FACULTY OF ENGINEERING
DEGREE OF BACHELOR OF ENGINEERING
Department of Civil Engineering

(REGULAR PROGRAMME)

REGULATIONS

CURRICULUM
(2021-2022)

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act 1956)

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KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University Established under Section 3 of UGC Act 1956)
Eachanari, Coimbatore-641 021. INDIA

FACULTY OF ENGINEERING
DEGREE OF BACHELOR OF ENGINEERING / TECHNOLOGY
REGULAR PROGRAMME
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

These regulations are effective from the academic year 2021 – 2022 and applicable to the candidates admitted to B. E. / B. Tech. during 2021 - 2022 and onwards.

1. ADMISSION

1.1 Candidates seeking admission to the first semester of the eight semesters B. E./B.Tech Degree Programme:

Should have passed the Higher Secondary Examination (10+2) (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III or any similar Examination of any other University or authority accepted by the Karpagam University as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

1.2 Candidates seeking admission to the first semester of the eight semesters B. Tech. (Bio-Technology) Degree Programme:

Should have passed the Higher Secondary Examination (10+2) (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry (or) Physics, Chemistry and Biology as three of the four subjects (or) Physics, Chemistry, Botany and Zoology as subjects of study under Part-III or any similar Examination conducted by any other authority accepted by the Karpagam University as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

1.3 Lateral Entry Admission

Candidates who possess Diploma in Engineering / Technology (10+3 or 10+2+2) awarded by the Directorate of Technical Education, Tamil Nadu or its equivalent and candidates who possess a Bachelor Degree in Science (10+2+3) with Mathematics as one of the subjects, awarded by any University or its equivalent are eligible to apply for admission to the third semester of B. E./B. Tech.. Such candidates shall undergo two additional engineering subjects in the 3rd and 4th semester as prescribed by the University.

Eligibility criteria for admission in the first semester is given in the table below

S. No.	Programme	Eligibility criteria
1.	B. E.Automobile Engineering	Diploma in Automobile Engg./ Mechanical Engg / Metallurgy/ Mechanical and Rural Engg. / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engg. / Tool and Die Design.
2	B.E Bio Medical Engineering	Diploma in Electrical & Electronics Engg. / Electronics & Communication Engg./ Computer Science Engg/ Mechatronics Engg/Computer Technology/Instrumentation Technology
3.	B. E. Civil Engineering	Diploma in Civil Engg. / Sanitary Engg. / Civil and Rural Engg.
4.	B. E. Computer Science and Engineering	Diploma in Computer Engg. / Electrical Engg. / Electronics Engg. / Electrical & Electronics Engg. / Electronics & Communication Engg. / Electronics & Telecommunication Engg./ Information Technology/ Computer Science / Instrumentation & Control Engg. / Electronics & Instrumentation.
5.	B. E. Electrical and Electronics Engineering	Diploma in Electrical Engg. / Electronics Engg. / Electrical & Electronics Engg. / Electronics & Communication Engg. / Electronics & Telecommunication Engg./ Information Technology/ Computer Science / Instrumentation & Control Engg. / Electronics & Instrumentation.
6.	B. E. Electronics and Communications Engineering	Diploma in Electronics Engg. / Electronics & Communication Engg. / Electrical Engg. / Instrument Technology / Electronics with specialization in Instrumentation / Electrical & Electronics Engg. / Information Technology/ Computer Science / Instrumentation & Control Engg./ Electronics & Telecommunication Engg.
7.	B. E. Mechanical Engineering	Diploma in Mechanical Engg./ Metallurgy/Automobile Engg./ Mechanical and Rural Engg. / Machine Tool Maintenance and Repairs / Machine Design and Drafting / Refrigeration and Air-conditioning / Production Engg. / Tool and Die Design
8.	B. Tech Bio - Technology	Diploma in Chemical Engineering / Leather Technology / Diploma in Petrochemical Engg.
9.	B. Tech Chemical Engineering	Diploma in Chemical Engineering /Petrochemical

		Engg./ Chemical Technology/ Petroleum Engg/ Polymer Technology/ Plastic Technology/Sugar Technology/Pulp & Paper Technology/ Petro-Chemical Engg
10.	B. Tech Food Technology	Diploma in Food Technology/Chemical Engineering / Leather Technology / Diploma in Petrochemical Engg.

1.4 Migration from other University

Candidates who have completed their first to sixth semesters of B. E./B. Tech. study in any University are eligible to apply for admission to their next semester of B. E./B. Tech. in the branch corresponding to their branch of study. The student will be exempted from appearing for Examination of the equivalent courses passed in the earlier programme and will have to appear for courses which he/she has not done during the period of his/her earlier programme. Along with the request letter and mark sheets, he/she has to submit a copy of syllabus of the programme duly attested by the Registrar, Competent authority,he/she has undergone. Equivalence Certificate shall be provided by the "Students' Affairs Committee" of Karpagam University. Students' Affairs Committee comprises all the Heads of the Departments and Dean of the Faculty of Engineering and a nominee of the Registrar.

2 . PROGRAMMES OFFERED

A candidate may undergo a programme in any one of the branches of study approved by the University as given below.

List of B. E. and B. Tech. Degree Programmes

1. B. E. Automobile Engineering
2. B.E Bio Medical Engineering
3. B. E. Civil Engineering
4. B. E. Computer Science and Engineering
5. B. E. Electrical and Electronics Engineering
6. B. E. Electronics and Communications Engineering
7. B. E. Mechanical Engineering
8. B. Tech. Bio-Technology
9. B. Tech Chemical Engineering
10. B. Tech Food Technology

3. MODE OF STUDY

3.1 Full-Time:

In this mode of study, the candidates are required to attend classes regularly on the specified working days of the University.

3.2 Conversion from full time mode of study to part time is not permitted.

3.3 Change from one programme to another is not permitted.

4. STRUCTURE OF PROGRAMMES

4.1 Every programme will have a curriculum with syllabus consisting of theory and practical courses such as:

(i) General core courses comprising Mathematics, Basic Sciences, Engineering Sciences and Humanities.

(ii) Core courses of Engineering/Technology.

(iii) Elective courses for specialization in related fields.

(iv) Workshop practice, computer practice, engineering graphics, laboratory work, in-plant training,seminar presentation, project work, industrial visits, camps, etc.

Every student is encouraged to participate in at least any one of the following programmes

- NSS / Sports/Physical exercise/NCC/YRC/Red Ribbon club/Environment club and Energy club
- Other Co-Curricular and Extra Curricular activities

(V) **Choice Based Credit System**

CBCS is introduced for students admitted in the academic year 2017-18. As per AICTE guidelines, CBCS is an approach in which students opt for courses of their choice. CBCS provides greater flexibility with multiple courses and enable students to undergo additional courses. CBCS is applicable to Full Time Undergraduate & Post Graduate Programmes of study. It provides a choice for students to select from the prescribed courses(Professional soft core, Professional Hard core, Professional Electives, Open Electives, Value added courses, Humanity Sciences, Basic sciences & Engineering sciences). A course designated as hard core for a particular programme of study must invariably be completed by the student to receive the degree in the programme. The Hardcore courses cannot be substituted by another courses. Students can exercise their choice among a set of Soft core courses from the list of Soft core courses specified for each Programme of study. The student should meet the criteria for prerequisites to become eligible to register for that course. The student should request for the course for every semester within the first week of semester. Maximum no of students to be registered in each course shall depend on availability of physical facilities, classroom availability and lab capacity. Registration of already requested courses by students in previous semester is not allowed.

4.2 Each course is normally assigned certain number of credits.

No. of credits per lecture period per week	1
No. of credits per tutorial period per week	1
No. of credits for 3 periods of laboratory course per week	2
No. of credits for 3 periods of project work per week	2
No. of credits for 2 periods of Value added course per week:	1
No. of credits for 3 weeks of in-plant training during Semester vacations	1

4.3 In every semester, the curriculum shall normally have a blend of theory courses not exceeding6and practical courses not exceeding 3. However, the total number of courses per semester shall not exceed 8.

4.4 The prescribed credits required for the award of the degree shall be within the limits specifiedbelow.

PROGRAMME	PRESCRIBED CREDIT RANGE
B. E./B. Tech.	165– 170

4.5 The medium of instruction for all Courses, Examinations, Seminar presentations and Project/Thesis reports is English.

4.6 Value Added Course

Besides core courses and elective courses, value added course is introduced. The blend of different courses is so designed that the student would be trained not only in his / her relevant professional field but also as a socially conscious human being.

4.7 Evaluation in the courses comprises two parts, one is the Continuous Internal Assessment (CIA) and the other one is the End Semester Examination (ESE). Evaluation in few courses may be by Internal Assessment only.

5. DURATION OF THE PROGRAMME

5.1 The prescribed duration of the programme shall be

Programme	Min. No. of semesters	Max. No. of semesters
B. E./B. Tech. (H. Sc. Candidates)	8	14
B. E./B. Tech. (Lateral Entry Candidates)	6	12

5.2 Each semester shall normally consist of 90 working days or 540 hours.

5.3 Additional classes for improvement, conduct of model test, etc., over and above the specified periods shall be arranged, if required. But for the purpose of calculation of attendance requirement for eligibility to appear for the end semester Examinations (as per Clause 11) by the students, 540 hours conducted within the specified academic schedule alone shall be taken into account and the overall percentage of attendance shall be calculated accordingly.

6. REQUIREMENTS FOR COMPLETION OF THE SEMESTER

6.1 Ideally every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate has been satisfactory during the course.

6.2 A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed

attendance requirements and shall be permitted to appear for the Examination on the recommendation of the Head of the Department concerned and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean. However, the candidate has to pay prescribed condonation fees.

6.3 Candidates who are not recommended for condonation and those who have less than 65% attendance will not be permitted to proceed to the next semester and have to redo the course. However, they are permitted to write the arrear Examinations, if any.

7. CLASS ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their period of study. Such Class Advisors shall advise the students and monitor the courses undergone by the students, check the attendance and progress of the students and counsel them periodically. If necessary, the Class Advisor may display the cumulative attendance particulars in the Department notice board and also discuss with or inform the Parents/Guardian about the progress of the students. Each student shall be provided with course plan for each course at the beginning of each semester.

8. CLASS COMMITTEE

8.1. Every class shall have a class committee consisting of teachers of the class concerned, Maximum of six student representatives [boys and girls] and the concerned Head of the Department. It is like the 'Quality Circle' with the overall goal of improving the teaching-learning process. The functions of the class committee include

- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 4 and 5 which should be displayed on Department Notice-Board.
- Informing the student representatives the details of Regulations regarding weight age used for each assessment. In the case of practical courses (laboratory / drawing / project work / seminar, etc.) the breakup of marks for each experiment / exercise /module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Solving problems experienced by students in the class room and in the laboratories.
- Informing the student representatives the academic schedule, including the dates of assessments and the syllabus coverage for each assessment.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any and requesting the teachers concerned to provide some additional academic support.

8.2 The class committee for a class under a particular branch is normally constituted by the Head of the Department. However, if the students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Dean.

8.3 The class committee shall be constituted within the first week of each semester.

8.4 The Chairperson of the Class Committee may convene the meeting of the class committee.

8.5 The Dean may participate in any Class Committee of the Faculty.

8.6 The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean through the HOD within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the Management, the same shall be brought to the notice of the Registrar by the HOD through Dean.

8.7 The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two subsequent meetings may be held in a semester at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

9. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

10. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

10.1 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' (Log book) which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

10.2 Continuous Internal Assessment (CIA): The performance of students in each subject will be continuously assessed by the respective teachers as per the guidelines given below:

THEORY COURSES:

S. No.	CATEGORY	MAXIMUM MARKS
1.	Assignment	5
2.	Seminar *	5
3.	Attendance	5
4.	Test – I	8
5.	Test – II	8
6.	Test – III	9
Continuous Internal Assessment : TOTAL		40

*Evaluation shall be made by a committee.

PATTERN OF TEST QUESTION PAPER (Test I & II)

INSTRUCTION	REMARKS
Maximum Marks	60
Duration	2 Hours
Part- A	1 to 9 Two Mark Questions, uniformly covering the two units of the syllabus. All the 9 Questions are to be answered. (**9 x 2 =18Marks)**.
Part- B	Question 10 to 12 will be of either or type, covering two units of the syllabus. Each Question may have subdivision. (**3 x 14 =42 Marks)**.

PATTERN OF TEST QUESTION PAPER (Test III)

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part - A	Part A will be online Examination. 20 Objective type Questions, Covering all the 5 units. **(20 x 1= 20 Marks) (Online Examination).**
Part- B	21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (**5 x 2= 10Marks)**.
Part- C	Question 26 to 30 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. **(5 x 14=70 Marks).**

PRACTICAL COURSES:

S. No	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model Examination	15
5.	Viva – Voce [Comprehensive]	10
Continuous Internal Assessment: TOTAL		40

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records maintained.

INTEGRATED THEORY AND PRACTICAL COURSES:

The Continuous Internal Assessment for Integrated Theory Course is awarded for 40 Marks with mark split up similar to regular theory course.

The external evaluation of integrated practical component from End semester Examination by internal mode is awarded for 50 Marks and later scaled down to 15 Marks and similarly the external evaluation for integrated theory from End semester Examination is awarded for 100 Marks and later scaled down to 45 Marks. Hence the external assessment for integrated theory and practical components contribute to 60 Marks.

10.3 ATTENDANCE

Attendance carries a maximum of 5 marks and the distribution is as under:

S. No.	Attendance %	Marks
1	91 and above	5.0
2	81-90	4.0
3	76-80	3.0

10.4 PROJECT WORK/ INTERNSHIPS:

Final year project work will be always in-house. However, as a special case, if a student is able to get a project from a government organization or private or public sector company,, the student may be permitted to do his/her project work in reputed institution/research organization/industry. Hence final year students may have commencement of eighth semester classes for 30 days in fast track mode and complete their final semester and are made eligible for undergoing Internships in Industry and also interested students are permitted for doing projects in Industries.

10.5 CERTIFICATION COURSES:

Students have to undergo a minimum of one value added course beyond curriculum as a certified course per semester for duration not less than 30 hours**.**

11. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION (ESE)

A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for Examination in all courses of the semester. Registration is mandatory for Semester Examinations as well as arrear Examinations failing which the candidate will not be permitted to attend the next semester. A candidate already appeared for a subject in a semester and passed the Examination is not entitled to reappear in the same subject of the semester for improvement of grade.

12. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each subject, for 100 marks, later scaled down to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part - A	Part A will be online Examination. 20 Objective type Questions. Covering all the 5 units. **20*1= 20 Marks (Online Examination)**
Part- B	21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (**5 *2= 10Marks)**.
Part- C	Question 26 to 30 will be of either or type, covering Five units of the syllabus. Each Question may have subdivision. **(5*14=70 Marks)**

13. PASSING REQUIREMENTS

13.1 Passing minimum: The passing minimum for CIA is 20 (i.e. out of 40 marks). The passing minimum for ESE is 30 (i.e. out of 60 marks). The overall passing minimum for theory/laboratory course is 50 (Sum of his/her score in CIA and ESE) out of 100 marks.

13.1.1 The passing minimum for value added course is 50 marks out of 100marks. There will be two tests, the first covering 50% of syllabus for 50 marks and the other for 50 marks.

13.2 If the candidate fails to secure a pass in a particular course ESE, itis mandatory that candidate shall register and reappear for the Examination in that course during the subsequent semester when Examination is conducted in that course. Further the candidate should continue to register and reappear for the Examination till a pass is secured in such supplementary Examination within the stipulated maximum duration of the programme (Clause 5.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance where he/she secures a pass shall be retained by the office of the Controller of Examinations and considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

13.3 If the candidate fails to secure a pass in a particular course in CIA, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent semester when CIA is conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate should continue to register and reappear for the CIA till a pass is secured in such subsequent Examination within the stipulated maximum duration of the programme (Clause 5.1).

13.3.1 If a candidate fails to secure a pass in value added course, he/she has to appear for the tests when course is conducted subsequently.

13.4 ONLINE COURSE (MOOC) COORDINATOR

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a MOOC coordinator for the online courses. The Online course MOOC coordinator shall identify the courses which students can select for their programme from the available online courses offered by the different agencies periodically and inform the same to the students. Further, the coordinator shall advice the students regarding the online courses and monitor their course.

13.4.1 Student shall study at least one online course from Sawayam/NPTEL in anyone of the first seven semesters for which examination shall be conducted at the end of the course by the respective organization body. The student can register to the course which are approved by the department. The student shall produce a pass certificate from the respective body before the end of the seventh semester.

14. AWARD OF LETTER GRADES

14.1 All assessments of a course will be done on absolute mark basis. However, for the purpose of reporting the performance of a candidate letter grades, each carrying certain number of points will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AB		0	ABSENT

14.2 GRADE SHEET

After results are declared, Grade sheet will be issued to each student which will contain the following details:

i. The list of courses enrolled during the semester and the grade scored,
ii. The Grade Point Average (**GPA**) for the semester and
iii. The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of Credits (**C**) of courses enrolled and the Grade Points (**GP**) corresponding to the grades scored in those courses, taken for all the courses to the sum of the number of credits of all the courses in the semester.

$$GPA = \frac{\text{Sum of } [C*GP]}{\text{Sum of } C}$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from First semester. **RA** grade and value added course will be excluded for calculating **GPA** and **CGPA**.

14.3REVALUATION

Revaluation and Re-totaling is allowed on representation. A candidate can apply for revaluation of his/her semester Examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary Examinations, Practical Examinations, Technical Seminars, In-plant Training and Project Work.

14.4 TRANSPARENCY AND GRIEVANCE COMMITTEE

A student may get the Photostat copy of the answer script on payment of prescribed fee, if he/she wishes. The students can represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HOD, the Dean of another Faculty nominated by the University), HOD of the Department concerned, the faculty of the course and Dean from other discipline nominated by the University and the COE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External Examiner will be final. The student has to pay prescribed fee for the same.

15. ELIGIBILITY FOR AWARD OF DEGREE

A student shall be declared to be eligible for award of Degree if he/she has

- Successfully gained the required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
- No disciplinary action is pending against him/her.

The award of the degree must be approved by the Board of Management of Karpagam University.

16. CLASSIFICATION OF THE DEGREE AWARDED

16.1 A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 5.1) securing a CGPA of not less than **8** shall be declared to have passed the Examination in First Class with Distinction.

16.2 A regular candidate or a lateral entrant is eligible to register for BE (Honors),B.Tech (Honors). If, he / she has passed all the courses in the first appearance and holds / maintains a CGPA of 7.5 at VI Semester. He / she has to take an additional 20 credits by studying online courses through Swayam/NPTEL. Such a candidate is eligible for the award of BE (Honor),B.Tech(Honor). However, is he / she fails in securing 20 additional credits but maintains CGPA of 7.5 and above is not eligible for Honors degree but eligible for First class with Distinction.

16.3 A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses within the specified minimum number of semesters (vide Clause

5.1) plus one year (two semesters), securing CGPA of not less than **6.5** shall be declared to have passed the Examination in First Class.

16.3 All other candidates (not covered in Clauses 17.1 and 17.2) who qualify for the award of the degree (vide Clause 15) shall be declared to have passed the Examination in Second Class.

17. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

17.1 A candidate may for valid reasons and on prior application, be granted permission to Withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination. .

17.2 Such withdrawal shall be permitted only once during the entire duration of the degree programme. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the Examination

.**17.3** Withdrawal application is valid only if it is made within 10 days prior to the commencement of the Examination in that course or courses and recommended by the Head of the Department, Dean and approved by the Registrar.

17.3.1 Notwithstanding the requirement of mandatory TEN days' notice, applications for withdrawal for special cases under extraordinary conditions may be considered on the merit of the case.

17.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during III semester.

17.5 Withdrawal from the ESE is NOT applicable to arrear Examinations.

17.6 The candidate shall reappear for the withdrawn courses during the Examination conducted in the subsequent semester.

18. PROVISION FOR AUTHORISED BREAK OF STUDY

18.1 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he/she applies to the Registrar, through the Head of the Department and Dean stating reasons thereof and the probable date of rejoining the programme.

18.2 The total number of semesters for completion of the programme from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum no. of semesters specified in Clause 5.1 irrespective of the period of break of study (vide Clause 18) in order that he/she may be eligible for the award of the degree (vide Clause 15). The candidate thus permitted to rejoin the programme at the commencement of the semester after the break shall be governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the curriculum and regulations in force at that period of time.

18.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause17). However, additional break of study granted will be counted for the purpose of classification.

18.4 The total period for completion of the programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in Clause 5.1 irrespective of the period of break of study (vide Clause 18.3) in order that he/she may be eligible for the award of the degree.

18.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Withdrawal' or 'Break of Study' (Clause18 and 18 respectively).

19. SUPPLEMENTARY ESE: After the publication of VIII semester results, if a student has **ONE** arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for supplementary Examination.

20. INDUSTRIAL VISIT

Every student is required to undergo one industrial visit for every semester, starting from the third semester of the programme.

21. DISCIPLINE

Every student is required to observe discipline and decorous behavior both inside and outside the University and not to indulge in any activity which will tend to bring down the prestige of the University. The erring student will be referred to the Disciplinary Committee constituted by the University, to enquire into acts of indiscipline and recommend to the University about the disciplinary action to be taken.

If a student indulges in malpractice in any of the ESE/CIA he/she shall be liable for punitive action as prescribed by the University from time to time.

22. REVISION OF REGULATION AND CURRICULUM

The University may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi, if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam University.

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act 1956)
FACULTY OF ENGINEERING
B.E (CIVIL ENGINEERING)
COURSE OF STUDY AND SCHEME OF EXAMINATION
(2021 BATCH ONWARDS)

SEMESTER I

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			Page Number
			PEO	PO	L	T	P		CIA	ESE	Total	
									40	60	100	
21BECC101	English	HS	1	10	2	0	2	3	40	60	100	04
21BECC102	Mathematics I	BS	1	1	3	1	0	4	40	60	100	06
21BECC141	Engineering Physics	BS	1,2	3	3	1	2	5	40	60	100	08
21BECC142	Engineering Chemistry	BS	1	1	3	0	4	5	40	60	100	11
21BECC143	Python programming	ES	1	2,4	2	0	2	3	40	60	100	14
21BECE111	Engineering Graphics	ES	1	1	1	0	4	3	40	60	100	17
TOTAL					14	2	14	23	240	360	600	

SEMESTER II

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			Page Number
			PEO	PO	L	T	P		CIA	ESE	Total	
									40	60	100	
21BECC201	Communicative English	HS	1	10	2	0	2	3	40	60	100	20
21BECC202	Mathematics II	BS	1	11	3	1	0	4	40	60	100	22
21BECE203	Energy Science and engineering	ES	1	1	1	1	0	2	40	60	100	24
21BECE204	Introduction to Mechanical Engineering	ES	1	1	2	1	0	3	40	60	100	26
21BECE241	Basic Electrical and Electronics Engineering	ES	1	1	3	1	2	5	40	60	100	28
21BECE211	Workshop Practices	ES	1	1	1	0	4	3	40	60	100	30
TOTAL					12	4	8	20	240	360	600	

SEMESTER III

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			Page Number
			PEO	PO	L	T	P		CIA	ESE	Total	
21BECE301	Mathematics-III (Transforms And Discrete Mathematics)	BS	1	1	3	1	0	4	40	60	100	33
21BECE302	Introduction to Civil Engineering	HSM	1	1	3	0	0	3	40	60	100	35
21BECE303	Engineering Geology	PC	1,2	2	3	0	0	3	40	60	100	37
21BECE304	Engineering Mechanics	ES	1	1	3	1	0	4	40	60	100	39
21BECE341	Surveying & Geomatics (Theory & Lab)	PC	1	6	1	1	2	3	40	60	100	41
21BECE342	Soil Mechanics (Theory & Lab)	PC	1,2	2,3	2	0	2	3	40	60	100	43
21BECE311	Computer-aided Civil Engineering Drawing	ES	1	4,5, 9, 10	1	0	2	2	40	60	100	46
TOTAL					16	3	6	22	280	420	700	

SEMESTER IV

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			Page Number
			PEO	PO	L	T	P		CIA	ESE	Total	
21BECE401	Disaster Management	PC	1,2	1,4	1	1	0	2	40	60	100	49
21BECE402	Environmental studies	BS	1,2	7	3	0	0	3	40	60	100	51
21BECE403	Foundation Engineering	PC	1,2	2,3	3	0	0	3	40	60	100	53
21BECE441	Introduction to Fluid Mechanics (Theory & Lab)	PC	1	3	2	0	2	3	40	60	100	55
21BECE442	Introduction to Solid Mechanics (Theory & Lab)	PC	1	3	2	0	2	3	40	60	100	57
21BECE443	Instrumentation & Sensor Technologies for Civil Engineering Applications (Theory & Lab)	PC	1,2	1,4	1	1	2	3	40	60	100	60
21BECE411	Materials,Testing &Evaluation	PC	1,2	4,9	0	0	4	4	40	60	100	62
21BECE451	In plant Training	MC	1,3	9,11	0	0	0	1	100*	0	100	64
TOTAL					12	2	10	22	380	420	800	

SEMESTER V

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			Page Number
			PEO	PO	L	T	P		CIA	ESE	Total	
21BECE501	Structural Engineering	PC	1,2	2	3	1	0	4	40	60	100	66
21BECE502	Mechanics of Materials	PC	1	3	3	0	0	3	40	60	100	68
21BECE503	Transportation Engineering	PC	1,3	6	3	0	0	3	40	60	100	70
21BECE504	Hydrology & Water Resources Engineering	PC	1,3	7	2	1	0	3	40	60	100	72
21BECE505	Professional Practice, Law & Ethics	HSM	3	8	2	0	0	2	40	60	100	74
21BECE541	Environmental Engineering (Theory & Lab)	PC	1,3	7	2	0	2	3	40	60	100	77
21BECE542	Hydraulic Engineering (Theory & Lab)	PC	1	3	2	0	2	3	40	60	100	80
21BECE551	Civil Engineering-Societal and Global Impact	HSM	1,3	8	2	0	0	2	100*	0	100	82
TOTAL					19	2	4	23	380	420	800	

SEMESTER VI

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			Page Number
			PEO	PO	L	T	P		CIA	ESE	Total	
21BECE601	Construction Management	PC	1	9,11	2	1	0	3	40	60	100	85
21BECE641	Estimation, valuation and Quantity Surveying (Theory & Lab)	PC	1	11	2	1	4	5	40	60	100	87
21BECE***	Elective-I	PE	1	6,12	3	0	0	3	40	60	100	89
21BECE***	Elective-II	PE	1	6,12	3	0	0	3	40	60	100	89
21BECE***	Elective-III	PE	1	6,12	3	0	0	3	40	60	100	89
21BECE***	Elective- IV	PE	1	6,12	3	0	0	3	40	60	100	89
21BECE651	In plant Training	MC	1,3	9,11	0	0	0	1	100*	0	100	90
TOTAL					16	2	4	21	340	360	700	

SEMESTER VII

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			Page Number
			PEO	PO	L	T	P		CIA	ESE	Total	
21BECE***	Elective V	PE	1	6,12	3	0	0	3	40	60	100	92
21BECE***	Elective-VI	PE	1	6,12	3	0	0	3	40	60	100	92
	Open Elective-I	OE	1	6	3	0	0	3	40	60	100	92
	Open Elective-II	OE	1	6	3	0	0	3	40	60	100	92
21BECE791	Project work - Phase I	PW	1,2,3	4,5,9, 11	0	0	12	6	80	120	200	93
21BECE751	In Plant Training	MC	1,3	9,11	0	0	0	1	100*	0	100	94
TOTAL					12	0	12	19	340	360	700	

SEMESTER VIII

Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			Page Number
			PEO	PO	L	T	P		CIA	ESE	Total	
21BECE***	Elective VII	PE	1	6,12	3	0	0	3	40	60	100	96
21BECE***	Elective VIII	PE	1	6,12	3	0	0	3	40	60	100	96
	Open Elective-III	OE	1	6	3	0	0	3	40	60	100	96
	Open Elective-IV	OE	1	6	3	0	0	3	40	60	100	96
21BECE891	Project work Phase II & Viva Voce (Continued from VII Semester)	PW	1,2,3	4,5,9,11	0	0	12	6	80	120	200	97
TOTAL					12	0	12	18	240	360	600	

TOTAL NO OF CREDITS=166
Total Marks =5500

L: Lecture Hour T: Tutorial Hour CIA: Continuous Internal Assessment P: Practical Hour C: Credit ESE: End semester Examination

HSM- Humanities and Social Science including Management Courses

PC- Professional Core Courses **PW-** Project Work

PE- Professional Elective Courses **MC-** Mandatory Courses

BS- Basic Science Courses

LIST OF ELECTIVES

PROFESSIONAL ELECTIVES (PE)

The Professional Elective Courses (PEC-CE) are shown in different tracks

Track	Professional Electives
I	Structural Engineering
II	Geotechnical Engineering
III	Environmental Engineering
IV	Construction Engineering & Management

STRUCTURAL ENGINEERING

Course Code	Course Title	Pre-requisite	Instruction hours/week			Credits	Maximum Marks			Page Number
			L	T	P		CIA	ESE	Total	
21BECEE01	Structural Analysis-I	21BECE501	3	0	0	3	40	60	100	98
21BECEE02	Structural Analysis-II	21BECEE01	3	0	0	3	40	60	100	100
21BECEE03	Advanced Structural Analysis	21BECEE02	3	0	0	3	40	60	100	102
21BECEE04	Structural Mechanics	21BECE502	3	0	0	3	40	60	100	104
21BECEE05	Reinforced Concrete	Nil	3	0	0	3	40	60	100	106
21BECEE06	Concrete Technology	Nil	3	0	0	3	40	60	100	108
21BECEE07	Design of Concrete Structures-I	21BECEE05	3	0	0	3	40	60	100	110
21BECEE08	Design of Concrete Structures-II	21BECEE07	3	0	0	3	40	60	100	112
21BECEE09	Pre stressed Concrete Structures	21BECEE06	3	0	0	3	40	60	100	114
21BECEE10	Design of Steel Structures	21BECEE08	3	0	0	3	40	60	100	116
21BECEE11	Concrete Materials	21BECEE06	3	0	0	3	40	60	100	118

GEOTECHNICAL ENGINEERING

Course Code	Course Title	Pre-requisite	Instruction hours/week			Credits	Maximum Marks			Page Number
			L	T	P		CIA	ESE	Total	
21BECEE12	Ground Improvement Techniques	21BECE403	3	0	0	3	40	60	100	120
21BECEE13	Environmental Soil pollution	Nil	3	0	0	3	40	60	100	122
21BECEE14	Earth Reinforcement	21BECEE12	3	0	0	3	40	60	100	124
21BECEE15	Environmental Geo-Technology	21BECEE12	3	0	0	3	40	60	100	126

ENVIRONMENTAL ENGINEERING

Course Code	Course Title	Pre-requisite	Instruction hours/week			Credits	Maximum Marks			Page Number
			L	T	P		CIA	ESE	Total	
21BECEE16	Ecological Engineering	Nil	3	0	0	3	40	60	100	128
21BECEE17	Transport of Water and Wastewater	Nil	3	0	0	3	40	60	100	130
21BECEE18	Physico-Chemical Processes for Water and Wastewater Treatment	21BECEE17	3	0	0	3	40	60	100	132
21BECEE19	Biological Processes for Contaminant Removal	Nil	3	0	0	3	40	60	100	134
21BECEE20	Rural Water Supply and Onsite Sanitation Systems	21BECEE19	3	0	0	3	40	60	100	136
21BECEE21	Solid and Hazardous Waste Management	21BECEE18	3	0	0	3	40	60	100	138
21BECEE22	Air and Noise Pollution and Control	Nil	3	0	0	3	40	60	100	140
21BECEE23	Environmental Impact Assessment and Life Cycle Analyses	21BECEE21	3	0	0	3	40	60	100	142

CONSTRUCTION ENGINEERING & MANAGEMENT

Course Code	Course Title	Pre-requisite	Instruction hours/week			Credits	Maximum Marks			Page Number
			L	T	P		CIA	ESE	Total	
21BECEE24	Building Construction Practice	21BECEE11	3	0	0	3	40	60	100	144
21BECEE25	Construction Project Planning &Systems	21BECEE24	3	0	0	3	40	60	100	146
21BECEE26	Sustainable Construction Methods	21BECEE24	3	0	0	3	40	60	100	148
21BECEE27	Construction Engineering Materials.	Nil	3	0	0	3	40	60	100	150
21BECEE28	Contracts Management	21BECEE24	3	0	0	3	40	60	100	152
21BECEE29	Construction Equipment& Automation	21BECEE24	3	0	0	3	40	60	100	154
21BECEE30	Repairs & Rehabilitation of Structures	21BECEE24	3	0	0	3	40	60	100	156

LIST OF OPEN ELECTIVES

COURSES OFFERED BY OTHER DEPARTMENTS

Course Code	Course Title	Instruction hours/week			Credits	Maximum Marks			Page Number
		L	T	P		CIA	ESE	Total	
SCIENCE AND HUIMANITIES									
21BESHOE01	Applied Electrochemistry	3	0	0	3	40	60	100	170
21BESHOE02	Green Chemistry	3	0	0	3	40	60	100	172
21BESHOE03	Solid Waste Management	3	0	0	3	40	60	100	174
COMPUTER SCIENCE ENGINEERING									
21BECSOE01	Internet Programming	3	0	0	3	40	60	100	176
21BECSOE02	Machine Learning	3	0	0	3	40	60	100	178
ELECTRICAL & ELECTRONICS ENGINEERING									
21BEEEOE01	Electric Hybrid Vehicle	3	0	0	3	40	60	100	180
21BEEEOE02	Renewable Energy Resources	3	0	0	3	40	60	100	182
ELECTRONICS & COMMUNICATION ENGINEERING									
21BEECOE01	Neural Networks and its Applications	3	0	0	3	40	60	100	184
BIOTECHNOLOGY									
21BTBTOE01	Bioreactor design	3	0	0	3	40	60	100	186
21BTBTOE02	Food Processing and Preservation	3	0	0	3	40	60	100	188
21BTBTOE03	Basic Bioinformatics	3	0	0	3	40	60	100	190
21BTBTOE04	Fundamentals of Nano biotechnology	3	0	0	3	40	60	100	192
MECHANICAL ENGINEERING									
21BEMEOE01	Computer Aided Design	3	0	0	3	40	60	100	194
21BEMEOE02	Industrial Safety And Environment	3	0	0	3	40	60	100	196

CHEMICAL ENGINEERING									
21BTCEOE01	Energy Management In Chemical Industries	3	0	0	3	40	60	100	198
21BTCEOE02	Industrial Wastewater Treatment	3	0	0	3	40	60	100	200
21BTCEOE03	Solid and Hazardous Waste Management	3	0	0	3	40	60	100	202
FOOD TECHNOLOGY									
21BTFTOE01	Processing of Food Materials	3	0	0	3	40	60	100	204
21BTFTOE02	Nutrition and Dietetics	3	0	0	3	40	60	100	206
21BTFTOE03	Ready to Eat Foods	3	0	0	3	40	60	100	208
21BTFTOE04	Agricultural Waste and Byproducts Utilization	3	0	0	3	40	60	100	210
BIOMEDICAL ENGINEERING									
21BEBMEOE01	Robotics in medicine	3	0	0	3	40	60	100	212
21BEBMEOE02	Artificial organs and Implants	3	0	0	3	40	60	100	214

COURSES OFFERED TO OTHER DEPARTMENT

SUB. CODE	TITLE OF THE PAPER	L	T	P	C	CIA	ESE	TOTAL	Page Number
21BECEOE01	Housing, Plan and Management	3	0	0	3	40	60	100	158
21BECEOE02	Building Services	3	0	0	3	40	60	100	160
21BECEOE03	Repair and Rehabilitation of Structures	3	0	0	3	40	60	100	162
21BECEOE04	Computer Aided Civil Engineering Drawing	3	0	0	3	40	60	100	164
21BECEOE05	Contracts Management	3	0	0	3	40	60	100	166
21BECEOE06	Air and Noise Pollution and Control	3	0	0	3	40	60	100	168

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act 1956)

Coimbatore – 641 021, INDIA.

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

B.E. CIVIL ENGINEERING (FULL TIME)

(2021 BATCH ONWARDS)

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO-1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSO)

The B.E. Degree Programme in Civil Engineering is offered in the department with the following programme specific outcomes:

PSO-1 The Graduates of this Programme with proficiency in mathematics and physical sciences will excel in the core areas of civil engineering such as structural, environmental and water resources engineering.

PSO-2 Utilize principles, methods, software's and codes of practices to excel in the areas of planning, analysis and designs related to Civil Engineering systems.

PSO-3 Prepare detailed drawings, cost estimates, reports, walk through views, interact with clients, manage workers, work in a team and executes construction works.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Civil Engineering education at KAHE, Coimbatore, mainly based on practical oriented learning. The courses offered are focused on training the students to make them adaptable to any type of role in different fields of Civil Engineering.

The B.E. Degree Programme in Civil Engineering is offered in the department with the following educational objectives:

PEO-1 To equip the graduates with sufficient knowledge and experience to become leaders in industry and academia

PEO-2 To offer platform for research and development

PEO-3 To impart professional ethics with a commitment to the society and environment

SEMESTER I

Semester-I

21BECC101 **ENGLISH** **4H-3C**

Instruction Hours/week: L: 2 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
2. To help students acquire their ability to speak effectively in real life situations.
3. To inculcate the habit of reading and to develop their effective reading skills.
4. To ensure that students use dictionary to improve their active and passive vocabulary.
5. To enable students to improve their lexical, grammatical and communicative competence.
6. To improve the student's communication skill at interview level.

Course Outcomes

Students undergoing this course will be able to

1. Use English language for communication: verbal & non –verbal.
2. Enrich comprehension and acquisition of speaking & writing ability.
3. Gain confidence in using English language in real life situations.
4. Improve word power: lexical, grammatical and communication competence.
5. To guide the students to write business letters and other forms of technical writing.
6. To enable students to prepare for oral communication in formal contexts.

UNIT I: BASIC WRITING SKILLS

Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents - Techniques for writing precisely.

UNIT II: VOCABULARY BUILDING

The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations.

UNIT III: GRAMMAR AND USAGE

Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers – Articles – Prepositions – Redundancies – Clichés.

UNIT IV: LISTENING AND READING SKILLS

Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise.

UNIT V: WRITING PRACTICES

Comprehension - Précis Writing - Essay Writing Listening Comprehension - Common Everyday Situations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations

Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

SUGGESTED READINGS

1. Sangeeta Sharma , Meenakshi Raman, .(2015),Technical Communication: Principles And Practice, 2nd Edition, OUP, New Delhi.
2. Sanjay Kumar and PushpLata, (2011), Communication Skills ,Oxford University Press.
3. Liz Hamp - Lyons and Ben Heasly, (2006), Study Writing, Cambridge University Press
4. F.T. Wood., (2007), Remedial English Grammar, Macmillan.
5. Michael Swan, (1995). Practical English Usage, OUP.

21BECC102 **MATHEMATICS -I** **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. To understand geometrical aspects of curvature and elegant application of differential calculus. To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
3. To introduce sequence and series and Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
4. To understand the concept of functions of several variables and vector identities.
5. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage
6. To make the student to solve various Engineering problems

Course Outcomes

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

1. In rank and Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices and the students will be able to use matrix algebra techniques for practical applications.
2. To apply differential and integral calculus to notions of evolute and introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed inengineering application
3. To solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
4. To understand the ideas of limits and continuity and an ability to calculate with them and apply them and also to calculate grad, div and curl in Cartesian and other simple coordinate systems.
5. To apply integration to compute multiple integrals, area, volume, integrals in polar and Cartesian coordinates, in addition to change of order and vector integration.
6. This course equips students to have basic knowledge and understanding in one field of materials, integral and differential calculus

UNIT I: MATRICES

Introduction - Characteristic equation – Eigen values and Eigenvectors of a real matrix – Properties – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic forms – Reduction to canonical form through orthogonal reduction. Simple problems using Scilab.

UNIT II: DIFFERENTIAL CALCULUS

Overview of Derivatives - Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes- Evolutes as Envelope of normals.

UNIT III: DIFFERENTIAL EQUATIONS

Linear Differential equations of second and higher order with constant coefficients – Homogeneous equation of Euler’s and Legendre’s type – Method of variation parameters.

UNIT IV: FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives- Homogeneous functions and Euler's theorem - Total derivative - Differentiation of implicit functions - Jacobians -Partial differentiation of implicit functions- Taylor's series for functions of two variables- Errors and approximations - Maxima and minima of functions of two variables- Lagrange's method of undetermined multipliers.

UNIT V: SEQUENCES AND SERIES

Sequences: Definition and examples – **Series:** Types and Convergence – Series of positive terms – Tests of convergence: Comparision test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

Total : 60

Suggested Readings:

1. Grewal B.S., (2014), Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, New Delhi.
2. Erwin Kreyszig, (2016), Advanced Engineering Mathematics, 10th Edition, John Wiley, India.
3. BaliN.P. and Manish Goyal, (2014), A text book of Engineering Mathematics, Laxmi Publications, New Delhi, India.
4. Veerarajan T**,** (2008), Engineering Mathematics for first year,Tata McGraw-Hill, New Delhi,.
5. Ramana B.V**,** (2010), Higher Engineering Mathematics, 11th Reprint, Tata McGraw Hill New Delhi.
6. Hemamalini. P.T**,** (2014), Engineering Mathematics**,** McGraw Hill Education (India) Private Limited, New Delhi.
7. ThomasG.B and. FinneyR.L**,** (2002), Calculus and Analytic geometry, 9th Edition,Pearson**,**.
8. Michale D. Greenberg, (2011),Advanced Engineering Mathematics, 2nd Edition, Books Pearson Education, First Indian reprint.
9. Peter V. O'Neil,(2012), Advanced Engineering Mathematics, 7th Edition, Cengage learning.
10. Gilbert Strang, (2009), Introduction to Linear Algebra, 4th Edition, Wellesley-Cambridge Press.

Websites :

1. www.efunda.com
2. www.mathcentre.ac.uk
3. www.intmath.com/matrices-determinants
4. www. Intmath.com/calculus/calculus-intro.php

Semester-I

21BECC141 **ENGINEERING PHYSICS** **6H-5C**

(Theory & Lab)

Instruction Hours/week: L:3 T : 1 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives

The Goal of this course is for students to

1. Inculcate the basics of properties of matter, sound and its applications.
2. Basics of laser and optical fiber with appropriate applications.
3. Disseminate the fundamentals of thermal physics and their applications.
4. Introduce the concepts of quantum mechanics for diverse applications.
5. Impart the basic knowledge of crystal and its various crystal structures.

Course Outcomes

Upon completion of this course, the students will be able to

1. Understand the elastic nature of materials.
2. Infer the characteristics of laser for various engineering applications.
3. Extend the knowledge on optical fiber for communication purposes.
4. Illustrate the thermal properties of materials through various methods.
5. Develop the idea of quantum mechanics through applications.
6. Identify the different atomic arrangements of crystals and its defects.

UNIT I: PROPERTIES OF MATTER AND SOUND **9**

Elasticity – basic definitions, stress - strain diagram -factors affecting elastic modulus and tensile strength–Poisson's ratio – Twisting couple - Torsion pendulum- bending of beams – bending moment – young's modulus – cantilever method, uniform and non-uniform bending – I-shaped girders.

Loudness, decibel, echo, reverberation, Sabine's formula, Ultrasonic – Production, Industrial and medical applications.

UNIT II: LIGHT, LASER AND FIBER OPTICS **9**

Light – interference – reflection, refraction – Air wedge - LASER- Principle – characteristics - emission and absorption process- Einstein's coefficients derivation. Types of LASER - Nd:YAG, CO_2, Semiconductor LASER- Applications of LASER in industry and medicine.

Fiber optics: Total internal reflection – modes of propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers (Material, refractive index and mode) – fiber optical communication system (block diagram) - Fiber optic sensors: pressure and displacement.

UNIT III: THERMAL PHYSICS **9**

Introduction– thermal expansion of solids and liquids – expansion joints – bimetallic strips – Mode of heat transfer- heat conductions in solids – thermal conductivity – derivation,

Phonons -Forbe's and Lee's disc method: theory and experiment – conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV: QUANTUM PHYSICS **9**

Merits of quantum theory, Demerits of classical theory – Black body radiation, Photo electric effect – Compton scattering: experimental description, dual nature of matter and radiation – de Broglie wavelength, uncertainty principle – Schrödinger's wave equation – time dependent and time independent equations – particle in one dimensional box- physical significance of wave function, Scanning Electron Microscope, Transmission Electron Microscope.

UNIT V: CRYSTAL PHYSICS **9**

Crystalline materials – types - unit cell, primitive cell, intercepts, interfacial angle - crystal systems, Bravais lattices, Miller indices – determination of inter-planar distances - Coordination number and packing factor for SC, BCC, FCC, HCP structures-crystal imperfections: point defect, line defect, surface and volume defect. Crystal growth techniques: Czochralski and Bridgman method.

SUGGESTED READINGS

1. Bhattacharya D.K. & Poonam T., Engineering Physics, Oxford University Press,2015.
2. Gaur R.K. and Gupta S.L, Engineering Physics, Dhanpat Rai Publications, 2012.
3. Pandey .B.K. & Chaturvedi .S, Engineering Physics, Cengage Learning India, 2012.
4. Halliday.D., Resnick R. & Walker. J, Principles of Physics, Wiley, 2015.
5. Charles Kittel, Kittel's Introduction to Solid State Physics, Wiley India Edition, 2019.
6. P.M. Mathews, K.Venkatesan, A text book of Quantum Mechanics, 2/e, Mc Graw Hill Education, 2017.
7. Laser Fundamentals, William T Silfvast, Cambridge Univ Press. 2012.
8. Fiber Optics and Optoelectronics, R P Khare, Oxford, 2012.
9. Daniel V.Schroeder, An Introduction to Thermal Physics, Pearson, 2014.
10. D.S. Mathur, Elements of properties of matter, S.Chand, 2010.

JOURNALS

1. Nature Physics.
2. Journal of Applied Mechanics (ASME).
3. Ultrasonics and sonochemistry (Elsevier).
4. Journal of Light wave Technology (IEEE).
5. Optics and Laser Technology (Elsevier).
6. Applied Thermal Engineering (Elsevier).
7. Physical Review B (American Physical Society).

WEBLINKS

1. https://nptel.ac.in/courses/122/103/122103011/
2. https://nptel.ac.in/courses/113/104/113104081/
3. http://hyperphysics.phy-astr.gsu.edu/hbase/optmod/lascon.html

(ii) Laboratory

Course Objective:

1. To develop basic laboratory skills and demonstrating the application of physical principles.
2. To prepare for the lab experiment and perform individually a wide spectrum of experiments.
3. To present experimental data in various appropriate forms like tabulation, and plots.
4. To analyze, Interpret and Summarize experimental results.
5. To communicate clearly understanding of various experimental principles, instruments/setup, and procedure
6. To develop the skills for understanding basic electric circuits.

Course Outcome:

1. The students will have the knowledge on Physics practical experiments and that knowledge will be used by them in different engineering and technology applications.
2. Prepare for the lab experiment and perform individually a wide spectrum of experiments.
3. Present experimental data in various appropriate forms like tabulation, and plots.
4. Analyze, Interpret and Summarize experimental results.
5. Communicate clearly understanding of various experimental principles, instruments/setup, and procedure.
6. Prepare to develop the skills for understanding basic electric circuits.

LIST OF EXPERIMENTS – PHYSICS (Any 10 Experiments)

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc.
2. Uniform bending (or) Non-uniform Bending– Determination of young's modulus.
3. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille's flow.
4. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
5. Laser- Determination of the wave length of the laser using grating, Acceptance angle of optical fiber.
6. Spectrometer- Determination of wavelength using grating.
7. Air wedge – Determination of thickness of a thin sheet/wire.
8. Lee's disc – Determination of thermal conductivity.
9. Determination of Band gap of a semiconductor.
10. Potentiometer – Determination of thermo EMF of a thermo couple.
11. Characteristics of photo diode.
12. Particle size determination using LASER.

Semester-I

21BECC142 **ENGINEERING CHEMISTRY** **7H-5C**

(Theory and Lab)

Instruction Hours/week: L:3 T:0 P:4 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Concepts in chemistry for engineering

Course Objective

1. To understand the terminologies of atomic and molecular structure
2. To study the basics of Periodic properties, Intermolecular forces
3. To study about spectroscopic technique
4. To understand the thermodynamic functions
5. To comprehend the basic organic chemistry and to synthesis simple drug.
6. To understand the chemical principles in the projects undertaken in field of engineering and technology

Course Outcomes

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electr onegativity.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. Rationalise bulk properties and processes using thermodynamic considerations.
5. List major chemical reactions that are used in the synthesis of molecules.
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I: PERIODIC PROPERTIES, INTERMOLECULAR FORCES

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers. Ionic, dipolar and van Der Waals interactions.

UNIT II: ELECTROCHEMISTRY AND STORAGE DEVICES

Thermodynamic functions. Free energy and emf. Cell potentials, the Nernst equation and applications. Types of electrodes Standard Hydrogen Electrode (SHE) & Calomel. Energy storage devices Primary and secondary cells leclanche cell, Lead Acid Battery, Nickel Cadmium Battery, Lithium Battery Charging and discarging reactions.

UNIT III: CORROSION AND ITS CONTROL

Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion - Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings – Organic coatings-Paints - Constituents and functions –Inorganic

coatings- Metallic coatings - Electroplating (Au) and Electro less plating (Ni) - Surface conversion coating - Hot dipping

UNIT IV: WATER TECHNOLOGY

Sources-Characteristics – Specification for drinking water, BIS &WHO-Alkalinity – Types of alkalinity and determination – Hardness – Types and estimation by EDTA method - Domestic water treatment – Disinfection methods (Chlorination, Ozonation. UV treatment) – Boiler feed water – Requirements – Disadvantages of using hard water in boilers – Internal conditioning (Phosphate, Calgon and Carbonate conditioning methods) – External conditioning – Demineralization process – Desalination - Reverse osmosis.

UNIT V: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS

Spectroscopy (Principles and Instrumentation only).Electronic spectroscopy. Vibrational and rotational spectroscopy. Applications. Surface characterization techniques Scanning electron microscope (SEM) and Transmission electron microscopy (TEM). Fluorescence and its applications in medicine.

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SUGGESTED READINGS

1. B. H. Mahan, (2010).University chemistry, Pearson Education,
2. M. J. Sienko and R. A. Plane, Chemistry: Principles and Applications.
3. C. N. Banwell, (2001)Fundamentals of Molecular Spectroscopy, McGraw-Hill,.
4. B. L. Tembe, Kamaluddin and M. S. Krishnan, Engineering Chemistry (NPTEL Web-book)
5. P. W. Atkins, (2009).Physical Chemistry, Oxford University Press,
6. K. P. C. Volhardt and N. E. Schore, (2014).5th Edition, Organic Chemistry: Structure and Function, W.H. Freeman,
7. P C Jain & Monica Jain, (2015).Engineering Chemistry, DhanpatRai Publishing Company,

(ii) Chemistry Laboratory

Course Objectives

1. To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.
2. To estimate the amount of sodium carbonate and sodium hydrogen carbonate, hardness, chloride in water sample
3. To make the student acquire practical skills in the determination of conductance of solutions, EMF etc
4. To acquaint the students with the determination of rate constant of a reaction
5. To carried out different types of titrations for estimation of concerned in materials
6. To determine the partition coefficient of a substance between two immiscible liquids.

Course Outcomes

1. The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
2. Estimate rate constants of reactions from concentration of reactants/products as a function of time
3. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc

4. Determine the partition coefficient of a substance between two immiscible liquids.
5. Acquaint the students with the determination of acid value of an oil
6. Carrying out different types of titrations for estimation of concerned in materials using comparatively more qualities and quantities of materials involved for accurate results

Choice of 10 experiments from the following:

1. Determination of surface tension and viscosity
2. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixure using volumetric titration
3. Determination of Ca / Mg using complexometric titration
4. Thin layer chromatography
5. Determination of chloride content of water
6. Determination of the rate constant of a reaction
7. Conductometry - Determination of cell constant and conductance of solutions
8. pH Metry – Determination of Acid / Base
9. Potentiometry - determination of redox potentials and emfs
10. Saponification/acid value of an oil
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal
13. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Semester-I

21BECC143 **PYTHON PROGRAMMING** **4H-3C**

(Theory & Lab)

Instruction Hours/week: L:2 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives:

Students undergoing this course are exposed to:

1. Describe the core syntax and semantics of Python programming language.
2. Discover the need for working with the strings and functions.
3. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
4. Indicate the use of regular expressions and built-in functions to navigate the file system.
5. Infer the Object-oriented Programming concepts in Python.
6. Students will solve problems, explore real-world software development challenges, and create practical and contemporary applications.

Course Outcomes:

Upon Completion of this course, the student will be able to:

1. Explain various operators used in python.
2. Apply the string handling functions to solve the given problem
3. Describe Object oriented concepts with python
4. Use image processing techniques in python programming to solve a given problem
5. Discuss the functions of networking in python
6. Solve a given analogy

UNIT I: INTRODUCTION

Installing Python; basic syntax, interactive shell, editing, saving, and running a script variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages

UNIT II: CONDITIONAL STATEMENT & STRING HANDLING

Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation – Manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers.

UNIT III: OBJECT ORIENTED PROGRAMMING WITH PYTHON

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects – OOP, continued: inheritance, polymorphism, operator overloading; abstract classes; exception handling, try block

UNIT IV: IMAGE PROCESSING WITH PYTHON

Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions Simple Graphics and Image Processing: "turtle" module; simple 2d drawing – colors, shapes; digital images, image file formats, image processing Simple image manipulations with 'image' module (convert to b/w, rayscale, blur, etc).

UNIT V: NETWORKINGWITH PYTHON

Multithreading, Networks, and Client/Server Programming; introduction to HTML, interacting with remote HTML server, running html-based queries, downloading pages; CGI programming, programming a simple CGI form.

TEXT BOOK:

1. Shroff ,"Learning Python: Powerful Object-Oriented Programming: 5th Edition, Fifth edition (24 July 2013)
2. Timothy A. Budd 'Exploring Python' – TATA McGRAW-HILL Edition - 2011
3. Vamsi Kurama , "Python Programming: A Modern Approach", Pearson Education, 2018.

REFERENCE BOOKS :

1. "Python Essential Reference". Addison-Wesley Professional; 4 edition (July 19, 2009) by David M.Baezly
2. "Python Cookbook" O'Reilly Media; 3rd edition (June 1, 2013) by David M. Baezly.
3. Guido Van Rossum, Fred . L. Drake 'Introduction to Python' – Network Theory Limited – March 2011
4. Alex Martelli 'Python in a Nutshell' - O'Reilly - 2nd Edition, 2006

WEBSITES:

1. https://www.codecademy.com/learn/python
2. www.learnpython.org/

(ii) Laboratory

Course Objectives:

Students undergoing this course are exposed to:

1. To write, test, and debug simple Python programs.
2. To implement Python programs with conditionals and loops.
3. Use functions for structuring Python programs.
4. Represent compound data using Python lists, tuples, and dictionaries.
5. Read and write data from/to files in Python.

Course Outcomes:

Upon completion of the course, students will be able to:

1. Write, test, and debug simple Python programs.
2. Implement Python programs with conditionals and loops.
3. Develop Python programs step-wise by defining functions and calling them.
4. Use Python lists, tuples, dictionaries for representing compound data.
5. Read and write data from/to files in Python.

LIST OF EXPERIMENTS:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball in Pygame

Semester-I

21BECE111 **ENGINEERING GRAPHICS** **5H–3C**

Instruction hours / week L : 1 T : 0 P:4 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

Course Objectives

1. To prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
2. To prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice
3. To give exposure to solid modeling, computer-aided geometric design, creating working drawings and engineering communication.
4. To develop graphic skill for communication of concepts, ideas and design of engineering products
5. To give exposure to existing national standards related to technical drawings
6. To gather skills in technical drawing.

Course Outcomes

1. Introduction to engineering design and its place in society
2. Exposure to the visual aspects of engineering design and engineering graphics standards
3. Exposure to solid modeling, computer-aided geometric design, creating working drawings and engineering communication.
4. To develop graphic skill for communication of concepts, ideas and design of engineering products
5. To give exposure to existing national standards related to technical drawings
6. To gather skills in technical drawing.

UNITI: INTRODUCTION

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Bureau of Indian Standards (BIS), Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning– linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Reducing Scale, Enlarging Scale, Plain Scale, Diagonal Scale and Vernier Scale. Conic sections including the Ellipse, Parabola and Hyperbola (eccentricity method only); Cycloid, Epicycloid, Hypocycloid and Involute.

UNIT II: FREE HANDSKETCHING

Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT III: INTRODUCTION TO COMPUTER GRAPHICS – 2D

Overview of Computer Graphics, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars, Drawing Area, Dialog boxes and windows, Shortcut menus

,The Command Line (where applicable), Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Annotations, layering & other functions.

UNIT IV: PROJECTION OF POINTS, LINES ANDPLANESURFACES

Projection of points and straight lines located in the first quadrant inclined to both planes– Determination of true lengths and true inclinations. Projection of polygonal surface and circular lamina inclined to both reference planes

UNITV: ISOMETRIC PROJECTIONS

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple solids, truncated prisms, pyramids, cylinders and cones; Conversion of Isometric Views to Orthographic Views and Vice-versa

SUGGESTED READINGS

1. Venugopal K and Prabhu Raja V, (2015), Engineering Graphics, New Age International Publishers.
2. C M Agrawal and Basant Agrawal, (2012), Engineering Graphics, Tata McGraw Hill, New Delhi.
3. James D. Bethune, (2019), Engineering Graphics with AutoCAD, Macromedia Press.
4. Narayana, K.L. & P Kannaiah, (2010), Text book on Engineering Drawing, Scitech Publishers.
5. Shah, M.B. & Rana B.C., (2010), Engineering Drawing and Computer Graphics, Pearson Education.
6. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House.

SEMESTER II

21BECC201 **COMMUNICATIVE ENGLISH** **4H-3C**

Instruction Hours/week: L:2 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students to

1. To help students acquire their ability to speak effectively in real life situations.
2. To enable students to communicate in effective way without any barriers.
3. To inculcate the habit of listening and to develop their effective listening skills.
4. To ensure that students use different aids in order to attain effective communication.
5. To enable students to improve their group behavior and presentation skill.

Course Outcomes

Students undergoing this course will be able to

1. Enrich comprehension and acquisition of listening, speaking & writing ability.
2. Gain confidence in using English language and develop leadership qualities.
3. To guide the students to effectively manage the team as a team player.
4. To develop the students Interpersonal and Interview skills.
5. Use English language for communication: verbal & non –verbal
6. To enable students to prepare for oral communication in formal contexts.

UNITI: COMMUNICATION SKILLS

Communication Skills: Introduction, Definition, The Importance of Communication. The Communication Process – Source, Message, Encoding, Channel, Decoding Receiver, Feedback, Context. Barriers to Communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional Barriers. Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective-Past Experiences, Prejudices, Feelings, Environment.

UNIT II: ELEMENTS OF COMMUNICATION

Introduction, Face to Face Communication- Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication. Communication Styles: Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style.

UNIT III: BASIC LISTENING SKILLS

Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations. Effective Written Communication: Introduction, When and When Not to Use Written Communication-Complexity of the Topic, Amount of Discussion's Required, Shades of Meaning, Formal Communication. Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience Organization of the Message

UNIT IV: INTERVIEW SKILLS AND GIVING PRESENTATIONS

Purpose of an interview, Do's and Don'ts of an interview- Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery.

UNIT V: WRITING PRACTICES

Group Discussion: Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion

Note: Students shall have hands on training in improving Speaking skill in the language laboratory @ 2 periods per each unit.

SUGGESTED READINGS

1. Sanjay Kumar,Pushpalata, (2011),Communicationskills,1st Edition Oxford Press.
2. Konarnira, (2011), Communication Skills forprofessionals,2nd Edition New arrivals.
3. JohnAdair,4th Edition, (2009), . Effective communication, 1stEditionCengageLearning
4. Indiapvt.ltd
5. Butter Field, (2011), Soft skill for everyone, Macmillan.
6. Stephen. P. Robbins, (2013).Communication skills, Oxford Press.

21BECC202 **MATHEMATICS -II** **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. Evaluate first order differential equations including separable, homogeneous, exact and linear
    a. Solvable for p, x and y, Clairaut's form.
2. Solving differential equation of certain type and Power series solutions of Legendre polynomials, Bessel functions of the first kind and their properties.
3. To introduce the basic concepts of PDE for solving standard partial differential equations
4. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations
5. To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, to specify some difficult integration that appear in applications can be solved by complex integration in application areas such as fluid dynamics and flow of the electric current.
6. To make the student to solve various Engineering problems

Course Outcomes:

The students will learn:

1. Solve first order differential equations utilizing the standard techniques for separable, exact, linear, Bernoulli cases.
2. Apply various techniques in solving differential equations and to understand the method of finding the series solution of Bessel's and Legendre's differential equations.
3. Understand how to solve the given standard partial differential equations.
4. Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
5. To Evaluate complex integrals using the Cauchy integral formula and the residue Theorem and to appreciate how complex methods can be used to prove some important theoretical results.
6. To understand the fundamentals and basic concepts in vector calculus, ODE, complex functions and problems related to engineering applications by using these techniques.

UNIT I: MULTIPLE INTEGRALS

Double integral – Cartesian coordinates – Polar coordinates – Area as double integrals - Change of order of integration – Triple integration in Cartesian co-ordinates

UNIT II: VECTOR CALCULUS

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green's theorem, Gauss divergence theorem and Stoke's theorems (Statement Only)- Surfaces : hemisphere and rectangular parallelopipeds.

UNIT III: ANALYTIC FUNCTIONS

Analytic functions - Cauchy-Riemann equations in Cartesian and polar forms – Sufficient condition for an analytic function (Statement Only) - Properties of analytic functions – Constructions of an analytic function - Conformal mapping: w = z+a, az, 1/z and bilinear

transformation.

UNIT IV: COMPLEX INTEGRATION

Complex Integration - Cauchy's integral theorem and integral formula (Statement Only) – Taylor series and Laurent series - Residues – Cauchy's residue theorem (Statement Only) - Applications of Residue theorem to evaluate real integrals around unit circle and semi circle (excluding poles on the real axis).

UNIT V: LAPLACE TRANSFORM

Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Initial and final value theorems. Inverse Laplace transforms – Convolution theorem (statement only) – Solution of Ordinary Differential Equations with constant coefficients using Laplace transforms – Transform of periodic functions.

Total : 60

Suggested Readings:

1. Grewal, B.S., (2014), Higher Engineering Mathematics Khanna Publishers, New Delhi, 43rd Edition.
2. Kreyszig Erwin, (2016), Advanced Engineering Mathematics , John Wiley and Sons, 10th Edition, New Delhi.
3. Bali N. P and Manish Goyal, (2011), A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd.
4. Ramana B.V, (2008), Higher Engineering Mathematics, Tata McGraw Hill Publishing Company, New Delhi.
5. Kandasamy. P, Thilagavathy. K, Gunavathy. K.,(2008), Engineering Mathematics, S Chand & Co. Ltd, New Delhi.
6. Hemamalini. P.T**,** (2014), Engineering Mathematics**,** McGraw Hill Education (India) Private Limited, New Delhi.
7. Venkataraman, M. K.,(2005), Engineering Mathematics, The National Publishing Company, Chennai.
8. Dass, H.K., and Er. Rajnish Verma,(2011), Higher Engineering Mathematics, S. Chand Private Ltd.
9. Glyn James,(2012), Advanced Modern Engineering Mathematics, 3rd Edition, Pearson Education,
10. Peter V. O'Neil,(2012), Advanced Engineering Mathematics, 7th Edition, Cengage learning.
11. Sastry.S.S,(2014), Engineering Mathematics''. Vol.I&II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi.
12. Wylie, R.C. and Barrett. L.C., (2012), Advanced Engineering Mathematics, Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi.
13. Narayanan. S, Manicavachagampillay.T.K and Ramaniah, (2002),Advanced Mathematics for Engineering Students, Viswanathan S.(Printers and Publishers) Pvt. Ltd. Chennai.

Websites:

1. www.intmath.com
2. www.efunda.com
3. www.mathcentre.ac.uk
4. www.sosmath.com/diffeq/laplace/basic/basic.html

Semester-II

21BECE203 **Energy Science & Engineering** **2H-2C**

Instruction Hours/week: L: 1 T: 1 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

Course Objectives

1. The objective of this Course is to provide an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field
2. To emphasis on alternative energy sources and their technology and application.
3. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy,
4. To focus on alternatives, renewable energy sources such as solar, biomass (conversions), wind power, waves and tidal, geothermal, ocean thermal, hydro and nuclear.
5. To know the energy conservation methods will be emphasized from Civil Engineering perspective.
6. The knowledge acquired lays a good foundation for design of various civil engineering systems/ projects dealing with these energy generation paradigms in an efficient manner.

Course Outcomes

1. List and generally explain the main sources of energy and their primary applications nationally and internationally
2. Have basic understanding of the energy sources and scientific concepts/principles behind them
3. Understand effect of using these sources on the environment and climate
4. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.
5. List and describe the primary renewable energy resources and technologies.
6. To quantify energy demands and make comparisons among energy uses, resources, and technologies.

UNIT I: INTRODUCTION TO ENERGY SCIENCE

Introduction to Energy, sustainability and the environment. Primary energy sources – world energy resources–Indian energy scenario–energy cycle of the earth –environmental aspects of energy utilization, CO_2 emissions and Global warming–renewable energy resources and their importance.

UNIT II: ENERGY STORAGE SYSTEM

Li-ion batteries - Principle of operation, Battery components and design Electrode, Advance Ni-MH batteries for transportation, Future prospects of Ni-MH batteries vs. lithium ion batteries, Zebra cell, Li-iron sulphide cells, Vanadium and iron-based batteries, Semi-fluid flow batteries for large scale grid application, Ni-H_2 cells for space applications.

UNIT III: ENERGY & EFFECT ON ENVIRONMENT

Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability, energy economics; Climate change, acid rain, ozone layer depletion, Case Studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act.

UNIT IV: CIVIL ENGINEERING PROJECTS CONNECTED WITH THE ENERGY SOURCES

Coal mining technologies, Oil exploration off shore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear fuel storage and disposal systems.

UNIT V: ENGINEERING FOR ENERGY CONSERVATION& ENERGY AUDITING

Need, Types, Methodology and Barriers. Role of energy Managers. Instruments for energy auditing. Concept of Green Building and Green Architecture; Green building concepts; Energy conservation opportunities Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems.

TEXT BOOKS:

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press.

REFERENCE BOOKS:

1. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam
2. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waaub, XVIII,
3. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. (2006) Energy and the Environment, 2nd Edition, John Wiley
4. UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment
5. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
6. Rai G.D (2011). An Non conventional Energy sources;Khanna Publishers, New Delhi.

Semester-II

21BECE204 Introduction to Mechanical Engineering 3H-3C

Instruction Hours/week: L: 2 T: 1 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1.To explain the basic theorems used in mechanical engineering.
2.To explain the fundamentals of manufacturing process and machine tools.
3.To explain the principles of refrigeration and air- conditioning
4.To Study about the operations of power plants.
5.To know about the automobile engineering
6.To Gain the basic manufacturing and machining processes.

Course Outcomes

1.To impart the basic knowledge of various basic fields of mechanical engineering.
2.Gain the basic manufacturing and machining processes.
3.Able to know about basic machining process.
4.Study about the operations of power plants.
5.Know about the automobile engineering
6.The principles of refrigeration and air- conditioning

UNIT I: MANUFACTURING PROCESSESFOUNDRY

Principles - Patterns - Types, Molding Processes, Cupola and Induction Furnaces, metal forming - Principles - Hot and cold working of metals - Forging, rolling, extrusion and wire drawing, sheet metal operations. welding - Principles - Oxy-Acetylene Welding and Manual Metal Arc Welding, Brazing and Soldering.

UNIT II: MACHINE TOOLS

Machining principles - Construction and working principles of basic machine tools - Lathe, Drilling, Shaper, Planer and Milling machine. Introduction to CNC machines.

UNIT III: AUTOMOBILE ENGINEERING

Working principle of petrol and diesel engines - Four stroke and two stroke cycles - Comparison between four stroke and two stroke engines - Working principle of simple carburetor - Lubrication system and cooling system.

UNIT IV: ENERGY ENGINEERING&HYDRAULIC MACHINES

Introduction to Boilers - Working principle of Thermal, Hydro - Electric and Nuclear Power Plants - Merits and demerits. Solar – Wind power plants.

Turbines - Impulse turbine - Pelton wheel, Reaction turbines - Kaplan and Francis turbines - Pumps - Working principle of Reciprocating pumps and Centrifugal pumps.

UNIT V: REFRIGERATION AND AIR- CONDITIONING

Terminology of Refrigeration and Air Conditioning - Basic principles of Vapour Compression and Absorption Refrigeration System – Window and Split Room Air Conditioners.

TEXT BOOKS:

1. Pearson Education; Second edition (30 May 2018), Basic Mechanical Engineering, Pravin Kumar (Author).
2. Basic Mechanical Engineering, DHANANJAY KACHALE, Publisher: Ignite Academy; 1 edition (2019).

REFERENCE BOOKS

1. Elements of Mechanical Engineering by Mehta Tiwari Mathur, Publisher: Jain Brothers; 13th Edition,2016 edition (2016).
2. Basic Mechanical Engineering, Shanmugam, Tata McGraw Hill Publishing company Limited, New Delhi, 2010
3. Basic Mechanical Engineering, Rajput, R.K, Laxmi Publications (P) Ltd,New Delhi, 2008

Semester II

21BECE241 **Basic Electrical & Electronics Engineering (Theory & Lab.)** **6H-5C**

Instruction Hours/week: L:3 T:1 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

i) Theory

Course Objectives

1. To impart the basic knowledge about the DC electric circuits.
2. To impart the basic knowledge about the AC electric circuits
3. To understand the working of electrical machines and transformers.
4. To understand the working of various semiconductor devices and digital Electronics.
5. To study the various types of measuring instruments.
6. To understand the working of low-voltage electrical installations.

Course Outcomes

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

1. Attributing the electric circuits with DC excitation by applying various circuit laws.
2. Attributing the electric circuits with AC excitation.
3. Attributing the electrical machines and transformer.
4. Evaluate the various digital circuits in real time applications.
5. Analysis various semiconductor devices in real time applications.
6. Reproduce the measuring instruments and electrical installation.

UNIT I: DC CIRCUITS

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

UNIT II: AC CIRCUITS

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III: ELECTRICAL MACHINES AND TRANSFORMER

Construction and working of a three-phase and Single-phase induction motor. Construction, working and speed control of DC motor. Magnetic materials, BH characteristics, Construction and working principle of ideal and practical transformer.

UNIT IV: SEMICONDUCTOR DEVICES AND DIGITAL ELECTRONICS

Bipolar Junction Transistor – Characteristics. Introduction to operational Amplifier – Model–Applications. Number systems – binary codes - logic gates - Boolean algebra, laws & theorems

UNIT V: MEASURING INSTRUMENTS AND ELECTRICAL INSTALLATION

Principle, construction, and operation of moving coil and moving iron meters- Measurement of Power. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, RCCB, MCCB. Earthing. Types of Batteries and its application in Electric Vehicle, Important Characteristics for Batteries. Elementary calculations for energy consumption and battery back up.

TEXT BOOK

1. S.K.Bhattacharya, "Basic Electrical Engineering", Pearson, 2019.
2. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.

REFERENCES

1. VN Mittle and Arvind Mittal,(2006) ,Basic Electrical Engineeering, McGraw Hill.
2. A.Sudhaka and Shyammohan S Palli,(2013), Circuits and Networks, McGraw Hill.
3. R.Muthusubramanian and S.Salivahanan,(2014),Basic Electrical and Electronics Engineering, McGraw Hill.

WEBSITES:

1. www. nptel.ac.in.
2. encyclopedia-magnetica.com/doku.php/coenergy.
3. https://en.wikibooks.org/wiki/electronics/measuring instruments.

ii) Laboratory

Course Objective

1. To impart the basic knowledge about the Electric circuits.
2. To observe the speed control experiments in DC motor.
3. To acquire the knowledge of energy consumption measurements in single phase system.
4. To observe and analyze the electrical parameters in R load
5. To experiment the basic laws in voltage and current.
6. To study about various logic families

Course Outcomes (Cos)

At the end of this course, students will be able

1. Getting basic practical knowledge about the Electric circuits using ohms law.
2. To analysis various parameters using KVL and KCL.
3. To observe the speed control experiments in DC motor.
4. Gathered knowledge of commercial system energy calculations.
5. To analysis various parameters in R load circuits.
6. To verify the logic gates.

List of Experiments

1. Experimental verification of electrical circuit problems using Ohms law
2. Experimental verification of electrical circuit problems using Kirchoff's Voltage law.
3. Experimental verification of electrical circuit problems using Kirchoff's Current law.
4. Measurement of electrical quantities – voltage, current, power & power factor in R load.
5. Measurement of energy using single phase energy meter.
6. Speed control of DC Shunt Motor.
7. Verification of truth table of Logic Gates.

Semester-II

21BECE211 **WORKSHOP PRACTICES** **5H - 3C**

Instruction hours / week L: 1 T: 0 P: 4 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

Course Objectives

1. To prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
2. To prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice.
3. To gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
4. To fabricate components with their own hands.
5. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
6. By assembling different components, they will be able to produce small devices of their interest.

Course Outcomes

1. Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
2. Students will be able to fabricate components with their own hands.
3. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
4. By assembling different components, they will be able to produce small devices of their interest.
5. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
6. Communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice.

(i) LECTURES &VIDEOS:

DETAILED CONTENTS

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Electrical &Electronics
5. Carpentry
6. Plastic molding, glass cutting
7. Metal casting
8. Welding

(ii) WORKSHOPPRACTICE:

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical &Electronics
5. Welding shop
6. Casting
7. Plumbing Exercises

SUGGESTEDREADINGS:

1. Gowri S, Jeyapoovan, T.,Engineering Practices Lab Manual, 5th edition, Vikas Publishing House Pvt. Ltd, Chennai. 2017.
2. Bawa, H.S, Workshop Practice, 2nd edition, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2009.
3. Choudhry S K, Elements of workshop technology, Vol 2, 13th edition, Indian book distributing company, Kolkatta,2010.
4. D K Singh, Manufacturing Technology, 2nd edition, Pearson Education,2008.
5. Kalpakjian S., Steven S. Schmid, Manufacturing Engineering and Technology, 4thedition,Pearson Education India Edition,2001.
6. Roy A. Lindberg, Processes and Materials of Manufacture, 4th edition, Prentice Hall India,1997.
7. Rao P.N., Manufacturing Technology, Vol. I and Vol. II, 4th edition, Tata McGrawHillHouse,2018.

SEMESTER III

Semester-III

21BECE301 **Mathematics III** **4H-4C**

(Transforms and Discrete Mathematics)

Instruction Hours/week: L: 3 T: 1 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. The objective of this course is to familiarize the students with statistical techniques.
2. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.
3. To understand the basic concepts of Set Theory.
4. To extend student's logical and mathematical maturity and ability to deal with abstraction.
5. To understand the basic concepts of graph theory.
6. To make the student to solve their core engineering problems.

Course Outcomes:

The students will learn:

1. To have a lucid idea about Laplace Transforms.
2. To equip themselves in the different Transform techniques like Z transforms.
3. To aware of a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science.
4. To apply a given logic sentence express it in terms of predicates, quantifiers, and logical connectives.
5. To develop the given problem as graph networks and solve with techniques of graph theory.
6. To develop the fundamentals and basic concepts in Laplace transform, Set Theory and to solve problems related to engineering applications by using these techniques.

UNIT I: FOURIER TRANSFORMS

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT II: Z-TRANSFORMS AND DIFFERENCE EQUATIONS

Z-transforms-Elementary properties - methods, Inverse Z-transform (using partial fraction and residues)- Convolution theorem- Formation of difference equations -solution of difference equations using Z-transform.

UNIT III: SETS, RELATION AND FUNCTION

Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions, their compositions and inverses.

UNIT IV: LOGIC AND PROOFS

Basic connectives and truth tables – Tautologies – Logical equivalence and Implications – Propositional logic and First order Logic – Laws of logic **–** Rules of inference – The Predicate calculus – The Statement Function, Variables and Quantifiers – Predicate Formulas– Free and Bound Variables – Introduction to proofs.

UNIT V: GRAPHS

Graphs and graph models – Graph terminology and special types of graphs–Matrix representation of graphs and graph isomorphism– Connectivity – Euler and Hamilton paths.

Total: 60

SUGGESTED READINGS:

1. Grewal B.S., “Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Erwin kreyszig, (2006), Advanced Engineering Mathematics, 9th Edition,John Wiley & Sons.
3. Veerarajan T, (2008), Engineering Mathematics for first year,Tata McGraw-Hill, New Delhi.
4. Ramana B.V, (2010), Higher Engineering Mathematics, 11th Reprint, Tata McGraw Hill New Delhi.
5. K. H. Rosen, Discrete Mathematics and its Applications, 7th Edition, Tata McGraw-Hill, Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
6. Tremblay, J.P. and Manohar.R, " Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 38th Reprint, 2011.
7. S.Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum’s Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rdEdition, 2010.
8. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill,2000.
9. N. Deo, Graph Theory with Applications to Engineering & Computer science, 2016 Edition ,Prentice Hall of India,1974.
10. B.Kolman, R.C.Busby and S.C.Ross, “Discrete Mathematical structures”, 6th Edition, PHI, 2010.

Websites:

1. www.dmtcs.org/dmtcs-ojs/index.php/dmtcs
2. www.nptel.com
3. www. mathworld.wolfram.com

Semester-III

21BECE302 **Introduction to Civil Engineering** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40** External**:60**Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field of Civil Engineering
2. To motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interest and keenness.
3. To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects of public utility.
4. To Exploration of the various possibilities of a career in this field
5. To Providing a foundation for the student to launch off upon an inspired academic pursuit into this branch of engineering
6. To Understanding the vast interfaces this field has with the society at large

Course Outcomes:

1. Introduction to what constitutes Civil Engineering
2. Identifying the various areas available to pursue and specialize within the overall field of Civil Engineering
3. Highlighting the depth of engagement possible within each of these areas
4. Exploration of the various possibilities of a career in this field
5. Understanding the vast interfaces this field has with the society at large
6. Providing inspiration for doing creative and innovative work

UNIT I: BASIC PRINCIPLES

Role of civil engineering - Infrastructure; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career.

Overview of National Planning for Construction and Infrastructure Development: Position of construction industry and other industries.

Fundamentals of Architecture & Town Planning: Aesthetics in Civil Engineering, fundamentals of architectural design & town planning; Building Systems - Development of Smart cities.

Fundamentals of Building Materials: Stones, bricks, mortars, Plain, Reinforced & Pre-stressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; Recycling of Construction & Demolition wastes.

UNIT II: BASICS OF CONSTRUCTION MANAGEMENT AND CONTRACTS MANAGEMENT

Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Importance of Contract Management.

Environmental Engineering and Sustainability: Elementary knowledge on Water treatment systems; Effluent treatment systems; Solid waste management.

Geotechnical Engineering: Basics of soil mechanics, rock mechanics and geology;

various types of foundations; basics of rock mechanics and tunneling.

UNIT III: HYDROLOGY, STRUCTURAL ENGINEERING AND SURVEYING

Fundamentals of fluid flow, basics of water supply systems; Underground Structures; Multi- purpose reservoir projects.

Structural Engineering: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies.

Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS.

UNIT IV: TRAFFIC &TRANSPORTATION ENGINEERING

Investments in transport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, harbor and airport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under heterogeneous traffic; Case studies .

UNIT V: COMPUTATIONAL METHODS, IT, IOT IN CIVIL ENGINEERING

Typical software used in Civil Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modeling; Highlighting typical available software systems(Applications and features) -SAP, STAAD, MATLAB, ETAB, MIKE21, REVIT, TEKLA, AUTOCAD, GEOSTUDIO, MSP, PRIMAVERA, Arc GIS.

TEXT BOOKS:

1. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
2. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Studyand Application.

REFERENCE BOOKS:

1. The National Building Code, BIS,(2017)
2. Avtarsingh (2002), Law of Contract, Eastern Book Co.
3. Avtarsingh (2005), Law of Arbitration and Conciliation, Eastern Book Co.
4. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
5. T. Ramappa(2010), Intellectual Property Rights Law in India, Asia Law House
6. Bare text (2005), Right to Information Act.

Semester-III

21BECE303 **Engineering Geology** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Identify the main and most common igneous, sedimentary and metamorphic rocks encountered by foundations and construction.
2. To identify and define the main morphological and geological characteristics as shown on maps,
3. Analyze geological parameters important in geotechnical studies.
4. To establish and describe topographical and geological sections,
5. Identify potential geological hazards and various structures and ways of preventing and dealing with them.
6. To collect, analyze, and report geologic data using standards in engineering practice

Course Outcomes:

After completing the course, the students will be able to

1. Site characterization and how to collect, analyze, and report geologic data using standards in engineering practice
2. The fundamentals of the engineering properties of earth materials and fluids.
3. Rock mass characterization and the mechanics of planar rock slides and topples.
4. Soil characterization and the unified soil classification system.
5. The mechanics of soils and fluids and their influence on settlement, liquefaction, and soil slope stability.
6. Students are able to identify the different types of formation of earth.

UNIT I: GENERAL GEOLOGY

Geology in Civil Engineering – Branches of geology – Earth Structures and composition –Earth processes – Weathering – Work of rivers, wind, sea and groundwater and their engineering significance– Earthquakes -Seismo-tectonics of Indian plates, seismic zones of India.

UNIT II: MINERALOGY

Physical properties of minerals – Study of the following rock forming minerals – Quartz family. Feldpar family, Augite, Hornblende, Biotite, Muscovite, Calcite, Garnet – Properties, behaviour and engineering significance of clay minerals – Coal and petroleum – Their origin and occurrence in India.

UNIT III: PETROLOGY

Classification of rocks – Distinction between igneous, sedimentary and metamorphic rocks. Description, occurrence, engineering properties and distribution of following rocks. Igneous rocks – Granite, Syenite, Diorite, Gabbro, Pegmatite, Dolerite and Basalt -Sedimentary rocks sandstone, Limestone, shale conglomerate, metamorphic rocks. Quartzite, Marble, Slate, Phyllite, Gniess and Schist.

UNIT IV: STRUCTURAL GEOLOGY

Attitude of beds – Outcrops – Introduction to Geological maps – study of structures – Folds, faults and joints.

UNIT V: INVESTIGATIONS IN CIVIL ENGINEERING

Remote sensing techniques – Study of air photos and satellite imageries – Interpretation for Civil Engineering projects – Geological conditions necessary for construction of Dams, Tunnels, Buildings, Road cuttings, Landslides – Causes and preventions. Sea erosion and coastal protection.

TEXT BOOKS:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons.
2. Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.

REFERENCE BOOKS:

1. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).
2. Garg. S.K. (2004), Physical and Engineering Geology, Khanna Publishers. – Delhi.
3. Blyth – Edward Arnold F.G.H (1998), A Geology for Engineers, (7th Edition)

Semester-III

21BECE304 **Engineering Mechanics** **4H-4C**

Instruction Hours/week: L: 3 T: 1 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To gain working knowledge of statics with emphasis on force equilibrium and free body diagrams.
2. To understand the mechanical behavior of materials under various load conditions.
3. To gain the knowledge of Centre of gravity and centroid of different sections.
4. To understand basic dynamics concepts – force, momentum, work and energy.
5. To determine the type of forces in members.
6. To apply basic knowledge of maths and physics to solve real-worldproblems

Course Outcomes:

After completing the course, the students will be able to

1. Analyze the system of forces in two and three dimensional objects and also to draw the free body diagram of any object.
2. Calculate the forces through method of joints and able to determine the type of friction in the bodies.
3. Evaluate the centroid, centre of gravity, moment of inertia for standard and composite sections.
4. Employ the methods of virtual work and energy method to the system of rigid bodies.
5. Determine the type of motion and to solve simple problems using De Alembert's Principle.
6. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems

UNITI: INTRODUCTION TO ENGINEERING MECHANICS

Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant-Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy.

UNITII: FRICTION

Introduction to friction- Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;Basic Structural Analysis: Equilibrium in three dimensions; Method of Joints; Simple Trusses; Zero force members; Beams & types of beams; Frames.

UNITIII: CENTROID AND CENTRE OF GRAVITY

Centroid of simple figures, composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

UNITIV: VIRTUAL WORK AND ENERGY METHOD

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium- Stability of equilibrium.

UNIT V: INTRODUCTION TO KINETICS OF RIGID BODIES

Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

TEXT BOOKS:

1. Dr.N. Kottiswaran, Engineering Mechanics, Balaji Publications. 2016
2. Bansal R.K.,A Text Book of Engineering Mechanics, Laxmi Publications. 2010

REFERENCE BOOKS:

1. Irving H. Shames, Engineering Mechanics, 4th Edition, Prentice Hall. 2006
2. Vela Murali, "Engineering Mechanics", Oxford University Press. 2010
3. Khurmi R.S. Engineering Mechanics, S. Chand &Co.2010
4. Tayal A.K, Engineering Mechanics, Umesh Publications. 2010

Semester-III

21BECE341	**Surveying & Geomatics (Theory & Lab)**	**4H-3C**

Instruction Hours/week: L: 1 T: 1 P: 2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i)Theory

Course Objectives

1. To describe the function of surveying in civil engineering construction,
2. Work with survey observations, and perform calculations,
3. Customary units of measure. Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements
4. Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-loop traverses,
5. Operate an automatic level to perform differential and profile leveling; properly record notes; mathematically reduce and check leveling measurements
6. Measure horizontal, vertical, and zenith angles with a transit, theodolite, total station or survey grade GNSS instruments

Course Outcomes

After completing the course, the students will be able to

1. Students will gain basic knowledge of surveying and unit conversions and its pronviple.
2. Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities
3. Translate the knowledge gained for the implementation of Civil infrastructure facilities
4. Relate the knowledge on Surveying to the new frontiers of science like Hydrographic surveying, Electronic Distance Measurement, Global Positioning System, Photogrammetric and Remote Sensing.
5. Able to measure horizontal, vertical, and zenith angles with a transit, theodolite, total station or survey grade GNSS instruments,
6. Able to identify and calculate the errors in measurements

UNIT I: INTRODUCTION TO SURVEYING

Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, measurement around obstacles- Compass Surveying- Bearing of survey lines, Plane table surveying-Levelling- Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes.

UNIT II: TRIANGULATION AND TRILATERATION

Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Trigonometric leveling Curves-Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves

UNIT III: MODERN FIELD SURVEY SYSTEMS

Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.

UNIT IV: PHOTOGRAMMETRY SURVEYING

Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammerty, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.

UNIT V: REMOTE SENSING

Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

(ii)Laboratory

List of experiments:

1. Chain Traversing
2. Compass traversing
3. Simple levelling
4. Fly levelling
5. Triangulation ad Trilateration
6. Study of theodolite, Total Station and GPS
7. Setting out works- Foundation marking- Simple curve(Right/left- handed)
8. Distance, height and area measurement using total station.

TEXT BOOKS:

1. Dr. B. C. Punmia, Er Ashok K Jain, Dr. Arun K Jain, Surveying I & II, Laxmi Publications Private Limited, 2016
2. Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications,2001.

REFERENCE BOOKS:

1. Arora, K.R., Surveying, Vol-I, II and III, Standard Book House,2015.
2. Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India,2006.
3. Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros,2011
4. Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International,2010
5. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.

Semester- III

21BECE342 **Soil Mechanics (Theory & Lab)** **4H-3C**

Instruction Hours/week: L: 2 T: 0 P: 2 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

(i)Theory

Course Objectives

1. Describe the nature of soil and gives an overall preview of the classification of soils.
2. Express the state of stresses acting on soils, especially the transmission of stresses between soil particles based on Boussinesq, Westergaard, Newmark's principle.
3. Examine the compaction and consolidation behavior of soils by considering the interaction of soils with and without the presence of water.
4. Assess the capillary phenomena of soils in the seepage condition.
5. Evaluate the strength properties of soils by experimental testing procedures for the design of various civil engineering structures.
6. To gain the knowledge of different soil classification.

Course Outcomes

After completing the course, the students will be able to

1. Distinguish the soil engineering properties and its classification.
2. Analyze the distribution of stresses in subsoil under the energy of external loads using Boussinesq, Westergaard, Newmark's principles.
3. Examine the mechanism of compaction and consolidation for the settlements analysis of soils and determine the bearing capacity of shallow foundations.
4. Analyze the effective stress concepts and permeability characteristics of soils for the design of hydraulic structures and safety analysis of slopes.
5. Will gain knowledge of the soil classification.
6. Evaluate the strength parameters of soils by using the mohr –coulomb failure theory and various experimental programs.

UNIT I: SOIL CLASSIFICATION

Nature of soil - phase relationships - Soil description and classification for engineering purposes, their significance - Index properties of soils - BIS Classification system - Unified and Textural classification systems - Field Identification of soils

UNIT II: STRESS DISTRIBUTION

Stress distribution - Soil media - capillary stress and quick sand conditions -Newmark's influence chart - Equivalent point load and other approximate methods - Pressure bulb

UNIT III: COMPACTION AND CONSOLIDATION

Soil compaction-Comparison of laboratory and field compaction methods - Factors influencing compaction behaviour of soils - Terzaghi’s one dimensional consolidation theory - Computation of rate of settlement - √t and log t methods - e-log p relationship - Factors influencing compression behaviour of soils - Components of settlement - Immediate and consolidation settlement.

UNIT IV: EFFECTIVE STRESS AND PERMEABILITY

Soil water - Effective stress concepts in soils - Capillary stress -Permeability - Darcy's Law - Permeability measurement in the laboratory and field - Factors influencing permeability of soils - Seepage - Flow nets - Simple problems of sheet pile and weir- Stability of slopes - Fellenius method - Friction circle method

UNIT V: SHEAR STRENGTH

Shear strength of cohesive and cohesion less soils - Mohr-Coulomb failure theory - Measurement of shear strength - Direct shear test - Unconfined compression test - Triaxial compression test - Vane shear tests - Pore pressure parameters - Cyclic mobility - Liquefaction.

(ii) Laboratory

List of experiments:

1. Field Density using Core Cutter method.
2. Field Density using Sand replacement method.
3. Natural moisture content using Oven Drying method.
4. Field identification of Fine Grained soils.
5. Specific gravity of Soils.
6. Grain size distribution by Sieve Analysis.
7. Grain size distribution by Hydrometer Analysis.
8. Consistency limits by Liquid limit
9. Consistency limits by Plastic limit
10. Consistency limits by Shrinkage limit.
11. Permeability test using Constant-head test method.
12. Permeability test using Falling-head method.
13. Compaction test: Standard Proctor test.
14. Compaction test: Modified Proctor test.
15. Relative density.
16. Consolidation Test.
17. Tri axial Test(UU)
18. Vane shear test
19. Direct Shear Test
20. Unconfined Compression Strength Test.

TEXT BOOKS:

1. Gopal Ranjan and Rao A.S.R. "Basic and Applied soil mechanics", Wiley Eastern Ltd, New Delhi (India), 2000
2. Arora K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers And Distributors, New Delhi, 2002
3. Punmia, B.C. "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi, 2005
4. Palani kumar. M, "Soil Mechanics", Prentice Hall of India Pvt. Ltd, Leaning Private Limited, Delhi, 2013
5. Craig. R.F., "Soil Mechanics". E & FN Spon, London and New York, 2007
6. Purushothama Raj. P., "Soil Mechanics and Foundation Engineering", 2nd Edition, Pearson Education, 2013

REFERENCE BOOKS:

1. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers Distribution Ltd., New Delhi. 2007
2. Das, B.M. "Principles of Geotechnical Engineering”. Thompson Brooks / Coles Learning Singapore, 5th Edition, 2002
3. Coduto, D.P. "Geotechnical Engineering – Principles and Practices", Prentice Hall of India Pvt. Ltd, New Delhi, 2002
4. Mc Carthy D.F. “Essentials of Soil Mechanics and Foundations”. Prentice-Hall, 2002

Semester-III

21BECE311 Computer-Aided Civil Engineering Drawing 3H-2C

Instruction Hours/week: L: 1 T: 0 P: 2 **Marks:** Internal:40 External:60 Total:100

End Semester Exam:3 Hours

Course Objectives:

1. To develop parametric design and the conventions of formal Engineering drawing.
2. Produce and interpret 2D & 3D drawings
3. To communicate a design idea/concept graphically/visually.
4. To examine a design critically and with understanding of CAD - The student learn to interpret drawings.
5. To produce designs using a combination of 2D and 3D software.
6. To get detailed information's through CAD drawings.

Course Outcomes:

After completing the course, the students will be able to

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/ visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact
6. Planning and designing of structures

UNIT I: INTRODUCTION

Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co- ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

UNIT II: SYMBOLS AND SIGN CONVENTIONS

Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

UNIT III: MASONRY BONDS:

English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

UNIT IV: BUILDING DRAWING

Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity.

UNIT V: PICTORIAL VIEW

Principles of isometrics and perspective drawing. Perspective view of building, Software's

List of Drawing Experiments:

1. Buildings with load bearing walls including details of doors and windows.
2. RCC frames building- plan an section
3. Structural detailing of RC elements
4. Reinforcement drawings for typical slabs, beams, columns and spread footings.
5. Industrial buildings – Simple Trusses - PEB
6. Perspective view of one storey buildings

TEXT BOOKS:

1. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt.Ltd.,
2. Subhash C Sharma & Gurucharan Singh (2005), " Civil Engineering Drawing" , Standard Publishers

REFERENCE BOOKS:

1. (Corresponding set of) CAD Software Theory and User Manuals.
2. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
3. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria & Sons.
4. Ajeet Singh (2002), " Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, New Delhi

SEMESTER IV

Semester-IV

21BECE401 **Disaster Management** **2H-2C**

Instruction Hours/week: L: 1 T: 1 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To understand basic concepts in Disaster preparedness and planning management.
2. To understand the disaster phenomenon, its different contextual aspects, impacts and public health consequence.
3. To increase skills and abilities for implementing the disaster risk reduction.
4. To ensure skills to design, implement and evaluate research on disasters.
5. To ensure ability to analyze potential effects of disasters and the strategies and methods to deliver public health response to avert these effects.
6. To understand Categories of Disasters

Course Outcomes:

After completing the course, the students will be able to

1. Describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities.
2. Learn more about the information on risks, relief needs.
3. Capacity to manage the public health aspects of the disasters.
4. Perform research on the different aspects of the emergencies and disaster events.
5. Work on the field of emergencies.
6. Understand the impacts of Disasters Key Skills

UNIT I: INTRODUCTION

Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation, communication system during disaster - Disasters classification; natural disasters - manmade disasters - hazard and vulnerability profile of India, ecological fragility - mountain and coastal areas.

UNIT II: DISASTER IMPACTS

Disaster impacts health, psycho-social issues; demographic aspects -hazard locations - global and national disaster trends - climate change and urban disasters.

UNIT III: DISASTER RISK REDUCTION

Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems,

UNIT IV: DISASTERS, ENVIRONMENT AND DEVELOPMENT

Factors affecting vulnerability such as impact of developmental projects and environmental modifications sustainable and environmentally friendly recovery; reconstruction and development methods.

UNIT V: POST DISASTER MANAGEMENT:

Funding techniques – community rebuilding models – psychology and health rehabilitation – temporary housing and sanitation models, Agencies of disaster.

TEXT BOOKS:

1. Pradeep Sahni, Disaster Risk Reduction in South Asia, PrenticeHall, 2004.
2. Singh B.K., Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication2008.

REFERENCE BOOKS:

1. Ghosh G.K., Disaster Management, APH PublishingCorporation,2006.
2. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June2003
3. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva:IASC.

Semester-IV

21BECE402 **Environmental Studies** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To create the awareness about environmental problems among people.
2. To develop an attitude of concern for the environment.
3. To motivate public to participate in environment protection and improvement.
4. To understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. To Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
6. To Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems

Course Outcomes

After completing the course, the students will be able to

1. Determine the concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
3. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
5. Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and / or practitioners
6. Develop an attitude of concern for the environment.

UNIT I: INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem.

UNIT II: NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources - Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources - Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT III: BIODIVERSITY AND ITS CONSERVATION

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels). Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT IV: ENVIRONMENTAL POLLUTION

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban, industrial and e-wastes. Role of an individual in prevention of pollution. Case studies.

UNIT V: SOCIAL ISSUES AND THE ENVIRONMENT

Concept of sustainability and sustainable development. Water conservation - Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws International agreements (Montreal and Kyoto protocols).Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides). Environmental Movements. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies. Human population growth: Impacts on environment, human health and welfare.

TEXT BOOKS:

1. Mishra, D.D. Fundamental Concepts in Environmental Studies. S.Chand& CompanyPvt. Ltd., New Delhi.(2010)
2. Arvind Kumar. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.(2004)

REFERENCE BOOKS:

1. Anubha Kaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies.New Age International Pvt. Ltd. Publications, New Delhi.
2. Daniel, B. Botkin., and Edward, A. Keller. 1995. Environmental Science John Wileyand Sons, Inc., New York.
3. Odum, E.P., Odum, H.T. and Andrews, J. 1971. Fundamentals of Ecology. Philadelphia:Saunders.
4. Rajagopalan, R. 2016. Environmental Studies: From Crisis to Cure, Oxford UniversityPress**.**

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Semester-IV

21BECE403 **Foundation Engineering** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To describe the selection of foundation based on different soil conditions and explorations of soils for analyze and design the foundations.
2. To express the concept of bearing capacity and settlement of foundations.
3. To describe the load transfer mechanism of pile foundation in different soil conditions and design of single and pile groups.
4. To assess the characteristics of problematic soils and remedial measures for the construction of foundation on such soils.
5. To assess the earth pressures on retaining walls by using active and passive earth pressure theories.
6. To have deep knowledge on types of foundation

Course Outcomes

After learning the course the students should be able to:

1. Understand the various soil conditions through the different methods of soil exploration and investigation.
2. Assess the bearing capacity of shallow foundation and its settlement based on different sub soil parameters using in-situ tests.
3. Assess the load carrying capacities and design of pile foundation.
4. Express the engineering behavior of expansive soils and selection of suitable foundation for such soils.
5. Assess the earth pressures acting on retaining wall subjected to various loads and design of retaining wall for the appropriate/suitable foundation system.
6. Deep knowledge on types of foundation

UNIT I: SELECTION OF FOUNDATION AND SUB-SOIL EXPLORATION

Types of foundation - Factors affecting the selection of foundations - Types of foundation based on soil condition-Soil exploration- Boring and drilling methods of exploration -Soil sampling techniques -Field penetration tests -Bore log- Excavation methods -Introduction to geophysical methods

UNIT II: SHALLOW FOUNDATION

Design criteria -Modes of shear failures - Bearing capacity theories - IS Code and Presumptive methods of bearing capacity – Settlement of foundation -Allowable bearing pressure - Bearing capacity from in-situ tests - Factors affecting bearing capacity - Bearing capacity of raft/mat foundation as per code of practice - Contact pressures under rigid and flexible footings - Floating foundation.

UNIT III: PILE FOUNDATIONS

Load transfer mechanism - Types of piles and their function - Factors influencing selection of pile - Method of installation - Load carrying capacity of piles - Static formula and dynamic formulae - Penetration test data & Pile load test - Pile group - Group capacity - Negative skin friction.

UNIT IV: FOUNDATIONS ON PROBLEMATIC SOIL AND INTRODUCTION TO GEOSYNTHETICS

Significant characteristics of expansive soil - Footing on expansive soil - Problems and preventive measures - Under-reamed pile foundation, design and field installation - Significant characteristics of silt and loess, problems -Remedial measures - Introduction to geosynthetics.

UNIT V: RETAINING WALLS

Types of retaining walls - Rankine's theories of earth pressure - Mechanism of active and passive earth pressure - Design of different retaining walls under different soil conditions.

TEXT BOOKS:

1. P. Purushothama Raj; Soil Mechanics and Foundation Engineering; Pearson Education.
2. B.C. Punamia; Soil Mechanics & Foundation Engineering; Laxmi Pub. Pvt. Ltd., Delhi.
3. V. N. S. Murthy; Soil Mechanics & Foundation Engineering; SaiKripa Technical Consultants, Banglore
4. Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd.
5. Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi

REFERENCE BOOKS:

1. Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
2. Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
3. Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.

Semester-IV

21BECE441	**Introduction to Fluid Mechanics (Theory and Lab)**	**4H-3C**

Instruction Hours/week: L: 2 T: 0 P: 2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objective

1. To provide exposure to the students to fluid statics, kinematics and dynamics.
2. To measure the pressure and computations of hydrostatic forces on structural components
3. To explain the concepts of Buoyancy all find useful applications in many engineering problems.
4. To analyze engineering problems involving fluids – such as those dealing with pipe flow,open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow with a mechanistic perspective is essential for the civil engineering students.
5. To classify the model analysis problems using Dynamic similarity principles
6. To apply dimensional analysis

Course Outcome

After completing the course, the students will be able to

1. Understand the broad principles of fluid statics, kinematics and dynamics
2. Understand definitions of the basic terms used in fluid mechanics
3. Understand classifications of fluid flow
4. Be able to apply the continuity, momentum and energy principles
5. Be able to apply dimensional analysis
6. Understand the open channel flow, jets, turbines and pumps, dams and spillways, culverts, river.

UNIT I: BASIC CONCEPTS AND DEFINITIONS

Distinction between a fluid and a solid;-Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

UNIT II: FLUID STATICS

Fluid Pressure-Pressure at a point, Pascal's law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micro manometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

UNIT III: FLUID KINEMATICS

Classification of fluid flow- steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line,

streak line and stream tube; stream function, velocity potential function. One, two- and three - dimensional continuity equations in Cartesian coordinates

UNIT IV: FLUID DYNAMICS

Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: venturimeter, orifice meter and pitot tube.

UNIT V: DIMENSIONAL ANALYSIS AND DYNAMIC SIMILITUDE

Definitions of Reynolds Number, Froude Number, Mach number, Weber Number and Euler Number; Buckingham's π-Theorem.

(ii)Laboratory

Lab Experiments

1. Calculation of viscosity
2. Study of Pressure Measuring Devices
3. Verification of Bernoulli's Theorem
4. Venturimeter
5. Orificemeter
6. Impacts of jets
7. Velocity distribution in pipes
8. Laminar Flow

TEXT BOOKS:

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press,2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard BookHouse

REFERENCE BOOKS:

1. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGrawHill
2. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc GrawHill.

Semester-IV

21BECE442	**Introduction to Solid Mechanics (Theory and Lab)**	**4H-3C**

Instruction Hours/week: L: 2 T: 0 P: 2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objective

1. To introduce the continuum mechanics and material modeling of engineering materials based on first energy principles.
2. To know about the thermodynamics, this allows understanding, modeling and design of a large range of engineering materials.
3. To describe the subject of mechanics of materials involves analytical methods for determining the strength, stiffness, and stability of the various members in a structural system.
4. To obtain stresses and deflections of beams on elastic foundations
5. To solve torsion problems in bars and thin walled members
6. The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics)

Course Outcome

After completing the course, the students will be able to

1. Identify the characteristics and calculate the magnitude of combined stresses in individual members and complete structures;
2. Analyze solid mechanics problems using classical methods and energy methods;
3. Compare the various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress;
4. Locate the shear center of thin wall beams.
5. Evaluate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading;
6. Apply various failure criteria for general stress states at points; solve torsion problems in bars and thin walled members.

UNIT I: SIMPLE STRESSES AND STRAINS

Concept of stress and strain-St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law-stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section–composite bars– Temperature stresses. Strain Energy–Resilience-Gradual, sudden, impact and shock loadings – simple applications.

UNIT II: COMPOUND STRESSES AND STRAINS

Two dimensional system, stress at a point on a plane- principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications-Two dimensional stress-

strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

UNIT III: SHEAR FORCE AND BENDING MOMENT DIAGRAMS

Shear force (SF) and Bending moment (BM) diagrams. SF and BM diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contraflexure -application of moments.

UNIT IV: FLEXURAL STRESSES-THEORY OF SIMPLE BENDING

Derivation of bending equation: Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections, I,T, Angle and Channel sections – Design of simple beam sections. Shear Stresses- Derivation of moment equation– Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections. Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.

UNIT V: TORSION

Derivation of torsion equation and its assumptions-Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs. Thin Cylinders and Spheres

(ii)Laboratory

List of Experiments:

1. Bending tests on simply supported beam and Cantilever beam.
2. Compression test on wood
3. Impact test
4. Shear test
5. Investigation of Hook's law
6. Determination of torsion and deflection,
7. Measurement of forces on supports in statically determinate beam,
8. Determination of shear forces in beams,
9. Determination of bending moments in beams,
10. Measurement of deflections in statically determinate beam,
11. Measurement of strain in a bar
12. Bend test steel bar;
13. Yield/tensile strength of steel bar;

TEXT BOOKS:

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
2. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.

REFERENCE BOOKS:

1. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall,2004
2. Laboratory Manual of Testing Materials - William KendrickHall
3. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T.DEwolf– TMH 2002.
4. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

Semester-IV

21BECE443 Instrumentation and Sensor Technologies for Civil Engineering Applications (Theory and Lab) 4H-3C

Instruction Hours/week: L: 1 T: 1 P: 2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives

1. To understand instrumentation, sensor theory and technology, data acquisition, digital signal processing, damage detection algorithm, life time analysis and decision making.
2. To understand theoretical and practical principles of design of sensor systems
3. To allow students to prepare, deploy and analyze observations from standard instruments.
4. Laboratory experiments shall be used on application of concepts introduced in the lectures.
5. To describe the requirements during the transmission of measured signals
6. To construct Instrumentation/Computer Networks
7. To suggest proper sensor technologies for specific applications

Course Outcomes

1. To analyze the errors during measurements
2. To specify the requirements in the calibration of sensors and instruments
3. To describe the noise added during measurements and transmission
4. To describe the measurement of electrical variables
5. To describe the requirements during the transmission of measured signals
6. To construct Instrumentation/Computer Networks

UNITI: FUNDAMENTALS OF MEASUREMENT, SENSING AND INSTRUMENTATION

Definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations.

UNIT II: SENSOR INSTALLATION AND OPERATION

Predict the response of sensors to various inputs, Construct a conceptual instrumentation and monitoring program, describe the order and methodology for sensor installation. Differentiate between types of sensors and their modes of operation and measurement. Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty.

UNIT III: TRANSDUCERS

Definition and classification - common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature - basic principles and working

of LVDT, electromagnetic and ultrasonic flow meters, piezoelectric force transducer, load cell, strain gauge- bridge configuration for four strain gauges, RTD, Thermistors, thermocouple, Need for instrumentation system, data acquisition system.

UNIT IV: DATA ANALYSIS AND INTERPRETATION

Fundamental statistical concepts- Data reduction and interpretation- Time domain signal processing- Discrete signals, Signals and noise, a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range).

UNIT V: TUTORIALS FROM THE ABOVE MODULES

Demonstrating clearly the understanding and use for the sensors and instruments used for the problems posed and inferences drawn from the measurement and observations made along with evaluation report

(ii)Laboratory

Practical's:

1. Instrumentation of typical civil engineering members/structures/structural elements Use of different sensors, strain gauges, inclinometers.
2. Performance characteristics Errors during the measurement process Calibration of measuring sensors and instruments measurement, noise and signal processing Analog Signal processing.
3. Digital Signal Processing Demonstration & use of sensor technologies.

TEXT BOOKS:

1. Alan S Morris , Measurement and Instrumentation Principles,3rd/e, Butterworth Heinemann.2001
2. David A. Bell, Electronic Instrumentation and Measurements 2nd/e, Oxford Press. 2007

REFERENCE BOOKS:

1. S. Tumanski, Principle of Electrical Measurement, Taylor &Francis. 2006
2. Ilya Gertsbakh, Measurement Theory for Engineers,Springer. 2010

Semester-IV

21BECE411 **Materials, Testing and Evaluation** **4H-4C**

Instruction Hours/week: L: 0 T: 0 P: 4 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course objectives

1. Make measurements of behavior of various materials used in Civil Engineering.
2. Provide physical observations to complement concepts learnt
3. Introduce experimental procedures and common measurement instruments, equipment, devices.
4. Exposure to a variety of established material testing procedures and techniques
5. Different methods of evaluation and inferences drawn from observations
6. To compute engineering values (e.g. stress or strain) from laboratory measures

Course outcomes:

1. yield strength and other related attributes

Practical:

1. Gradation of coarse and fine aggregates
2. Different corresponding tests and need/application of these tests in design and quality control.
3. Tensile Strength of materials
4. Compressive strength test on aggregates
5. Tension I - Elastic Behavior of metals &materials
6. Tension II - Failure of Common Materials
7. Concrete I - Early Age Properties
8. Concrete II - Compression and Indirect Tension
9. Compression –Directionality
10. Torsion test on circular
11. Hardness tests (Brinnel's and Rockwell)
12. Bituminous Mix Design and Tests on bituminous mixes – Marshall method
13. Concrete Mix Design as per BIS

TEXT BOOKS:

1. Arora S.P. and Bindra S.P, Planning Techniques and Method of Construction, DhanpatRai and Sons. 2004
2. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C, Construction Planning, Equipment and Methods, McGraw Hill, Singapore. 2006

REFERENCE BOOKS:

1. Chudley, R., Greeno, 'Building Construction Handbook' (6th ed.),R. Butterworth-Heinemann. 2006
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand& Bros, Fifth Edition
3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO,

etc. corresponding to materials used for Civil Engineering applications
4. Kyriakos Komvopoulos, Mechanical Testing of Engineering Materials,Cognella.2011
5. Dr. R.K. Rajput, Engineering materials, S. Chand& Company Ltd., New Delhi, 2000

Semester-IV

21BECE451	**In plant Training**	**1C**

Instruction Hours/week: L: 0 T: 0 P: 0 **Marks:** Internal**:100** External**:0** Total**:100**

SEMESTER V

Semester-V

21BECE501 **Structural Engineering** **4H-4C**

Instruction Hours/week: L: 3 T: 1 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. Students will be exposed to the theories and concepts of concrete and steel design
2. To understand the concept of analysis of structures by various classical methods
3. Hands-on design experience and skills will be gained and learned through problem sets and a comprehensive design project.
4. An understanding of real-world open-ended design issues will be developed. Weekly recitations and project discussions will be held besides lectures.
5. To know about statically determinate and indeterminate suspension bridges and arches.
6. To analyze the forces in cables under concentrated and uniformly distributed loads.

Course Outcomes:

After completing the course, the students will be able to

1. Employ the principles of sustainable development as an engineer
2. Apply their knowledge of structural mechanics dealing with the in addressing design problems of Structural Engineering
3. Possess the skills to solve problems dealing with different loads in concrete and steel
4. Apply their skill in analysis and design of various structural elements.
5. Practice special design concepts in their design projects.
6. Analyze the forces in cables under concentrated and uniformly distributed loads

UNIT I: INTRODUCTION

Concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design.

UNIT II: PLANNING AND DESIGN PROCESS

Materials, Loads, and Design Safety; Behavior and Properties of Concrete and Steel; Wind and Earthquake Loads.

UNIT III: MATERIALS AND STRUCTURAL DESIGN CRITERIA

Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminate structures.

UNIT IV: DESIGN OF STRUCTURAL ELEMENTS

Concrete Elements, Steel Elements, Structural Joints; Theories and concepts of both concrete and steel design and analysis both at the element and system levels. Approximate Analysis Methods as a Basis for Design; Design of Tension Members and Connections; Bending

Members; Structural Systems.

UNIT V: SYSTEM DESIGN CONCEPTS

Special Topics that may be covered as Part of the Design Project Discussions; Flat slabs; Prestressed Concrete Elements; Constructability and Structural Control; Fire Protection.

Text Book:

1. S.Ramamrutham & R.Narayan, Theory of structures, Dhanpat Rai Publishing Co, New Delhi. 2013
2. Bhavaikatti, S.S (2008), Structural Analysis – Vol. 1 & Vol. 2, Vikas Publishing Pvt Ltd., New Delhi . 2008

Reference Books:

1. Nilson, A. H. Design of Concrete Structures. 13th edition. McGraw Hill, 2004
2. Mc Cormac, J.C., Nelson, J.K., Jr., Structural Steel Design. 3rd edition. Prentice Hall, N.J.,2003
3. Nawy, E. G., Pre stressed Concrete: A Fundamental Approach, Prentice Hall, NJ,
4. Related Codes of Practice of BIS. 2003
5. Smith, J. CStructural Analysis, Harpor and Row, Publishers, New York. 2000
6. NBC, National Building Code, BIS(2017).
7. Dr. B.C.Punmi, Strength of materials and Theory of Structures Vol. I & II Laxmi Publications, Chennai.2011
8. Gambhir.M.L., Fundamentals of Structural Mechanics and Analysis, PHI Learning Pvt. Ltd., New Delhi.2011

Semester-V

21BECE502 **Mechanics of Materials** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To understand the deformation and strains under different load action and response in terms of forces and moments
2. To Understand the behavior under different loading actions
3. To calculate the reactions, forces and moments for various engineering application.
4. To understand the energy methods used to derive the equations to solve engineering problems.
5. Make use of the capabilities to determine the forces and moments for design.
6. To understand the impact of engineering solutions in a global and societal context

Course Outcomes:

After completing the course, the students will be able to

1. Design a system, component, or process to meet desired needs.
2. Identify, formulate, and solve engineering problems.
3. Use the techniques, skills, and modern engineering tools necessary for engineering practice.
4. Apply principles of engineering, basic science, and math to model, analyze, design and realize physical systems, components or processes.
5. Will design a system, component, or process to meet desired needs
6. Will understand the impact of engineering solutions in a global and societal context

UNIT I: DEFORMATION AND STRAIN

Description of finite deformation, Infinitesimal deformation; Stability of dams, retaining walls and chimneys. Generalized state of stress and strain: Stress and strain tensor, Yield criteria and theories of failure; Tresca, Von-Mises, Hill criteria, Heigh-Westerguard's stress space.

UNIT II: MOMENTUM BALANCE AND STRESSES

Forces and Moments Transmitted by Slender Members, Shear Force and Bending Moment Diagrams, Momentum Balance, Stress States / Failure Criterion. Mechanics of Deformable Bodies covering Force-Deformation Relationships and Static Indeterminacy, Uni axial Loading and Material Properties, trusses and their Deformations, Statically Determinate and Indeterminate Trusses.

UNIT III: FORCE-STRESS- EQUILIBRIUM

Multiaxial Stress and Strain-Strain covering Multiaxial Strain and Multiaxial Stress-strain Relationships.

UNIT IV: BENDING: STRESS AND STRAINS; DEFLECTIONS AND TORSION

Pure Bending, Moment-curvature Relationship, Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams, Shear and Torsion, Torsion and Twisting,

Thermo elasticity, Energy methods, Variation Methods; Strain energy, elastic, complementary and total strain energy, Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano's theorem, Maxwell Bettie's reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of beams and frames.

UNIT V: STRUCTURAL STABILITY

Stability of columns, Euler's formula, end conditions and effective length factor, Columns with eccentric and lateral load; Plasticity and Yield Design covering 1D-Plasticity – An Energy Approach, Plasticity Models, Limit Analysis and Yield Design.

TEXT BOOK:

1. Norris, C.H. and Wilber, J. B. and Utku, S. "Elementary Structural Analysis" Mc Graw Hill, Tokyo, Japan.
2. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.

REFERENCE BOOKS:

1. Kazmi, S. M. A., 'Solid Mechanics" TMH, Delhi,India.
2. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall,2004
3. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill,1979.

Semester-V

21BECE503 **Transportation Engineering** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To recognize the function and scope of Transportation Engineering.
2. To understand the alignments of roads, rails and bridges.
3. To recognize problems and issues in Parking, Accident, Public Transport.
4. To have a real understanding on pavement designs.
5. To gain knowledge about the pavement material sand designs.
6. Describe Transportation Planning Process and apply Traffic Forecasting Methods.

Course Outcomes:

After completing the course, the students will be able to

1. Carry out surveys involved in planning and highway alignment
2. Identify the proper alignment of highways and their classifications.
3. Design the horizontal and vertical alignment of highways.
4. Solve the traffic problems through traffic regulations and control.
5. Assess the materials used in pavement and their maintenance.
6. Design the pavements as per IRC

UNIT I: **HIGHWAY DEVELOPMENT AND PLANNING**

Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.

UNITII: **GEOMETRIC DESIGN OF HIGHWAYS**

Introduction- highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, Alignments of bridges, problems.

UNIT III: **TRAFFIC ENGINEERING & CONTROL**

Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems.

UNIT IV: **PAVEMENT MATERIALS AND MAINTENANCE**

Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements and Problems.

UNITV: DESIGN OF PAVEMENTS:

Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid

pavements; design of concrete pavements as per IRC; problems.

TEXT BOOKS:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros,2017
2. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press,2011.

REFERENCE BOOKS:

1. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers. 2005
2. Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning,
3. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, 'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley
4. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.

Semester-V

21BECE504 Hydrology and Water Resources Engineering 3H-3C

Instruction Hours/week: L: 2 T: 1 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To understand the interaction among various processes in the hydrologic cycle.
2. To gain the knowledge of measurement of rainfall in different areas.
3. To understand application of systems concept, advanced optimization techniques to cover the socio-technical aspects in the field of water resources.
4. To understand the basic aquifer parameters and estimate groundwater resources for different hydro-geological boundary conditions.
5. To understand the concept of precipitation and measurement of precipitation.
6. To gain the knowledge of distribution systems in canals.

Course Outcomes:

After completing the course, the students will be able to

1. Calculate the probable maximum precipitation.
2. Determine the different abstractions from precipitation.
3. Evaluate the volume of runoff through unit hydrograph and base flow separation method.
4. Analyze the usage of surface and subsurface water.
5. Calculate the discharges from canals and their distribution.
6. Applying the knowledge of GPS and GIS in the context to hydrological extreme flood and drought events in water resources engineering

UNIT I: INTRODUCTION

Hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data. Precipitation- Forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth- area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

UNIT II: ABSTRACTIONS FROM PRECIPITATION

Evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapo transpiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modeling infiltration capacity, classification of infiltration capacities, infiltration indices.

UNIT III: RUNOFF

Runoff volume, SCS-CN method of estimating runoff volume, flow- duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India,

environmental flows. Ground water and well hydrology- Forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

UNIT IV: WATER WITHDRAWALS AND USES

Water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

UNIT V: DISTRIBUTION SYSTEMS

Canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods.

TEXT BOOKS:

1.K. Subramanya, Engineering Hydrology, Mc-Graw Hill.
2.K. Subramanya, Water Resources Engineering, Tata Mc- Graw Hill.

REFERENCE BOOKS:

1. K.N.Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
2. L. W. Mays, Water Resources Engineering, Wiley.
3. J. D. Zimmerman, Irrigation, John Wiley &Sons
4. C. S. P. Ojha, R.Berndtsson and P.Bhunya, Engineering Hydrology, Oxford.

Semester-V

21BECE505 **Professional Practice, Law &Ethics** **2H-2C**

Instruction Hours/week: L: 2 T: 0 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The course is designed to address the following:

1. To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession
2. To develop some ideas of the legal and practical aspects of their profession
3. To give an understanding of Intellectual Property Rights, Patents.
4. To give a good insight into contracts and contracts management
5. To know about Intellectual Property Rights, Patents.
6. To Gathered ideas of the legal and practical aspects of their profession

Course Outcomes

1. Familiarize the students to what constitutes professional practice, introduction of various stakeholders and their respective roles; understanding the fundamental ethics governing the profession
2. Gained a good insight into contracts and contracts management in civil engineering, dispute resolution mechanisms; laws governing engagement of labour.
3. Good understanding of Intellectual Property Rights, Patents.
4. To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession
5. To develop good ideas of the legal and practical aspects of their profession
6. Gathered ideas of the legal and practical aspects of their profession

UNIT-I PROFESSIONAL PRACTICE & PROFESSIONAL ETHICS:

Professional Practices- Respective roles of various stakeholders: Government (constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Standardization Bodies; professional bodies -Institution of Engineers, Indian Roads Congress, IIA/ COA, ECI, Local Bodies/ Planning Authorities ; Clients/ owners; Developers; Consultants; Contractors; Manufacturers/ Vendors/ Service agencies

Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures.

UNIT-II: **GENERAL PRINCIPLES OF CONTRACTS MANAGEMENT:**

Indian Contract Act, 1872 and amendments covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and sub-contracts; Joint Ventures & Consortium; Complex contract terminology; Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications; Critical /" Red Flag" conditions; Contract award & Notice

To Proceed; Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays, Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Non-performance; Contract documentation; Contract Notices; Wrong practices in contractin; Reverse auction; Case Studies; Build-Own-Operate & variations; Public- Private Partnerships; International Commercial Terms;

UNIT-III*:* ARBITRATION, CONCILIATION AND ADR (ALTERNATIVE DISPUTE RESOLUTION) SYSTEM:

Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok A dalats

UNIT IV: ENGAGEMENT OF LABOUR AND LABOUR & OTHER CONSTRUCTION-RELATED LAWS:

Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piecerate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers Act (1996) and Rules (1998); RERA Act 2017, NBC 2017

UNIT V: LAW RELATING TO INTELLECTUAL PROPERTY:

Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies.

TEXT/REFERENCE BOOKS:

1.The National Building Code, BIS,2017

2.RERA Act,2017

3.Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edition. Professional Offset

4.Avtar singh (2002), Law of Contract, Eastern Book Co.

5.T. Ramappa(2010), Intellectual Property Rights Law in India, Asia Law House Bare text

(2005), Right to Information Act
6. American Society of Civil Engineers (2011) ASCE Code of Ethics Principles Study and Application.

Semester-V

21BECE541 **Environmental Engineering (Theory and Lab)** **4H-3C**

Instruction Hours/week: L: 2 T: 0 P: 2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i)Theory

Course Objectives:

1. To understand the impact of humans on environment and environment on humans.
2. To know the adverse effect of the pollutants on the environment viz atmosphere, water and soil.
3. To gain the knowledge of most appropriate technique for the treatment of water, wastewater solid waste.
4. To know the rolls of government and non-government agencies in environment pollution control.
5. To understand the concept of solid waste management.
6. To know the different designing elements in sewer systems.

Course Outcomes:

After completing the course, the students will be able to

1. Determine the quality of water used for different purposes.
2. Inspect the sewer appurtenances.
3. Design the different elements of water treatment plant.
4. Handle the solid waste without disturbing the environment.
5. Design the water supply system for any building.
6. Select the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air.

UNIT I: WATER

Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

UNIT II: SEWAGE

Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans.

UNIT III: WATER TREATMENT

Aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes. Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

UNIT IV: SOLID WASTE MANAGEMENT

Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

UNIT V: BUILDING PLUMBING

Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used. Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

(ii)Laboratory

Practical Work: List of Experiments

1. Physical Characterization of water: Turbidity, Electrical Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic, etc.
3. Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness.
4. Analysis of ions: copper, chloride and sulfate.
5. Optimum coagulant dose.
6. Chemical Oxygen Demand(COD).
7. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD).
8. Break point Chlorination.
9. Bacteriological quality measurement: MPN.
10. Ambient Air quality monitoring (TSP, RSPM, SOx, NOx).
11. Ambient noise measurement.

TEXT BOOKS:

1. MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.2013
2. S.K.Garg , Environmental Engineering, Kanna Publications, 2000

REFERENCE BOOKS:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
2. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition2008.
3. Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.

Semester-V

21BECE542 **Hydraulic Engineering (Theory and Lab)** **4H-3C**

Instruction Hours/week: L: 2 T: 0 P: 2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

(i) Theory

Course Objectives:

1. To introduce the students about various hydraulic engineering problems like open channel flows and hydraulic machines.
2. To relate the theory and practice of problems in hydraulic engineering.
3. To have knowledge in hydraulic machines
4. To apply fundamental concepts and techniques of hydraulics and hydrology in the analysis, design, and operation of water resources systems
5. To Identify the pumps classification and be able to develop a system curve used in pump selection
6. To gain knowledge of pump and turbines

Course Outcomes:

After completing the course, the students will be able to

1. Review an effective section for flow in different cross sections.
2. Analyze problems in uniform, gradually and rapidly varied flows in steady state conditions.
3. Recognize the principles, working and application of turbines.
4. Compare the principles, working and application of pumps.
5. Design and select pumps for different hydraulic applications
6. Will gain a complete knowledge of open channel flow.

UNIT I: INTRODUCTION TO OPEN CHANNEL FLOW

Comparison between open channel flow and pipe flow- geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section. Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity. Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.

UNIT II: UNIFORM FLOW

Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient ".Most economical section of channel. Computation of Uniform flow, Normal depth.

UNIT III: NON-UNIFORM FLOW

Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method.

UNIT IV: FLOW THROUGH PIPES

Loss of head through pipes-Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problem.

UNIT V: HYDRAULIC MACHINES

Centrifugal pumps - Minimum speed to start the pump - NPSH - Cavitations in pumps - Operating characteristics - Multistage pumps - Reciprocating pumps - Negative slip - Indicator diagrams and its variations - Air vessels - Savings in work. Turbines - Classification - Impulse turbine – Pelton wheel - Reaction turbines - Francis turbine - Kaplan turbine - Draft tube - Cavitation - Performance of turbine - Specific speed - Runaway speed.

(ii) Laboratory

Practical Work:

1. Uniform Flow.
2. Flow through pipes.
3. Turbulent flow through pipes.
4. Laminar flow through pipes.
5. Major losses / Minor losses in pipe
6. Flow under Sluice Gate.
7. Gradually Varied Flow.
8. Venturi Flume.
9. Standing Wave Flume.
10. Hydraulic Jump.

TEXTBOOKS:

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard BookHouse
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGrawHill.

REFERENCE BOOKS:

1. Open channel Flow, K. Subramanya, Tata McGrawHill.
2. Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.
3. Burnside, C.D., “Electromagnetic Distance Measurement,” Beekman Publishers,1971.

Semester-V

21BECE551 Civil Engineering – Societal &Global Impact 2H-2C

Instruction Hours/week: L: 2 T: 0 P: 0 **Marks:** Internal**:100** External : **0** Total**:100**

Course Objectives:

1. To understand the importance of Civil Engineering and the impact on the Society at global levels.
2. To give awareness about the impact of Civil Engineering for the various specific fields of human Endeavour
3. To think innovatively to ensure Sustainability of the Environment.
4. Need to think innovatively to ensure Sustainability.
5. To know the requirements for energy and how they are met: past, present and future
6. To know the impact which Civil Engineering projects have on the Society at large and on the global arena and using resources efficiently and effectively.

Course Outcomes:

After completing the course, the students will be able to

1. To apply knowledge in sustainable development in civil engineering
2. Practice Civil Engineering by effective utilization of resources on global level.
3. Contrast the extent of Infrastructure, its requirements for energy and how they are met in past, present and future.
4. Potentials of Civil Engineering for Employment creation and its Contribution to the GDP.
5. Applying professional and responsible judgment and take a leadership role.
6. The Built Environment and factors impacting the Quality of Life

UNIT I: INTRODUCTION TO COURSE AND OVERVIEW

Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis.

UNIT II: UNDERSTANDING THE IMPORTANCE OF CIVIL ENGINEERING

Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering.

UNIT III: INFRASTRUCTURE

Habitats, Megacities, Smart Cities, futuristic visions; Transportation; Futuristic systems; Energy generation; Water provisioning; Telecommunication needs; Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring

Sustainability.

UNIT IV: CIVIL ENGINEERING PROJECTS

Waste avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; New Project Management paradigms & Systems, contribution of Civil Engineering to GDP, Contribution to employment, Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development.

UNIT V: BUILT ENVIRONMENT

Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability.

TEXTBOOKS:

1. *Žiga*Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer,Dordrecht
2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economic and Working Environment, 120th ASEE Annual Conference and Exposition

REFERENCE BOOKS:

1. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
2. Bogle D. (2010) UK's engineering Council guidance on sustainability. Proc ICE Engineering Sustainability 163. June Issue ES2 p61-63
3. Brown R R., Ashley R M., Farrelly M. (2011). Political and Professional Agency Entrapment: An Agenda for Urban Water Research**.** Water Resources Management. Vol. 23, No.4. European Water Resources Association (EWRA) ISSN0920-4741.
4. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options

SEMESTER VI

Semester-VI

21BECE601 **Construction Management** **3H-3C**

Instruction Hours/week: L: 2 T: 1 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To understand modern construction practices
2. To understand how the construction projects are administered with respect to contract structures and issues.
3. To understand the planning and organizing works in construction site
4. To understand networking concepts of CPM and PERT
5. To control and monitor construction projects with respect to time and cost
6. To optimize the construction projects based on costs.

Course Outcomes

After completing the course, the students will be able to

1. An idea of how structures are built and projects are developed on the field
2. A good idea of basic construction dynamics- various stakeholders, project objectives, processes, resources required and project economics
3. A basic ability to plan, control and monitor construction projects with respect to time and cost
4. An idea of how to optimize construction projects based on costs
5. An ability to put forward ideas and understandings to others with effective communication processes.
6. Will gain the knowledge of the different network analysis in construction management

UNIT I: BASICS OF CONSTRUCTION

Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution; Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts.

UNIT II: CONSTRUCTION METHODS AND EQUIPMENTS

Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods conventional walls and slabs; conventional framed structure with block work walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges. Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities.

UNIT III: NETWORKS

Basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

UNIT IV: PLANNING AND ORGANIZING CONSTRUCTION SITE AND RESOURCES IN SITE:

Site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction

UNIT V: CONTRACTS MANAGEMENT

Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods-Contract Recovery Construction Costs: Make-up of construction costs; Classification of costs, time- cost trade-off in construction projects, compression and decompression.

TEXT BOOKS:

1. Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.

REFERENCE BOOKS:

1. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
2. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM,Laxmi Publications, 2016.
3. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
4. Chudley, R., Construction Technology, ELBS Publishers, 2007.
5. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011

Semester-VI

21BECE641 **Estimation, Valuation and Quantity Surveying (Theory and Lab)** **7H-5C**

Instruction Hours/week: L: 2 T: 1 P: 4 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

(i)Theory

Course Objective

1. To understand competitive bidding works and to submit a competitive bid proposal.
2. To understand the technical specifications for various works to be performed for a project and impact the cost of a structure.
3. To understand the different methods of contract and their proposals.
4. To understand the valuation process involved.
5. To understand the government policies and their applications.
6. To understand about business forecasting and investment analysis.

Course Outcomes

1. Have an idea of Economics in general, Economics of India particularly for public sector agencies and private sector.
2. Be able to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
3. Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.
4. Be able to quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure.
5. Be able to fill a tender document and submit the same in bid.
6. Be able to focus on business forecasting and investment analysis

UNIT I: BASIC PRINCIPLES AND METHODOLOGY OF ECONOMICS

Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts and Identities for both closed and open economies. Aggregate demand and Supply. Price Indices, Interest rates, Direct and Indirect Taxes.

UNIT II: ELEMENTS OF BUSINESS/MANAGERIAL ECONOMICS AND FORMS OF ORGANIZATIONS

Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money. Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.

UNIT III: ESTIMATION

Measurements for various items- Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass

haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying

UNIT IV: SPECIFICATIONS

Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.

UNIT V: TENDER

Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management.

(ii)Laboratory

Term Work Assignments:

1. Deriving an approximate estimate for a multistoried building by approximatemethods.
2. Detailed estimate for the following with the required material survey for thesame.
    a. Ground plus three storied RCC Framed structure building with block work walls
    b. bridge with minimum 2spans
    c. factory building
    d. roadwork
    e. cross drainage work
    f. Ground plus three storied building with load-bearing walls g Cost of finishes, MEP works for (f)above
3. Preparation of valuation report in standard Government form.
4. Assignments on rate analysis, specifications and simple estimates.
5. Detailed estimate of minor structure.
6. Preparation of Bar bending schedule.

TEXT BOOKS:

1. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers,2016
2. D.D.Kohli and Ar. R.C.Kohli., A text book of Estimating and costing, S Chand and Company pvt ltd, New Delhi, 2013

REFERENCE BOOKS:

1. Mankiw Gregory N. (2002), Principles of Economics, ThompsonAsia
2. V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGrawHill
3. Misra, S.K. and Puri (2009), Indian Economy,Himalaya
4. Typical PWD Rate Analysis documents.

B.E Civil Engineering		**2021-2022**
		Semester-VI
21BECE* **	**Professional Elective-I**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Civil Engineering		**2021-2022**
		Semester-VI
21BECE* **	**Professional Elective-II**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Civil Engineering		**2021-2022**
		Semester-VI
21BECE* **	**Professional Elective-III**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Civil Engineering		**2021-2022**
		Semester-VI
21BECE* **	**Professional Elective-IV**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

Semester-VI

21BECE651	**In plant Training**	**1C**

Instruction Hours/week: L: 0 T: 0 P: 0 **Marks:** Internal**:100** External**:0** Total**:100**

SEMESTER VII

B.E Civil Engineering		**2021-2022**
		Semester-VII
21BECE* **	**Professional Elective-V**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Civil Engineering		**2021-2022**
		Semester-VII
21BECE* **	**Professional Elective-VI**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Civil Engineering		**2021-2022**
		Semester-VII
**********	**Open Elective-I**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Civil Engineering		**2021-2022**
		Semester-VII
**********	**Open Elective-II**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	

Semester-VII

21BECE791	**Project work Phase–I**	**12H-6C**

Instruction Hours/week: L: 0 T: 0 P: 12 **Marks:** Internal**:80** External**:120** Total**:200**

End Semester Exam:3 Hours

OBJECTIVE

1. To work in convenient groups of not more than four members in a group on a project involving theoretical and experimental studies related to Civil Engineering.
2. Each student shall finally produce a comprehensive report covering background information, literature Survey, problem statement, Project work details and conclusions.
3. This experience of project work shall help the student in expanding his / her knowledge base
4. Will provide opportunity to utilise the creative ability and inference capability.
5. Students will gain the presentation skills.
6. To explain his/her project to the external examiner and can publish the projects in a reputed journal.

Semester-VII

21BECE751	**In plant Training**	**1C**

Instruction Hours/week: L: 0 T: 0 P: 0 **Marks:** Internal**:100** External**:0** Total**:100**

SEMESTER VIII

B.E Civil Engineering		**2021-2022**
		Semester-VIII
21BECE* **	**Professional Elective-VII**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Civil Engineering		**2021-2022**
		Semester-VIII
21BECE* **	**Professional Elective-VIII**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Civil Engineering		**2021-2022**
		Semester-VIII
*******	**Open Elective-III**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

B.E Civil Engineering		**2021-2022**
		Semester-VIII
******	**Open Elective-IV**	**3H-3C**
Instruction Hours/week: L: 3 T: 0 P: 0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

Semester-VIII

21BECE891 **Project work Phase–II & Viva voce** **12H-6C**

Instruction Hours/week: L: 0 T: 0 P: 12 **Marks:** Internal**:80** External**:120** Total**:200**

End Semester Exam:3 Hours

OBJECTIVE

1. To work in convenient groups of not more than four members in a group on a project involving theoretical and experimental studies related to Civil Engineering.
2. Each student shall finally produce a comprehensive report covering background information, literature Survey, problem statement, Project work details and conclusions.
3. This experience of project work shall help the student in expanding his / her knowledge base
4. Will provide opportunity to utilise the creative ability and inference capability.
5. Students will gain the presentation skills.
6. To explain his/her project to the external examiner and can publish the projects in a reputed journal.

Semester-

21BECEE01 **Structural Analysis-I** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To equip the students with the comprehensive methods of structural analysis with emphasis on analysis of elementary structures.
2. To know the different method for determination of deflection of statically determinate beams, frames & pin jointed trusses.
3. To gain knowledge about moving loads and influence lines.
4. To analyze the forces in cables under concentrated and uniformly distributed loads.
5. To know more about the complete analysis and designing the structure.
6. To do calculation about the determinate and non- determinate structures.

Course Outcomes:

After completing the course, the students will be able to

1. Apply unit load method and strain energy method for determination of deflection of statically determinate beams, frames & pin jointed trusses
2. Analyze statically indeterminate structures using strain energy method and method of consistent deformation
3. Know about moving loads and influence lines
4. Know about Statically determinate and indeterminate suspension bridges and arches.
5. Analyze the forces in cables under concentrated and uniformly distributed loads
6. Analyze determinate and non- determinate structures

UNIT I: PRINCIPLE OF VIRTUAL WORK – UNIT LOAD METHOD

Betti's theorem – Maxwell's law of reciprocal deflections - principle of least work - application of unit load method and strain energy method for determination of deflection of statically determinate beams, frames - pin jointed trusses (simple numerical problems) Concepts of temperature effects and lack of fit. (No numerical problems) Statically indeterminate structures: Degree of static and kinematic indeterminacies – Introduction to force and displacement method (step by step procedure).

UNIT II: MOMENT DISTRIBUTION METHOD&TRUSS ANALYSIS

Analysis of determinate truss-Methods of 8 15% joints and sections(Numerical problems) Elastic theorems and energy principles - strain energy due to axial load, bending moment, shear and torsion - strain energy method, Castigliano's method for deflection (Derivations only)

UNIT III: STRAIN ENERGY METHODS

Analysis of beams, frames and trusses with internal and external redundancy – (Simple problems with maximum two redundant) Concepts of effect of pre strain, lack of fit, temperature changes and support settlement(No numerical problems).

UNIT IV: MOVING LOADS AND INFLUENCE LINES

Introduction to moving loads - concept of influence lines - influence lines for reaction, shear force and bending moment in simply supported beams and over hanging beams - analysis for different types of moving loads - single concentrated load - several concentrated loads, uniformly distributed load on shorter and longer than the span.

UNIT V: ARCHES

Arches - Types of arches – Analysis of three hinged, two hinged and fixed arches - Parabolic and circular arches – Settlement and temperature effects.

TEXT BOOKS:

1. BhavaiKatti, S.S,(2008), "Structural Analysis – Vol. 1 Vol. 2", Vikas Publishing House Pvt. Ltd., New Delhi.
2. Ghali.A, Nebille,A.M. and Brown,T.G. (2013) "Structural Analysis" A unified classical and Matrix approach" 6th edition. Spon Press, London and New York.
3. Gambhir. M.L., (2011), "Fundamentals of Structural Mechanics and Analysis"., PHI Learning Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. Nilson, A. H. (2004) Design of Concrete Structures. 13th edition. McGraw Hill.
2. Mc Cormac, J.C., Nelson, J.K (2003), Jr., Structural Steel Design. 3rd edition. Prentice Hall, N.J.
3. Nawy, E. G. Pre stressed Concrete: A Fundamental Approach, Prentice Hall, NJ, (2003).
4. Related Codes of Practice of BIS
5. Smith, J. C., Structural Analysis, Harpor and Row, Publishers, New York.
6. W. McGuire, R. H. Gallagher and R. D. Ziemian.(2000) "Matrix Structural Analysis", 2nd Edition, John Wiley and Sons.
7. NBC, National Building Code, BIS(2017).
8. ASCE, (2002), Minimum Design Loads for Buildings and Other Structures, ASCE 7-02, American Society of Civil Engineers, Virginia.
9. Punmia. B.C., (2004), Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures", Laxmi Publications.
10. Vaidyanathan, R. and Perumal, P. (2003), "Comprehensive structural Analysis – Vol. I & II", Laxmi Publications, New Delhi.

Semester-

21BECEE02 **Structural Analysis-II** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To introduce the students to advanced methods of analysis like matrix methods, Plastic analysis and FE method and also analysis of space structures.
2. To analysis plane stress, plane strain and displacement function by finite element method.
3. To Calculation the deflection of trusses, beams and frames by using unit load method.
4. To analysis of element by global stiffness matrix method.
5. To make the students understand the matrix method and its application clearly.
6. To do design the trusses, beams and frames.

Course Outcomes:

After completing the course, the students will be able to

1. Understand indeterminate structure and methods of analysis by flexible method.
2. Analyze the element by global stiffness matrix method
3. Analyze the stress, strain and displacement by finite element method.
4. Calculation the deflection of trusses, beams and frames by using unit load method.
5. Analyze the space truss using method of tension coefficients.
6. Apply influence line for indeterminate beams.

UNIT I: FLEXIBILITY METHOD

Equilibrium and compatibility – Determinate vs Indeterminate structures – Indeterminacy – Primary structure – Compatibility conditions – Analysis of indeterminate pin-jointed plane frames, continuous beams, rigid jointed plane frames (with redundancy restricted to two).

UNIT II: STIFFNESS MATRIX METHOD

Element and global stiffness matrices – Analysis of continuous beams – Co-ordinate transformations – Rotation matrix – Transformations of stiffness matrices, load vectors and displacements vectors – Analysis of pin-jointed plane frames and rigid frames (with redundancy limited to two)

UNIT III: FINITE ELEMENT METHOD

Introduction – Discretization of a structure – Displacement functions – Truss element – Beam element – Plane stress and plane strain – Triangular elements

UNIT IV: PLASTIC ANALYSIS OF STRUCTURES

Statically indeterminate axial problems – Beams in pure bending – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – Plastic analysis of indeterminate beams and frames – Upper and lower bound theorems

UNIT V: SPACE AND CABLE STRUCTURES

Analysis of Space trusses using method of tension coefficients – Beams curved in plan Suspension cables – suspension bridges with two and three hinged stiffening girders

TEXT BOOKS:

1. Punmia. B.C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures", Laxmi Publications. 2004
2. BhavaiKatti, S.S, "Structural Analysis – Vol. 1 Vol. 2", Vikas Publishing House Pvt. Ltd., New Delhi.2008

REFERENCE BOOKS:

1. Negi L.S. &Jangid R.S.,(2003) "Structural Analysis", Tata McGraw Hill Publications, New Delhi.
2. Ghali.A, Nebille,A.M. and Brown,T.G.(2013) "Structural Analysis" A unified classical and Matrix approach" 6th edition. Spon Press, London and New York.
3. Pandit G.S. & Gupta S.P.(2004) "Structural Analysis – A Matrix Approach", Tata McGraw Hill.
4. William Weaver Jr. & James M. Gere, (2004)"Matrix Analysis of Framed Structures", CBS Publishers and Distributors, Delhi,
5. Vaidyanathan, R. and Perumal, P., "Comprehensive structural Analysis – Vol. I & II", Laxmi Publications, New Delhi.2003
6. Ghali.A, Nebille,A.M. and Brown,T.G. (2013) "Structural Analysis" A unified classical and Matrix approach" 6th edition. Spon Press, London and New York.
7. Gambhir. M.L., (2011), "Fundamentals of Structural Mechanics and Analysis"., PHI Learning Pvt. Ltd., New Delhi.

Semester-

21BECEE03 **Advanced Structural Analysis** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. The main objective is to enable the student to have a good grasp of all the fundamental issues in these advanced topics in structural analysis, besides enjoying the learning process, and developing analytical and intuitive skills.
2. The basic concepts of structural analysis and matrix algebra
3. To demonstrations through many examples of how matrix methods can be applied to linear static analysis of skeletal structures.
4. To analyses of Plane and space trusses; beams and grids; plane and space frames by the stiffness method
5. To analysis of trusses by flexibility method.
6. Simple structures can be conveniently solved using a reduced stiffness formulation, involving far less computational effort.

Course Outcomes

1. The basic concepts of structural analysis and matrix algebra
2. Descriptions and demonstrations through many examples of how matrix methods can be applied to linear static analysis of skeletal structures.
3. Analyses of Plane and space trusses; beams and grids; plane and space frames by the stiffness method
4. Analysis of trusses by flexibility method.
5. Simple structures can be conveniently solved using a reduced stiffness formulation, involving far less computational effort.
6. Analysis of elastic instability and second-order response.

UNIT I: REVIEW OF BASIC CONCEPTS IN STRUCTURAL ANALYSIS

Review topics on Structural Analysis and Linear Algebra. structure; loads; (equilibrium, compatibility, force-displacement relations); levels of analysis; analysis of statically determinate structures; applications of principle of virtual work and displacement-based and force-based energy principles; deriving stiffness and flexibility coefficients.

UNIT II: REVIEW OF ANALYSIS OF INDETERMINATE STRUCTURES

Force methods: Statically indeterminate structures (method of consistent deformations; theorem of least work). Displacement Methods: Kinematically indeterminate structures (slope-deflection method; moment distribution method).

UNIT III: MATRIX CONCEPTS AND MATRIX ANALYSIS OF STRUCTURES

Matrix; vector; basic matrix operations; rank; solution of linear simultaneous equations;

Eigen values and Eigen vectors. Introduction; coordinate systems; displacement and force transformation matrices; Contra-gradient principle; element and structure stiffness matrices; Element and structure flexibility matrices; equivalent joint loads; stiffness and flexibility approaches.

UNIT IV: MATRIX ANALYSIS OF STRUCTURES WITH AXIAL ELEMENTS

Introduction: Axial stiffness and flexibility; stiffness matrices for an axial element, plane truss element and space truss element; One-dimensional axial structures: Analysis by conventional stiffness method (two DOF per element) and reduced element stiffness method (single DOF);Analysis by flexibility method; Plane trusses: Analysis by conventional stiffness method (four DOF per element) and reduced element stiffness method (single DOF);Analysis by flexibility method; Space trusses: Analysis by conventional stiffness method (six DOF per element) and reduced element stiffness method (single DOF).

UNIT V: ANALYSIS OF ELASTIC INSTABILITY AND SECOND-ORDER EFFECTS

Effects of axial force on flexural stiffness: Review of buckling of ideal columns; flexural behaviour and stiffness measures for beam-columns - braced and un braced, under axial compression; Solution by slope deflection method: Slope deflection equations for prismatic beam columns using stability functions; modifications for pinned and guided-fixed-end conditions; fixed end moments in beam-columns; Solution by matrix method: Stiffness matrix for prismatic beam column element; estimation of critical elastic buckling loads; second-order analysis.

TEXT BOOKS:

1. Punmia.B.C., (2004), Ashok Kumar Jain and Arun Kumar Jain, “Theory of Structures”, Laxmi Publications.
2. Vaidyanathan, R. and Perumal, P. (2003), “Comprehensive structural Analysis – Vol. I & II”, Laxmi Publications, New Delhi.

REFERENCE BOOKS:

1. Devdas Menon, (2009), "Advanced Structural Analysis", Naros Publishing House,.
2. Amin Ghali, Adam M Neville and Tom G Brown, (2007) "Structural Analysis: A Unified Classical and Matrix Approach",SixthEdition, Chapman & Hall
3. Devdas Menon, (2008) "Structural Analysis", Narosa Publishing House,A joint venture by IISc and IITs
4. BhavaiKatti, S.S,(2008), “Structural Analysis – Vol. 1 Vol. 2”, Vikas Publishing House Pvt. Ltd., New Delhi.
5. Ghali.A, Nebille,A.M. and Brown,T.G. (2013) “Structural Analysis” A unified classical and Matrix approach” 6th edition. Spon Press, London and New York.
6. Gambhir. M.L., (2011), “Fundamentals of Structural Mechanics and Analysis”., PHI Learning Pvt. Ltd., New Delhi.

21BECEE04 **Structural Mechanics** **Semester-3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. The main objective is to enable the student to have a good grasp of calculating various structural material properties under direct loading condition
2. Analyze Statically Determinate structures like Beam, Column & Truss.
3. To analysis of determinate structures under action of transverse loading along with analysis of members under direct loading is to be studied.
4. To know behavior of structure under different loading conditions is needed to understand so that design can do by the engineer.
5. To analysis of Industrial Trusses is also incorporated to give an idea of typical structure to the students.
6. To enables the student to analyse Steel & Concrete Structures used in Civil Engineering construction.

Course Outcomes

After completing the course, the students will be able to

1. Study the external effects on the body due to action of force system.
2. Understand the design that can be done by the engineer.
3. Analysis of determinate structures under action of transverse loading, along with, analysis of members under direct loading is to be studied.
4. Analysis of industrial trusses is also incorporated to give an idea of typical structure to the students.
5. Analyze steel & concrete structures used in civil engineering construction.
6. Analyze Statically Determinate structures like Beam, Column & Truss.

UNIT I: DIRECT STRESS & STRAIN

Different types of Structures and Loads - Direct Stress, linear Strain, Hook's Law Numerical Problems on Direct Stress & Linear Strain. Stress Strain curve of Mild Steel. Modulus of Elasticity. Yield , Breaking & Ultimate Stress and factor of Safety along with numerical problems - Lateral Strain and Poission's ratio with numerical problems - Basics Concepts of Shear Stress , Shear Strain & Shear Modulus - Bulk Modulus , volumetric Strain along with numerical Problems - Differentiate between Sudden , Gradual & Impact loads Define Strain Energy , Proof Resilience for Sudden , Gradual & Impact load along with numerical problems

UNIT II: PRINCIPAL STRESSES AND STRAIN:

UNIT III: S.F & B.M IN BEAM

Statically Determinate Beam Like Cantilever , Simply Supported & Over Hang Beam - Shear Force and Bending Moment and its relationship - Sagging & Hogging Bending Moment

and its importance - Point of Contra-flexure & its importance - S.F & B.M Diagram for Cantilever , Simply Supported & Over Hang Beam subjected to Point Load and U.D.L

UNIT IV: BENDING & SHEAR STRESSES IN BEAM

Bending Theory Equation Bending stress, Sectional Modulus, Neutral Axis Apply Bending theory to statically determinate beams having rectangular or circular section - Shear Stress equation Shear Stress Distribution Diagram for Solid &Hollow Rectangular and Circular Section Apply Shear Stress Equation & Draw Shear Stress Distribution Diagram for I, H, T, Channel & Angle Section.

UNIT V: ANALYSIS OF TRUSS

Perfect& Imperfect Truss various trusses for different spans and application - Analysis of Triangle, Howe, North Light & Fan trusses under Panel Point Loads using Graphical & Method of Joint.

TEXT BOOKS:

1. S. Ramamrutham and R. Narayan, Strength of materials Publisher: Bharath-A28KED5E1JUIJA (2002)

REFERENCE BOOKS:

1. R.S Khurmi ,Theory of Structures (SI Units), S Chand; Twelfth edition (2020)
2. Timo Shanko, Strength of Material, D.Van Nostard Company Ltd(1988)

Semester-

21BECEE05 **Reinforced Concrete** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. The main objective is to introduce the different types of philosophies related to design of basic structural elements such as slab, beam, column and footing which form part of any structural system with reference to Indian standard code of practice.
2. To understand the general mechanical behavior of reinforced concrete.
3. Analyze and design reinforced concrete flexural members.
4. Analyze and design reinforced concrete compression members.
5. Analyze and design for vertical and horizontal shear in reinforced concrete.
6. Analyze transfer and development length of concrete reinforcement.

Course Outcomes:

After completing the course, the students will be able to

1. Understand the general mechanical behavior of reinforced concrete.
2. Analyze and design reinforced concrete flexural members.
3. Analyze and design reinforced concrete compression members.
4. Analyze and design for vertical and horizontal shear in reinforced concrete.
5. Analyze transfer and development length of concrete reinforcement.
6. Analyze and design for deflection and crack control of reinforced concrete members.

UNIT I: METHODS OF DESIGN OF CONCRETE STRUCTURES

Concept of Elastic method, ultimate load method and limit state method – Advantages of Limit State Method over other methods – Design codes and specification – Limit State philosophy as detailed in IS code – Design of beams and slabs by working stress method.

UNIT II: LIMIT STATE DESIGN FOR FLEXURE

Analysis and design of singly and doubly reinforced rectangular and flanged beams – Analysis and design of one way, two way and continuous slabs subjected to uniformly distributed load for various boundary conditions.

UNIT III: LIMIT STATE DESIGN FOR BOND, ANCHORAGE SHEAR & TORSION

Behaviour of RC members in bond and Anchorage – Design requirements as per current code – Behaviour of RC beams in shear and torsion – Design of RC members for combined bending shear and torsion.

UNIT IV: LIMIT STATE DESIGN OF COLUMNS

Types of columns – Braced and un braced columns – Design of short Rectangular and circular columns for axial, uni axial and biaxial bending.

UNIT V: LIMIT STATE DESIGN OF FOOTING

Design of wall footing – Design of axially and eccentrically loaded rectangular pad and sloped footings – Design of combined rectangular footing for two columns only.

TEXT BOOKS:

1. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi, 2002.
2. Subramanian,N., "Design of Reinforced Concrete Structures", Oxford University Press, New Delhi, 2013.

REFERENCE BOOKS:

1. Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.
2. Jain, A.K., "Limit State Design of RC Structures", Nemchand Publications, Roorkee, 1998
3. Sinha, S.N., "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002
4. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 2009
5. Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete", Laxmi Publication Pvt. Ltd., New Delhi, 2007.
6. Bandyopadhyay. J.N., "Design of Concrete Structures"., Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
7. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2000
8. SP16, IS456:1978 "Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999
9. Shah V L Karve S R., "Limit State Theory and Design of Reinforced Concrete", Structures Publilcations, Pune, 2013

		Semester-
21BECEE06	**Concrete Technology**	**3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To impart knowledge to the students on the properties of materials for concrete by suitable tests, mix design for concrete and special concretes.
2. To identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy.
3. To Acquire and apply fundamental knowledge in the fresh and hardened properties of concrete
4. To Evaluate the effect of the environment on service life performance, properties and failure modes of structural concrete and demonstrate techniques of measuring the Non-Destructive Testing of concrete structure
5. To develop an awareness of the utilization of waste materials as novel innovative materials for use in concrete
6. To design a concrete mix which fulfills the required properties for fresh and hardened concrete

Course Outcomes:

After completing the course, the students will be able to

1. Define and classify the properties of materials required for concrete tests on those materialsand design procedures for making conventional and special concretes.
2. Identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy
3. Acquire and apply the fundamental knowledge in the fresh and hardened properties of concrete
4. Evaluate the effect of the environment on service life performance, properties and failure modes of structural concrete and demonstrate techniques of measuring the Non Destructive Testing of concrete structure
5. Develop an awareness of the utilization of waste materials as novel innovative materials foruse in concrete
6. Design a concrete mix which fulfills the required properties for fresh and hardened concrete

UNIT I: CONSTITUENT MATERIALS

Cement-Different, types-Chemical composition and Properties -Tests on cement-IS Specifications- Aggregates-Classification-Mechanical properties and tests as per BIS Grading requirements- Water- Quality of water for use in concrete.

UNIT II: CHEMICAL AND MINERAL ADMIXTURES

Accelerators-Retarders- Plasticizers- Super plasticizers- Water proofers – Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaolin - Their effects on concrete properties

UNIT III: PROPORTIONING OF CONCRETE MIX

Principles of Mix Proportioning-Properties of Concrete Related to Mix Design Physical Properties of materials required for Mix Design – Design Mix and Nominal Mix-BIS Method of Mix Design – Mix Design Examples

UNIT IV: FRESH AND HARDENED PROPERTIES OF CONCRETE

Workability-Tests for workability of concrete-Slump Test and Compacting factor Test-Segregation and Bleeding-Determination of Compressive and Flexural strength as per BIS – Properties of Hardened Concrete-Determination of Compressive and Flexural Strength-Stress-strain curve for concrete Determination of Young's Modulus.

UNIT V: SPECIAL CONCRETE

Light weight concretes – High strength concrete – Fibre reinforced concrete – Ferro cement – Ready mix concrete – SIFCON-Shot crete – Polymer concrete – High performance concrete- Geopolymer Concrete

TEXT BOOKS:

1. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
2. Shetty, M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003

REFERENCE BOOKS:

1. Santhakumar,A.R; "Concrete Technology" , Oxford University Press, New Delhi, 2007
2. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London,1995
3. Gambir, M.L; "Concrete Technology", 3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2007
4. IS10262-1982 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998.

Semester-

21BECEE07 **Design of Concrete Structures-I** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To provide the students with the knowledge of the behavior of reinforced concrete structural elements in flexure, shear, compression and torsion
2. To enable them to design essential elements such as beams, columns, slabsstaircases and footings under various loads
3. To analyze and design for deflection and crack control of reinforced concrete members.
4. To know the short term and long-term deflections.
5. Use IS code of practice for the design of concrete elements
6. Understand the structural behavior of reinforced concrete elements in bending, shear, compression and torsion.

Course Outcomes

After completing the course, the students will be able to

1. Apply the fundamental concepts of limit state method
2. Understand the structural behavior of reinforced concrete elements in bending,shear, compression and torsion.
3. Design beams, slab, stairs, and columns and draw the reinforcement details.
4. Analyze and design for deflection and crack control of reinforced concretemembers.
5. Design the short term and long-term deflections.
6. Use IS code of practice for the design of concrete elements

UNIT I: INTRODUCTION- PLAIN AND REINFORCED CONCRETE

Properties of concrete and reinforcing steel-Objectives of design-Different design philosophies- Working Stress and Limit State method of design-Introduction to BIS code- Types of limit states characteristic and design values-partial safety factors-types of loads and their factors. Limit State of Collapse in Bending-assumptions-stress-strain relationship of steel and concrete- analysis of singly reinforced rectangular beams-balanced-under reinforced-over reinforced sections-moment of resistance codal provisions

UNIT II: LIMIT STATE OF COLLAPSE IN SHEAR AND BOND

Shear stresses in beams types of reinforcement-shear strength of RC beam-IS code recommendations for shear design-design of shear reinforcement examples Bond and development length - anchorage for reinforcement bars - code recommendations regarding curtailment of reinforcement.

UNIT III: DESIGN OF SINGLY REINFORCED BEAMS

Basic rules for design- design example of simply supported beam- design of cantilever beam detailing Analysis and design of doubly reinforced beams – detailing, T-beams- terminology- analysis of T beams- examples - Design for torsion-IS code approach- examples.

UNIT IV: DESIGN OF SLABS

Introduction- one-way and two-way action of slabs - load distribution in a slab- IS recommendations for design of slabs- design of one-way slab- cantilever slab- numerical problems – concepts of detailing of continuous slab –code coefficients.

UNIT V: TWO- WAY SLABS

Simply supported and restrained slabs – design using IS Code coefficients Reinforcement detailing Limit State of Serviceability- limit state of deflection- short term and long-term deflection-IS code recommendations- limit state of cracking- estimation of crack width- simple numerical examples

TEXT BOOKS:

1. Pillai S.U & Menon D–Reinforced Concrete Design, Tata McGraw Hill PublishingCo.,2005.
2. Punmia, B. C, Jain A.K and, Jain A.K ,RCC Designs, Laxmi Publications Ltd., 10e, 2015

REFERENCE BOOKS:

1. Varghese P.C, Limit State Design of Reinforced Concrete, Prentice Hall of India Pvt Ltd, 2008**.**

2. Relevant IS codes (I.S 456, I.S 875, SP 34)

21BECEE08 **Design of Concrete Structures-II** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**
End Semester Exam:3 Hours

Course Objectives

1. To provide knowledge in the structural design of selected advanced structures of concrete and enable them to design reinforced concrete structures for real-world applications.
2. To design eccentrically loaded and slender columns using SP 16 design charts and different types of foundations
3. To design and detail cantilever retaining wall and understand the design principles of Counterfort retaining wall
4. To design and detail circular slabs and domes
5. To design rectangular and circular water tanks using IS code coefficients (IS 3370).
6. To gain knowledge of design of rectangular footing and combined footing.

Course Outcomes

1. Design eccentrically loaded and slender columns using SP 16 design charts and different types of foundations
2. Design and detail cantilever retaining wall and understand the design principles of Counterfort retaining wall
3. Design and detail circular slabs and domes
4. Design rectangular and circular water tanks using IS code coefficients (IS 3370).
5. Gain knowledge of design of rectangular footing and combined footing.
6. Analyze combined footing with rectangular and trapezoidal sections

UNIT I: ANALYSIS AND DESIGN OF SHORT COLUMNS

Eccentric loading Columns subjected to compression and uniaxial bending- design using SP16 charts for limit state Columns subjected to combined axial load and biaxial bending moments-code procedure for design- design using SP16 charts for limit state Slender columns-behavior of slender columns-braced and un-braced columns-design procedure- design using SP16 charts for limit state.

UNIT II: FOUNDATIONS

Classification-IS code provisions for design of isolated footings- design principles of rectangular footings- Design of rectangular footings-uniform thickness and sloped- eccentrically loaded rectangular footing of uniform thickness-detailing. Combined footings (design principles only)- analysis of combined footings-rectangular and trapezoidal.

UNIT III: RETAINING WALLS

Types- Cantilever retaining wall- earth pressure and forces acting-stability-proportioning-

structural behavior of components -design example of cantilever retaining wall without surcharge-detailing Counterfort retaining wall- design principles of components and detailing (design not required)

UNIT IV: INTRODUCTION TO DESIGN OF WATER TANKS:

Design philosophy and requirements-joints- IS code recommendations Design of rectangular water tanks using IS code coefficients (IS 3370). Design of circular water tanks using- IS code coefficients (IS 3370).

UNIT V: CIRCULAR SLABS:

Stresses- reinforcements- simply supported, fixed and partially fixed subjected to uniformly distributed loads Design and detailing of spherical and conical domes.

TEXT BOOKS:

1. N. Krishnaraju, Prestressed Concrete , Tata McGraw- Hill, 5e, 2012
2. Pillai S.U &Menon D – Reinforced Concrete Design, Tata McGraw Hill Book Co., 2009

REFERENCE BOOKS:

1. Punmia, B. C, Jain A.K and, Jain A.K , R C C Designs, Laxmi Publications Ltd., 10e, 2015
2. Relevant IS codes (IS 456, IS 875IS 1343, IS 3370, SP 16, SP 34)

Semester-

21BECEE09 **Pre stressed Concrete Structures** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To make students familiar with the concepts and design of typical pre-stressed concrete Structural elements and to have a knowledge of the codal provisions.
2. To explain the torsion, shear and bending detail.
3. To analyze the ultimate strength of the materials.
4. To know more about limit state structure.
5. To design composite members and their applications.
6. To analyze continuous members.

Course Outcomes

After completing the course, the students will be able to

1. Analyze pre stressed concrete members
2. Design pre stressed concrete members using codal provisions
3. Design for shear and torsion of pre stressed concrete members
4. Design end blocks and provide detailing of reinforcements
5. Design composite members and other applications
6. Design continuous members.

UNIT I: INTRODUCTION

Basic concept and principles of pre-stressed concrete, materials, prestressing systems – Analysis of prestress and bending stresses loss of pre-stress Stresses at transfer and service loads.

UNIT II: LIMIT STATE DESIGN CRITERIA

Inadequacy of elastic and ultimate load method, criteria for limit states, strength and serviceability. Design of sections for flexure codal provisions- ultimate strength in flexure

UNIT III: SHEAR AND TORSIONAL RESISTANCE

Design of shear reinforcement, design of reinforcement for torsion, shear and bending. Deflections of prestressed concrete members: Importance, factors, short term and long-term deflection. Codal provisions.

UNIT IV: ANCHORAGE ZONE STRESSES IN POST TENSIONED MEMBERS

Stress distribution in end block, anchorage zone reinforcement. Prestressed concrete poles and sleepers: Design of sections for compression and bending Partial pre-stressing-Definitions, principles and design approaches and applications

UNIT V: COMPOSITE BEAMS

Analysis and design – Ultimate strength – applications, Elementary idea of composite construction for tee beams in bridges. Statically Indeterminate structures: advantages of continuous member (Concepts and steps for analysis).

TEXT BOOK:

1.Lin T.Y. Design of prestressed concrete structures, Asia Publishing House, Bombay 1995.

REFERENCE BOOKS:

1. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Co. Pvt. Ltd., 1997.
2. Ramaswamy G.S., Modern prestressed concrete design, Arnold Heinimen, New Delhi, 1990
3. IS 1343 – 1998 IS Code Bureau of Indian Standards.

Semester-

21BECEE10 **Design of Steel Structures** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To introduce the limit state design of steel structural components subjected to bending, compression and tensile loads including the connections.
2. To enable design of structural components using timber.
3. To discuss the connections practically.
4. To assess loads on truss and design on purlins
5. To design structural components using timber and plate girders.
6. To design columns under axial loads using specifications.

Course Outcomes

After completing the course, the students will be able to

1. Design bolted and welded connections
2. Design tension members and beams using the is specifications
3. Design columns under axial loads using is specifications
4. Design beams and plate girders.
5. Assess loads on truss and design purlins.
6. Design structural components using timber.

UNIT I: INTRODUCTION TO STEEL AND STEEL STRUCTURES

Properties of steel, structural steel sections. Introduction to design: Design loads and load combinations, limit state design concepts. Connections bolted and welded (direct loads)

UNIT II: TENSION MEMBERS

Types of sections – net area- design of tension members- concept of shear lag-use of lug angle-connections in tension members

UNIT III: COMPRESSION MEMBERS

Design of struts- solid and built up columns for axial loads-- design of lacings and battens-column bases- slab base – gusseted base

UNIT IV: DESIGN OF ROOF TRUSSES

Types-design loads and load combinations assessment of wind loads- design of purlins. Moment resistant/Eccentric connections (in plane and out of plane)

UNIT V: DESIGN OF TIMBER STRUCTURES

Types of timber - classification - allowable stresses-design of beams-flexure, shear, bearing and deflection considerations-Design of columns. Design of composite beam sections with timber and steel.

TEXT BOOKS:

1. P. Dayaratnam., Design of Steel Structures, Wheeler Publishing, 2003
2. Punmia B. C., Jain A. K. and Jain A. K., Design of Steel Structures, LaxmiPublications Ltd, 2017

REFERENCE BOOKS:

1. Raghupathi, Steel Structures, Tata McGraw Hill, 2006
2. Ramchandra S and Virendra Gehlot, Design of Steel Structures Vol. II, Standard Book House, 2007.

Semester-

21BECEE11 **Concrete Materials** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To characterize the various materials, both conventional and modern, that are commonly used in civil engineering construction.
2. To identify the various tests for quality control in the use of these materials.
3. To apply the various tests involved in the concrete, bricks and stones.
4. To classify the modern materials which are used in concrete.
5. To know the applications of laminar composites, Fibre textiles and Geo synthetics.
6. To relate the properties and characteristics of different admixtures.

Course Outcomes

After completing the course, the students will be able to

1. Recognize the tests involved in the concrete, bricks and stones.
2. Distinguish the properties of different ingredients of concrete.
3. Analyse the properties and characteristics of different admixtures.
4. Compare the testing methods of fresh and harden concrete.
5. Evaluate the modern materials which are used in concrete.
6. Assess the Applications of laminar composites, Fibre textiles and Geo synthetics.

UNIT I: STONES, BRICKS AND CONCRETE BLOCKS

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacture of clay bricks – Tests on bricks – Compressive Strength - Water Absorption – Efflorescence –Bricks for special use – Refractory bricks – Cement and Concrete hollow blocks – Lightweight concrete blocks – Code Practices

UNIT II: LIME , CEMENT, AGGREGATES AND MORTAR

Lime – Preparation of lime mortar – Cement. Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration - Compressive strength – Tensile strength – Soundness and consistency – Setting time – Aggregates – Natural stone aggregates – Industrial byproducts – Crushing strength – Impact strength – Flakiness – Abrasion Resistance – Grading – Sand – Bulking – Code Practices

UNIT III: CONCRETE

Concrete Ingredients – Manufacture – Batching plants – RMC – Properties of fresh concrete – Slump – Flow and compaction – Principles of hardened concrete – Compressive, Tensile and shear strength – Modulus of rupture – Tests – Mix specification – Mix proportioning – IS method – High Strength Concrete and HPC – Other types of Concrete – Code Practices

UNIT IV: TIMBER AND OTHER MATERIALS

Timber – Market forms – Industrial timber- Plywood - Veneer – Thermocole – Panels of laminates – Steel – Aluminum and Other Metallic Materials - Composition – uses – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Code Practices.

UNIT V: MODERN MATERIALS

Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles – Geo synthetics for Civil Engineering applications.

TEXT BOOK:

1. M. S. Shetty, Concrete Technology (Theory and Practice), S. Chand & Company Ltd., 2003.

REFERENCE BOOK:

1. R. K. Rajput, Engineering Materials, S. Chand & Company Ltd., 2000.

Semester-

21BECEE12 **Ground Improvement Techniques** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Understand the different problematic soils and effect of ground improvement techniques.
2. Describe the seepage analysis and suitable dewatering systems for the particular soil conditions.
3. Express the concept of compaction efforts on ground improvement and their installation and working principles.
4. Describe the load transfer mechanism and effect of geo textiles reinforcements in ground improvement.
5. Describe the various stabilization methods for the different types of problematic soils.
6. To express soil stabilization methods for the problematic soils

Course Outcomes

After learning the course the students should be able to:

1. Understand the suitable ground improvement techniques for different the different weak deposits.
2. Describe the dewatering systems for different soil conditions and their effect.
3. Express the working principles of different compaction methods on improving weak deposits.
4. Express the design of geo textiles reinforcements for ground improvement.
5. Express the soil stabilization methods for the problematic soils.
6. Suitable dewatering systems for the particular soil conditions.

UNIT I: PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES

Role of ground improvement in foundation engineering -Methods of ground improvement -Geotechnical problems in various soils - Selection of suitable ground improvement techniques based on soil conditions.

UNIT II: DEWATERING

Dewatering Techniques - Well points - Vacuum and electroosmotic methods - Seepage analysis for two - dimensional flow for fully and partially penetrated slots in homogeneous deposits - Simple cases - Design.

UNIT III: STONE COLUMN, LIME COLUMN AND SOIL NAILING

Stone column and lime piles - Functions and Methods of installation- Design and load carrying capacity - Soil nailing - Design and applications - Case studies

UNIT IV: EARTH REINFORCEMENT

Earth reinforcement - Principles and mechanism of reinforced earth - Design of reinforced earth-Fibre based geo textiles - Filtration and drainage - Separation and Erosion control - Case studies

UNIT V: GROUTING

Grouting - Types of grout - Requirements of grout - Grouting equipment - Grout monitoring -Electro-chemical stabilization - Stabilization with cement and lime - Stabilization of expansive clays.

TEXT BOOKS:

1. Purushothama Raj, P, Ground Improvement Techniques, Tata Mc-Graw-Hill Publishing company, New Delhi, 2012.
2. Moseley, M.P, Ground Improvement, USA and Canada – CRC Press Inc. Florida, 2004.

REFERENCE BOOKS

1. Koemer, R.M, Design with Geosynthetics, Prentice Hall, New Jersey, 2002.

Khedkar, M.S and Mandal, J, Soil Reinforcement with Geotextiles, CIRIA- Special Publication, London, 2009.

Semester-

21BECEE13 **Environmental Soil Pollution** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Describe the nature of soil and physical-chemical properties of soils.
2. Describe the chemical analysis of soils, distribution of metals in soils and controlling the process distribution.
3. Examine the chemical mass transfer mechanism and biological process of contaminant in soils.
4. Assess the various ground improvement techniques in the waste management.
5. Evaluate the characterization of contaminated site and various remedial measures.
6. To Assess the chemical and and biological process of contaminant in soils

Course Outcomes

After completing the course, the students will be able to

1. Describe the behavior of various soils and their physical-chemical characteristics related to soil pollution.
2. Describe the chemical analysis of soils, distribution of metals in soils and controlling the process distribution.
3. Assess the chemical and and biological process of contaminant in soils.
4. Examine the various ground improvement techniques in the waste management.
5. Evaluate the contaminated site to take various remedial measures and their design procedures.
6. The nature of soil and physical-chemical properties of soils can be identified

UNIT I: PHYSICS AND CHEMISTRY OF SOIL

Soil formation - Composition -Soil fabric -Mass-volume relationship - Index properties and soil classification -Hydraulic and consolidation characteristics - Chemical properties - Surface charge and point of zero charge - Anion and Cation exchange capacity of clays - Specific surface area -Bonding in clays- Soil pollution- Factors governing soil-pollutant interaction.

UNIT II: INORGANIC AND ORGANIC GEOCHEMISTRY

Inorganic geochemistry - Metal contamination - Distribution of metals in soils - Geochemical processes - Chemical analysis of metal in soil - Organic geochemistry - Organic contamination – Distribution and Process controlling of NAPLs in soils - Chemical analysis of NAPLs in soils.

UNIT III: CONTAMINANT FATE AND TRANSPORTIN SOIL

Transport processes -Advection -Diffusion -Dispersion -Chemical mass transfer processes -Sorption and desorption -Precipitation and dissolution -Oxidation and reduction -Acid base reaction -Complexation -Ion exchange -Volatilization -Hydrolysis -Biological process microbial transformation of heavy metals.

UNIT IV: GROUND IMPROVEMENT TECHNIQUES IN WASTE MANAGEMENT

Role of Ground Improvement-Drainage and Ground Water Lowering-Electro osmotic Methods Diaphragm walls-Thermal and Freezing methods – In situ Densification - Deep Compaction - Dynamic Compaction -Blasting - Sand piles and pre-loading -Stone Columns and lime piles- Earth reinforcement - Rock bolts Cables and guniting – Geo textiles as reinforcement Filtration - Drainage and Erosion control.

UNIT V: SOIL REMEDIATION TECHNOLOGIES

Contaminated site characterization - Containment - Soil vapour extraction - Soil washing - Solidification and Stabilization - Electro-kinetic remediation - Thermal desorption - Vitrification -Bioremediation - Phytoremediation - Soil fracturing –Bio stimulation – Bio augmentation - Chemical oxidation and reduction

TEXT BOOKS:

1. Calvin Rose, An Introduction to the Environmental Physics of Soil, Water and Water Sheds, Cambridge University Press, 2004.
2. Paul Nathanail C. and Paul Bardos R, Reclamation of Contaminated Land, John Wiley & Sons Limited, 2004.

REFERENCE BOOKS:

1. Hari D. Sharma and Krishna R. Reddy, Geo-Environmental Engineering : Site Remediation, Water Contaminant and Emerging Water Management Technologies, John Wiley & Sons Limited, 2004.
2. William J. Deutsch, Groundwater Geochemistry : Fundamentals and Applications to Contamination, Lewis Publishers, 2010.
3. Marcel Vander Perk, Taylor & Francis, Soil and Water Contamination from Molecular to Catchment Scale, 2006.

Semester-

21BECEE14 **Earth Reinforcement** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Understand the history and the various reinforced earth techniques that are suitable for different soils and in different structures.
2. Assess the stability, mode of failure and design of earth retaining wall.
3. Express the site characterization, risk assessment of contaminated site and suitable remediation of methods.
4. Assess the geo synthetics techniques for roads and slopes construction and its stability.
5. Assess the use of Geo synthetics in drainage requirements and landfill designs.
6. To express the site characterization, risk assessment of contaminated site and suitable remediation of methods.

Course Outcomes

After completing the course, the students will be able to

1. Identify the appropriate reinforced earth techniques for different soils and in different structures.
2. Assess the various mode of failure and stability of earth retaining wall and design of earth retaining wall.
3. Express the characterization and risk assessment of contaminated site in order to develop the appropriate remediation of methods.
4. Assess the stability and construction of roads and slopes with the application of geo synthetics techniques.
5. Assess the concept of geo synthetics reinforcement in the application of drainage andlandfill.
6. Assess the stability, mode of failure and design of earth retaining wall.

UNIT I: BASICS OF REINFORCED EARTH CONSTRUCTION

Historical Background - Components, Mechanism of earth reinforcement - Advantages and Disadvantage of reinforced earth Construction - Sandwich technique for clayey soil- Requirements, testing &evaluation of earth reinforcements.

UNIT II: DESIGN OF REINFORCED EARTH RETAINING WALLS

Design of Reinforced earth retaining wall - Internal and external stability - Selection of materials - Typical design problems - Modes of failure of foundation - Determination of force induced in reinforcement ties – Location of failure surface, tension failure and pull out resistance- Bearing capacity improvement in soft soils.

UNIT III: CONTAMINANT FATE AND TRANSPORT IN SOIL

Site characterization -Risk assessment of contaminated site - Remediation methods for soil and groundwater -Selection and planning of remediation methods -Some examples of in-situ remediation.

UNIT IV: GEOSYNTHETICS FOR ROADS AND SLOPES

Roads - Applications to Temporary and Permanent roads - Role of Geo synthetic in enhancing properties of road -Control of mud pumping - Enhancing properties of subgrade - Design requirements Slopes - Causes for slope failure - Improvement of slope stability with Geo synthetic - Drainage requirements - Construction technique - Simple Numerical Stability Checking Problems on Reinforced Slopes.

UNIT V: GEOSYNTHETICS - FILTER, DRAIN AND LAND FILLS

Filter and Drain - Conventional granular filter design criteria, Design criteria of Geo synthetic and filter – Soil retention – Geo synthetic permeability, anti clogging, survivability and durability - Landfills - Typical design of Landfills - Landfill liner and cover - EPA Guidelines - Barrier walls for existing landfills and abandoned dumps.

TEXT BOOKS:

1. Koerner. R.M, "Design with Geo synthetics", Prince Hall Publications, 2017.
2. Koerner. R.M. &Wesh, J.P, "Construction and Geotechnical Engineering using synthetic fabrics", Wiley Inter Science, NewYork, 2005.

REFERENCE BOOKS:

1. Hidetoshi Octial, Shigenori Hayshi& Jen Otani, "Earth Reinforcement Practices",Vol. I, A.A. Balkema, Rotterdam, 1992.
2. Bell F.G, "Ground Engineer's reference Book", Butter worths, London, 1987.
3. Ingold, T.S, "Reinforced Earth", Thomas, Telford, London, 1982.
4. Siva kumar Babu G. L.,"An introduction to Soil Reinforcement and Geo synthetics", Universities Press, Hyderabad, 2006.
5. Swami Saran, "Reinforced Soil and its Engineering Applications", I. K. International Pvt. Ltd, New Delhi, 2017.
6. Venkattappa Rao, G., & Suryanarayana Raju., G. V.S, "Engineering with Geo synthetics", Tata McGraw Hill publishing Company Limited., New Delhi, 1990.
7. Sarsby R W- Editor, "Geo synthetics in Civil Engineering", Wood head Publishing Ltd & CRC Press, 2007

Semester-

21BECEE15 **Environmental Geo-technology** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Understand the behavior of soils for the geo environmental applications.
2. Describe the characterization of soil mineralogy, ground water flow and the contaminant transport for the different soil conditions.
3. Express the concept of waste contaminant transport and the design principles.
4. Describe the different remedial measures for the contaminant systems.
5. Describe the electrical and thermal, and centrifuge methods of evaluation of for the advanced soil characterization.
6. To understand the characteristics of soils for the impact of ground contamination on geo environment.

Course Outcomes

After learning the course the students should be able to:

1. Understand the characteristics of soils for the impact of ground contamination on geo environment.
2. Describe the classification of soil mineralogy, ground water flow and contaminant transport for the design of remedial systems.
3. Express the design principles of waste contaminant transport.
4. Describe the different contaminant systems and their remedial measures.
5. Describe the he advanced soil characterization for the evaluation of contaminant systems.
6. Remedial measures for the contaminant systems

UNIT I: FUNDAMENTALS OF GEO ENVIRONMENTAL ENGINEERING

Scope of geo environmental engineering - Multiphase behavior of soil -Role of soil in geo environmental applications - Environmental interactions-Sources and type of ground contamination - Impact of ground contamination on geo environment - case histories.

UNIT II: SOIL-WATER-CONTAMINANT INTERACTION

Soil mineralogy characterization - Soil-water interaction - Forces of interaction between soil particles -Concepts of unsaturated soil -Importance of unsaturated soil in geo environmental problems - Measurement of soil suction - Water retention curves -Ground water flow – Sources of ground water contaminants - Contaminants transport.

UNIT III: WASTE CONTAINMENT SYSTEM

Evolution of waste containment facilities and disposal - Site selection based on environmental impact assessment - Different role of soil in waste containment -Different components of waste containment system and its stability issues - Property evaluation for checking soil suitability - Design of waste containment facilities.

UNIT IV: CONTAMINANT SITE REMEDIATION

Site characterization - Risk assessment of contaminated site - Remediation methods for soil and groundwater -Selection and planning of remediation methods -Some examples of in-situ remediation.

UNIT V: ADVANCED SOIL CHARACTERIZATION

Contaminant analysis - Water content and permeability measurements -Electrical and thermal property evaluation -Use of GPR for site evaluation - Introduction to geotechnical centrifuge modeling.

TEXT BOOKS:

1. Rowe R.K., "Geotechnical and Geo environmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Reddi L.N. and Inyang, H. I., "Geo environmental Engineering, Principles and Applications" Marcel DekkerInc. New York, 2000.

REFERENCE BOOKS:

1. Bagchi,A., "Design of landfills and integrated solid waste management" John Wiley & Sons, Inc., USA, 2004.
2. Fredlund D.G. and Rahardjo, H., "Soil Mechanics for Unsaturated Soils" Wiley-Inter science, USA, 2003.
3. Hillel D., "Introduction to Environmental Soil Physics" Academic Press, New York, 2003.
4. Hillel D., "Introduction to Soil Physics" Academic Press, New York, 2002.
5. Mitchell, J.K., "Fundamentals of Soil Behavior" Wiley,2005.
6. Sparks, D.L., "Environmental Soil Chemistry" Academic Press, New York, 2002.
7. Sharma H.D. and Reddy K.R., "Geo environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
8. Alvarez-Benedi J. and Munoz-Carpena, R., "Soil-Water Solute Process Characterization: An Integrated Approach" CRC Press, New York, 2005.

Semester-

21BECEE16 **Ecological Engineering** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To impart knowledge on the principles of ecological engineering that strengthen the functions of ecosystems,
2. To restore devastated ecosystems, and utilize the functions of ecosystems to develop ecological engineering designs for environmental management.
3. Analyze water quality modeling based on dispersion, mixing, the amount of dissolved oxygen presents in water and assessing its performance.
4. To design the Ecological Engineering Processes Self-organizing and its processes.
5. To discover the Eco technology for Waste Treatment Ecological engineers.
6. To realize Eco technology for Waste Treatment Ecological engineers and ecotechnology

Course Outcomes:

After successful completion of course, the students are able to

1. Identify the application, development and evolution of ecology.
2. Knowledge of system approach in ecological Engineering and estimate the sources separation systems, aqua cultural system and agro systems.
3. Analyze the ecological processes self-organizing the design process.
4. Balance the Case studies of Integrated Ecological Engineering
5. Realize eco technology for waste treatment ecological engineers and eco technology balance the case studies of integrated ecological engineering.
6. Understand the basic concepts involved in ecological system and assess the ecological modeling based on population dynamics.

UNIT I: ECOSYSTEMS & ECOTECHNOLOGY

Aim, scope and applications of ecology – Development and evolution of ecosystems – Principles and concepts pertaining to communities in ecosystem – Energy flow and material cycling in ecosystems – productivity in ecosystems.

UNIT II: SYSTEMS APPROACH IN ECOLOGICAL ENGINEERING

Principles, components and characteristics of systems – Classification of systems – Structural and functional interactions of environmental systems – Environmental systems as energy systems – Mechanisms of steady-state maintenance in open and closed systems – Modeling and Eco technology – Elements modeling – Modelling procedure – Classification of ecological models- Applications of models in Eco technology – Ecological economics.

UNIT III: ECOLOGICAL ENGINEERING PROCESSES SELF-ORGANIZING DESIGN AND PROCESSES

Multi seeded microcosms – Interface coupling in ecological systems – Concept of energy – Determination of sustainable loading of ecosystems.

UNIT IV: ECOTECHNOLOGY FOR WASTE TREATMENT ECOLOGICAL ENGINEERS

Classification of eco technology – Principles of ecological engineering. Eco sanitation- Principles and operation of soil infiltration systems – Wetlands and ponds – source separation systems – Aqua cultural systems – Agro ecosystems – Detritus based treatment for solid wastes – Applications of ecological engineering for marine systems.

UNIT V: CASE STUDIES

Case studies of Integrated Ecological Engineering Systems and their commercial prospects.

TEXT BOOKS:

1. Jorgensen, S.E. Ecological Engineering: Principles and Practice. CRC Press, 2003.
2. Mitsch, J.W. and Jorgensen, S.E. Ecological Engineering – An Introduction to Eco technology, John Wiley & Sons, New York, 1989.

REFERENCE BOOKS:

1. Mitsch, W.J. Ecological Engineering and Ecosystem Restoration, Wiley 2nd Ed., 2003.
2. White I.D., Mottershed, D.N. and Harisson, S.J. Environmental systems - An Introductory text, Chapman Hall, London, 1994.

Semester-

21BECEE17 Transport of Water and Wastewater 3H-3C

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To understand and apply the principle of hydraulics in water transportation and distribution and wastewater collection and conveyance.
2. To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain and computer application on design
3. To design water supply mains taking into account all the design parameters.
4. To analyze a water supply distribution network.
5. Design of water and sewage network and solve operational problems in transmission using software.
6. To estimate the quantity of storm drainage and design a proper storm drainage for speedy draining of storm water from the city area.

Course Outcomes:

After successful completion of course, the students are able to

1. Design water supply main, distribution network and sewer for various field conditions Troubleshooting in water and sewage transmission
2. Select an appropriate pipe material, necessary pipe appurtenances and able to locate the leaking mains for the water distribution system.
3. Estimate the quantity of storm drainage and design a proper storm drainage for speedy draining of storm water from the city area.
4. Design a sewer network for the proper disposal of the sewage generated from the city limits to treatment plant.
5. Collect, analyze and usage of data in the relevant tools and Employ modern advanced computing tools in environmental studies.
6. Design a sewer network for the proper disposal of the sewage generated from the city limits to treatment plant.

UNIT I: GENERAL HYDRAULICS AND FLOW MEASUREMENT

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity– Flow measurement.

UNIT II: WATER TRANSMISSION AND DISTRIBUTION

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps-characteristics- economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

UNIT III: WASTEWATER COLLECTION AND CONVEYANCE

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

UNIT IV: STORM WATER DRAINAGE

Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods.

UNIT V: CASE STUDIES AND SOFTWARE APPLICATIONS

Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based software's.

TEXT BOOKS:

1. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2. Bajwa, G.S. "Practical Handbook on Public Health Engineering", Deep Publishers, Shimla, 2003
3. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993.

REFERENCE BOOKS:

1. Frank R. Spellman, " Water& Wastewater Conveyance", CRC Press 1 st edition,2016.
2. "Water transmission and distribution", by American Water works associations 4 th edition,2010.
3. Dr. R.K.Bansal, "Fluid mechanics and hydraulic machines", Laxmi Publications,2008.

Semester-

21BECEE18 Physico-Chemical Processes for Water and Wastewater Treatment 3H-3C

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To discuss about the quality, standards, basic unit operations and processes involved in treatment.
2. To educate the students on the principles and process of various treatment systems for water and wastewater.
3. Develop an understanding of the characteristics of water and wastewater that must be considered during the treatment plant.
4. Students will gain competency in the iterative process employed in design of treatment systems.
5. Learn how to use the theory to calculate and design the specific unit processes presented.
6. To determine the quality of generated sludge by treatment of water and waste water and various methods for disposal of sludge

Course Outcomes:

After completing the course, the students will be able to

1. Provide the student with a better knowledge and toolbox to both choose and design a water treatment process based on achieving the required water quality needed as a function of the source water quality.
2. Identify and assess the characteristics of water and wastewater along with their environmental impacts.
3. Design of the various unit processes in wastewater treatment plants.
4. Understand the principles and mechanisms involved in advanced waste water treatment.
5. Make them conclude the waster water to be treated in a concern treatment system.
6. Describe process for removal of oil, grease etc & disposal of skimming

UNIT I: QUALITY, QUANTITY OF WATER AND WASTE WATER

Quality of water and waste water. Wholesome water -Impurity of water- Characteristics of water- Examination of water - Standards of potable water quality - Characteristics of sewage - Examination of sewage - Standards of quality of treated water and wastewater - Quantity of water and waste water - Waste water and gas flow - Water requirement for domestic and industrial purposes - Waste water formation and estimation - Spectrum of particulate size distribution - Variation of flows.

UNIT II: SCREENING AND SKIMMING

Purpose of screenings and terms : blinding, stratification , contamination (oversize , fines, foreign body), gradation, grading, Flow equalization -Types of bar racks and screens -Disposal of screenings - Removal of oil, grease etc. - Floatation - Skimming tank - Disposal of skimming.

UNIT III: SEDIMENTATION

Introduction - Principles of Sedimentation and Stokes' law applied to fluids - Characteristics of the settleable solids - Classification of sedimentation tanks for water and waste water - Factors influencing sedimentation -Deciding size of sedimentation tank for water and wastewater -Standard design loading - Detention period -Coagulation – purpose, principle - Types of coagulants and its suitability -Determination of optimum coagulation dose. - Feeding of coagulant and feeding devices - Flocculation and flocculation tanks and design criteria of flocculator - Clarifiers, its types and design criteria. - Settling efficiency of particles - Grit removal

UNIT IV: FILTRATION

Theory of filtration- Mechanism for particle size -Hydraulics of filters -Types of filters and their flow direction -Filter clogging -Filter washing -Break through -Deciding size of filter unit - Advances in filtration.

UNIT V: SOFTENING DESALINATION &DISINFECTION:

Chemical precipitation - Water and wastewater softening -Estimation of dose of chemical - Methods of softening - ammonia, borax, lye, lime-soda, chelating, Ion exchange method etc. - osmosis, electrolysis -. Methods of disinfection -chlorination – chlorine dose, chlorine demand, application of chlorine - Use of various forms of chlorine, break through chlorination - Removal of colour.

TEXT BOOKS:

1. Metcalf & Eddy, "Wastewater Engineering Treatment Disposal Reuse",Tata McGraw-Hill, New York, 2003 5 th edition, 2013.
2. S.K.Garg, "Water supply engineering" and "Sewage waste disposal and air pollution engineering" (VOL 1 & 2), Khanna Publishers, 2017.

REFERENCE BOOKS:

1. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, "Environmental Engineering", McGraw-Hill,2013
2. Qasim. S.R., "Wastewater Treatment Plant – Planning, Design and operation, Holt Rinchart and Winston, New York, 2002.
3. Weber, W.J. Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.
4. Karia.G.L, "Wastewater treatment- Concepts and design approach", PHI learning private ltd, 2013.

Semester-

21BECEE19 Biological Processes for Contaminant Removal 3H-3C

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. Understand the background of biological treatment processes.
2. Get required knowledge on design parameters and coefficients.
3. Acquire knowledge on the design of suspended growth treatment plants.
4. Apply knowledge of enzyme reaction kinetics to reactor design.
5. Study different work scenarios to determine the most effective options.
6. To examine the different equipment options required for each treatment

Course Outcomes:

After successful completion of course, the students are able to

1. Develop conceptual schematics required for biological treatment of wastewater.
2. Have a sound knowledge of microbiology fundamentals applied to biological treatments.
3. Correctly implement the procedures for determining kinetic and stochiometric parameters.
4. Analyze the different options applicable to different substrates.
5. Examine the different equipment options required for each treatment.
6. Study different work scenarios to determine the most effective options

UNIT I: INTRODUCTION

Microbiology fundamentals and kinetic and stoichiometric coefficients - Bacterial growth and biological oxidation - Kinetics and stoichiometric of biological growth

UNIT II: AEROBIC BIOLOGICAL TREATMENT

Fixed and suspension cultures - Suspension cultures - Characteristics of the activated sludge process - Control parameters - Overproduction of sludge and oxygen consumption - Scums -Fixed cultures - percolators and bio discs - Nutrient (N and P) removal.

UNIT III: ANAEROBIC BIOLOGICAL TREATMENT

Biogas production, collection and use - Mechanism and phases of the anaerobic process - Gas production, collection and use - Energetics and stiochiometric of the process - Anaerobic contact process and slurry filter - anaerobic digestion of slurry.

UNIT IV: ENERGETICS AND STOICHIOMETRIC

Activated sludge process - Balanced diet - C:N:P ratio - Presence of toxic substances - Operational difficulties – swelling - rising sludge.

UNIT V: CONTROL PARAMETERS

Load – pH – VFAs – Acidity - Alkalinity - Gas quantity – Quality.

TEXT BOOKS:

1. Metcalf and Eddy, "Waste Water Engineering – Treatment and reuse", Tata McGraw-Hill, New Delhi, 2003.
2. Arceivala S. J., "Waste Water Treatment and disposal, Marceldekker publishers,1981.
3. Larry D. Benefield and Clifford W. Randall, "Biological process design for Wastewater Treatment", 1994.

REFERENCE BOOKS:

1. Howard S. Peavy, Donald R. Rowe and George Techobanoglous, "Environmental Engineering", McGraw – Hill co., 2013.
2. Arceivala S. J., "Wastewater Treatment and Pollution control", Tata McGrawHill Co., New Delhi, 1998.
3. Linvil G. Rich., "Low-Maintenance, Mechanically simple wastewater treatment Systems" , McGraw-Hill Co., 1980

Semester-

21BECEE20 Rural Water Supply and Onsite Sanitation Systems 3H-3C

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To educate the students on the principles rural water supply and sanitation.
2. To learn about the development of water supply in rural areas.
3. To learn about environmental sanitation methods in rural areas.
4. Develop an understanding of the characteristics of water and wastewater that must be considered during design of a treatment plant.
5. Develop understanding of events governing the rural water supply and sanitation.
6. To plan and identify the removal of hazards by composting

Course Outcomes:

At the end of the course, the student will be able to

1. Identify and formulate problems for rural application.
2. Develop conceptual schematics required for the treatment of water and wastewater for rural application.
3. Function on a multi – disciplinary team.
4. Identify pertinent criteria constraining the design of systems and processes.
5. Gain knowledge about water supply scheme in rural areas and environmental sanitation methods and design in rural areas.
6. Identify the occupational hazards.

UNIT I: RURAL WATER SUPPLY

Issues of rural water supply –Various techniques for rural water supply- merits- National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies

UNIT II: LOW COST WATER TREATMENT

Introduction – Epidemiological aspects of water quality methods for low cost water treatment - Specific contaminant removal systems.

UNIT III: RURAL SANITATION

Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system in rural areas- Treatment and Disposal of wastewater - Compact and simple wastewater treatment units and systems in rural areas- stabilization ponds - septic tanks - Imhoff tank- soak pits- low cost excreta disposal systems- Effluent disposal.

UNIT IV: INDUSTRIAL HYGIENE AND SANITATION

Occupational Hazards- Schools- Public Buildings Hospitals- Eating establishments- Swimming pools – Cleanliness and maintenance and comfort- Industrial plant sanitation.

UNIT V: SOLID WASTE MANAGEMENT

Disposal of Solid Wastes- Composting- land filling incineration- Biogas plants - Rural health - Other specific issues and problems encountered in rural sanitation.

TEXT BOOKS:

1. CPHEEO Manual on Water Supply and Treatment, Govt. of India 2003.
2. Manual on Sewerage and Sewage Treatment, Govt. of India 1999.
3. Metcalf & Eddy, Wastewater Engg. Treatment and Reuse, Tata McGraw Hill, New Delhi 2000.
4. Todd, D.K. Ground Water Hydrology, John Wiley & Sons, New York 2000.

REFERENCE BOOKS:

1. Eulers, V.M., and Steel, E.W., Municipal and Rural Sanitation, 6th Ed., McGraw Hill Book Company, 1965.
2. Park, J.E., and Park, K., Text Book of Preventive and Social Medicine, Banarsidas Bhanot, 1972.
3. Wright, F.B., Rural Water Supply and Sanitation, E. Robert Krieger Publishing, Company, Huntington, New York, 1977.
4. Juuti, P., Tapio S. K., and Vuorinen H., Environmental History of Water: Global Views on Community Water Supply and Sanitation, IWA Publishing (Intl Water, Assoc), 2007.

Semester-

21BECEE21 **Solid and Hazardous Waste Management** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To impart basic knowledge about the solid and hazardous waste management.
2. To make the students categorize the waste and reduce the source reduction.
3. To develop a idea for them in processing the waste by knowing the waste characterization.
4. To extend the sense broadly about collection, storage and up to transportation level.
5. Formulate them to do the apt processing for disposal from the waste emerged out to the environment.
6. To design the different elements of waste management systems.

Course Outcomes:

After completing the course, the students will be able to

1. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation.
2. Define and explain important concepts in the field of solid waste management
3. Suggest suitable technical solutions for treatment of municipal waste.
4. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges.
5. Design the different elements of waste management systems.
6. Design the different elements of waste management systems.

UNIT I: SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management – Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes, plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management- Integrated solid waste management.

UNIT II: WASTE CHARACTERIZATION AND SOURCE REDUCTION

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer

responsibility - Recycling and reuse.

UNIT III: STORAGE, COLLECTION AND TRANSPORT OF WASTES

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport

UNIT IV: WASTE PROCESSING TECHNOLOGIES

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes- treatment of biomedical wastes - Health considerations in the context of operation of facilities.

UNIT V: WASTE DISPOSAL

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps-remediation of contaminated sites.

TEXT BOOKS:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
2. P.M.Cherry, " Solid and Hazardous waste management", CBS publishers and distribution PVT Ltd, 2016, 1st edition. 10.
3. M.S.Bhatt, Asherefilliyan, " Solid waste management – An Indian perspective ", Synergy books India 2012.

REFERENCE BOOKS:

1. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi,2014.
2. John Pitchtel, Waste Management Practices, CRC Press, Taylor and Francis Group,2014
3. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
4. William A. Worrell, P. Aarne Vesilind, Solid Waste Engineering, Cengage Learning, 2012.

Semester-

21BECEE22 **Air and Noise Pollution and Control** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To impart knowledge on the principles and design of control of indoor/ particulate / gaseous air pollutant and its emerging trends.
2. To apply sampling techniques and Suggest suitable air pollution prevention equipment's and techniques for various gaseous and particulate pollutants.
3. To apply air pollution monitoring and modeling
4. To induce operational considerations under the processing and control monitoring.
5. To apply sampling techniques of gaseous contaminants.
6. To control noise pollution by specific measurements, standard and preventive measures.

Course Outcomes:

After completion of this course, the student will be able to

1. Apply sampling techniques and Suggest suitable air pollution prevention equipment's and techniques for various gaseous and particulate pollutants.
2. Apply air pollution monitoring and modeling
3. Induce operational considerations under the processing and control monitoring.
4. Apply sampling techniques of gaseous contaminants.
5. Control noise pollution by specific measurements, standard and preventive measures.
6. Gain the knowledge on the principles and design of control of indoor/ particulate / gaseous air pollutant and its emerging trends.

UNIT I: INTRODUCTION

Structure and composition of Atmosphere – Sources and classification of air pollutants - Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects on the planet – Global Climate Change, Ozone Holes – Ambient Air Quality and Emission Standards – Air Pollution Indices – Emission Inventories.

UNIT II: AIR POLLUTION MONITORING AND MODELLING

Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants -Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques – Air Pollution Climatology.

UNIT III: CONTROL OF PARTICULATE CONTAMINANTS

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators, cyclones, Fabric filters,

Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

UNIT IV: CONTROL OF GASEOUS CONTAMINANTS

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

UNIT V: AUTOMOBILE AND NOISE POLLUTION

Vehicular Pollution: Automobile emission- Types of emissions- Exhaust emissions, evaporative emissions, crank-case emissions- Prevention and control of vehicular pollution. Noise Pollution: Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures. Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control.

TEXT BOOKS:

1. Anjaneyulu D, “Air pollution and control technologies”, Allied Publishers, Mumbai, 2002.
2. Khitoliya R K, “Environmental Pollution”, 2/e, S. Chand Publishing, 2012.

REFERENCE BOOKS:

1. Rao C.S, “Environmental pollution control engineering”, Wiley Eastern Ltd., New Delhi, 1996.
2. Rao M.N, and Rao H.V.N, “Air Pollution Control” Tata-McGraw-Hill, New Delhi, 1996.
3. David H.F Liu, Bela G.Liptak, “Air Pollution”, Lewis Publishers, 2000.
4. Mudakavi, J R, “Principles and Practices of Air Pollution Control and Analysis” IK International, 2010.
5. Air Pollution act, India, 1998.

Semester-

21BECEE23 Environmental Impact Assessment and Life Cycle Analyses 3H-3C

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment.
2. To develop the EIA models and life cycle assessment.
3. To provide knowledge related to the broad field of environmental risk assessment.
4. To learn the important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.
5. To standardize the environment from the impact risks.
6. To know the remediation techniques and development of predictive models.

Course Outcomes:

After completing the course, the students will be able to

1. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
2. Know about the legal requirements of Environmental and Risk Assessment for projects.
3. Identify environmental attributes to be considered for the EIA study and Prepare environmental base map based on impact evaluation and analysis
4. Specify methods for prediction of the impacts and Conduct environmental audit.
5. Evaluate the audit data and prepare the report.
6. Know the remediation techniques and development of predictive models

UNIT I: ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Introduction, definitions and concepts, rationale and historical development of EIA, EIA for civil engineers. road components of EIA: Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration. Pertinent institutional information, unique pollution problems, existing visual quality, public participation techniques. Composite consideration, potential cultural resources, potential visual impacts, geographical study area.

UNIT II: METHODOLOGIES

Measurement of environmental impact, organization, scope and methodologies of EIA pertinent environmental factors. Six generic steps, descriptive checklists, simple interaction matrix, stepped matrix, uniqueness ratio, habitat evaluation system. Public involvement techniques, comprehensive environmental impact study, various project types, archaeological properties, leachate testing, evaluation species, proposing agency, EIA Models. Status of EIA in

India: EIA Regulations in India, TOR for Hydropower Projects and other projects. Case studies from hydropower projects, hazardous industries and mining.

UNIT III: ENVIRONMENTAL MANAGEMENT

Principles, problems and strategies; Review of political, ecological and remedial actions. Future strategies; multidisciplinary environmental strategies, the human, planning, decision-making and management dimensions. Environmental audit: Definitions and concepts, partial audit, compliance audit, methodologies and regulations.

UNIT IV: EMS AND STANDARDIZATION

Introduction to ISO and ISO 14000.EMAS regulations, wider application of system based approach. Local infrastructure development and environmental management: A system approach, Regional environmental management system, Conversion plan development and implementation strategies, Environmental management systems in local government**.**

UNIT V: LCA

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting. Carbon trading Energy foot printing, Food foot printing and Carbon foot printing.GHG emissions, global warming, climate change and Carbon credits, CDM, Initiatives in India; Sustainable development; Future scenarios.

TEXT BOOKS:

1. L. W. Canter, Environmental Impact Assessment, 2nd Ed., McGraw-Hill, 1997.
2. P. Judith and G. Eduljee, Environmental Impact Assessment for Waste Treatment and Disposal Facilities, John Wiley & Sons, 1994.
3. G. Burke, B. R. Singh and L. Theodore, Handbook of Environmental Management and Technology, 2nd Ed., John Wiley & Sons, 2000.

REFERENCE BOOKS:

1. C. H. Eccleston, Environment Impact Statements: A Comprehensive Guide to Project and Strategic Planning, John Wiley & Sons, 2000.
2. R. Welford, Corporate Environmental Management - Systems and Strategies, Universities Press, 1996.
3. K. Whitelaw and Butterworth, ISO 14001: Environmental System Handbook, 1997.
4. The Economist Intelligence Unit, Best Practices - Environment, Universities Press, 1993.
5. R. Therivel, John Glasson, Andrew Chadwick, Introduction to Environmental Impact Assessment (Natural and Built Environment), Routledge, 2005.

Semester-

21BECEE24 **Building Construction Practice** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

After successful completion of the course, the student will be able to

1. Select suitable materials for buildings and adopt suitable construction techniques.
2. Select suitable techniques used in super and sub structure construction.
3. Select the type of foundation need for a structure.
4. Find the different construction techniques available.
5. Supervision of different types of masonry
6. Applying different construction techniques in underwater construction

Course Outcomes

After completing the course, the students will be able to

1. In investigation of soil condition, Deciding and design of suitable foundation for different structures
2. In supervision of different types of masonry
3. In applying different construction techniques in underwater construction
4. In explaining erection techniques for high rise structures.
5. Select suitable materials for buildings and adopt suitable construction techniques.
6. Select suitable techniques used in super and sub structure construction.

UNIT I: BUILDING MATERIALS

Stone as building material; Requirement of good building stones, dressing of stones, Deterioration and Preservation of stone work. Bricks; Classification, Manufacturing of clay bricks, Requirement of good bricks. Field and laboratory tests on bricks; compressive strength, water absorption, efflorescence, dimension and war page. Cement Concrete blocks, Stabilized Mud Blocks, Sizes, requirement of good blocks. Mortar: types and requirements. Timber as construction material Fine aggregate: Natural and manufactured: Sieve analysis, zoning, specify gravity, bulking, moisture content, deleterious materials. Coarse aggregate: Natural and manufactured: Importance of size, shape and texture. Grading of aggregates, Sieve analysis, specific gravity, Flakiness and elongation index, crushing, impact and abrasion tests.

UNIT II: FOUNDATION AND MASONRY

Preliminary investigation of soil, safe bearing capacity of soil, Function and requirements of good foundation, types of foundation. Masonry: Definition and terms used in masonry. Brick masonry, characteristics and requirements of good brick masonry. Requirements of good stone masonry, Classification, characteristics of different stone masonry, Joints in stone masonry. Types of walls; load bearing, partition walls, cavity walls.

UNIT III: CONSTRUCTION PRACTICES

Specifications, details and sequence of activities and construction co-ordination – Site

Clearance – Marking – Earthwork – masonry – stone masonry – Bond in masonry – concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – pre cast pavements – Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – laying brick — weather and water proof – roof finishes – acoustic and fire protection.

UNIT IV: SUB STRUCTURE CONSTRUCTION

Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunneling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation

UNIT V: SUPER STRUCTURE CONSTRUCTION

Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks;

TEXT BOOKS:

1. Varghese, P.C., "Building Construction", Prentice Hall India,2007.
2. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015

REFERENCE BOOKS:

1. National Building Code, Bureau of Indian Standards, New Delhi,2017.
2. Chudley, R., Construction Technology, ELBS Publishers,2007.
3. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill,2011
4. Nunnally, S.W. Construction Methods and Management, Prentice Hall,2006
5. Punmia, B.C., Khandelwal, K.K., Project Planning with PERTandCPM,LaxmiPublications,2016.

Semester-

21BECEE25 **Construction Project Planning &Systems** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To analyze and apply the project planning systems and techniques
2. To plan, organize and manage the production and business processes of lesser or medium complexity within the business systems (civil engineering and public utility companies, local government offices)
3. To develop detailed appreciation for construction planning and scheduling
4. To apply their learned knowledge as it pertains to upper level construction management skills and procedures.
5. To update their knowledge on time and cost overruns and their corrective measures.
6. To apply their learned knowledge as it pertains to Project monitoring skills.

Course Outcomes

At the end of this course the student is expected to have learnt how to

1. Plan construction projects, schedule the activities using network diagrams,
2. develop detailed appreciation for construction planning and scheduling
3. Apply their learned knowledge as it pertains to upper level construction management skills and procedures.
4. Update their knowledge on time and cost overruns and their corrective measures.
5. Apply their learned knowledge as it pertains to Project monitoring skills.
6. Identify and understand the safety concepts of quality control.

UNIT I: PROJECT PLANNING SYSTEMS

Definition of Projects; Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data.

UNIT II: PLANNING TECHNIQUES

Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT-Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion. Allocation of Resources- materials, equipment, staff, labour and finance; resource levelling and optimal schedules; Project organisation, documentation and reporting systems

UNIT III: CONTRACTS MANAGEMENT

Importance of Contracts Management; Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization,

Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and levelling. Common Good Practices in Construction.

UNIT IV: PROJECT MONITORING

Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management;

UNIT V: QUALITY CONTROL

Concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

TEXT BOOKS:

1. Varghese, P.C., "Building Construction", Prentice Hall India,2007.
2. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015

REFERENCE BOOKS:

1. National Building Code, Bureau of Indian Standards, New Delhi,2017.
2. Chudley, R., Construction Technology, ELBS Publishers,2007.
3. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill,2011
4. Nunnally, S.W. Construction Methods and Management, Prentice Hall,2006
5. Punmia,B.C.,Khandelwal,K.K., Project Planning withPERT and CPM, Laxmi Publications, 2016.

Semester-

21BECEE26 **Sustainable Construction Methods** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Demonstrate an ability to evaluate and/or design whole or parts of projects, taking into account not only the financial and economic issues but also the social and environmental impacts affecting the sustainability of infrastructure.
2. Promote an approach to project evaluation that is based on an appreciation of the needs of society, the potential for sustainable development
3. To recognition the problems that may result from poorly conceived or poorly implemented projects and programs.
4. To know the construction method which is used in the sustainable environment.
5. To know the cutting edge rating systems in detail, including its evolution, objectives, criteria, levels of certification benefits, and shortcomings
6. To know a series of case studies representing diverse project types, sizes, certification levels, and climate regions

Course Outcomes

After taking this class students should be able to:

1. Understand rating systems and compares key features such as cost, ease of use, and building performance
2. Know the construction method which is used in the sustainable environment.
3. Know the cutting edge rating systems in detail, including its evolution, objectives, criteria, levels of certification benefits, and shortcomings
4. Know a series of case studies representing diverse project types, sizes, certification levels, and climate regions
5. Know what are "lessons learned" of sustainable construction through LEED case studies
6. Understand the concept of sustainable development or sustainability in the built environment

UNIT I: TYPES OF FOUNDATIONS AND CONSTRUCTION METHODS

Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with block work walls).

UNIT II: MODULAR CONSTRUCTION METHODS

Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

UNIT III: CUTTING EDGE OF SUSTAINABLE CONSTRUCTION

Identification of cutting edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity.

UNIT IV: SUSTAINABILITY IN BUILT ENVIRONMENT

The fundamental concepts of sustainable development in the built environment; the environmental - resources issues and industrial - construction metabolism with examples. Environmental ethics and environmental justice; ecological - environmental economics including Life Cycle Costing; building assessment (frameworks) and ecolabels. Energy systems, energy, entropy, energy conservation and renewable energy; Life Cycle Assessment, embodied energy, energy, and materials.

UNIT V- LEED CONSTRUCTION MANAGEMENT

Examination of the current LEED for New Construction rating system, and case study analysis of highly successful recent "green construction projects" through student team assignments and presentations. Preparation for the LEED Green Associate professional licensing exam.

TEXT BOOKS:

1. Sustainable Construction: Green Building Design and Delivery. Third Edition, Charles J. Kibert, New York: John Wiley & Sons, 2012.
2. Working Toward Sustainability: Ethical Decision Making in a Technological World, CJ Kibert et al, New York: John Wiley & Sons, 2011.

REFERENCE BOOKS:

1. Varghese, P.C., “Building Construction”, Prentice Hall India,2007.
2. National Building Code, Bureau of Indian Standards, New Delhi,2017.
3. Chudley, R., Construction Technology, ELBS Publishers,2007.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill,2011
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall,2006
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERTandCPM, Laxmi Publications,2016.

Semester-

21BECEE27 **Construction Engineering Materials** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To gain knowledge of various materials, both conventional and modern, that are commonly used in construction.
2. To gain knowledge in selecting the appropriate materials for construction.
3. To know the various tests for quality control in the use of conventional and modern materials.
4. To gain brief knowledge about ready Mix Concrete.
5. To know the different codal provisions available for different construction Materials.
6. To Provide hands-on, research, and collaborative activities to vary and deepen the study of construction materials.

Course Outcomes

After completing the course, the students will be able to

1. Impart knowledge of various types of properties, uses, and variety of materials important in construction.
2. Various quality control aspects of the civil engineering materials by performing different lab test on materials.
3. Provide hands-on, research, and collaborative activities to vary and deepen the study of construction materials.
4. Know what are market forms of Timbers, Plywood's, Steels etc.
5. Understand the concept of Modern materials used in the construction.
6. The various tests for quality control in the use of conventional and modern materials

UNIT I: STONES – BRICKS – CONCRETE BLOCKS

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacture of clay bricks – Tests on bricks – Compressive Strength - Water Absorption – Efflorescence –Bricks for special use – Refractory bricks – Cement and Concrete hollow blocks – Lightweight concrete blocks – Code Practices.

UNIT II: LIME – CEMENT – AGGREGATES – MORTAR

Lime – Preparation of lime mortar – Cement. Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration - Compressive strength – Tensile strength – Soundness and consistency – Setting time – Aggregates – Natural stone aggregates – Industrial byproducts – Crushing strength – Impact strength – Flakiness – Abrasion Resistance – Grading – Sand – Bulking – Code Practices.

UNIT III: CONCRETE

Concrete – Ingredients – Manufacture – Batching plants – RMC – Properties of fresh concrete – Slump – Flow and compaction – Principles of hardened concrete – Compressive, Tensile and shear strength – Modulus of rupture – Tests – Mix specification – Mix proportioning – IS method – High Strength Concrete and HPC – Other types of Concrete – Code Practices.

UNIT IV: TIMBER AND OTHER MATERIALS

Timber – Market forms – Industrial timber- Plywood - Veneer – Thermocole – Panels of laminates – Steel – Aluminum and Other Metallic Materials - Composition – uses – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Code Practices.

UNIT V: MODERN MATERIALS

Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fiber textiles – Geosynthetics for Civil Engineering applications.

TEXT BOOKS:

1. Sustainable Construction: Green Building Design and Delivery. Third Edition, Charles J. Kibert, New York: John Wiley & Sons, 2012.
2. R. K. Rajput, Engineering Materials, S. Chand & Company Ltd., 2000.
3. M. S. Shetty, Concrete Technology (Theory and Practice), S. Chand & Company Ltd., 2003.

REFERENCE BOOKS:

1. Working Toward Sustainability: Ethical Decision Making in a Technological World, CJ Kibert et al, New York: John Wiley & Sons, 2011.
2. Varghese, P.C., "Building Construction", Prentice Hall India,2007.
3. National Building Code, Bureau of Indian Standards, New Delhi,2017.
4. Chudley, R., Construction Technology, ELBS Publishers,2007.
5. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill,2011
6. Nunnally, S.W. Construction Methods and Management, Prentice Hall,2006
7. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
8. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications,2016.

Semester-

21BECEE28 **Contracts Management** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To gain the knowledge of resources available near construction site.
2. To gain detailed knowledge of contract parameters.
3. To developed a more detailed appreciation for construction planning and scheduling
4. To apply their learned knowledge as it pertains to upper level construction management skills and procedures
5. To evaluate the best practices associated with the development of contract parameters.
6. To understand the legal aspects of acts governing the contracts

Course Outcomes

After completing the course, the students will be able to

1. Apply project Procurement management concepts in a project environment.
2. Describe techniques used to procure resources within a project's scope and techniques to reduce procurement risks.
3. Evaluate the best practices associated with the development of contract parameters.
4. Understand the legal aspects of acts governing the contracts
5. Understand the basics of the bid process, important points in a tender document, and unbalanced contracts.
6. Resources available near construction site.

UNIT I: CONTRACT MANAGEMENT:

Introduction, Importance of Contracts, Overview of Contract Management, Overview of Activities in Contract Management; Planning and People- Resource Management; Types of Contracts, Parties to a Contract; Contract Formation, Formulation of Contract, Contract Start-Up, Managing Relationships; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price.

UNIT II: CONTRACT PARAMETERS

Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Notices under contracts; Conventional and Alternative Dispute Resolution methods.

UNIT III: VARIOUS ACTS GOVERNING CONTRACTS

Contract Administration and Payments- Contract Administration, Payments; Contract Management in Various Situations- Contract Management in NCB Works, Contract Management in ICB Works Contracts, Contract of Supply of Goods- Design, Supply and Installation Contracts, Contract Management in Consultancy,

UNIT IV: BID PROCESS AND BID EVALUATION

Bid process, important points in a tender document, and unbalanced contracts. Material covered includes: Request For Proposal and problems Different types of proposals Design Conditions and Standard Component List-Tender document - Unbalanced proposals. Exercises: Evaluating Unit Prices Premium Portion Of The Overtime Rate Handling Bid Questions.

UNIT V: MANAGING RISKS AND CHANGE

Managing Risks, Managing Change; Contract Closure and Review- Ending a Contract, Post-Implementation Review; Legal Aspects in Contract Management- Contract Management Legal View, Dispute Resolution, Integrity in Contract Management; Managing Performance-Introduction, Monitoring and Measurement.

TEXT BOOKS:

1. R. K. Rajput, Engineering Materials, S. Chand & Company Ltd., 2000.
2. M. S. Shetty, Concrete Technology (Theory and Practice), S. Chand & Company Ltd., 2003.
3. Sustainable Construction: Green Building Design and Delivery. Third Edition, Charles J. Kibert, New York: John Wiley & Sons, 2012.

REFERENCE BOOKS:

1. Working Toward Sustainability: Ethical Decision Making in a Technological World, CJ Kibert et al, New York: John Wiley & Sons, 2011.
2. Varghese, P.C., “Building Construction”, Prentice Hall India,2007.
3. National Building Code, Bureau of Indian Standards, New Delhi,2017.
4. Chudley, R., Construction Technology, ELBS Publishers,2007.
5. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill,2011
6. Nunnally, S.W. Construction Methods and Management, Prentice Hall,2006
7. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
8. Punmia, B.C., Khandelwal, K.K., Project Planning with PERTandCPM,LaxmiPublications,2016.

Semester-

21BECEE29 **Construction Equipment& Automation** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Understand the various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects
2. To know about modern earth moving equipments
3. To gain knowledge of different crushers available for preparation of coarse aggregates.
4. To know about the different conveyors available in construction site and selecting a appropriate conveyor for the work.
5. To know the equipment's used for earthwork.
6. To know the equipment's used for lifting, demolishing, grouting and dewatering purposes.

Course Outcomes

At the end of this course students will be able to

1. Know various types of equipment have to be used in the constructions projects.
2. Know the equipment's used for earthwork.
3. Know the equipment's used for lifting, demolishing, grouting and dewatering purposes.
4. Know the equipment's used in batching asphalt and concrete plants.
5. Know the material handling conveyors, use of drones and use of robots for repetitive activities.
6. The various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects

UNIT I: CONSTRUCTION EQUIPMENT'S AND MANAGEMENT:

Identification – Planning of equipment – Selection of Equipment - Equipment Management in Projects - Maintenance Management – Equipment cost – Operating cost – Cost Control of Equipment - Depreciation Analysis – Replacement of Equipment- Replacement Analysis - Safety Management.

UNIT II: EQUIPMENT FOR EARTHWORK

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment.

UNIT III: OTHER CONSTRUCTION EQUIPMENT

Equipment for Dredging, Trenching, Drag line and clamshells, Tunneling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Equipment for Demolition. Under water concreting equipment's.

UNIT IV: ASPHALT AND CONCRETE PLANTS

Aggregate production- Different Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Pumping Equipment – Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment.

UNIT V: MATERIALS HANDLING EQUIPMENT

Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes- Industrial Trucks. Equipment for transportation of materials. Equipment Productivities; Use of Drones for spread out sites; Use of robots for repetitive activities.

TEXT BOOKS:

1. R. K. Rajput, Engineering Materials, S. Chand & Company Ltd., 2000.
2. M. S. Shetty, Concrete Technology (Theory and Practice), S. Chand & Company Ltd., 2003.
3. Sustainable Construction: Green Building Design and Delivery. Third Edition, Charles J. Kibert, New York: John Wiley & Sons, 2012.

REFERENCE BOOKS:

1. Working Toward Sustainability: Ethical Decision Making in a Technological World, CJ Kibert et al, New York: John Wiley & Sons, 2011.
2. Varghese, P.C., “Building Construction”, Prentice Hall India,2007.
3. National Building Code, Bureau of Indian Standards, New Delhi,2017.
4. Chudley, R., Construction Technology, ELBS Publishers,2007.
5. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill,2011
6. Nunnally, S.W. Construction Methods and Management, Prentice Hall,2006
7. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
8. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, LaxmiPublications,2016.

Semester-

21BECEE30 **Repairs & Rehabilitation of Structures** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Students must gained knowledge on quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures.
2. To assessing damage to structures and various repair techniques
3. To know various types and properties of repair materials
4. To Analyse the damage to structures using various tests
5. To gain the importance and methods of substrate preparation
6. To know about various repair techniques of damaged structures, corroded structures

Course Outcomes

After completing the course, the students will be able to

1. Various distress and damages to concrete and masonry structures
2. The importance of maintenance of structures, types and properties of repair materials etc
3. Assessing damage to structures and various repair techniques
4. Various types and properties of repair materials
5. Damage to structures using various tests
6. The importance and methods of substrate preparation

UNIT I: MAINTENANCE AND REPAIR STRATEGIES

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

UNIT II: STRENGTH AND DURABILITY OF CONCRETE

Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness.

UNIT III: SPECIAL CONCRETES

Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.

UNIT IV: TECHNIQUES FOR REPAIR AND PROTECTION METHODS

Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT V: REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – Demolition Techniques – Engineered demolition methods – Case studies.

TEXT BOOKS:

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991.
2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987
3. Shetty M.S., "Concrete Technology – Theory and Practice", S.Chand and Company, 2008.

REFERENCE BOOKS:

1. Ravishankar.K., Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and
2. Rehabilitation of Concrete Structures", Allied Publishers, 2004.
3. Gambhir.M.L., "Concrete Technology", McGraw Hill, 2013
4. R. K. Rajput, Engineering Materials, S. Chand & Company Ltd., 2000.
5. M. S. Shetty, Concrete Technology (Theory and Practice), S. Chand & Company Ltd., 2003.
6. Sustainable Construction: Green Building Design and Delivery. Third Edition, Charles J. Kibert, New York: John Wiley & Sons, 2012.
7. Working Toward Sustainability: Ethical Decision Making in a Technological World, CJ Kibert et al, New York: John Wiley & Sons, 2011.
8. Varghese, P.C., "Building Construction", Prentice Hall India,2007.
9. National Building Code, Bureau of Indian Standards, New Delhi,2017.
10. Chudley, R., Construction Technology, ELBS Publishers,2007.

Semester-

21BECEOE01 Housing Plan and Management 3H- 3C

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To examine the role and tasks of basic housing policies and building bye laws
2. Understand the process of integrated service delivery in the context of economic, social, environmental and institutional factors
3. Analyze the Innovative construction methods and Materials
4. Analyze city management strategies and strengthen the urban governance through a problem solving approach
5. To know the Importance of basic housing policies and building bye laws
6. To use Housing Programmes and Schemes

Course Outcome

After completing the course, the students will be able to

1. Know the Importance of basic housing policies and building bye laws
2. Use Housing Programmes and Schemes
3. Plan and Design of Housing projects
4. Examine Innovative construction methods and Materials
5. Know Housing finance and loan approval procedures
6. Understand Construction as well as managing techniques

UNIT I: INTRODUCTION TO HOUSING

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II: HOUSING PROGRAMMES

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organizations.

UNIT III: PLANNING AND DESIGN OF HOUSING PROJECTS

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV: CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation.

UNIT V: HOUSING FINANCE AND PROJECT APPRAISAL

Appraisal of Housing Projects – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing o f Housing Units, Rents, Recovery Pattern (Problems).

TEXT BOOKS

1. Meera Mehta and Dinesh Mehta, Metropolitan Housing Markets, Sage Publications Pvt. Ltd., New Delhi, 2002.
2. Francis Cherunilam and Odeyar D Heggade, Housing in India, Himalaya Publishing House, Bombay, 2001.

REFERENCES

1. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002.
2. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 2000.

21BECEOE02 **BUILDING SERVICES** **Semester- 3H- 3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Defining and identifying of engineering services systems in buildings.
2. The role of engineering services systems in providing comfort and facilitating life of users of the building.
3. The basic principles of asset management in a building & facilities maintenance environment
4. Importance of Fire safety and its installation techniques.
5. To understand Electrical system and its selection criteria
6. To use the Principles of illumination & design

Course Outcome

After completing the course, the students will be able to

1. Machineries involved in building construction
2. Understand Electrical system and its selection criteria
3. Use the Principles of illumination & design
4. Know the principle of Refrigeration and application
5. Importance of Fire safety and its installation techniques
6. Know the principle behind the installation of building services and to ensure safety in buildings

UNIT I: MACHINERIES

Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

UNIT II: ELECTRICAL SYSTEMS IN BUILDINGS

Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations

UNIT III: PRINCIPLES OF ILLUMINATION & DESIGN

Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminous flux – Candela – Solid angle illumination – Utilization factor – Depreciation factor – MSCP – MHCP –Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.

UNIT IV: REFRIGERATION PRINCIPLES & APPLICATIONS

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation, sublimation – saturation temperature – Super heated vapour – Sub cooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditioners – Chilled water plant – Fan coil systems – Water piping – Cooling load – Air conditioning systems for different types of buildings – Protection against fire to be caused by A.C. Systems

UNIT V: **FIRE SAFETY INSTALLATION**

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers

TEXT BOOKS

1. E.R.Ambrose, "Heat Pumps and Electric Heating", John and Wiley and Sons, Inc., New York, 2002.
2. Handbook for Building Engineers in Metric systems, NBC, New Delhi, 2005.

REFERENCES

1. Philips Lighting in Architectural Design, McGraw-Hill, New York, 2000.
2. A.F.C. Sherratt, "Air-conditioning and Energy Conservation", The Architectural Press, London, 2005.
3. National Building Code.

21BECEOE03 REPAIR AND REHABILITATION OF STRUCTURES **Semester- 3H- 3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To learn various distress and damages to concrete and masonry structures
2. To know the influence of corrosion in durability of structures
3. To understand the importance of maintenance of structures
4. To study the various types and properties of repair materials
5. To learn various techniques involved in demolition of structures
6. To Assessing damage of structures and various repair techniques

Course Outcome

After completing the course, the students will be able to

1. Various distress and damages to concrete and masonry structures
2. Durability of structures and corrosion mechanism
3. The importance of maintenance of structures, types and properties of repair materials etc
4. Assessing damage of structures and various repair techniques
5. the various types and properties of repair materials
6. Modern technique and equipment being adopted for the demolition of structures

UNIT I: INTRODUCTION

Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors.

UNIT II: DURABILITY OF STRUCTURES

Corrosion mechanism – diagnosis- causes and effects - cover thickness and cracking, measurements for corrosion - methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

UNIT III: MAINTENANCE AND REPAIR STRATEGIES

Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.

UNIT IV: MATERIALS FOR REPAIR

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete. eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete.

UNIT V: TECHNIQUES FOR REPAIR AND REPAIR OF STRUCTURES

Non-destructive Testing Techniques, Corrosion protection techniques ,Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning. Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure Engineered demolition techniques for dilapidated structures - case studies.

TEXT BOOKS:

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials,Maintenance and Repair", Longman Scientific and Technical UK, 1991.
2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987
3. Shetty M.S., "Concrete Technology – Theory and Practice", S.Chand and Company, 2008.

REFERENCE BOOKS:

1. Ravishankar.K., Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and
2. Rehabilitation of Concrete Structures", Allied Publishers, 2004.
3. Gambhir.M.L., "Concrete Technology", McGraw Hill, 2013
4. R. K. Rajput, Engineering Materials, S. Chand & Company Ltd., 2000.
5. M. S. Shetty, Concrete Technology (Theory and Practice), S. Chand & Company Ltd., 2003.
6. Sustainable Construction: Green Building Design and Delivery. Third Edition, Charles J. Kibert, New York: John Wiley & Sons, 2012.
7. Working Toward Sustainability: Ethical Decision Making in a Technological World, CJ Kibert et al, New York: John Wiley & Sons, 2011.

Semester-

21BECEOE04 COMPUTER-AIDED CIVIL ENGINEERING DRAWING 3H- 3C

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/ visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact.
6. To Communicate a design idea/concept graphically/ visually

Course Outcomes:

After completing the course, the students will be able to

1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/ visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact
6. Planning and designing of structures

UNIT I: INTRODUCTION

Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co- ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

UNIT II: SYMBOLS AND SIGN CONVENTIONS

Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

UNIT III: MASONRY BONDS:

English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

UNIT IV: BUILDING DRAWING

Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity.

UNIT V: PICTORIAL VIEW

Principles of isometrics and perspective drawing. Perspective view of building, Software's

TEXT BOOKS:

1. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt.Ltd.,
2. Subhash C Sharma & Gurucharan Singh (2005), " CivilEngineering Drawing" , StandardPublishers

REFERENCE BOOKS:

1. (Corresponding set of) CAD Software Theory and UserManuals.
2. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd NewAsian.
3. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria&Sons.
4. Ajeet Singh (2002), " Workingwith AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, NewDelhi

Semester-

21BECEOE05 **Contracts Management** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To have developed a more detailed appreciation for construction planning and scheduling
2. To apply their learned knowledge as it pertains to upper level construction management skills and procedures.
3. To evaluate the best practices associated with the development of contract parameters.
4. To understand the legal aspects of acts governing the contracts
5. To discuss techniques for appropriate risks and changes, monitoring and measuring the contract closure
6. To understand the basics of the bid process, important points in a tender document, and unbalanced contracts.

Course Outcomes

After completing the course, the students will be able to

1. Apply project Procurement management concepts in a project environment.
2. Describe techniques used to procure resources within a project's scope and techniques to reduce procurement risks.
3. Evaluate the best practices associated with the development of contract parameters.
4. Understand the legal aspects of acts governing the contracts
5. Discuss techniques for appropriate risks and changes, monitoring and measuring the contract closure
6. Understand the basics of the bid process, important points in a tender document, and unbalanced contracts.

UNIT I: CONTRACT MANAGEMENT:

Introduction, Importance of Contracts, Overview of Contract Management, Overview of Activities in Contract Management; Planning and People- Resource Management; Types of Contracts, Parties to a Contract; Contract Formation, Formulation of Contract, Contract Start-Up, Managing Relationships; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price.

UNIT II: CONTRACT PARAMETERS

Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Notices under contracts; Conventional and Alternative Dispute Resolution methods.

UNIT III: VARIOUS ACTS GOVERNING CONTRACTS

Contract Administration and Payments- Contract Administration, Payments; Contract Management in Various Situations- Contract Management in NCB Works, Contract Management in ICB Works Contracts, Contract of Supply of Goods- Design, Supply and Installation Contracts, Contract Management in Consultancy,

UNIT IV: BID PROCESS AND BID EVALUATION

Bid process, important points in a tender document, and unbalanced contracts. Material covered includes: Request For Proposal and problems Different types of proposals Design Conditions and Standard Component List-Tender document - Unbalanced proposals. Exercises: Evaluating Unit Prices Premium Portion Of The Overtime Rate Handling Bid Questions.

UNIT V: MANAGING RISKS AND CHANGE

Managing Risks, Managing Change; Contract Closure and Review- Ending a Contract, Post-Implementation Review; Legal Aspects in Contract Management- Contract Management Legal View, Dispute Resolution, Integrity in Contract Management; Managing Performance- Introduction, Monitoring and Measurement.

TEXT BOOKS:

1. R. K. Rajput, Engineering Materials, S. Chand & Company Ltd., 2000.
2. M. S. Shetty, Concrete Technology (Theory and Practice), S. Chand & Company Ltd., 2003.
3. Sustainable Construction: Green Building Design and Delivery. Third Edition, Charles J. Kibert, New York: John Wiley & Sons, 2012.

REFERENCE BOOKS:

1. Working Toward Sustainability: Ethical Decision Making in a Technological World, CJ Kibert et al, New York: John Wiley & Sons, 2011.
2. Varghese, P.C., “Building Construction”, Prentice Hall India,2007.
3. National Building Code, Bureau of Indian Standards, New Delhi,2017.
4. Chudley, R., Construction Technology, ELBS Publishers,2007.
5. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill,2011
6. Nunnally, S.W. Construction Methods and Management, Prentice Hall,2006
7. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
8. Punmia, B.C., Khandelwal, K.K., Project Planning with PERTandCPM,LaxmiPublications,2016.

Semester-

21BECEOE06 **Air and Noise Pollution and Control** **3H-3C**

Instruction Hours/week: L: 3 T: 0 P: 0 **Marks:** Internal**:40**External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. To impart knowledge on the principles and design of control of indoor/ particulate / gaseous air pollutant and its emerging trends
2. To induce operational considerations under the processing and control monitoring.
3. To apply sampling techniques of gaseous contaminants.
4. To control noise pollution by specific measurements, standard and preventive measures.
5. To enable to evaluate the behavior of air pollutants.
6. To have knowledge about appropriate control measures of air pollution

Course Outcomes:

After completion of this course, the student will be able to

1. Have knowledge about appropriate control measures of air pollution.
2. To apply sampling techniques and suggest suitable air pollution prevention equipment's and techniques for various gaseous and particulate pollutants.
3. Have knowledge about the air pollution monitoring and modeling.
4. Understand causes of air pollution and Analyze different types of air pollutants.
5. Evaluate air pollutant behavior in the atmosphere.
6. Enable to evaluate the behavior of air pollutants.

UNIT I: INTRODUCTION

Structure and composition of Atmosphere – Sources and classification of air pollutants - Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects on the planet – Global Climate Change, Ozone Holes – Ambient Air Quality and Emission Standards – Air Pollution Indices – Emission Inventories.

UNIT II: AIR POLLUTION MONITORING AND MODELLING

Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants -Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques – Air Pollution Climatology.

UNIT III: CONTROL OF PARTICULATE CONTAMINANTS

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators, cyclones, Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

UNIT IV: CONTROL OF GASEOUS CONTAMINANTS

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

UNIT V: AUTOMOBILE AND NOISE POLLUTION

Vehicular Pollution: Automobile emission- Types of emissions- Exhaust emissions, evaporative emissions, crank-case emissions- Prevention and control of vehicular pollution. Noise Pollution: Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures. Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control.

TEXT BOOKS:

1. Anjaneyulu D, "Air pollution and control technologies", Allied Publishers, Mumbai, 2002.
2. Khitoliya R K, "Environmental Pollution", 2/e, S. Chand Publishing, 2012.

REFERENCE BOOKS:

1. Rao C.S, "Environmental pollution control engineering", Wiley Eastern Ltd., New Delhi, 1996.
2. Rao M.N, and Rao H.V.N, "Air Pollution Control" Tata-McGraw-Hill, New Delhi, 1996.
3. David H.F Liu, Bela G.Liptak, "Air Pollution", Lewis Publishers, 2000.
4. Mudakavi, J R, "Principles and Practices of Air Pollution Control and Analysis" IK International, 2010.
5. Air Pollution act, India, 1998.

Semester-

21BESHOE01 **APPLIED ELECTROCHEMISTRY** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objective

1. To make the students conversant with the information on electrochemical material.
2. To make the student acquire sound knowledge of conducting polymers.
3. To acquaint the student with concepts of Energy storage devices.
4. To develop energy storage devices.
5. To impart knowledge on basic principles of solar cells and its applications
6. To understand the chemical principles in the projects undertaken in field of engineering.

Course Outcomes

1. Outline the basic principles of chemistry in electrochemical material (K)
2. Examine the properties of conducting polymers(S)
3. Apply the concepts of electrochemistry in storage devices.(S)
4. Identify the concepts of storage devices and its applications. (S)
5. Apply the suitable materials for the manufacturing of storage devices. (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I: METAL FINISHING

Fundamental principles, surface preparation-Electroplating of copper, nickel, chromium, zinc and precious metals (gold & silver)- Electroplating for electronic industry-Alloy plating, brass plating- Electro less plating of nickel- anodizing – Electroforming – Electro winning.

UNIT II: CONDUCTING POLYMERS AND ELECTROCHEMICALS

Lectropolymerisation- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers- poly acetylene- Electrolytic production of perchlorates and manganese dioxide-Electro organic chemicals- constant current electrolysis.

UNIT III: BATTERIES AND POWER SOURCES-I

Principles of energy conservation- electrochemical energy conservation-thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

UNIT IV: BATTERIES AND POWER SOURCES-II

Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries, Lithium ion batteries- construction, characteristics, problems associated with system-

Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

UNIT V: ELECTROCHEMICAL MATERIAL SCIENCE

Solar cells- Preparation of CdS/Cu_2S solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics.

TEXT BOOKS:

1. Cynthia G. Zoski (2007) Hand Book of Electrochemistry, Academic Press, Elesevier., UK
2. D.Pletcher and F.C.Walsh, (2012) Industrial Electrochemistry, Chapman and Hall, London
3. Vladimir S. Bagotsky , Alexander M. Skundin , Yurij M. Volfkovich, (2015)Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors, Wiley India Pvt. Ltd
4. Bruno Scrosati (2012) Applications of Electroactive PolymersChapman & Hall, London
5. K.L. Chopra (2011) Thin Film Devices ApplicationPlenum Press, New York
6. M.M.Baizer (2011) Organic electrochemistry: An introduction and a guide Dekker Inc. New York
7. http://www.anoplate.com/finishes/
8. http://hyperphysics.phy-astr.gsu.edu/hbase/electric/battery.html
9. http://inventors.about.com/od/sstartinventions/a/solar_cell.htm

21BESHOE02	**GREEN CHEMISTRY**	**Semester-3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

Course Objective

1. To make the students conversant about the green chemistry
2. To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
3. To acquaint the student with concepts of green technology.
4. To develop an understanding of the basic concepts of renewable energy resources.
5. To acquaint the students with the basics information on catalysis.
6. To apply the concepts of green catalysts in the synthesis

Course Outcomes

1. Outline the basic principles of green chemistry (K)
2. Examine the different atom efficient process and synthesis elaborately (S)
3. Apply the concepts combustion of green technology (S)
4. Identify and apply the concepts of renewable energy(S)
5. Apply the concepts of green catalysts in the synthesis (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I: INTRODUCTION TO GREEN CHEMICAL PRINCIPLES

Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

UNIT II: ATOM EFFICIENT PROCESSES

Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis.

UNIT III: BIOTECHNOLOGY AND GREEN CHEMISTRY

Bio technology and its applications in environmental protection-Bio informatics-Bio remediation, biological purification of contaminated air. Green chemistry for clean technology-Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

UNIT IV: RENEWABLE RESOURCES

Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion.

UNIT V: CATALYSIS IN GREEN CHEMISTRY

Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

SUGGESTED READINGS

1. Sanjay K. Sharma, Ackmez Mudhoo (2010)Green Chemistry for Environmental Sustainability CRC Press , London
2. Ahluwalia V. K. and M. Kidwai (2007) New Trends in Green Chemistry2nd edition Anamaya publishers., New Delhi.
3. Dr. Sunita Ratan (2012) A Textbook of Engineering Chemistry S.K. Kataria and Sons., New Delhi
4. Mukesh Doble. Ken Rollins, Anil Kumar (2007) Green Chemistry and Engineering, 1st edition Academic Press, Elesevier., New Delhi.
5. Desai K. R. (2005) Green Chemistry Himalaya Publishing House, Mumbai.
6. Matlack A. S. (2001) Introduction to Green Chemistry Marcel Dekker: New York
7. http://www.organic-chemistry.org/topics/green-chemistry.shtm
8. http://www.essentialchemicalindustry.org/processes/green-chemistry.html
9. http://www.chm.bris.ac.uk/webprojects2004/vickery/green_solvents.htm
10. http://www.epa.gov/research/greenchemistry/
11. http://www.amazon.in/Green-Chemistry-Catalysis

		Semester-
21BESHOE03	**SOLID WASTE MANAGEMENT**	**3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

Course Objective

1. To make the students conversant with basics of Solid wastes and its classification.
2. To make the student acquire sound knowledge of different treatments of solid wastes.
3. To acquaint the student with concepts of waste disposals.
4. To develop an understanding of the basic concepts of Hazardous waste management's.
5. To acquaint the students with the basics of energy generation from waste materials.
6. To understand the chemical principles in the projects undertaken in field of engineering and technology

Course Outcomes

1. Outline the basic principles of Solid waste and separation of wastes (K)
2. Identify the concepts of treatment of solid wastes(S)
3. Identify the methods of wastes disposals.(S)
4. Examine the level of Hazardousness and its management. (S)
5. Examine the possible of the energy production using waste materials. (S)
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology (A)

UNIT I: SOLID WASTE

Definitions – Sources, Types, Compositions, Properties of Solid Waste – Municipal Solid Waste – Physical, Chemical and Biological Property – Collection – Transfer Stations – Waste Minimization and Recycling of Municipal Waste

UNIT II: WASTE TREATMENT

Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/ Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNIT III: WASTE DISPOSAL

Sanitary Land Fill Method of Solid Waste Disposal – Land Fill Classification, Types, Methods & Siting Consideration – Layout & Preliminary Design of Land Fills – Composition, Characteristics generation, Movement and Control of Landfill Leachate & Gases – Environmental Monitoring System for Land Fill Gases, Waste landfill Remediation

UNIT IV: HAZARDOUS WASTE MANAGEMENT

Definition & Identification of Hazardous Waste – Sources and Nature of Hazardous Waste – Impact on Environment – Hazardous Waste Control – Minimization and Recycling -

Assessment of Hazardous Waste Sites – Disposal of Hazardous Waste, Underground Storage Tanks Construction, Installation & Closure, Remediation, risk assessment.

UNIT V: ENERGY GENERATION FROM WASTE

Thermal conversion Technologies – Pyrolysis systems, Combustion systems, Gasification systems, Environment control systems, Energy recovery systems. Biological & Chemical conversion technologies – Aerobic composting, low solids. Anaerobic digestion, high solids anaerobic digestion, Energy production from biological conversion products, other biological transformation processes. Chemical transformation processes.

SUGGESTED READINGS

1. Dara.S.S, Mishra.D.D (2011) A Text book of Environmental Chemistry and Pollution ControlS.Chand and Company Ltd., New Delhi
2. Naomi B. Klinghoffer and Marco J. Castaldi (2013) Waste to Energy Conversion Technology (Woodhead Publishing Series in Energy) Woodhead Publishing Ltd., Cambridge, UK
3. Frank Kreith, George Tchobanoglous (2002) Hand Book of Solid Waste Management- 2nd editionMcGraw Hill Publishing Ltd., Newyork
4. Shah, L Kanti (Basics of Solid & Hazardous Waste Management Technology Prentice Hall (P) Ltd., New Delhi
5. Salvatore Caccavale (2016)A Basic Guide to RCRA: Understanding Solid and Hazardous Waste Management2 edition American Society of Safety Professionals
6. www.iitk.ac.in/3inetwork/html/reports/IIR2006/Solid_Waste.
7. http://www.unep.or.jp/ietc/ESTdir/Pub/MSW/
8. www.alternative-energy-news.info/technology/garbage-energy/
9. nzic.org.nz/Chem Processes/environment/

21BECSOE01 **INTERNET PROGRAMMING** **Semester-3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To introduce the basic concepts of Fuzzy logic and its applications in various domain
2. To educate how to use Fuzzy computation to solve real-world problems
3. To have a solid understanding of Basic fuzzy models.
4. Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
5. To learn about applications on Fuzzy based systems
6. To familiarize with fuzzy fiction and de fuzzy fiction procedures

Course Outcomes

After completing the course, the students will be able to

1. Understand the basic concepts of Fuzzy logic and its applications in various domain
2. Gain knowledge on theory of Reasoning
3. Develop fuzzy controllers
4. Understand concepts of adaptive fuzzy control
5. Ability to develop how to use Fuzzy computation to solve real- world problems
6. Design fuzzy based model for any application.

UNIT I : INTRODUCTION

Introduction - Network of Networks, Intranet, Extranet and Internet. World Wide Web- Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. TCP/IP- Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing- Classful and Classless Addressing, Subnetting

UNIT II: HTML

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps- map, area, attributes of image area- Extensible Markup Language (XML)- Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts- Introduction- Environment Variable, GET and POST Methods.

UNIT III: PERL

Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling- JavaScript- Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies- Definition of cookies, Create and Store a cookie with example. Java Applets- Container Class, Components, Applet Life Cycle, Update method, Applications.

UNIT IV: CLIENT-SERVER PROGRAMMING

Client-Server programming In Java - Java Socket, Java RMI. Threats - Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks-Network security techniques- Password and Authentication- VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall- Introduction, Packet filtering, Stateful, Application layer, Proxy.

UNIT V: INTERNET TELEPHONY

Introduction, VoIP- Multimedia Applications- Multimedia over IP: RSVP, RTP, RTCP and RTSP-Streaming media, Codec and Plugins, IPTV- Search Engine and Web Crawler- Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.

TEXT BOOKS:

1. Robert W. Sebesta, "Programming the World Wide Web", Pearson Education, 2016
2. Paul Deitel, Harvey Deitel and Abby Deitel, "Internet and World Wide Web-How to Program", 5th Edition, 2011.

REFERENCES:

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013.
2. Rahul Banerjee, Internetworking Technologies, An Engineering Perspective, PHI Learning, Delhi, 2011.

WEBSITES:

1. https://nptel.ac.in/courses/106/105/106105084/
2. https://supportline.microfocus.com/Documentation/books/sx22sp1/piover.htm
3. https://www.geeksforgeeks.org/internet-and-web-programming/

		Semester-
21BECSOE02	**MACHINE LEARNING**	**3H-3C**
Instruction Hours/week: L:3 T:0 P:0	**Marks:** Internal**:40** External**:60** Total**:100**	
	End Semester Exam:3 Hours	

Course Objectives

1. Introduce the basic concepts and techniques of Machine Learning.
2. To have a complete understanding of the Supervised and Unsupervised learning techniques
3. To study the various probability based learning techniques
4. To learn Dimensionality Reduction Techniques.
5. To understand Evolutionary Models and Graphical models of machine learning algorithms
6. To design appropriate machine learning algorithms for problem solving

Course Outcomes

After completing the course, the students will be able to

1. Distinguish between, supervised, unsupervised and semi-supervised learning
2. Apply the appropriate machine learning strategy for any given problem
3. Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
4. Design systems that uses the appropriate graph models of machine learning
5. Modify existing machine learning algorithms to improve classification accuracy / efficiency
6. Analyze and suggest appropriate machine learning approaches for various types of problems

UNIT I: INTRODUCTION

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II: NEURAL NETWORKS AND GENETIC ALGORITHMS

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT III: BAYESIAN AND COMPUTATIONAL LEARNING

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV: INSTANT BASED LEARNING

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

UNIT V: ADVANCED LEARNING

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

TEXT BOOKS:

1. Michael Bowles, "Machine Learning in Python-Essential Techniques for Predictive Analysis", Wiley Publication, 2015.
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014.
3. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014.

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning",3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press,2014
2. Tom MMitchell, "Machine Learning", First Edition, McGraw Hill Education, 2013.
3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.

WEBSITES:

1. https://nptel.ac.in/courses/106106139/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-867-machine-learning-fall-2006/
3. https://www.dataquest.io/blog/machine-learning-python/

Semester-

21BEEEOE01 **ELECTRIC HYBRID VEHICLE** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To understand the basic concepts of electric hybrid vehicle.
2. To gain the knowledge about electric propulsion unit.
3. To gain the concept of Hybrid Electric Drive-Trains.
4. To gain the different Energy Management Strategies.
5. To study about the efficiency manipulation in drives
6. To understand and gain the knowledge about various energy storage devices

Course Outcomes

After completing the course, the students will be able to

1. Summarize the basic concepts in bioprocess Engineering.
2. Explain the concept of Hybrid Electric Vehicles.
3. Understand the concept of Hybrid Electric Drive-Trains.
4. Identify the different Energy Management Strategies.
5. Understand the concept of different Energy Storage devices.
6. Analyze the different motor drives used in Hybrid Electric Vehicles

UNIT I: INTRODUCTION

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II: HYBRID ELECTRIC DRIVE-TRAINS

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT III: ELECTRIC PROPULSION UNIT

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV: ENERGY STORAGE

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT V: ENERGY MANAGEMENT STRATEGIES

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

SUGGESTED READINGS:

1. Iqbal Hussein Electric and Hybrid Vehicles: Design Fundamentals CRC Press – 2nd edition 2010.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design Standardsmedia – 2nd edition 2009.
3. James Larminie, John Lowry Electric Vehicle Technology Wiley – 2nd edition 2012.
4. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles andApplications with Practical Perspectives", John Wiley & Sons, 2011.
5. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
6. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and FuelCell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
7. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

WEBSITES:

1. https://www.energy.gov/eere/electricvehicles/electric-vehicle-basics
2. https://swayam.gov.in/nd1_noc20_ee18/preview
3. https://nptel.ac.in/courses/108103009/

Semester-

21BEEEOE02 **RENEWABLE ENERGY RESOURCES** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To gain the knowledge about energy management.
2. To understand the basic concepts in economic analysis in energy management.
3. To understand the basic principles of energy audit.
4. To gain the knowledge about the basic concept of types of Energy Audit
5. To gain and Evaluate the different energy efficient motors
6. Understand the concept of Energy conservation.

Course Outcomes

After completing the course, the students will be able to

1. Understand the concept of Energy Management.
2. Analyze the different methods for economic analysis
3. Knowledge about the basic concept of Energy Audit and types.
4. Evaluate the different energy efficient motors
5. Understand the concept of Energy conservation.
6. Investigate the different methods to improve power factor.

UNIT I: INTRODUCTION

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization - Energy Conservation and Energy Efficiency - Needs and Advantages, Energy Conservation Act 2001.

UNIT II: SOLAR ENERGY

Introduction to solar energy: solar radiation, availability, measurement and estimation– Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storage.

UNIT III: WIND ENERGY

Introduction – Basic principles of wind energy conversion- components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

UNIT IV: HYDRO ENERGY

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

UNIT V: OTHER SOURCES

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

SUGGESTED READINGS

1. Rai.G.D Non-conventional sources of energy Khanna publishers 2011
2. Khan.B.H Non-Conventional Energy Resources The McGraw Hills, Second edition 2009
3. Rao.S. & Parulekar Energy Technology Khanna publishers, Eleventh Reprint 2013
4. Godfrey Boyl Renewable Energy: Power sustainable future Oxford University Press, Third edition 2012.
5. John W Twidell and Anthony D Weir Renewable Energy Resources Taylor and Francis – 3rd edition 2015.

WEBSITES:

1. https://nptel.ac.in/courses/103/107/103107157/
2. https://nptel.ac.in/courses/121/106/121106014/
3. https://nptel.ac.in/courses/108/108/108108078/

Semester-

21BEECOE01 NEURAL NETWORKS AND ITS APPLICATIONS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To introduce the basic concepts of neural networks and its applications in various domain
2. To educate about supervised and unsupervised learning process
3. To gain a solid understanding of various neural network model
4. To study about annealing technique
5. To learn the concepts of Self-Organizing Map (SOM) algorithm
6. To understand steps involved in ballistic arm movements.

Course Outcomes

At the end of the course the students will be able to

1. Understand the basic concepts of neural networks and its applications in various domains
2. Gain knowledge about learning process in Neural Networks
3. Design using Adaptive Resonance Theory (ART) technique
4. Describe steps in annealing process
5. Acquire knowledge on SOM concepts
6. Explain ballistic arm movements.

UNIT I: INTRODUCTION TO NEURAL NETWORKS

Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules-types of neural networks-single layer, multiple layer-feed forward, feedback networks

UNIT II: LEARNING PROCESS

Error– correction learning– memory based learning- hebbian learning-competitive learning-Boltzmann learning-supervised and unsupervised learning-adaptation-statistical learning theory.

UNIT III: PERCEPTION

Single layer Perception-Adaptive filtering-unconstrained Optimization-Least-mean square algorithm- Leaning Curve-Annealing Technique-perception convergence Theorem-Relationship between perception and Baye's Classifier-Back propagation algorithm.

UNIT IV: ATTRACTOR NEURAL NETWORK AND ART

Hopfield model-BAM model -BAM Stability-Adaptive BAM -Lyapunov function-effect of gain- Hopfield Design-Application to TSP problem-ART-layer 1-layer 2-orienting subsystem-ART algorithm-ARTMAP.

UNIT V: SELF ORGANIZATION

Self-organizing map-SOM Algorithm-properties of the feature map-LVQ-Hierarchical Vector Quantization. Applications of self-organizing maps: The Neural Phonetic Type Writer Learning Ballistic Arm Movements.

SUGGESTED READINGS:

1. SimonHaykin Neural Networks and Learning Machines 3rd Edition Pearson/Prentice Hall 2009
2. SatishKumar Neural Networks: A Classroom Approach TMH 2008
3. Rajasekaran.S, Vijayalakshmi Pai.G.A Neural Networks, Fuzzy Logic and Genetic Algorithms, Synthesis and Applications PHI, New Delhi 2003.
4. LaureneFausett Fundamentals of Neural Networks: Architectures, Algorithms, and Applications Pearson/Prentice Hall 1994
5. Wasserman P.D Neural Computing Theory & Practice Van Nortrand Reinhold 1989.
6. Freeman J.A, S kapura D.M Neural networks, algorithms, applications, and programming techniques Addition Wesley 2005.

WEB LINKS

1. https://nptel.ac.in/courses/117105084/
2. https://www.geeksforgeeks.org/adaptive-resonance-theory-art/

		Semester-
21BTBTOE01	**BIOREACTOR DESIGN**	**3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. Impart basic knowledge in bioprocess Engineering
2. Design the bioreactors for various operations.
3. Discuss the principle and working of heat transfer equipments.
4. Extend the knowledge in principle of heat transfer inside a bioreactor
5. Construct the equipments used in mass transfer operations.
6. Illustrate the equipments used in separation process.

Course Outcomes

After completing the course, the students will be able to

1. Summarize the basic concepts in bioprocess Engineering.
2. Design the bioreactors for various operations.
3. Develop the heat transfer equipments for Bioprocess Engineering.
4. Construct the equipments used in mass transfer operations.
5. Categorize the equipments used in separation process.
6. Describe the applications of bioreactors.

UNIT I: **INRODUCTION TO BIOPROCESS ENGINEERING**

Introduction – Biotechnology and Bioprocess Engineering- Biologists and Engineers Differ in their approach to research-How Biologists and Engineers work Together- Bioprocesses: Regulatory constraints.

UNIT II: REACTOR DESIGN

Design of Airlift fermentor, Bubble column reactor and Continuous stirred tank reactor.

UNIT III: HEAT TRANSFER EQUIPMENTS

Design of Shell and tube Heat exchanger, Double pipe heat exchanger, long tube vertical evaporator and forced circulation evaporator.

UNIT IV : MASS TRANSFER EQUIPMENTS

Design of Bollmann extractor, fractionating column, packed tower and spray tray absorber

UNIT V: SEPARATION EQUIPMENTS

Design of plate and frame filter press, leaf filter, rotary drum filter, disc bowl centrifuge, rotary drum drier and Swenson –walker crystallizer.

SUGGESTED READINGS:

1. James Edwin Bailey, David F. Ollis (2015) Biochemical Engineering Fundamentals, Second Edition. McGraw-Hill Education (India) private limited.
2. Don W. Green, Robert H.Perry (2008). Chemical Engineer Hand book. The McGraw-Hill Companies, Inc.
3. Pauline. M. Doran (2015). Bioprocess Engineering Principles Second Edition . Academic Press.

21BTBTOE02 **FOOD PROCESSING AND PRESERVATION** **Semester-3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Discuss the scope and importance of food processing.
2. Impart basic knowledge in different food processing methods carried out in the food techcompanies.
3. Extend the brief knowledge in food conservation operations.
4. Explain the methods of food preservation by cooling.
5. Tell the concepts of preservation methods for fruits.
6. Create deeper understanding on preservation methods for vegetables.

Course Outcomes

After completing the course, the students will be able to

1. Describe the scope and importance of food processing.
2. Outline the various processing methods for foods.
3. Extend the knowledge in food conservation operations.
4. Describe the methods of food preservation by cooling.
5. Summarize the preservation methods for fruits.
6. Demonstrate the preservation methods for vegetables.

UNIT I : SCOPE AND IMPORTANCE OF FOOD PROCESSING

Properties of food - Physical, thermal, mechanical, sensory. Raw material Preparation - Cleaning, sorting, grading, peeling.

UNIT II: PROCESSING METHODS

Heating- Blanching and Pasteurization. Freezing- Dehydration- canning-additives-fermentation- extrusion cooking- hydrostatic pressure cooking- dielectric heating- micro wave processing and aseptic processing – Infra red radiation processing-Concepts and equipment used.

UNIT III: FOOD CONVERSION OPERATIONS

Size reduction – Fibrous foods, dry foods and liquid theory and foods – equipments - membrane separation- filtration- equipment and application.

UNIT IV: FOOD PRESERVATION BY COOLING

Refrigeration, Freezing-Theory, freezing time calculation, methods freezing of freezing equipments, freeze drying, freeze concentration, thawing, effect of low temperature on food. Water activity, methods to control water activity.

UNIT V: PRESERVATION METHODS FOR FRUITS AND VEGETABLES

Pre processing operations - preservation by reduction of water content: drying / dehydration and concentration – chemical preservation – preservation of vegetables by acidification, preservation with sugar - Heat preservation– Food irradiation- Combined preservation techniques.

SUGGESTED READINGS:

1. R. Paul Singh, Dennis R.Heldman (2014).Introduction to food engineering. Academic press.
2. P.Fellows. (2017). Food processing technology principles and practice, Fourth Edition. Wood head publishing Ltd.
3. Mircea Enachescu Dauthy. (1995). Food and vegetable processing.FAO agricultural services bulletin.
4. M.A. Rao, Syed S.H.Rizvi, Ashim K. Datta. (2014). Engineering properties of foods. CRC press.
5. B. Sivasankar. (2002). Food processing and preservation.PHI learning Pvt.Ltd.

		Semester-
21BTBTOE03	**BASIC BIOINFORMATICS**	**3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Elaborate the available tools and databases for performing research in bioinformatics.
2. Expose students to sequence alignment tool in bioinformatics.
3. Construct the phylogenetic trees for evolution.
4. Discuss the 3D structure of protein and classification.
5. Acquire basic knowledge in protein secondary structure prediction.
6. Extend the brief knowledge in Micro array data analysis.

Course Outcomes

After completing the course, the students will be able to

1. Summarize the basic concepts and importance of Bioinformatics in various sectors.
2. Demonstrate the sequence alignment tool in bioinformatics.
3. Construct the phylogenetic trees for evolution.
4. Analyze the three dimensional protein structure and classification using various tools.
5. Illustrate the protein secondary structure prediction by comparative modeling.
6. Extend the knowledge in micro array technology and applications of bioinformatics in various sectors.

UNIT I: OVERVIEW OF BIOINFORMATICS

The scope of bioinformatics; bioinformatics & the internet; useful bioinformatics sites. Data acquisition: sequencing DNA, RNA & proteins; determination of protein structure; gene & protein expression data; protein interaction data. Databases – contents, structure & annotation: file formats; annotated sequence databases; miscellaneous databases.

UNIT II: RETRIEVAL OF BIOLOGICAL DATA

Data retrieval with Entrez & DBGET/ LinkDB; data retrieval with SRS (sequence retrieval system).Searching sequence databases by sequence similarity criteria: sequence similarity searches; amino acid substitution matrices; database searches, FASTA & BLAST; sequence filters; iterative database searches & PSI-BLAST. Multiple-sequence alignment, gene & protein families: multiple-sequence alignment & family relationships; protein families & pattern databases; protein domain families.

UNIT III: PHYLOGENETICS

Phylogenetics, cladistics & ontology; building phylogenetic trees; evolution of macromolecular sequences. Sequence annotation: principles of genome annotation; annotation tools & resources.

UNIT IV: STRUCTURAL BIOINFORMATICS

Conceptual models of protein structure; the relationship of protein three-dimensional structure to protein function; the evolution of protein structure & function; obtaining, viewing & analyzing structural data; structural alignment; classification of proteins of known three-dimensional structure: CATH & SCOP; introduction to protein structure prediction; structure prediction by comparative modeling; secondary structure prediction; advanced protein structure prediction & prediction strategies.

UNIT V: MICROARRAY DATA ANALYSIS

Microarray data, analysis methods; microarray data, tools & resources; sequence sampling & SAGE. Bioinformatics in pharmaceutical industry: informatics & drug discovery; pharma informatics resources. Basic principles of computing in bioinformatics: running computer software; computer operating systems; software downloading & installation; database management.

SUGGESTED READINGS:

1. Dan E krane Michael L Rayme. (2004). Fundamental concepts of Bioinformatics. Pearson Education.
2. Andreas D Baxevanis B.F. Franchis Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins. Wiley-Interscience.
3. David W. Mount. (2004). Sequence and Genome Analysis. Cold Spring Harbor Laboratory.
4. Jonathan Pevsner.(2015). Bioinformatics and functional genomics. wiley-Liss.
5. Michael J Koernberg. (2016).Microarray Data Analysis: Methods and applications. Humana Press

Semester-

21BTBTOE04 FUNDAMENTALS OF NANOBIOTECHNOLOGY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Impart the skills in the field of nano biotechnology and its applications.
2. Acquire knowledge in the nano particles and its significance in various fields.
3. Extend the knowledge in types and application of nano particles in sensors.
4. Define the concepts of biomaterials through molecular self assembly.
5. Equip students with clinical applications of nano devices.
6. Describe deeper understanding of the socio-economic issues in nanobiotechnology.

Course Outcomes

After completing the course, the students will be able to

1. Develop skills in the field of nano biotechnology and its applications.
2. Summarize the nanoparticles and its significance in various fields.
3. Extend the knowledge in types and application of nano particles in sensors.
4. Define the concepts of biomaterials through molecular self assembly.
5. Outline the clinical applications of nano devices.
6. Describe the socio-economic issues in nano biotechnology.

UNIT I: INTRODUCTION

Introduction, Scope and Overview, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Future of Nanotechnology: Nano Technology Revolution, Silicon based Technology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Controversies and confusions, Understanding advanced capabilities, Nanotechnology in Different, Fields: Nanobiotechnology, Materials, Medicine, Dental care.

UNIT II: NANO PARTICLES

Introduction, Types of Nanoparticles, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles, Applications, Toxic effects of Nanomaterials, Significance of Nanoparticles Nanofabrications- MEMS/NEMS, Atomic Force Microscopy, Self assembled monolayers/ Dip- pen Nanolithography, Soft Lithography, PDMS Molding, Nano Particles, Nano wires and Nanotubes.

UNIT III: MEDICAL NANOTECHNOLOGY

Nanomedicine, Nanobiosensor and Nanofludics. Nanocrystals in biological detection, Electrochemical DNA sensors and Integrated Nanoliter systems. Nano-Biodevices and Systems. Fabrication of Novel Biomaterials through molecular self assembly- Small scale systems for in vivo drug delivery- Future nanomachine.

UNIT IV: NANOBIOTECHNOLOGY

Clinical applications of nanodevices. Artificial neurons. Real-time nanosensors- Applications in cancer biology. Nanomedicine. Synthetic retinyl chips based on bacteriorhodopsins. High throughput DNA sequencing with nano carbontubules. Nanosurgical devices.

UNIT V: ETHICAL ISSUES IN NANOTECHNOLOGY

Introduction, Socioeconomic Challenges, Ethical Issues in Nanotechnology: With Especial Reference to Nanomedicine, Nanomedicine Applied in Nonmedical Contexts, Social Issues Relating to Nanomedicine. Social and Ethical Issues, Economic Impacts, Other Issues, Nanotechnology and Future Socio-economic challenges.

SUGGESTED READINGS:

1. Niemeyer, C.M. and Mirkin, C.A (2005). Nanobiotechnology: Concepts, Applications and Perspectives. Wiley-VCH.
2. Goodsell, D.S. (2004). Bionanotechnology. John Wiley and Sons, Inc.
3. Shoseyov, O. and Levy, I (2008).Nanobiotechnology: Bioinspired Devices and Materials of the Future. Humana Press.
4. Bhushan, B. (2017). Springer Handbook of Nanotechnology. Springer-Verlag Berlin Heidelberg.
5. FreitasJr R.A (2006) Nanomedicine. Landes Biosciences.
6. Kohler, M. and Fritzsche, W. (2008). Nanotechnology – An Introduction to Nanostructuring Techniques. Wiley-VCH.

21BEMEOE01 **COMPUTER AIDED DESIGN** **Semester-3H - 3C**

Instruction hours / week: L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**
End Semester Exam :3Hours

Course Objective

1. To provide an overview of how computers are being used in mechanical component design
2. To study about the various computer graphics concepts
3. To get basic knowledge on geometric modeling
4. To study about the basics of parametric design and object representation
5. To get basic knowledge in product design and development.

Course Outcomes:

After completing the course, the students will be able to

1. Give the overview of the cad systems and its importance
2. Explain the ideas and principles behind the computer graphics
3. Explain the process involved in graphic transformations
4. Understand the operations involved in the geometric modeling.
5. Describe the concepts of parametric design
6. Understand the basics of the product design and development.

UNIT I:OVERVIEW OF CAD SYSTEMS

Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems.

UNIT II: INTERACTIVE COMPUTER GRAPHICS AND GRAPHICSTRANSFORMATIONS

Generative, cognitive and image processing graphics. Static and dynamic data graphics. Transport of graphics data. Graphic standards. Generation of graphic primitives - display transformation in Two- and Three – Dimensional graphics concepts, Graphical input technique, Geometric transformations, Visual Realism, Computer animation, customizing graphics software.

UNIT III: GEOMETRIC MODELING

Wireframe, surface, NURBS and solid modeling-applications and advantages. Creating primitive solids, sweeping solids, Boolean operations. Extracting entities from a solid. Filleting of edges of solids. Boundary representation (B-rep) Constructive Solid Geometry (CSG) and Analytical Solid Modeling (ASM)

UNIT IV: PARAMETRIC DESIGN AND OBJECTREPRESENTATION

Types of co-ordinate systems. Parametric design - definition and advantages. Parametric

representation of analytic and synthetic curves. Parametric representation of surfaces and solids - manipulations.

UNIT V: PRODUCT DESIGN ANDDEVELOPMENT

Automated 2D drafting - basics, mating conditions–Types of translators (IGES, STEP, ACIS and DXF). Mass property calculations.

SUGGESTED READINGS

1. Vera B Anand, Computer Graphics and Geometric Modeling for Engineers,1st edition, John Wiley & Sons, New York,2000
2. Radhakrishnan P and Subramanyan S, CAD/CAM/CIM, 2nd edition, New Age International Pvt. Ltd,2008
3. Ibrahim Zeid, CAD/CAM Theory and Practice,2ndedition,McGraw Hill Inc., New York,2009
4. Barry Hawhes, The CAD/CAM Process,1st edition, Pitman Publishing, London,2007(digital)
5. William M Newman and Robert Sproul, Principles of Interactive Computer Graphics,1stedition,McGraw Hill Inc., New York,2001
6. Rao S S, Optimization Techniques, 1stedition,Wiley Eastern, New Delhi,2006

Semester-

21BEMEOE02 **INDUSTRIAL SAFETY AND ENVIRONMENT** **3H– 3C**

Instruction hours / week L : 3 T : 0 P:0 **Marks:** Internal **: 40** External **: 60** Total**:100**

End Semester Exam :3Hours

Course Objective

1. To get the basic introduction on logistics
2. To study the basics of supply chain and its concepts.
3. To know the various phases involved in supply chain
4. To study about different supply chain models
5. To know the various activities involved in supply chain management.

Course Outcome

After completing the course, the students will be able to

1. Understand the role of logistics
2. Understand the phases of supply chain
3. Get the knowledge on various supply chain models
4. Link the supply chain concepts with customer
5. Perform various activities involved in supply chain
6. Understand the management system of supply chain and the information system followed for managing the same.

UNIT I: CONCEPTS

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNIT II: TECHNIQUES

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III: ACCIDENT INVESTIGATION ANDREPORTING

Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

UNIT IV: SAFETY PERFORMANCEMONITORING

Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities -Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

UNIT V: SAFETY EDUCATION ANDTRAINING

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

SUGGESTED READINGS

1. Accident Prevention Manual for Industrial Operations, 3rd edition, N.S.C. Chicago,2010(digital).
2. Heinrich H.W. "Industrial Accident Prevention", 2nd edition, Tata McGraw-Hill Company, New York, 1941.
3. Krishnan N.V, Safety Management in Industry, 1st edition, Jaico Publishing House, Bombay,1997.
4. John R Ridley, Safety at Work,3rd edition,Elsevier,2014
5. Roland P. Blake ,Industrial Safety, 2nd edition,Prentice Hall, Inc., New Jersey,1973
6. L M Deshmukh, Industrial safety management,1st edition, TATA McGraw Hill,2005

Semester-

21BTCEOE01 ENERGY MANAGEMENT IN CHEMICAL INDUSTRIES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives:

1. Familiarize basic concepts and fundamental aspects of industrial and domestic thermal systems design.
2. Plan to optimize energy using systems and procedures to meet energy demand.
3. Examine the relationship between energy systems and society.
4. Audit and evaluate energy management in energy intensive industries.

Course Outcomes:

After completing the course, the students will be able to

1. Plan for energy needs for process industries.
2. Use optimization techniques for conservation of energy in chemical industries
3. Evaluate the production rate and analyze the cost from economic balance for energy consumption.
4. Enumerate the societal values of energy resources and the need for the conservation strategies.

UNIT I: PLANNING FOR ENERGY NEEDS

Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modeling and optimal mix of energy sources.

UNIT II: ENERGY AND ENVIRONMENT

Energy; various forms; energy storage; structural properties of environment; bio-geo-chemical cycles; society, environment population and technology.

UNIT III: ENERGY AND SOCIETY

Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generation of power requirements and benefit.

UNIT IV: MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES

Chemical industries; classification; conservation in unit operations such as separation; cooling tower; drying; conservation applied to refineries, petrochemical, fertilizers, cement, pulp and paper, food and chlor-alkali industries; conservation using optimization techniques.

UNIT V: ECONOMIC BALANCE IN ENERGY CONSUMPTION

Cost analysis; capacity; production rate; system rate; system cost analysis; corporate models; production analysis and production using fuel inventories; input-output analysis; economics; tariffs

SUGGESTED READINGS:

1. W.F. Kenney, Energy Conservation in the Process Industries. Academic Press Inc., 1984.
2. Vladimir S. Stepanov, Analysis of Energy Efficiency of Industrial Processes. 1st Edition, Springer-Verlag, 1993.
3. Jakob de Swaan Arons, Hedzer van der Kooi, Krishnan Sankaranarayanan, Efficiency and Sustainability in the Energy and Chemical Industries, 1st Edition, Marcel Dekker, Inc., 2004.
4. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, Guide to energy management, The Fairmont Press (2008).
5. Nagabhushan Raju, K., Industrial Energy Conservation Techniques: Concepts, Applications and Case Studies, Atlantic Publishers & Distributors (2007).
6. Jerrold H Kertz, Energy Conservation and Utilization, Allyn and BacurInc, 2016.
7. Gemand M Gramlay, Energy, Macmillion publishing Co, Newyork, 2005
8. Krentz J. H., Energy Conservation and Utilization, Allyn and Bacur Inc., 2006.
9. NPTEL course: Energy Management Systems: nptel.ac.in/courses/108/106/108106022/

Semester-

21BTCEOE02 INDUSTRIAL WASTEWATER TREATMENT 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Introduce the principles of wastewater and solid waste treatment and management.
2. Know about the fundamental concepts in water and wastewater treatment technologies.
3. Learn the hazardous solid waste disposal and management issues related to sludge treatmentand disposal.
4. Examine the constituents of waste water and its effects.

Course Outcomes

After completing the course, the students will be able to

1. Identify and separate the contaminants from the effluent for treatability.
2. Determine the biomass yield and substrate utilization rate for biological treatment process anddesign of activated sludge process.
3. Develop a flow sheet for the waste water treatment from dairy, sugar, pulp and paper, textileand pharmaceutical industries.
4. Design process flow diagram for water reuse and sludge disposal.

UNIT I: INTRODUCTION TO WASTE WATER ENGINEERING

Waste Water Engineering - Overview, inorganic non-metallic constituents and metallic constituents, physical and biological Characteristics.

UNIT II: OPERATIONS AND UNIT PROCESS

Screening, Flow Equalization, Mixing, Flocculation, Grit removal, Sedimentation, Coagulation, Precipitation, Oxidation and Neutralization

UNIT III: FUNDAMENTALS OF BIOLOGICAL TREATMENT

Introduction, Microbial growth kinetics, types of biological process for wastewater treatment - aerobic and anaerobic oxidation, Biological Nitrification and De-nitrification, biological phosphorous removal, activated sludge process (with design Considerations), trickling filters and lagoons.

UNIT IV: WASTE WATER TREATMENT IN SPECIFIC INDUSTRIES

Dairy, Sugar, Pulp and Paper, Textile and Pharmaceutical Industries

UNIT V: WATER REUSE

Wastewater reclamation technologies and reuse, Solid processing flow diagrams, sludge and scum pumping, grinding, screening, degritting, blending, anaerobic digestion, composting, conditioning, dewatering and incineration.

SUGGESTED READINGS:

1. Metcalf Eddy, Wastewater Engineering -Treatment and Reuse, Fourth Edition, Tata McGraw Hill, New Delhi, 2002.
2. Mark J. Hammer, Water and Wastewater Technology, Seventh Edition, Prentice Hall of India Pvt Limited, New Delhi, 2012.
3. James M. Montgomery, Water Treatment Principles and Design, First Edition, A Wiley Interscience publication, New York,1985
4. NPTEL course: Waste water treatment https://nptel.ac.in/courses/105/105/105105178/

21BTCEOE03 SOLID AND HAZARDOUS WASTE MANAGEMENT **Semester-3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Understand solid and hazardous waste engineering principles and management issues
2. Impart knowledge pertaining to the engineering design of solid and hazardous waste facilities
3. Deduce the source reduction, recycling and reuse techniques of solid waste
4. Elucidate the salient features of solid waste management and handling.

Course Outcomes

After completing the course, the students will be able to

1. Analyse the collection systems and method of transfer of solid waste.
2. Describe the processing techniques for solid and hazardous waste.
3. Select the suitable methods for disposal of solid and hazardous waste.
4. Interpret the legislation for management, handling and disposal of solid and hazardous waste.

UNIT I : CHARACTERISTICS AND SOURCE REDUCTION OF SOLID WASTE

Definition, sources, and types of solid waste - Composition, physical, chemical and biological properties of solid wastes - Percapita generation rates - Sampling and characterization of solid waste - Source reduction of wastes -Waste exchange – Recycling and reuses - Salient features of Indian legislations on management and handling of municipal solid wastes.

UNIT II: COLLECTION AND TRANSPORT OF SOLID WASTE

Estimation of solid waste and factors affecting generation rates - On-site handling, storage, and processing- Collection services: municipal and commercial - Industrial services - Collection systems: Hauled-container system (HCS) and stationary container system (SCS) - Vehicle and labour assessment - Assessment of collection route - Transfer and transport - Transfer station location- Means and methods of transfer.

UNIT III: PROCESSING AND DISPOSAL OF SOLID WASTE

Objective of processing - material separation and processing technologies- biological, chemical and thermal conversion technologies- disposal in Landfills: site selection methods and operations, leachate and gas generations and movement and control of gas and leachate techniques - Composting: aerobic and anaerobic - Resource and energy recovery schemes.

UNIT IV: HAZARDOUS WASTE CHARACTERIZATION AND MANAGEMENT

Definitions and Identifications of hazardous waste - Origin and characterization of hazardous solid waste- Typical hazardous wastes in MSW - Hazardous waste management: minimization, collection, storage, handling, transport, and disposal - design of hazardous waste landfills - TCLP tests - National and International legislation for hazardous waste management – Atomic Energy Regulatory

Board -International Atomic Energy Agency - Department of Atomic Energy - Nuclear Power Corporation - Nuclear power plants in India.

UNIT V: NUCLEAR WASTE AND E-WASTE

Sources - classification - effects of nuclear waste- initial treatment of nuclear waste vitrification, ion exchange, synroc – long term management - above ground disposal, geological disposal, ocean dumping, transmutation, space disposal - reuse of waste - nuclear safety and waste regulation - case study on nuclear disaster - source of e-waste - material composition of e-waste - recycling and recovery - integrated approaches to e-waste recycling - socio economic factors - treatment option -disposal option - e-waste legislation.

SUGGESTED READINGS:

1. McDougall, F. R., White, P. R., Franke, M., & Hindle, P. Integrated solid waste management: a life cycle inventory. John Wiley & Sons, 2008.
2. Ronald E. Hester, Roy M. Harrison "Electronic Waste Management", Royal Society of Chemistry, 2009.
3. Bagchi, A.. Design of landfills and integrated solid waste management. John Wiley & Sons, 2004.
4. Peavy, SH, Rowe, RD and Tchobanoglous, G, "Environmental Engineering", McGraw-Hill Inter Edition, 1985.
5. Charles, A.W., "Hazardous Waste Management", McGraw-Hill Publication, 2002
6. NPTEL course: Solid waste management: https://nptel.ac.in/courses/105/106/105106056/

21BTFTOE01 **PROCESSING OF FOOD MATERIALS** **Semester-3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**
End Semester Exam:3 Hours

Course Objectives

1. Explain the milling, extraction and manufacture of tremendous products from cereals, pulses and oil seeds
2. Summarize the production and processing methods of fruits and vegetables
3. Discuss the chemical composition, processing, production, spoilage and quality of milk and milk products
4. Outline the overall processes involved in the production of meat, poultry and fish products
5. Review the production and processing methods of plantation and spice products

Course Outcomes

After completing the course, the students will be able to

1. Discuss the basics of food processing.
2. Demonstrate the various processing technologies involved in fruits and vegetables, dairy, cereals, meat, fish, egg and plantation products.
3. Infer the basics on microbiology of food products.
4. Describe the process of manufacture of various food products.
5. Recognize various methods of preservation of food.
6. Express the possible arena of entrepreneurial activity related to food products.

UNIT I: CEREAL, PULSES AND OIL SEEDS TECHNOLOGY

Rice milling, Pulse milling, Wheat milling - Oil extraction - Methods of manufacture of Bread - different processes of manufacture - types of breads - buns, biscuits, cakes and cookies -Pasta products -Tortilla - Method of manufacture.

UNIT II: FRUITS AND VEGETABLE PROCESSING

Production of Fruits and vegetables in India, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technology as applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing.

UNIT III: DAIRY PROCESSING

Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardized, toned and double toned milk, milk powder - Equipments - Pasteurizers, homogenizers and pumps - Method of manufacture of dairy products – Ice cream, Cheese, Paneer, Yoghurt - Pasteurization and microorganisms involved in spoilage of milk.

UNIT IV: MEAT, POULTRY AND FISH PROCESSING

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Fish and other Marine Products Processing .

UNIT V: PLANTATION PRODUCT TECHNOLOGY

Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - green tea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods of processing of Pepper, cardamom, ginger, vanilla and turmeric

SUGGESTED READINGS

1. Chakraverty A. Post harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing. 3rd Edition, 2019. (ISBN-13: 978-8120409699)
2. Srivastava R.P. and Sanjeev Kumar S. Fruit and Vegetable Preservation: Principles and Practices. CBS Publisher. 3rd Edition. 2019. (ISBN-13: 978-8123924373)
3. Jari Sahoo and Manish Kumar Chatli. Textbook on Meat, Poultry and Fish Technology. Daya Publishing House. 2014. (ISBN-13: 978-935243441)
4. Fidel Toldra. Lawries Meat Science. Woodhead Publishing. 8th Edition, 2017. (ISBN: 978-0-081006948)
5. NIIR Board. Modern Technology of Milk Processing and Dairy Products. NIIR Project Consultancy Services. 4th Edition, 2013. (ISBN: 9788190568579)
6. Tyagi SK. Spices, Plantation Crops, Medicinal and Aromatic Plants. New India Publishing Agency. 2015. (ISBN: 9788193014486)

Semester-

21BTFTOE02 **NUTRITION AND DIETETICS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course objectives

1. To explain the basic concepts of food and nutrition.
2. To define the overall classification, function, and source of carbohydrates, lipids and proteins.
3. To recite the availability, source, deficiency and physiological role of fat and water soluble vitamins.
4. To outline the role of health and nutritional importance of micro and macro minerals.
5. To discuss the recent trends and developments in nutrition.

Course outcomes

After completing the course, the students will be able to

1. Recognize the basics in the area of nutritional assessment in health and disease
2. Evaluate the biological functions of various macromolecules in terms of food and health.
3. Select the balanced diet for a healthy life to avoid or prevent the deficiency disorders.
4. Choose an appropriate diet, products that prevent vitamin deficiency disorders.
5. Identify the proper foods rich in minerals to live a healthy life.
6. Design the diet with the recent concepts of human nutrition to prevent / treat the dreadful diseases.

UNIT I: HUMAN NUTRITION

Historical perspective of nutrient requirements – Assessment of nutritional status - Recommended dietary allowances (RDA) of macronutrients for all age groups - Assessment of protein quality – Malnutrition and related disorders – Balanced diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing.

UNIT II : BIOMOLECULES

Carbohydrates- Definition, classification, functions, sources of carbohydrates and, deficiency. Lipids – Definition, classification, function, sources, refined and hydrogenated fats process. Proteins – Definitions, Classification, Function, Amino Acids, Sources of Proteins.

UNIT III: VITAMINS

Physiological role, bio-availability, requirements, sources and deficiency of fat soluble vitamins: vitamin A, D, E and K. Water soluble vitamins: vitamin C, thiamine, riboflavin, niacin, pantothenic acid, biotin, folic acid, vitamin B12, vitamin B6.

UNIT IV: MINERALS

Physiological role, bio-availability, requirements, sources and deficiency of macro minerals: calcium, phosphorus, magnesium, sodium, potassium, chlorine. Micro minerals: iron, zinc, copper, selenium, chromium, iodine, manganese, molybdenum and fluoride.

UNIT V: RECENT TRENDS IN NUTRITION

Principles of dietary management in gout, rheumatism, AIDS/HIV - Cancer-risk factors, symptoms, dietary management, role of food in prevention of cancer. Role of functional foods, health foods and novel foods, organically grown foods, Recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

SUGGESTED READINGS

1. Sunetra Roday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3rd edition 2018. (ISBN-13: 9780199489084)
2. Charis Galanakis. Nutraceutical and Functional Food Components. Academic Press, 1st Edition, 2017. (ISBN: 9780128052570)
3. Ashley Martin. Nutrition and Dietetics. Syrawood Publishing House. 1st Edition, 2016. (ISBN:9781682860588)
4. Robert E. C. Wildman. Handbook of Nutraceuticals and Functional Foods. CRC Press, 2nd Edition, 2016. (ISBN-10: 9781498770637)
5. Srilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6th Edition. 2017. (ISBN-13: 9789386418883)

Semester-

21BTFTOE03 **READY TO EAT FOODS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. Outline the current status of snack food Industry
2. Describe the production, processing and marketing trends of potato and tortilla chips
3. Outline the overall processing of popcorn
4. Explain the production and processing of fruits involved in snack food preparation
5. Summarize the sensory analysis methods and packaging techniques of snack foods

Course Outcomes

After completing the course, the students will be able to

1. List the various manufacturing process in snack food industries
2. Acquire knowledge about current production and marketing status of Snack foods
3. Elucidate the advantages of Sensory Evaluation
4. Packaging technologies in Snack Food Industries
5. Demonstrate the equipments involved in the snack production processes
6. Use flavorings in the popcorn industries

UNIT I: SNACK FOOD INDUSTRY

Introduction-History-Past innovations- Outline of snack food industry- Nutrition-Total Quality Management of Technology-Domestic Snack Food Market-Global Market-Snack Food Association Future Considerations

UNIT II: POTATO AND TORTILLA CHIPS PROCESSING

Potato Production- Potato snack Ingredients- Potato Analysis and Composition-Potato chip manufacturing process-Unit Operations-Other value added products from Potato.

Tortilla chips - Raw Materials- Processing steps-Equipment involved-Reconstitution of Dry Maize Flour-Unit operations.

UNIT III: POPCORN PROCESSING

Introduction- Raw popcorn selection and preparation-Popping Methods-Home preparation of Popcorn-Equipments-Industrial manufacturing process- Flavorings and Applicators-Popcorn Packaging- Relative Nutrition- Marketing.

UNIT IV: FRUIT BASED SNACKS

Introduction-production and processing of fruit crops – fruit purees – fruit powders – canned fruit snacks – alcoholic preservation of fruit snacks – fruit candies – fruit bars – exotic fruits.

UNIT V: SENSORY EVALUATION AND PACKAGING

Introduction- Analytical methods-Sensory methods- Sensory Aspect of Processing- Quality properties of Snack Foods and Packaging Materials-Automated Bag- Pouch Packaging- Cartoning Case Packing-Current Issues in Snack Foods Packaging

SUGGESTED READING

1. Lusas, E. W and Rooney, L. W. Snack Foods Processing. CRC Press,1st Edition 2001. (ISBN-13: 978-0367412746)
2. Panda, H. The Complete Technology Book on Snack Foods, National Institute of Industrial Research, Delhi. 2nd Edition 2013. (ISBN-13: 978-9381039243)
3. Sergio O Serna-Saldivar, Industrial Manufacture of Snack Foods, Kennedys Books Ltd. 2008. (ISBN-13: 978-0955808500)

Semester-

21BTFTOE04 AGRICULTURAL WASTE AND BYPRODUCTS UTILIZATION 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

1. To categorize the types of agricultural wastes
2. To outline the production and utilization of biomass
3. To explain the various parameters considered to be important in the designing of biogas units
4. To discuss the methods employed in the production of alcohol from agricultural wastes / byproducts
5. To summarize the overall aspects involved in the production of paperboards and particle boards from agricultural wastes

Course Outcomes

After completing the course, the students will be able to

1. List and classify the types of agricultural wastes
2. Collect and generate number of value added products from agricultural wastes
3. Recall the techniques involved in the production and utilization of biomass
4. Assess the various parameters considered to be important in the designing of biogas units
5. Illustrate the various methods employed in the production of alcohol from the byproducts of agricultural wastes
6. Choose the appropriate materials to produce paperboards and particle boards from agricultural wastes

UNIT I: TYPES OF AGRICULTURAL WASTES

Introduction and background of agricultural waste, crop waste, agricultural residues (annual crops), technical terms, rice by-product utilization - rice bran and germ, rice bran oil, economic products from agriculture waste/by-products.

UNIT II: BIOMASS PRODUCTION AND UTILIZATION

Biomass gasifier, Technology used for the utilization of agricultural wastes: Biomass gasifier, Nimbkar Agricultural Research Institute (NARI) gasifier, rice-husk based gasifier, heat and steam from sugarcane leaf and bagasse.

UNIT III: BIOGAS DESIGN AND PRODUCTION

Biogas: Definition, composition, history of biogas, production of biogas; types of biogas plant (floating drum type and fixed dome type) and their components (inlet, outlet, stirrer, slanting pipe, digester, gas holder and gas outer pipe), selection and design of biogas plant.

UNIT IV: PRODUCTION OF ALCOHOL FROM WASTE MATERIALS

Production of alcohol from waste materials: Introduction, production methods, cellulolysis (biological approach): pretreatment, cellulolytic processes (Chemical and Enzymatic hydrolysis), microbial fermentation, gasification process (thermochemical approach).

UNIT V: PRODUCTION OF PAPERBOARDS AND PARTICLEBOARDS FROM AGRICULTURAL WASTE

Production and testing of paperboards and particleboards from agricultural waste: Introduction, history, terminology and classification, raw materials, production steps - pulping, classifications of pulp, bleaching, plies, coating, grades.

SUGGESTED READINGS

1. Efthymia Alexopoulou. Bioenergy and Biomass from Industrial Crops on Marginal Lands. Elsevier, 1st Edition, 2020. (ISBN: 9780128188644)
2. Navanietha Krishnaraj Rathinam, Rajesh Sani. Biovalorisation of Wastes to Renewable Chemicals and Biofuels. Elsevier, 1st Edition, 2019. (ISBN: 9780128179529)
3. Simona Ciuta, Demetra Tsiamis, Marco J. Castaldi. Gasification of Waste Materials. Academic Press, 1st Edition, 2017. (ISBN: 9780128127162)
4. Nicholas E. Korres, Padraig O'Kiely, John A.H. Benzie, Jonathan S. West. Bioenergy Production by Anaerobic Digestion: Using Agricultural Biomass and Organic Wastes. Routledge, 1st Edition, 2013. (ISBN-13: 9780415698405)
5. Albert Howard, Yashwant Wad. The Waste Products of Agriculture. Benediction Classics, 1st Edition, 2011. (ISBN-13: 9781849025454)

Semester-

21BEBMEOE01 **ROBOTICS IN MEDICINE** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students

1. To understand the basics of Robotics, Kinematics.
2. To understand the basics of Inverse Kinematics.
3. To explore various kinematic motion planning solutions for various Robotic configurations.
4. To study the trajectory planning for robot.
5. To understand the task level programming
6. To explore various applications of Robots in Medicine

Course Outcomes

Upon completion of this course, students will be able to:

1. Explain various kinds robotics techniques, vision, planning and applications.
2. Outline the basic concept of robotics
3. Identify and discuss the Robot Vision
4. Describe about manipulators and kinematics.
5. Demonstrate Task level programming
6. Discuss the applications of robotic systems in medical field

UNIT I: INTRODUCTION

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot.

UNIT II: KINEMATICS

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three-Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT III: ROBOT VISION

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNIT IV: PLANNING

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

UNIT V: APPLICATIONS

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynecology, Orthopedics, Neurosurgery.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Robert Schilling	Fundamentals of Robotics-Analysis and control‖	Prentice Hall	2003
2	J.J.Craig	Introduction to Robotics‖,	Pearson Education	2005

REFERENCES:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	Staugaard, Andrew C	Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning‖	Prentice Hall Of India	1987
2	Grover, Wiess, Nagel, Oderey	Industrial Robotics: Technology, Programming and Applications‖	McGraw Hill	1986.
3	Wolfram Stadler	Analytical Robotics and Mechatronics‖	McGraw Hill,	1995
4	Saeed B. Niku,	Introduction to Robotics: Analysis, Systems, Applications‖	Prentice Hall	2001
5	K. S. Fu, R. C. Gonzales and C. S. G. Lee	Robotics‖	McGraw Hill	2008

WEBSITES:

1. www.mit.edu
2. www.nptel.com

Semester-

21BEBMEOE02 ARTIFICIAL ORGANS AND IMPLANTS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam:3 Hours

Course Objectives

The goal of this course is for students:

1. To discuss the overview of artificial organs &transplants
2. To extend the principles of implant design with a case study
3. To explain the implant design parameters and solution in use
4. To simplify about various blood interfacing implants
5. To know the biocompatibility of artificial organs
6. To learn about the implantable medical devices

Course Outcomes:

Upon completion of this course, students will be able to:

1. Explain the implant design parameters and solution in use
2. Analyze about various blood interfacing implants
3. Evaluate response of biomaterials in living system
4. Perceive knowledge about artificial organs &transplants
5. Demonstrate different types of soft tissue replacement and hard tissue replacement
6. Assess biocompatibility of artificial organs

UNIT I : ARTIFICIAL ORGANS

Artificial blood, Artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyser membrane), Dental Implants.

UNIT II: IMPLANT DESIGN & MATERIALS

Principles of implant design, Clinical problems requiring implants for solution. Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications.

UNIT III: IMPLANT DESIGN PARAMETERS AND ITS SOLUTION

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV: BLOOD INTERFACING IMPLANTS

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V: IMPLANTABLE MEDICAL DEVICES AND ORGANS

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

TEXT BOOKS:

S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	KopffW.J	Artificial Organs	John Wiley and sons, New York, 1st edition	1976
2	Park J.B.,	Biomaterials Science and Engineering‖	Plenum Press	1984

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S.NO.	Author(s) Name	Title of the book	Publisher	Year of publication
1	J D Bronzino	Biomedical Engineering handbook Volume II	CRC Press / IEEE Press	2000
2	R S Khandpur	Handbook of Biomedical Instrumentation	Tata McGraw Hill	2003
3	Joon B Park	Biomaterials – An Introduction	Plenum press, New York	1992
4	Yannas, I. V	Tissue and Organ Regeneration in Adults‖	New York, NY: Springer	2001
5	Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino	Clinical Engineering‖	CRC Press, 1st edition	2010
6	Myer Kutz	Standard Handbook of Biomedical Engineering & Design	McGraw- Hill	2003

WEBSITE:

1. www.mit.edu
2. www.nptel.com