. 5th Ed., PHI learning private limited, New Delhi. ISBN 10: 8120328922/ ISBN 13: 9788120328921
3. Kramer, S.L. (1996), Geotechnical Earthquake Engineering. Prentice Hall, Upper Saddle River, N.J. ISBN- 9780133749434
4. Lecture materials of SAARC Training Program on Techniques for Earthquake Resistant Structures (2012), SAARC Disaster Management Centre, New Delhi and IIT, Roorkee, India
5. Ansary M. A., and Noor M. A. (2006), Earthquake Resistant Design Manual. Bangladesh Earthquake Society, Academic Press and Publishers Library. ISBN– 984 08 0210 0
6. National Plan for Disaster Management 2010-2015 (2010), Disaster Management Bureau of the Government of the People's Republic of Bangladesh
7. Bangladesh National Building Code (BNBC- 2006), Housing and Building Research Institute, Bangladesh (2006)
8. Building Code Requirements for Structural Concrete (ACI 318M-08) and Commentary (2008), American Concrete Institute. ISBN 978-0-87031-283-0
9. Criteria For Earthquake Resistant Design of Structures (2002), Bureau of Indian Standards, New Delhi, India

CEE643 WIND ENGINEERING

(3 hours /week, 3.0 Credits)

Wind, cyclone, wave; difference among them; cyclone, types of cyclones, effect of cyclone, nature of wind due to cyclone, components of wind risks. Nature of wind, wind analysis by rose diagram and its impact assessment, components of related wind risks. Vibration, types of vibration due to wind, equations related to vibration, analysis of forced vibration of damped – single degree of freedom due to wind, criteria of foundation design subjected to vibration and related problems. Different types of exposures of wind on structure, wind load calculation on buildings by different methods-projected methods: BNBC-1993 and 2014(draft), Eurocode System (EN 1991-1-4), Wind load in Australian and New Zealand Code (AS/NZS1170.2 (2002).), ASCE 7-05, NBCC 2005, AIJ-1996, IS-2000, Hong Kong-2004, UBC-97, etc; wind loads calculation in industrial warehouses. Wind storms, damage and guidelines for mitigation measures. Wind induced damage to building and disaster risk reduction. Assessment of vulnerability of building due to winds, consideration of building safety in coastal zone subjected to wind.

Recommended Books:

1. Clough, R.W. and Penzien, J. (2003), Dynamics of Structures. Computers and Structures, Inc. ISBN-13: 978-0-923907-50-1
2. Chopra, A.K. (2001), Dynamics of Structures. 2nd Ed., Prentice-Hall, Inc. ISBN-81-203-2139-1
3. Holmes, J. D. (2002), Effective static load distributions in wind engineering. Journal of Wind Engineering and Industrial Aerodynamics, 90(2), 91-109.
4. Taranath, B. S. (2004), Wind and earthquake resistant buildings: structural analysis and design. CRC press. ISBN-13: 978-0-8247-5934-6
5. Ranjitha, K. P., Khan, K. N., Kumar, N. S., & Raza, S. A. (2014, July), Effect of Wind Pressure on RC Tall Buildings using Gust Factor Method. In International Journal of Engineering Research and Technology (Vol. 3, No. 7 (July-2014)), IJERT.
6. Bull J. W. (2015), Tall building: design advance for construction. Saxe-Coburg Publications. ISBN-13: 978-1874672258

CEE671 COASTAL ENGINEERING AND MANAGEMENT

(3 hours /week, 3.0 Credits)

Coastal Engineering works; waves: characteristics, types, theory, refraction, reflection, breaking, diffraction and damping; wind generated waves; wind wave prediction; coastal processes, features and formation; longshore sediment transport; sea level fluctuation: tides, storm surges, tsunami, coastal structures; models of coastal processes; coastal management: Boundaries of the coastal system, natural and socio-economic subsystem, coastal concerns and problems; policy for coastal zone management, legal, institutional, economic and environmental aspects; global changes and trends; examples of coastal zone management activities from different countries.

Recommended Books:

1. Horikawa, Kiyoshi. (1978). Coastal *engineering: an introduction to ocean engineering*. New York: Wiley.
2. Schenck, Hilbert van Nydeck. (1975). *Introduction to ocean engineering,*. New York: McGraw-Hill.
3. Nielsen, P. (2009) Coastal and Estuarine Processes. Advanced Series on Ocean Engineering, Volume 29, World Scientific, 343pp.
4. U.S. Army Corps of Engineers (1984). Shore Protection Manual. Volumes I and II. (This will be made available to all. It is freely available on the Internet and very useful.)
5. Sorensen, R.M. (2006) Basic Coastal Engineering, 3rd Edition. Springer, 324pp. (Has good coverage of most of the course topics.)

CEE673 INTEGRATED WATER RESOURCE MANAGEMENT FOR ENGINEERS

(3 hours /week, 3.0 Credits)

Water resources system; concepts and principles of integrated water resources management; planning processes and tasks; project formulation and appraisal; identification and evaluation of water management plans; comprehensive regional planning; water resources planning in Bangladesh; systems analysis, models and decision support system; economic and financial analysis; public involvement in water resources planning; environmental impact assessment; social and institutional aspects; water and environmental law.

Recommended Books:

1. McDonald, A.T and Kay, D (1998). *Water Resources: Issues and Strategies*. Longman Scientific and Technical.
2. Chapman, D. (1992). *Water management and Environmental Engineering*. Chapman and Hall.
3. Feachem, R, McGarry, M. and Mara, D (1977). *Water, Wastes and Health in Hot Climates*. Wiley.
4. *The World Ban*k, Washington, D.C *(2000) Water Resources Management, A World Bank Policy Paper,*
5. Global Water Partnership. UN-ESCAP (1996). *Integrated Water Resources Management, TAC Background Papers No. 4,* Global Water Partnership Technical Advisory Committee, Sweden.
6. Morgan, P. (1990). *Rural Water Supply and Sanitation.* McMillan.
7. Global Water Partnership, 2000. *Integrated Water Resources Management. TAC Background Papers, no 4*, 67 pp. www.gwpforum.org/gwp/library/Tacno4.pdf
8. Global Water Partnership, 2002. Toolbox, Integrated Water Resources Management. http://gwpforum.netmasters05.netmasters.nl/en/index.html

CEE675 FLOOD CONTROL

(3 hours /week, 3.0 Credits)

Flood Hydrology and Flood Characteristics: Cause of Floods and Flood Inundation, Flood Hydrology and Hydraulics, Classification of Floods: flash flood, river flood, coastal flood. **Flood Control and Mitigation**

Flood Modeling and Model Classification: Physically-based Models, Lumped Conceptual Models, Black Box Models.

Flood Routing Methods: Hydrodynamic Routing, Diffusion Routing, Muskingum Routing, Kinematics Routing

Flood Routing in River Basins, River Channels and Over Bank Flow Areas: River Basin Runoff Routing, River Channel Routing, Channel Network Routing, Flood Plain Routing

Flood Forecasting Models: Deterministic Models, Stochastic Models, Combined Deterministic - Stochastic Models, Model Output Updating Process

Flood Routing and Forecasting Using Artificial Neural Network (ANN): Types of Neural Network, Neural Network Architectures, Back Propagation Technique, Training and Testing ANN

Flood Control and Management: Comprehensive Flood Disaster Prevention and Management, Structural and Non-structural Flood Control Measures, Flood Risk Analysis and Mapping in GIS environment, Flood Plain Development and Management, Flood Damage Categories and Damage Assessment, Feasibility of Flood Control Projects

Structures during Floods: Vulnerability and Evaluation of Flood Damages to build environments, Flood Resistant Inland and Coastal Structures, Flood Resistant Rural Housing

Recommended Books:

1. Ghosh, S. N. (2014), Flood control and drainage engineering. CRC Press. ISBN 9781138026278
2. Chang, H. H. (1992), Fluvial processes in river engineering. Krieger Publishing Company.
   ISBN-13: 978-0-89464-737-6.
3. Freitag, B., Bolton, S., Westerlund, F., & Clark, J. (2012), Floodplain management: a new approach for a new era. Island Press. ISBN: 9781597266345
4. Rossmiller, R. (2013), Stormwater Design for Sustainable Development. McGraw Hill Professional. ISBN: 9780071816526

CEE681 ENVIRONMENTAL IMPACT ASSESSMENT AND INTERACTION

(3 hours /week, 3.0 Credits)

Terms used in EIA; Aims and objectives of EIA; Role of EIA in EM; EIA Methodology: Different methods of EIA, initial environmental examination, Baselines studies; Rapid EIA methods: check list, matrix methods; Scooping and communication and people's participation in EIA; Uncertainties in EIA; Impact prediction, evaluation and mitigation; EIA and risk assessment; EIA of development schemes; Economical evaluation of EIA; Cost and Cost/benefit analysis of EIA; Presentation and review of EIA; Strategic environmental assessment; EIA in developing countries; EIA systems practiced in different countries: Australia, Canada, China, Japan, Netherlands, UK, USA etc.; EIA and international agencies: ADB, EC, NEPA, USAID, World Bank, WHO etc.; EIA (State of art) in industrial projects; Application of EIA in energy and agricultural development; EIA for embankment and flood protection measures; EIA of irrigation activities: EIA of infrastructure development project; Environmental impact of flood in rainy season; EIA of draughts in dry season (specially Farakkah and other upstream barrages); EIA in solid waste management; EIA of gas field and tea garden; EIA in JMB project; EIA of transport system and road projects; EIA procedure in private sector, EIA procedure in govt. sector; Different EIA index calculation.

Recommended Books:

1. Canter, L. (1996). Environmental Impact Assessment. 2nd Ed., MacGraw-Hill. Inc., New York. ISBN-13: 978-0-07-009767-4
2. Momtaz, S. and Kabir, Z. (2018), Evaluating Environmental and Social Impact Assessment in Developing Countries- 2nd Ed., Elsevier. Paperback ISBN: 9780128150405.
3. Petts, J., Handbook of Environmental Impact Assessment 1st Edition, ISBN-13: 978-0632047727

4. Lawrence, D. (2005), Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, Inc. ISBN:9780471457220
5. Charles H. Eccleston, C. (2017), Environmental Impact Assessment: A Guide to Best Professional Practices- 1st Ed., CRC Press, ISBN 9781138074156
6. Itakura, Y. (1999), Integrated Environmental Management: Development, Information, and Education in the Asian-Pacific Region -1st Ed., CRC Press. ISBN 9781566704199

CEE683 WASTE REDUCTION AND CONTROL
(3 hours /week, 3.0 Credits)

Waste Management: Introduction to waste management, Impact of man on the environment, Waste legislation, Waste Management planning, Waste Management Cycle
Characteristics of different types of waste Solid Waste Management: Sources and characteristics of Solid waste, Solid waste generation, Collection and transportation (Community and Municipality), Volume reduction, sorting, Stabilization.
Industrial waste: Requirements of the water for various industries, Characteristics and volume of industrial waste, Problems associated with industrial waste water, Quality and treatment of industrial water
Conventional and Low Cost Treatment Method: Duckweed treatment for waste, Septic tank, Bio-gas plant, Different sanitation options, Sanitation practices in Bangladesh
Solid waste Control: Incineration, Resource recovery and recycling, Land filling, and Composting, and Mechanical Treatment before landfill, Planning and socio-economic aspects of solid waste management, Community mobilization in solid waste management.
Industrial Waste Control: Waste water treatment objectives, Physical, chemical and biological methods of industrial waste water treatment including neutralization, equalization, oil separation, flotation, sour water strippers, heavy metal removal, Air stripping, chemical oxidation, Overview of waste reduction techniques in industries, Waste problems in different industries, Treatment and disposal of industrial waste sludge, Laws and regulations for industrial wastewater and waste treatment.
Advanced and complex waste water treatment methods: Different types of settling, Advanced theory of coagulation, Advanced theory of filtration, Membrane filtration, Water softening, Air stripping, aeration and gas transfer, Reverse osmosis, desalination, water treatment by UV-radiation, Ozonization, adsorption, ion-exchange, modification of activated sludge
Waste Reduction and Preservation: Introduction, Zero waste, Hazardous waste management, Strategies, Regulation and implementation, Recycling legislation, Strategies and policy and Bangladesh Conservation Law. Examples: Solvent Waste Reduction, Selection of Sustainable Waste Management, Waste Management and Health, Application of Linear Program in Waste Management. Case studies: Field Trip on types of Waste generation in Bangladesh, Field trip on Waste or Waste water control practices in Bangladesh.

Recommended Books:

1. Metcalf and Eddy. (1972), Wastewater engineering: collection, treatment, disposal. 1st Ed., McGraw-Hill. ISBN-13: 978-0-07-041675-8
2. Ahmed, M. F., and Rahman, M. M. (2000), Water supply and sanitation: Rural and low income urban communities. ITN-Bangladesh, Centre for Water Supply and Waste Management, BUET.
3. Davis, M. L., & Masten, S. J. (2004), Principles of environmental engineering and science (p. 704), New York: McGraw-Hill. ISBN-13: 978-0-07-292186-1
4. LaGrega, M. D., Buckingham, P. L., & Evans, J. C. (2010), Hazardous waste management. Waveland Press. ISBN-13: 978-1-57766-693-6
5. Grady Jr, C. L., Daigger, G. T., Love, N. G., & Filipe, C. D. (2011), Biological wastewater treatment. 3rd Ed., CRC press. ISBN-13: 978-0-8493-9679-3.
6. Crittenden, J. C., Trussell, R. R., Hand, D. W., Howe, K. J., & Tchobanoglous, G. (2012), MWH's water treatment: principles and design. John Wiley & Sons. ISBN-13: 978-1-118-10377-7

CEE685 CHALLENGES IN ENVIRONMENTAL ENGINEERING
(3 hours /week, 3.0 Credits)

Introduction to Challenges in Environmental Engineering
General Concept: Challenges for the Environment, Water resources, Energy, Population, Agriculture, Land degradation, Industrialization, Urbanization.
Types of challenges: Acid rain, green house effects, Municipal waste water, problems of arsenic contamination, pesticides in agriculture. Fate and transport of environmental contaminations.
Design and Modeling of Environmental Systems
Chemical and biochemical reactions: Rate of reactions, material balances, mass balance on flows and solids, mass balance on air flow and particulates.
Flow regimes and reactors: Completely mixed batch-reactors, design plug flow reactor design.
Basic Concept of Environmental Biotechnology: Definition, scopes, significance and advantages of environmental biotechnology, Pollution and Biotechnology for Pollution Control, Phytoremediation and Bioremediation.
Energy Balanced: Earth's energy balance and the greenhouse effect. Mass Transport Processes: Advection and dispersion, molecular diffusion, the movement of a particle in a fluid stock's law, flow of water through a porous medium, Darcy's law for ground water.

Theory of Water Treatment
Sedimentation: Theories of sedimentation (ideal settling of discrete and flocculent particles and deviation from ideality);
Coagulation: Destabilization of colloidal particles;
Flocculation: Peri-kinetic and Ortho-kinetic) theories, Granular Media Filtration Theory (Transportation, Attachment, and detachment mechanisms), Mechanisms of physical adsorption and chemi-sorption, Iron, manganese and arsenic removal, Removal of nitrate and fluoride from water;
Disinfection: Mechanisms, factors effectiveness and alternatives to disinfection. Chemical precipitation.
Membrane Filtration Technology: Mechanisms of revise osmosis, principle and theory, membrane configuration and type, process variables, Electro-dialysis.

Gas Transfer: Henry's law, Dalton's law, rate of solution, and dispersion, two film theory, gas transfer equation, and governing factors, type of aeration and applicability.
Causes and Sources of order and taste: Treatment, and removal and prevention and control of aquatic growth.
Domestic Waste Water treatment: Introduction, Wastewater treatment categorization, Secondary waste water treatment, Advanced wastewater treatment, Preliminary treatment, Primary treatment, Secondary treatment, Sludge treatment and disposal**.**
Air Pollution Principles and Control: Sources and effects of air pollution, Control of particulate matter from stationary sources, mechanical separation, electro statistic precipitators.
Gas and Vapor Control Technology: Incineration, absorption and gas de-sulfurization. **Sustainability and Renewable Energy:** Challenges to sustainable development, concept of sustainability, Environment, development and sustainability. Factors governing sustainable development, the economics of sustainability. Renewable energy, Fossil fuels and climate changes, renewable energy sources, renewable energy in future, The world of hydrogen, Solar energy, Bio-energy: Energy crops, woody crops, agriculture crops, wood residues, animal waste, municipal solid waste, landfill gas, commercial and industrial waste etc. Wind and water energy.

Recommended Books:

1. Salvato, J.A., Nemerow, N.L. & Agardy, F.J. (2003), Environmental Engineering (Fifth edition). John Wiley & Sons, Inc., Hoboken, New Jersey. ISBN 0-471-41813-7
2. Weiner, R.F. & Matthews, R. (2003). Environmental Engineering (Fourth edition). Elsevier Science (USA). ISBN: 0750672943

CEE689 CHALLENGES IN DISASTER ENGINEERING
(3 hours /week, 3.0 Credits)

Natural Hazards and Disasters: Sciences of disaster, major types of disaster, impact of natural disasters in Bangladesh and future disasters.
Vulnerability of Built Environments: Structures (Engineered and non-engineered), Lifelines and their components, Regional land use policy and plan, Relationship between hazard and vulnerability i.e. Risk and Risk assessment and mitigation strategies, Development and disaster risk.
Earthquake: Historical records and geographical distribution, Seismicity of Bangladesh, Effects of Earthquake, Earthquake forecasting, Vulnerability of earthquakes on built and natural environments, Pre-disaster and post-disaster activities, Lesson learnt from past earthquakes, Challenges in seismic strengthening strategies and enforcement of seismic building code of practices.
Cyclone/Tidal Surge: Types of cyclones in Bangladesh, Historical examples and geographical distribution of cyclones, Cyclone forecasting and warning, Vulnerability on built and natural environments, Cyclone disaster preparedness and response, Good practices in Bangladesh, Challenges in reconstruction strategies of built environments.

Flood: Types of floods in Bangladesh, Historical records, examples and geographical distribution of floods, Forecasting, warning and monitoring systems, Impact/vulnerability on built and natural environments and also on river bank erosion, Flood risk assessment and mitigation strategies, Good practices in Bangladesh, Challenges in flood mitigation strategies.
Tsunami: Historical records and geographical distribution, Possibilities of tsunami occurrences in Bangladesh, Impacts(Vulnerability) of Tsunami on built and natural environments, Tsunami disaster mitigation and preparedness, Challenges Recovery/reconstruction strategies.
Landslides: Historical records and geographical distribution of landslides in Bangladesh, Various Landslide triggering mechanisms, Impacts(Vulnerability) of landslides on built and natural environments, Landslide hazard assessment methods, seismic aspects of slope stability, Landslide warning and mitigation, Challenges in evacuation/settlement of landslide affected public and development issues.
Drought: Historical records and geographical distribution of droughts in Bangladesh, Natural preconditions for droughts, Impacts of droughts, Famine, Mitigation strategies, Post-disaster activities, Lesson learnt, Challenges in future.
Man-Made Disasters: Deforestation, Hill Cutting, Fire, Epidemic, Damage to heritage/lakes/water bodies

Recommended Books:

1. Cannon, T. (1994). Vulnerability analysis and the explanation of 'natural 'disasters. Disasters, development and environment, 13-30.
2. Mohammad, N. (2006), Natural Hazards and disaster management. Chandu peers.
3. Anderson, M. B. (1995). Vulnerability to disaster and sustainable development: A general framework for assessing vulnerability. Disaster Prevention for Sustainable Development: Economic and Policy Issues. Washington, DC: World Bank, 41-59.

Summary of courses for graduate programs in Sanitation

Course No.	Course Title	Hours / Week Theory + Lab	Credit
	THEORY		
CEE731	Environmental Modelling	3+0	3.0
CEE733	Research Design and Methodology	3+0	3.0
CEE781	Sanitation Systems and Public Health	3+0	3.0
CEE783	Analysis of Sanitation Flow	3+0	3.0
CEE785	Sanitation Technology	3+0	3.0
CEE787	Institutional Aspects of Sanitation	3+0	3.0
CEE789	Emergency Sanitation	3+0	3.0
CEE791	Sanitation Financing and Project Management	3+0	3.0

PROJECT/THESIS			
CEE720	Sanitation based Project	0+3	3.0
CEE730	Sanitation based Thesis	0+12	12.0

Notes:

1. *Students of Masters (General; 2-semester program) in Sanitation must take 3 credits project course and 21 credits theory courses approved by GSC.*
2. *Students of Masters (Thesis; 3-semester program) in Sanitation must take 12 credits thesis and 24 credits theory courses approved by GSC.*

Detailed Syllabus for graduate programs in Sanitation

CEE720 SANITATION BASED PROJECT
(3 hours/week, 3.0 credits)

Project is a mandatory course to fulfill the Masters (General) in Sanitation program. Project work should be carried out on a selected topic that will be completed within 2nd semester. Project work will be evaluated as per the examination ordinance for graduate program.

CEE730 SANITATION BASED THESIS
(12 hours/week, 12.0 credits)

Thesis is a mandatory course to fulfill the Masters (Thesis) in Sanitation program. Thesis should be carried out on a selected topic that will be completed within 3rd semester. Thesis will be evaluated as per the examination ordinance for graduate program.

CEE731 ENVIRONMENTAL MODELLING
(3 hours/week, 3.0 credits)

Definition of mathematical model, Types of mathematical model, Method to create a model, Finite element and Finite volume method. Contaminant transport model in geo-environment. Biomass growth model, Population model, ecological model. Surface water quality and different parameters, Surface water models: management models, mathematical models, different types of mathematical models practiced for surface water management such as stochastic models, QUAL etc., DO- BOD model. Wastewater characteristics, Different type of wastewater reactors, Waste water models: management models, mathematical models, different types of mathematical models practiced for wastewater management. Drainage pattern, drainage characteristics, and catchment areas, Drainage models: management models, mathematical models, different types of mathematical models practiced for urban drainage.

Recommended Books:

1. Wainwright, J., and Mulligan, M. (Eds.), (2005). Environmental modelling: finding simplicity in complexity. 1st Ed., John Wiley and Sons. ISBN-13: 978-0-471-49618-2

2. Khandan, N. (2001). Modeling tools for environmental engineers and scientists. 1st Ed., CRC Press. ISBN-13: 978-1-56676-995-2
3. Kiely, G. (1997). Environmental Engineering. McGraw-Hill Company. ISBN (13): 978-0071164245.

CEE733 RESEARCH DESIGN AND METHODOLOGY
(3 hours/week, 3.0 credits)

Defining the Research Problem, Concepts Relating to Research Design, Developing a Research Plan, Sampling Design, Measurement and Scaling Techniques, Data Collection Method, Data Processing and Analysis, Testing of Hypothesis, Interpretation and Report Writing.
Assignment on Sanitation related project proposal writing, literature review, secondary data analysis

Recommended Books:

1. Kothari, C.R., (2004). Research Methodology (Methods and Techniques). New Age International (P) Ltd., Publishers. 4835/24, Ansari Road, Daryaganj, New Delhi – 110002
2. Geoffrey R. Marczyk, David DeMatteo, David Festinger (2005). Essentials of Research Design and Methodology. John Wiley & Sons., Hoboken, New Jersey.

CEE781 SANITATION SYSTEMS AND PUBLIC HEALTH
(3 hours/week, 3.0 credits)

Sanitation Systems: Introduction to sanitation, Sanitation in Bangladesh. Urban sanitation services, SDG goals; Compendium of sanitation technologies; Success and failure in urban sanitation; Diagnostics tools; Stakeholder analysis; Sanitation planning.
Public Health: Introduction to public health; Human health hazards related to human excreta; Review and assessment of transmission routes; Biological characteristics and lifecycles of sanitation-relevant pathogens; Non-infectious public health issues related to sanitation; Control measures risk evaluation tools.

Recommended Books:

1. World Health Organization (2006). Guidelines for the safe use of wastewater, excreta and greywater - Volume 3: Wastewater and excreta use in aquaculture. World Health Organization.
3. World Health Organization. (2016). Sanitation safety planning: manual for safe use and disposal of wastewater, greywater and excreta. World Health Organization.
4. Sandy Cairncross, Sir Richard Feachem (2018). Environmental Health Engineering in the Tropics: Water, Sanitation and Disease Control. Taylor & Francis Group.
5. McKeown, A. Elaine (2015). Impact of Water Pollution on Human Health and Environmental Sustainability. IGI Global.

CEE783 ANALYSIS OF SANITATION FLOW
(3 hours/week, 3.0 credits)

Classification of waste types; Sanitation streams and typical characteristics; Review of potential pollution and health issues associated with sanitation streams; Introduction to sanitation streams as a raw material; Laboratory induction; Analysis of sanitation streams-parameters including chemical, physical and biological parameters.

Recommended Books:

1. Andreas, N. Angelakis, Joan B. Rose (2014). Evolution of Sanitation and Wastewater Technologies through the Centuries. IWA Publishing.
2. Andersson, K., Rosemarin, A., Lamizana, B., Kvarnström, E., McConville, J., Seidu, R., Dickin, S. and Trimmer, C. (2016). Sanitation, Wastewater Management and Sustainability: from Waste Disposal to Resource Recovery. Nairobi and Stockholm: United Nations Environment Programme and Stockholm Environment Institute.

CEE785 SANITATION TECHNOLOGY

(3 hours/week, 3.0 credits)

Urban drainage and sewerage; Carbon, nitrogen and phosphorus removal & recovery; sludge treatment; Onsite sanitation, collection and transport; Faecal sludge treatment technologies; Innovation processes; Technology integrating group work; Slum drainage; Relevant literature on ISO standards.

Recommended Books:

1. Gensch, R., Jennings, A., Renggli, S., Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Berlin, Germany.
2. Armitage, N., Rooseboom, A. (2000a). The removal of urban litter from stormwater conduits and streams: Paper 1 - The quantities involved and catchment litter management options. Water S.A.
3. Armitage N., Rooseboom A. (2000b). The removal of urban litter from stormwater conduits and streams: Paper 2 - Model studies of potential trapping Structures. Water S.A.
4. Armitage, N., Rooseboom, A. (2000c). The removal of urban litter from stormwater conduits and streams: Paper 3 - Selecting the most suitable trap. Water S.A.
5. Carden, K., Armitage, N., Winter, K., Sichone, O., Rivett, U. (2006). Understanding the use and disposal of greywater in the non-sewered areas in South Africa: Final report (WRC Project K5/1524).
6. Andreas, N. Angelakis, Joan B. Rose (2014). Evolution of Sanitation and Wastewater Technologies through the Centuries. IWA Publishing.
7. Eva Kremere, Edward Morgan, Pedi Obani (2019). SDG6 - Clean Water and Sanitation: Balancing the Water Cycle for Sustainable Life on Earth. Emerald Publishing Limited.

CEE787 INSTITUTIONAL ASPECTS OF SANITATION

(3 hours/week, 3.0 credits)

Sanitation Governance: Definitions, debates, controversies; The different actors and decision making processes; Power relations among actors in the local and global levels: Gender, class & race relations and power asymmetries; Practices of coordination & decision making around contested water distribution; Contextualizing sanitation: the politics of urban waste; Formal and informal regulation, regulatory impact assessment; Case studies on regulatory frameworks around the world; Everyday sanitation from different perspectives; Sanitation history; Sanitation in colonial contexts; Shifting sanitation governance in light of justice concerns; Governance alternatives amongst the "crisis of imagination".

Behaviour Change: Introduction to behaviour change; Behaviour change frameworks; Intervention design; Case studies.

Advocacy and Leadership: Concepts of Leadership; Vision and Strategy; Communication skills; Self-reflection and way forward.

Recommended Books:

1. Peter Emmanuel Cookey; Chongrak Polprasert (2019), Regenerative Sanitation: A New Paradigm For Sanitation 4.0. IWA Publishing.
2. World Bank (2017) World Development Report 2017: Governance and the Law Main Messages. Washington, D.C.
3. Curtis, V. (2001). Hygiene: How myths, monsters, and mothers-in-law can promote behaviour change. Journal of Infection, 43(1), 75–79.
4. Aunger, R., & Curtis, V. (2017). A Practitioner's Manual: What is behaviour change and is it really as difficult as everyone thinks? London: London School of Hygiene & Tropical Medicine Environmental Health Group.
5. SaniFOAM: Devine, J. (2009). Introducing SaniFOAM: a framework to analyze sanitation behaviors to design effective sanitation programs. Washington, D.C.: Water and Sanitation Program.
6. Davis Jr. TP (2004). Barrier Analysis Facilitator's Guide: A Tool for Improving Behaviour Change Communication in Child Survival and Community Development Programs. Washington, D.C.: Food for the Hungry.
8. Gautam, O.P., Schmidt, W-P, Cairncross S, et al. (2017). Trial of a Novel Intervention to Improve Multiple Food Hygiene Behaviors in Nepal. Am. J. Trop. Med. Hyg 96(6): 1415–1426.
9. Biran, A, Schmidt, W-P, Varadharajan, KS, et al. (2014) Effect of a behaviour-change intervention on handwashing with soap in India (SuperAmma): a cluster-randomised trial. The Lancet Global Health 2(3): e145–e154.

CEE789 EMERGENCY SANITATION

(3 hours/week, 3.0 credits)

Humanitarian action, Principles and dilemmas; Key actors and legal framework; SPERE Handbook and WASH Cluster; Monitoring and evaluation, needs assessment; Sanitation related diseases; Excreta management; Solid waste management; Development of a sanitation plan in emergency situation.

Recommended Books:

1. Gensch, R., Jennings, A., Renggli, S., Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies.German WASH Network (GWN),

Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Berlin, Germany.
2. Sphere Association. The Sphere Handbook: Humanitarian Charter and Minimum
1. Standards in Humanitarian Response, fourth edition, Geneva, Switzerland, 2018.
2. Fiona Zakaria (2019). Rethinking Faecal Sludge Management in Emergency Settings. CRC Press.

CEE791 SANITATION FINANCING AND PROJECT MANAGEMENT
(3 hours/week, 3.0 credits)

Sanitation Financing: Sanitation financing options; Business models and PPP in sanitation; Financial viability; Modalities and challenges in sanitation financing; Sanitation plan; Service and value chain; Business models; Financial flow; Business canvas.
Project Management: Introduction to project management and planning; Key elements of project planning; Results based project management/ Theory of change; Stakeholder engagement; Project implementation planning; Monitoring, Evaluation and learning; Project planning software/ MS Project.

Recommended Books:
1. Rao, K. C.; Kvarnström, E.; Di Mario, L.; Drechsel, P. (2016). *Business models for fecal sludge management***.** Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Research Program on Water, Land and Ecosystems (WLE). 80p. (Resource Recovery and Reuse Series 6).
2. David Stephenson (2005). Water Services Management. IWA Publishing.