B.E. MECHANICAL ENGINEERING CURRICULUM AND SYLLABI

(2023 AND ONWARDS)

(REGULAR PROGRAMME)

Department of Mechanical Engineering
FACULTY OF ENGINEERING

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act, 1956)

(Accredited with A+ Grade by NAAC in the Second Cycle)

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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 2023

CHOICE BASED CREDIT SYSTEM

These regulations are effective from the academic year 2023 – 2024 and applicable to the candidates admitted to B. E. / B. Tech. during 2023 - 2024 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) prescribed by the State Government / Central Government with Mathematics/ Physics/ Chemistry/ Computer Science/ Electronics/ Information Technology/ Biology/ Informatics Practices/ Biotechnology/ Technical Vocational subject/ Agriculture/ Engineering Graphics/ Business Studies/ Entrepreneurship. (Any of the above three subjects) or any similar Examination of any other institution/ University or authority accepted by the Karpagam Academy of Higher Education as equivalent thereto).

Should obtained at least 45% marks (40% marks in case of candidates belonging to reserved category) in the above subjects taken together.

(OR)

Passed min. 3 years Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) subject to vacancies in the First Year, in case the vacancies at lateral entry are exhausted. (The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)

1.2 Lateral Entry Admission

Candidates who possess Diploma in Engineering / Technology (10+3 or 10+2+2) awarded by the Directorate of Technical Education with passed minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology 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.

OR

Passed B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject.

OR

Passed D.Voc. Stream in the same or allied sector.
(The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering

drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)

Eligibility criteria for admission in the third semester is given in the table below.

<table>
<tr><th>S. No.</th><th>Programme</th><th>Eligibility criteria</th></tr>
<tr><td>1.</td><td>B.E Bio Medical Engineering</td><td rowspan="10">Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology.

OR
Passed B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject.

OR
Passed D.Voc. Stream in the same or allied sector.
(The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the programme)</td></tr>
<tr><td>2</td><td>B. E. Civil Engineering</td></tr>
<tr><td>3.</td><td>B. E. Computer Science and Engineering</td></tr>
<tr><td>4.</td><td>B. E. Computer Science and Engineering (Cyber security)</td></tr>
<tr><td>5.</td><td>B. E. Electrical and Electronics Engineering</td></tr>
<tr><td>6.</td><td>B. E. Electronics and Communications Engineering</td></tr>
<tr><td>7.</td><td>B. E. Mechanical Engineering</td></tr>
<tr><td>8.</td><td>B. Tech. Artificial Intelligence and Data Science</td></tr>
<tr><td>9.</td><td>B. Tech Bio - Technology</td></tr>
<tr><td>10.</td><td>B. Tech Food Technology</td></tr>
</table>

1.3 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 Academy of Higher Education. 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 Bio Medical Engineering
2. B. E. Civil Engineering
3. B. E. Computer Science and Engineering
4. B. E. Computer Science and Engineering (Cyber Security)
5. B. E. Electrical and Electronics Engineering
6. B. E. Electronics and Communications Engineering
7. B. E. Mechanical Engineering
8. B.Tech. Artificial Intelligence and Data Science
9. B. Tech. Bio-Technology
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 weeks of field project/internship training during semester vacations	1

4.3 In every semester, the curriculum shall normally have a blend of theory courses not exceeding 6 and practical courses not exceeding 4. However, the total number of coursesper semester shall not exceed 9.

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

PROGRAMME	PRESCRIBED CREDIT RANGE
B. E./B. Tech.	160– 165

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. (HSC 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 the 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 and Practical Course is awarded for 40 Marks with mark split up similar to regular theory course. But Assignment and Seminar components are replaced by Observation and Record marks.

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

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 betwo 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 atleast 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.

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

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 are 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 Academy of Higher Education.

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 examinationsof 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 Academy of Higher Education.

23.KARPAGAM INNOVATION AND INCUBATION COUNCIL (KIIC)

(A Section 8 Company)

Based on the 2019 National Innovation and Startup Policy and the 2019–2023 Tamil Nadu Startup Policy, KIIC has recommended to the KAHE students who are affiliated with the KIIC that it be incorporated in the university Program Regulations 2023-24 and implement from this academic year.

23.1 Norms to Student Start-Ups

a) Any (UG/PG /(Ph.D.) Research scholars, student, right from the first year of their programme is allowed to set a startup (or) work part time/ full time in a startup or work as intern in a startup

b) Any (UG/PG / (Ph.D.) Research scholars) student right from the first year of their programme is allowed to earn credit for working on Innovative prototypes/business Models/ Pre incubation (case to case basis). Start Up activities will be evaluated based on the guidelines being given by the expert committee of the KIIC

c) Student Entrepreneurs may use the address of incubation center (KIIC) to register their venture while studying in KAHE.

d) Students engaged in startups affiliated with the KIIC or those who work for them may be exempted from KAHE's attendance requirements for academic courses under current regulations, up to a maximum of 30% attendance per semester, including claims for ODs and medical emergencies Potential Students who have been incubated at KIIC may be permitted to take their University semester exams even if their attendance is below the minimum acceptable percentage, with the proper authorization from the head of the institution.
(On case-to-case basis depends upon the applicability strength, societal benefits and quality of the Innovation and Subsequent engagement of the students with the/ her business)

e) Any Students Innovators/entrepreneurs are allowed to opt their startup in place mini project /major project, /seminar and summer training etc. (In plant training, Internship, value added Course.). The area in which the student wishes to launch a Startup may be interdisciplinary or multidisciplinary.

f) Student’s startups are to be evaluated by Expert committee, formed by KIIC and KAHE.

23.2 Guide lines to award Credits/ Marks to a Student startup

Student’s startup stages are divided into five phases and these startup phases can be considered equally in place of the course title as mentioned below with the same credits allotted to the course title in a university curriculum.

Sl. No.	Description/Startup phases	In place of the Subject / Course title	Grades/Credits /Marks
1	Idea stage/Problem Identification	Seminar	Same Marks/Credits can be awarded that are listed in the course title's curriculum for the respective startup phases.
2	Proof of Concept (POC) /Solution development	In-plant training /Internship	
3	Product Development (Lab scale) /Prototype Model/ Company Registered	Mini Project/ Value added Course	
4	Validation/Testing	Main Project phase I	
5	Business Model/Ready for Commercialization/Implementation	Main Project phase II	

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act, 1956)

Eachanari Post, Coimbatore-641021. Tamilnadu, India.

FACULTY OF ENGINEERING

B.E. (MECHANICAL ENGINEERING)

COURSE OF STUDY AND SCHEME OF EXAMINATION

(2023 Batch Onwards)

SEMESTER I

Course Code	Course title	Category	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
23BECC101	Professional Communicative English	HS	8,9,10,12	–	3	0	0	3	40	60	100	1
23BECC102	Matrices and Calculus	BS	1,2,3,12	1	3	1	0	4	40	60	100	3
23BECC103	Environmental Studies	BS	1,2,6,7,8,10,12	1	3	0	0	3	40	60	100	5
23BEME141	Engineering Physics	BS	1,2,3,6,9,10,12	1	4	0	2	5	40	60	100	7
23BECC142	Programming in C	ES	1,2,3,4,9,10,12	1	4	0	2	5	40	60	100	10
23BEME111	Engineering Graphics - I	ES	1,2,3,5,8,10,12	–	2	0	2	3	40	60	100	13
23BEMC151	Design Thinking	MC	1,2,3,4,6,7,8,9,10,12	–	1	0	2	2	100	-	100	15
23BEMC152	Sports and Yoga	MC	–	–	1	0	0	0	100	-	100	17
23BEMC153	தமிழர் மரபும் பண்பாடும்	MC	–	–	1	0	0	0	100	-	100	18
Total					**21**	**1**	**10**	**25**	**540**	**360**	**900**	

SEMESTER II

Course Code	Course title	Category	Objectives & Outcomes		Instruction Hours / Week			Cr	Maximum Marks			Pg. No.
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
23BECC201C	Transforms and its Applications	BS	1,2,3,12	1	3	1	0	4	40	60	100	20
23BEME202	Physics for Mechanical Engineers	BS	1,2,3,10,12	1	3	0	0	3	40	60	100	22
23BEME203	Engineering Chemistry	BS	1,2,6,7,8,10,12	1	3	0	0	3	40	60	100	24
23BEME241A/ 23BEME241B	Data Structure and Algorithms/Object Oriented Programming with Python	ES	1,2,3,4,9,10,12 / 1,2,3,4,9,10,12	1/1	4	0	2	5	40	60	100	26/ 28
23BEME211	Engineering Graphics - II	ES	1,2,3,5,6,10,12	1	2	0	2	3	40	60	100	30
23BECC212	Workshop Practices	ES	1,2,3,6,8,9,10,12	1,2	0	0	4	2	40	60	100	32
23BEMC251	Soft Skills	MC	–	–	1	0	0	0	100	-	100	34
23BEMC252	Women Safety and Security	MC	–	–	1	0	0	0	100	-	100	35
Total					**17**	**1**	**8**	**20**	**440**	**360**	**800**	

SEMESTER III												
Course Code	Course title	Category	Objectives & Outcomes		Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
23BEME301B	Numerical Methods	BS	1,2,3,12	1	3	1	0	4	40	60	100	36
23BEME302	Engineering Mechanics	BS	1,2,3,10,12	1	3	1	0	4	40	60	100	38
23BEME303	Manufacturing Technology I	PC	1,2,3,6,7,10,12	1,2	3	0	0	3	40	60	100	40
23BEME304	Thermodynamics	PC	1,2,3,10,12	1	3	1	0	4	40	60	100	42
23BEME341	Fluid Mechanics and Fluid Machines	PC	1,2,3,4,9,10,12	1	2	1	2	4	40	60	100	44
23BEME342	Basic Electrical and Electronics Engineering	ES	1,2,3,9,10,12	1	3	1	2	5	40	60	100	46
23BEME311	Machine Drawing	PC	1,2,3,5,6,8,9,10,12	1	1	0	2	2	40	60	100	48
23BEME391	Field Project / Internship	PW	–	–	0	0	2	1	100	0	100	50
23BEMC351	Aptitude and Reasoning	MC	–	–	1	0	0	0	100	0	100	51
23BEMC352A/ 23BEMC352B	Foreign Language (German/ French)	MC	–	–	1	0	0	0	100	0	100	53/ 54
Total					**20**	**5**	**8**	**27**	**440**	**360**	**800**	

SEMESTER IV												
Course Code	Course title	Category	Objectives &Outcomes		Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
23BEME401	Kinematics of Machinery	PC	1,2,3,4,10,12	1	3	1	0	4	40	60	100	55
23BEME402	Engineering Materials and Metallurgy	PC	1,2,3,4,9,10,12	1,2	3	0	0	3	40	60	100	57
23BEME441	Manufacturing Technology II	PC	1,2,3,6,7,9,10,12	1,2	3	0	2	4	40	60	100	59
23BEME442	Applied Thermodynamics	PC	1,2,3,7,8,9,10,12	1	2	1	2	4	40	60	100	61
23BEME443	Strength of Materials	PC	1,2,3,4,9,10,12	1	2	1	2	4	40	60	100	63
23BEME444	Industrial Metrology	PC	1,2,3,8,9,10,12	1	2	0	2	3	40	60	100	65
23BEMC451	Foundation of Entrepreneurship	MC	–	–	1	0	0	0	100	0	100	67
23BEMC452	Essence of Indian Traditional Knowledge and Heritage	MC	–	–	1	0	0	0	100	0	100	68
Total					**17**	**3**	**8**	**22**	**440**	**360**	**800**	

SEMESTER V												
Course Code	Course title	Category	Objectives &Outcomes		Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
23BEME501	Design of Machine Elements	PC	1,2,3,4,8,10,12	1	2	1	0	3	40	60	100	69
23BEME502	Renewable Energy Sources	PC	1,2,3,6,7,10,12	1	3	0	0	3	40	60	100	71
23BEME503	Additive Manufacturing	PC	1,2,3,4,6,10,12	1	3	0	0	3	40	60	100	73
23BEME541	Heat and Mass Transfer	PC	1,2,3,4,9,10,12	1	2	1	2	4	40	60	100	75
23BEME542	Dynamics of Machinery	PC	1,2,3,4,8,9,10,12	1	2	1	2	4	40	60	100	77
23BE_____	Open Elective I	OE	–	–	3	0	0	3	40	60	100	-
23BEME591	Field Project / Internship	PW	–	–	0	0	2	1	100	-	100	79
23BEMC551	Cyber Security	MC	–	–	1	0	0	0	100	-	100	80
Total					**17**	**3**	**6**	**21**	**440**	**360**	**800**	

SEMESTER VI												
Course Code	Course title	Category	Objectives &Outcomes		Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
23BEME601	Design of Transmission Systems	PC	1,2,3,6,8,10,12	1	2	1	0	3	40	60	100	82
23BEME6E_	Professional Elective-I	PE	-	-	3	0	0	3	40	60	100	-
23BEME6E_	Professional Elective-II	PE	-	-	3	0	0	3	40	60	100	-
23BEME6E_	Professional Elective-III	PE	-	-	3	0	0	3	40	60	100	-
23BE_____	Open Elective II	OE	-	-	3	0	0	3	40	60	100	-
23BEME611	Computer Aided Modeling Laboratory	PC	1,2,3,5,8,9,10,12	1	0	0	4	2	40	60	100	85
23BEME691	Mini project work	PW	1,2,3,4,6,7,8,9,10,11,12	1,2	0	0	2	1	100	-	100	86
23BEME651	Universal Human Values	MC	-	-	1	0	0	0	100	-	100	87
Total					**17**	**3**	**8**	**18**	**440**	**360**	**800**	

SEMESTER VII												
Course Code	Course title	Category	Objectives &Outcomes		Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
23BEME701	Principles of Management and Professional Ethics	PC	1,2,6,8,10,12	1	3	0	0	3	40	60	100	89
23BEME741	Finite Element Method	PC	1,2,3,4,5,9,10,12	1	2	1	2	4	40	60	100	91
23BEME7E___	Professional Elective-IV	-	-	-	3	0	0	3	40	60	100	-
23BEME7E___	Professional Elective- V	-	-	-	3	0	0	3	40	60	100	-
23BEME7E___	Professional Elective- VI	-	-	-	3	0	0	3	40	60	100	-
23BEME711	CAM Laboratory	PC	1,2,3,4,5,9,10,12	1	0	0	4	2	40	60	100	95
23BEME791	Project work Phase – I	PW	1,2,3,5,6,7,8,9,10,12	1	0	0	8	4	100	-	100	96
Total					**14**	**1**	**14**	**22**	**340**	**360**	**700**	

SEMESTER VIII												
Course Code	Course title	Category	Objectives &Outcomes		Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
23BEME891	Project work Phase – II and Vivo Voce	PW	1,2,3,4,5,6,7,8,9,10,11,12	1,2	0	0	16	8	160	240	400	97
Total					**0**	**0**	**16**	**8**	**160**	**240**	**400**	

PROFESSIONAL ELECTIVE I

Course Code	Course title	Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
		L	T	P		CIA	ESE	Total	
						40	60	100	
23BEME6E01	Composite Materials and Mechanics	3	0	0	3	40	60	100	98
23BEME6E02	Design Concepts in Engineering	3	0	0	3	40	60	100	100
23BEME6E03	Modern Robotics	3	0	0	3	40	60	100	102
23BEME6E04	Hydraulics and Pneumatics Power Control	3	0	0	3	40	60	100	104

PROFESSIONAL ELECTIVE II

Course Code	Course title	Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
		L	T	P		CIA	ESE	Total	
						40	60	100	
23BEME6E05	Refrigeration and Air Conditioning	3	0	0	3	40	60	100	106
23BEME6E06	Advanced Manufacturing Processes	3	0	0	3	40	60	100	108
23BEME6E07	Design of Pressure Vessels	3	0	0	3	40	60	100	110
23BEME6E08	Advanced Vehicle Technology	3	0	0	3	40	60	100	112

PROFESSIONAL ELECTIVE III

Course Code	Course title	Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
		L	T	P		CIA	ESE	Total	
						40	60	100	
23BEME6E09	Design for Manufacture and Assembly	3	0	0	3	40	60	100	114
23BEME6E10	Computational Fluid Dynamics	3	0	0	3	40	60	100	116
23BEME6E11	Energy Conservation Methods and Energy Audit	3	0	0	3	40	60	100	118
23BEME6E12	Material Handling and Solid processing Equipment	3	0	0	3	40	60	100	120

PROFESSIONAL ELECTIVE IV

Course Code	Course title	Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
		L	T	P		CIA	ESE	Total	
						40	60	100	
23BEME7E01	Rotating Machinery Design	3	0	0	3	40	60	100	122
23BEME7E02	Power Plant Engineering	3	0	0	3	40	60	100	124
23BEME7E03	Dynamics of Ground Vehicles	3	0	0	3	40	60	100	126
23BEME7E04	Operations Research	3	0	0	3	40	60	100	128

PROFESSIONAL ELECTIVE V

Course Code	Course title	Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
		L	T	P		CIA	ESE	Total	
						40	60	100	
23BEME7E05	Power Generation Equipment Design	3	0	0	3	40	60	100	130
23BEME7E06	Advanced I.C. Engines	3	0	0	3	40	60	100	132
23BEME7E07	Non-Destructive Testing	3	0	0	3	40	60	100	134
23BEME7E08	Industrial Safety Engineering	3	0	0	3	40	60	100	136

PROFESSIONAL ELECTIVE VI

Course Code	Course title	Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
		L	T	P		CIA	ESE	Total	
						40	60	100	
23BEME7E09	Quality Control and Reliability Engineering	3	0	0	3	40	60	100	138
23BEME7E10	Cogeneration and Waste Heat Recovery Systems	3	0	0	3	40	60	100	140
23BEME7E11	Logistics and Supply Chain Management	3	0	0	3	40	60	100	142
23BEME7E12	Battery Management System	3	0	0	3	40	60	100	144

COURSES OFFERED BY OTHER DEPARTMENTS

Course Code	Course title	Instruction Hours / Week			Credits	Maximum Marks			Pg. No.
		L	T	P		CIA	ESE	Total	
						40	60	100	
23BESHOE**	Green Chemistry	3	0	0	3	40	60	100	146
23BESHOE**	Material Sciences	3	0	0	3	40	60	100	147
23BEEEOE**	Hybrid Electric Vehicles	3	0	0	3	40	60	100	148
23BTFTOE**	Processing of Food Materials	3	0	0	3	40	60	100	149
23BTFTOE**	Agricultural Waste and By Products Utilization	3	0	0	3	40	60	100	150
23BECEOE**	Housing Plan and Management	3	0	0	3	40	60	100	152
23BECEOE**	Computer-Aided Civil Engineering Drawing	3	0	0	3	40	60	100	154
23PHPOE***	Materials Characterization	3	0	0	2	40	60	100	155
23CAPOE***	Robotics Process Automation	3	0	0	2	40	60	100	157

COURSES OFFERED TO OTHER DEPARTMENTS									
Course Code	**Course title**	**Instruction Hours / Week**			**Credits**	**Maximum Marks**			**Pg. No.**
		L	**T**	**P**		**CIA**	**ESE**	**Total**	
						40	**60**	**100**	
23BEMEOE01	Battery Management System	3	0	0	3	40	60	100	159
23BEMEOE02	Industrial Safety Engineering	3	0	0	3	40	60	100	161
23BEMEOE03	Non-Destructive Testing	3	0	0	3	40	60	100	163
23BEMEOE04	Operations Research	3	0	0	3	40	60	100	165

Programme Educational Objectives (PEO)

- To equip students with modern tools and technology for deliberating engineering solutions and to advance scientific knowledge through basic and applied research.
- To equip students with broad knowledge through series of expert interactions to support the industry development and to address social and engineering challenges of the nation.
- To create awareness and understanding related to societal issues, apart from developing a sense of commitment to the community and profession with sincere involvement.

Programme Outcomes (PO)

- **PO1 - Engineering Knowledge:** Ability to apply knowledge of mathematics, science and engineering fundamentals for solving the complex engineering problems.
- **PO2 - Problem Analysis:** Identify, formulate, review and analyze the complex engineering problems, by conceptual and fundamental principles of mechanical engineering to reach value added sustainable conclusions.
- **PO3 - Designs / development of solution:** 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, cultural, societal and environmental consideration.
- **PO4 - Conduct investigations of complex Problems:** Ability to apply appropriate tools, technique and research knowledge to investigate complex engineering problems.
- **PO5 - Modern tool usage:** To understand and apply modern techniques and IT tools for the design and analysis of mechanical systems.
- **PO6 - The engineer and society:** Understand the impact of engineering solutions in a societal context and to be able to respond effectively to the needs for sustainable development.
- **PO7 - Environment and sustainability:** Understanding the mechanism of pollutant formation and its control techniques.

- **PO8 - Ethics:** Understanding of human and ethical responsibilities towards the profession and society.
- **PO9 - Individual and team work:** Function effectively as an individual, and as a member or a leader in diverse teams, and in multi-disciplinary situations.
- **PO10 - Communication:** Ability to communicate effectively with engineering community and instruct in the form of reports, presentation and documents.
- **PO11 - Project management and finance:** Ability to understand the economics and cost analysis in order to take economically sound decisions.
- **PO12 - Lifelong learning:** To recognize the need for, and have the ability to engage in independent and lifelong learning.

Programme Specific Outcomes (PSO)

- **PSO1:** Analyze, design, develop and implement the concepts of mechanical systems and processes towards sustainable development.
- **PSO2:** Extend and implement new thoughts on product design and development with the aids of advanced materials research lab, while ensuring best manufacturing practices.

PEO	Programme Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
1	✓	✓	✓	✓	✓							✓
2	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
3						✓	✓	✓	✓	✓	✓	✓

Total Marks: 6000

Total number of credits: 161

PEO: Programme Educational Objectives **PO: Programme Outcomes**

L: Lecture Hour **T: Tutorial Hour** **CIA: Continuous Internal**

Assessment: Practical Hour **C: No. of Credits** **ESE: End Semester**

Examinations Note:

1. The passing minimum for Mandatory course is 50 marks out of 100 marks. There will be two tests,of which one will be class test covering 50% of syllabus for 50 marks and other for 50 marks.
2. Credits for mandatory courses are not counted for computation of CGPA.
3. A student will be eligible to get Under Graduate degree with Honors or additional Minor Engineering,if he/she completes an additional 20 credits. These could be acquired through MOOCs.

23BECC101 **SEMESTER-I**

PROFESSIONAL COMMUNICATIVE ENGLISH **3H-3C**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for students to

- Extend the communicative competence of learners.
- Develop usage of language effectively in academic /work contexts
- Make use of Language skills in Reading and Writing
- Use language efficiently in expressing their opinions via various media.
- Enhance inter-personal communication skills.

COURSE OUTCOMES:

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

- Identify new words by employing vocabulary building techniques.
- Build correct sentence structures and grammatical patterns in oral and written communication
- Construct business letters, proposals and E-Mail communication.
- Adopt the skills of planning, structuring, and delivery techniques in group discussions and presentations.
- Follow leadership, work ethics and management principles.

UNIT I VOCABULARY BUILDING **9**

Word formation process - One-word Substitutes – Homophones – Homonyms – British and American vocabulary – Punctuation marks and capitalization

UNIT II FUNDAMENTALS OF ENGLISH GRAMMAR **9**

Subject –verb agreement (Concord) – If-conditionals - Modal verbs - Question types (Wh, Yes or No & Question tag), Prepositions- Articles

UNIT III LANGUAGE SKILLS (READING AND WRITING) **9**

Reading (Skimming& Scanning) - Reading Methods (SQR3) – Writing -Business Letters (Job Application Letter & Resume Preparation, sales letter, Quotation letter) – E- Mail communication & etiquettes – Business Proposals (Structure & Types)

UNIT IV PROFESSIONAL SKILLS **9**

Interview skills – Dos and Don’ts of an Interview, Group Discussion – Dos and Don’ts of GD, Presentation skills – Planning, structuring and Delivering Techniques

UNIT V INTERPERSONAL SKILLS **9**

Personality development –Conflict management, Team work, Leadership Principles, Negotiation skills

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

TOTAL:45

TEXT BOOKS:

1. Raman. Meenakshi, Sharma. Sangeeta (2015).Technical Communication (Principles and Concepts). Oxford university press. New Delhi.
2. Sanjay Kumar, Pushpalata, (2011), Communication skills, 1stEditionOxfordPress.
3. Ashraf Rizvi M, Effective Technical Communication, McGraw Hill Education, First Edition, 2013.

CO – PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C101.1	-	-	-	-	-	-	-	1	2	3	-	3	-	-
C101.2	-	-	-	-	-	-	-	1	2	3	-	2	-	-
C101.3	-	-	-	-	-	-	-	2	2	3	-	2	-	-
C101.4	-	-	-	-	-	-	-	3	2	3	-	2	-	-
C101.5	-	-	-	-	-	-	-	3	2	3	-	3	-	-
AVG	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.00**	**2.00**	**3.00**	**-**	**2.40**	**-**	**-**

23BECC102 **SEMESTER-I**

MATRICES AND CALCULUS **4H-4C**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for students:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the student with the differential calculus of multivariable functions. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals.
- To make the students acquire sound knowledge in techniques of solving linear ordinary differential equations.
- To provide knowledge about the concepts of partial differential equation with constant coefficients.

COURSE OUTCOMES:

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

- Make use of orthogonal transformation to reduce the quadratic form to canonical form.
- Utilize differential calculus of multivariable to optimization problems.
- Apply multiple integrals for finding area and volume.
- Solve the n^{th} order Ordinary Differential Equations (ODE) and Homogeneous equation of Euler's type.
- Solve the n^{th} order Partial Differential Equations.

UNIT I MATRICES 12

Eigenvalues and Eigenvectors of a real matrix– Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS OF MULTIVARIABLE FUNCTIONS 12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions –Applications: Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT III MULTIPLE INTEGRALS 12

Proper and Improper integrals - Bernoulli's extension formula – Double integrals – Change of order of integration – Double integrals in polar coordinates – Area using double integrals – Evaluation of Triple Integrals

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 12

Linear differential equation of second and higher order with constant coefficients – Euler-Cauchy linear differential equation – Method of Variation of parameters.

UNIT V PARTIAL DIFFERENTIAL EQUATIONS 12

Homogeneous linear partial differential equations of second and higher order with constant coefficients – Classification of partial differential equations.

TOTAL: 45+15

TEXT BOOKS:

1. Grewal, B. S., & Grewal, J. S. (1996). Higher engineering mathematics. 2018, Khanna Publishers, New Delhi.
2. Kreyszig, E. (2007). Advanced Engineering Mathematics 10th Edition with Wiley Plus Set (p. 334). John Wiley & Sons.

REFERENCE BOOKS:

1. Thomas, B. T., and Ross L Finney (2002). Calculus and Analytic Geometry, Pearson Publishers, Ninth edition
2. Ross, S. L. (1984). Differential Equation-Jhon Wiley & Sons. Inc. New York.
3. Henner, V., Belozerova, T., & Khenner, M. (2013). Ordinary and partial differential equations. CRC Press.

WEBSITES:

1. www.archive.nptel.ac.in/courses/111/108/111108157/
2. www.nptel.ac.in/courses/111107108
3. www.archive.nptel.ac.in/courses/111/104/111104125/
4. www.nptel.ac.in/courses/111108081
5. www.nptel.ac.in/courses/111108144

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C102.1	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C102.2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C102.3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C102.4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C102.5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
AVG	**3.00**	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**1.00**	**-**

23BECC103 **SEMESTER-I**

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:

The goal of this course is for students to:

- Create the awareness about environmental problems among people.
- Develop an attitude of concern for the environment.
- Motivate public to participate in environment protection and improvement.
- To gain a variety of experiences and acquire a basic understanding of environment and it's associated problems.
- Relate critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

COURSE OUTCOMES:

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

- Outline the ecological processes supporting the life system.
- Infer the importance of environment and impact of human activities on natural resources.
- Explain the levels and values of biodiversity and its conservation.
- Summarize the problems of environmental pollution and its control measures.
- Interpret the remediation methods for social issues and degraded environment.

UNIT I INTRODUCTION - ENVIRONMENTAL STUDIES& ECOSYSTEMS 9

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grass and Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT II NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES 9

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 9

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 9

Definition, causes, effects and control measures of Air pollution, Water pollution-Water reuse and recycling, 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 9

Concept of sustainability and sustainable development, Circular economy. 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 (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols). Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides). Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., NG vehicles in Delhi).Human population growth: Impacts on environment ,human health and welfare.

Total Hours: 45

TEXT BOOKS:

1. Anubha Kaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.
2. Erach Bharucha. 2004. A text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, New Delhi.
3. Rajagopalan, R. 2016. Environmental Studies: From Crisis to Cure, Oxford University Press.
4. Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.
5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S. Chand& Company Pvt. Ltd., New Delhi.
6. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
7. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
8. Tripathy. S.N., and Sunakar Panda. (2004). Fundamentals of Environmental Studies (2nd ed.). Vrianda Publications Private Ltd, New Delhi.
9. Verma, P.S., and Agarwal V.K. 2001. Environmental Biology (Principles of Ecology). S. Chand and Company Ltd, New Delhi.
10. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, New Delhi.

CO-PO MAPPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C103.1	2	1	-	-	-	2	3	3	-	1	-	2	1	-
C103.2	2	1	-	-	-	2	3	3	-	1	-	2	1	-
C103.3	2	1	-	-	-	2	3	3	-	1	-	2	1	-
C103.4	2	1	-	-	-	2	3	3	-	1	-	2	1	-
C103.5	2	1	-	-	-	2	3	3	-	1	-	2	1	-
AVG	**2.00**	**1.00**	**-**	**-**	**-**	**2.00**	**3.00**	**3.00**	**-**	**1.00**	**-**	**2.00**	**1.00**	**-**

23BEME141 **SEMESTER I**

ENGINEERING PHYSICS **6H-5C**
(Theory & Laboratory)

Instruction Hours/week: L:4 T:0 P:2 **Marks:** Internal**:40** External**:60 T**otal**:100**

End Semester Exam: 3 Hours

(I)THEORY

COURSE OBJECTIVES:

The goal of this course is for students to

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

COURSE OUTCOMES:

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

- Identify the elastic properties of the materials using Young's modulus and rigidity modulus
- Examine the performance of light, laser and optical fibres
- Apply the concept of thermal properties for calculating thermal conductivity of the materials
- Relate the quantum concepts in electron microscope
- Outline the basics of crystals, structures and its defects

UNIT I PROPERTIES OF MATTER **9**

Elasticity –stress – strain – Hookes law- classification of elastic modulus -Poisson's ratio - Stress-Strain diagram and its uses - factors affecting elastic modulus and tensile strength Moment, Couple and Torque– Twisting couple on a wire - Torsion pendulum- bending of beams – bending moment – cantilever-young's modulus – uniform bending and non-uniform bending (Experimental) – I- shaped girders and its applications.

UNIT II LASER AND FIBER OPTICS **9**

LASER: Introduction - characteristics - Einstein's co-efficients derivation Principle of laser action-population inversion- pumping methods -Types of laser - Nd: YAG, CO_2- Applications of LASER in industry and medicine.

Fiber optics - principle– 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).

UNIT III THERMAL PHYSICS **9**

Mode of Heat Transfer -conduction, convection, radiation (qualitative) - thermal expansions of solid and liquid - bimetallic strips – thermal conductivity: Forbe's and Lee's disc method: theory and experiment – heat conduction through compound media (series and parallel) – Thermal insulators – Laws of thermodynamics – refrigerators-microwave oven and solar water heater.

UNIT IV QUANTUM PHYSICS **9**

Black body radiation -Energy Distribution laws: Stefan Boltzmann's law, Wein's Displacement law Rayleigh Jeans Law- Photo electric effect – Compton effect (Qualitative) – De Broglie hypothesis - uncertainty principle – physical significance of wave function - Schrödinger's Time dependent wave equation - Schrödinger's Time independent wave equation –Electron Microscope: Scanning Electron Microscope and Transmission Electron Microscope.

UNIT V CRYSTAL PHYSICS **9**

Classification of solids: Crystalline and amorphous solids – crystal structure - unit cell, primitive cell – seven crystal systems, Bravais lattices, Miller indices – inter-planar distances (Qualitative) - Coordination number and atomic packing factor for Simple Cubic, Body Centered Cubic, Face Centered Cubic, Hexagonal Closed Packing structures – Defects in crystal: Point & Line defect.

Total: 45

TEXT BOOKS:

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

- Nature Physics
- Journal of Applied Mechanics (ASME)
- Ultrasonics and sonochemistry (Elsevier)
- Journal of Light wave Technology (IEEE)
- Optics and Laser Technology (Elsevier)
- Applied Thermal Engineering (Elsevier)
- Physical Review B (American Physical Society)

WEB LINKS

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

(ii) LABORATORY

LIST OF EXPERIMENTS – PHYSICS (Any 7 Experiments)

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc
2. Uniform bending– Determination of young's modulus.
3. Non-uniform Bending – Determination of young's modulus.
4. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille's flow.
5. Laser- Determination of the wave length of the laser using grating,
6. Optical Fiber – Determination of Numerical Aperture and Acceptance angle of the optical fiber.
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. Characteristics of photo diode.

CO PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C103.1	3	2	1	-	-	-	-	-	2	2	-	1	1	-
C103.2	3	3	2	-	-	1	-	-	2	2	-	1	1	-
C103.3	3	2	-	-	-	-	-	-	2	2	-	1	1	-
C103.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C103.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.60**	**1.80**	**1.50**	**-**	**-**	**1.00**	**-**	**-**	**2.00**	**1.60**	**-**	**1.00**	**1.00**	**-**

23BECC142 **SEMESTER I**

PROGRAMMING IN C (Theory & Laboratory) **7H-5C**

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

End Semester Exam:3 Hours

(i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students:

- To interpret problem solving using C.
- To apply the concept of arrays and strings.
- To identify the functions of C Language.
- To apply the concept of pointers .
- To develop C Programs using user defined function and file handling.

COURSE OUTCOMES:

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

- Apply problem solving techniques for a given problem
- Solve problems using arrays and strings.
- Build modular applications in C using functions.
- Categorize dynamic memory management operators with pointers.
- Examine sequential and random access file processing.

UNIT I INTRODUCTION 9

An overview of computers and programming - Understanding computer systems - Programming logic - Steps in program development – Algorithm - Using pseudocode and flowchart – types of programming languages – Compiler – Interpreter – Linker - Introduction to C – Structure of C program - Identifiers and Keywords - Data types - Constants and variables - Type conversion – Operators - Expressions. Formatted and Unformatted Input/Output functions - Control structures

UNIT II ARRAYS AND STRINGS 9

Arrays in C - Declaring and initializing arrays in C - Defining and processing 1D and 2D arrays - Inserting and deleting elements of an array - Strings - Defining and initializing strings - Processing of string - Character arithmetic - String manipulation functions and libraryfunctions of string.

UNIT III FUNCTIONS 9

Functions - Types of Functions - Function prototypes - Function definition - Function call including passing arguments by value and passing arguments by reference - Passing arrays to functions - Math library functions - Recursive functions - Scope rules (local and global scope) - Storage classes in C.

UNIT IV POINTERS 9

Pointers - Pointer declaration and initialization - Types of pointers - Pointer expressions and arithmetic - Operations on pointers - Passing pointer to a function - Pointer and one-dimensional array - Pointers and strings – Command line arguments - Dynamic memory management functions.

UNIT V USER DEFINED TYPES AND FILE HANDLING 9

User defined types - Enumerator – Typedef - Structures - Declaration of a structure - Accessing structures - Array of Structures - Structures and pointers - Nested structures – Bit fields – Unions - Declaration of a union – Accessing unions – Union vs Structure - File Input/Output – Preprocessor directives.

TOTAL :45

TEXTBOOKS

1. Programming In C By Ashok N. Kamthane,3rd edition, Pearson, 2015.
2. Programming In C, Reema Thareja, Oxford University Press, Second Edition, 2016.

REFERENCES BOOKS

1. "C How To Program" By Paul Deitel And Harvey Deitel, 8th edition, Prentice Hall, 2015.
2. "Programming In Ansi C" By E. Balagurusamy, 8th edition, Mcgraw Hill Education, 2019.
3. "Let Us C", by Yashwant Kanetkar, 17th Edition, Bpb Publications, 2020.
4. "C: The complete reference", Herbert Schildt, 4th edition, Mcgraw Hill Education, 2017.

WEBSITES

1. www.hackerrank.com
2. www.codechef.com
3. www.learn-c.org
4. www.udemy.com
5. www.hackearth.com

(ii) LABORATORY

LIST OF EXPERIMENTS:

1. Develop a C Program to find the roots of quadratic equation for non-zero co-efficient using if-else ladder construct.
2. Develop Programs using simple control statements such as if else, while, do while. Example Extracting the digits of an integer, reversing digits, finding sum of digits.
3. Develop a C Program to implement a simple calculator to perform addition, subtraction, multiplication and division operations using switch construct. Display appropriate messages for invalid operator and divide by zero error.
4. Develop C Program to generate Fibonacci sequence, calculation of factorials, printing various patterns and generate the Prime numbers between the ranges m & n using for loop.
5. Develop a C program to read n elements into an integer array, Insert and Delete element from the array. Print the input array and the resultant array with suitable messages.

6. Develop a C program to read two matrices A (m x n) and B (p x q) and compute the product of the two matrices. Print both the input matrices and resultant matrix with suitable headings and output should be in matrix format only. Program must check the compatibility of orders of the matrices for multiplication. Report appropriate message in case of incompatibility.
7. Develop a C function Program to sort the given names in Ascending Order**.**
8. Develop a C program to count the vowels & consonants in a given string.
9. Develop a C Program to find the GCD of two integers using Euclid's algorithm
10. Develop a recursive C function to find the factorial of a number, n! , defined by fact(n)=1, if n=0. Otherwise fact(n)=n*fact(n-1). Using this function, develop a C program to compute the Binomial coefficient nCr. Perform input validation as well.
11. Develop a C program to find the smallest and largest elements in an array using pointers and then swap these elements and display the resultant array.
12. Develop a C program to find the sum of all the elements of an integer array using pointers.
13. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using structures and pointers

TOTAL : 30

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C103.1	3	2	1	-	-	-	-	-	2	2	-	2	1	-
C103.2	3	2	1	-	-	-	-	-	2	2	-	2	1	-
C103.3	3	2	1	-	-	-	-	-	2	2	-	2	1	-
C103.4	3	3	2	1	-	-	-	-	2	2	-	2	1	-
C103.5	3	3	2	1	-	-	-	-	2	2	-	2	1	-
AVG	**3.00**	**2.40**	**1.40**	**1.00**	**-**	**-**	**-**	**-**	**2.00**	**2.00**	**-**	**2.00**	**1.00**	**-**

SEMESTER I

23BEME111 ENGINEERING GRAPHICS I 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 the students to:

- Expose them to existing national standards related to technical drawings and develop their ability to produce engineering drawings using drawing instruments.
- Emphasize freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.
- Introduce CAD software for the creation of 2D engineering drawings.
- Develop a clear understanding of projection and the projection of points.
- Produce computer generated drawings using CAD software and develop a clear understanding of plane geometry.

COURSE OUTCOMES:

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

- Apply BIS and ISO standards in engineering drafting.
- Illustrate orthographic projections using free hand sketching.
- Explain the theory of CAD software.
- Construct the projection of points and lines using CAD software.
- Construct the projection of plane surfaces using CAD software.

UNIT I INTRODUCTION 9

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 HAND SKETCHING 9

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 9

Overview of Computer Graphics, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software, 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 and other functions. Sketching of 2D simple geometries, editing and dimensioning of 2D geometries.

UNIT IV PROJECTION OF POINTS AND LINES 9

Projection of points and straight lines located in the first quadrant inclined to both planes– Determination of true lengths and true inclinations (By using CAD software).

UNIT V PROJECTION OF PLANE SURFACES 9

Projection of polygonal surface and circular lamina inclined to both reference planes (By using CAD software).

TOTAL: 45

TEXT BOOKS:

1. Venugopal K and Prabhu Raja V, (2021), Engineering Graphics, New Age International Publishers.
2. James D. Bethune, (2020), Engineering Graphics with AutoCAD, Macromedia Press.
3. C M Agrawal and Basant Agrawal, (2019), Engineering Graphics, Tata McGraw Hill, New Delhi.

REFERENCE BOOKS:

1. Annaiah M.H., Prem Kumar, Chandrappa C N, (2022), Computer Aided Engineering Drawing, New Age International Private Limited.
2. Narayana, K.L. and P Kannaiah, (2021), Text book on Engineering Drawing, Scitech Publications (India) Pvt. Ltd.
3. Shah, M.B. and Rana B.C., (2010), Engineering Drawing and Computer Graphics, Pearson Education.
4. Bhatt N.D., Panchal V.M. and Ingle P.R, (2019), Engineering Drawing, Charotar Publishing House.

WEBSITES:

1. https://onlinecourses.nptel.ac.in/noc21_me128
2. https://www.mygreatlearning.com/academy/learn-for-free/courses/engineering-graphics-drawing
3. https://www.autodesk.in/solutions/technical-drawing

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C103.1	3	2	1	-	-	-	-	1	-	2	-	2	-	-
C103.2	2	1	-	-	-	-	-	1	-	2	-	2	-	-
C103.3	2	1	-	-	2	-	-	1	-	2	-	2	-	-
C103.4	3	2	1	-	3	-	-	1	-	2	-	2	-	-
C103.5	3	2	1	-	3	-	-	1	-	2	-	2	-	-
AVG	**2.60**	**1.60**	**1.00**	**-**	**2.67**	**-**	**-**	**1.00**	**-**	**2.00**	**-**	**2.00**	**-**	**-**

22BEMC151 **SEMESTER-I**

DESIGN THINKING **3H-2C**

Instruction Hours/week: L:1 T:0 P:2 **Marks:** Internal**:100 T**otal**:100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Illustrate design thinking concepts and principles
- Utilize design thinking methods in every stage of the problem
- Identify the different phases of design thinking
- Plan for various product and service communication in design thinking
- Interpret the use of tools for the design process

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Explain the design thinking process, tools and theories.
- Identify the types of users and the requirements of customers.
- Explore the concepts of Prototyping and its testing.
- Analyze design thinking strategies in product and service design.
- Customize existing products by utilizing design thinking strategies.

UNIT I INTRODUCTION 6

Understanding Design thinking and tools - Human-Centric Design Process - Design Thinking Process- DT Activity with case studies.

UNIT II EMPATHISE WITH USERS 6

Five Whys - Needs of user - Types of user research -Customer Journey Mapping - Observational Research

UNIT III PROTOTYPING 6

Ideas to presentable concepts - Scenario-based Prototyping – Testing prototypes - Usability and ergonomic testing - Rapid prototyping.

UNIT IV PRODUCT AND SERVICE DESIGN 6

Product Design - Interaction Design- Service Design - Communication Design - Transportation Design.

UNIT V DESIGN AND INNOVATION 6

DT For strategic innovations - Extreme Competition - Experience design - Standardization - Humanization - Creative Culture.

TOTAL HOURS: 30

TEXT BOOKS:

1. Bala Ramadurai, "Karmic Design Thinking", 2020.
2. Christian Mueller-Roterberg, “Handbook of Design thinking”, Amazon Digital Services LLC KDP Print US, 2018.
3. Tim Brown, “Change by Design”, Harper Business Publisher, 2019
4. Hasso Plattner, Christoph Meinel and Larry Leifer, "Design Thinking: Understand –Improve Apply", Springer, 2011
5. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C112.1	2	1	1	-	-	-	-	1	1	1	-	3	-	-
C112.2	3	2	1	-	-	-	-	2	1	1	-	3	-	-
C112.3	3	2	2	1	-	2	1	2	2	2	-	3	-	-
C112.4	3	3	2	1	-	2	1	2	2	2	-	3	-	-
C112.5	3	3	2	1	-	2	1	2	2	2	-	3	-	-
AVG	**2.80**	**2.20**	**1.60**	**1.00**	**-**	**2.00**	**1.00**	**1.80**	**1.60**	**1.60**	**-**	**3.00**	**-**	**-**

23BEMC152	SEMESTER-I
SPORTS AND YOGA	1H-0C
Instruction Hours/week: L:1 T:0 P:0	**Marks:** Internal**:100** External**:0** Total**:100**

COURSE OBJECTIVES

The goal of this course, is for the students:

1. To have knowledge of Physical fitness and exercise management to lead better quality life
2. To enable to officiate, supervise various sports events and organize sports events
3. To acquire the knowledge of Physical Education, Sports and Yoga and understand the purpose and its development
4. To gain knowledge to plan, organize and execute sports events

COURSE OUTCOMES

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

1. Practice physical activities and yoga for strength, flexibility and relaxation.
2. Use techniques for increasing concentration and decreasing anxiety for stronger academic performance.
3. Perform yoga exercises in various combination and forms.
4. Improve personal fitness through participation in sports and yoga activities.
5. Follow sound nutritional practices for maintaining good health and physical performance.

UNIT I INTRODUCTION TO PHYSICAL FITNESS

Explain importance of physical education - Describe importance of Physical Fitness & Wellness - Explain the components of physical fitness - Demonstrate healthy life style - Prevent health threats by changing life style

UNIT II FUNDAMENTALS OF ANATOMY & PHYSIOLOGY IN SPORTS & YOGA

Explain importance of anatomy and physiology - Describe effects of exercise in various body systems - Describe concept of correct posture - Explain corrective measures for posture deformities.

UNIT III YOGA & PRANAYAMA

Explain importance of yoga - Perform various pranayama for increasing concentration - Use meditation and other relaxation techniques for improving concentration.

TEXT BOOKS:

1. Ajmer Singh, Modern Trends and Physical Education class 11&class12, Kalyani Publication, New Delhi ISBN:9789327264319.
2. B.K.S. Iyengar, Lighton Yoga, Thomson's Publication, New Delhi ISBN: 8172235011
3. V.K. Sharma, Health and Physical Education, NCERT Books; Class11,12Saraswati House Publication, New Delhi
4. Acharya Yatendra, Yoga and Stress Management, Fingerprint Publishing ISBN: 938905303X
5. Swami Vivekanand, Patanjali Yoga Sutras, Fingerprint Publishing
6. Ramdev, Pranayam Rahasya, Patanjali-Divya Prakashan, Haridwar
7. Ramdev, Yoga its Philosophy & Practice, Divya Prakashan, Haridwar.

23BTMC153 **பருவம் -I**

தமிழர் மரபும் பண்பாடும் **1 H – 0 C**

கற்பித்தல் நேரம்/வாரம்: **L:1 T:0 P:0** **மதிப்பெண்: இடைத்தேர்வு: 100 மொத்தம்:100**

பாடத்திட்ட பயன் விளைவு:

- வரலாற்றிற்கு முற்பட்ட தமிழகத்தை மாணவர்களுக்கு அறிமுகப்படுத்துதல்
- பழந்தமிழர் பண்பாடு சார்ந்த வாழ்க்கை முறையை மாணவர்கள் அறிய ஊக்குவித்தல்
- தமிழ் மொழியின் பழைமையும், திராவிட மொழிகளில் தமிழ்மொழியின் தனிச்சிறப்பையும் மாணவர்களுக்கு அறிமுகப்படுத்துதல்.
- தமிழர்களின் வாழ்வியல், தமிழர்கலைகள், ஆற்றங்கரைப்பண்பாடுகள் குறித்து மாணவர்கள் அறியச்செய்தல்.
- இந்தியக்குடியுரிமைப்பணி முதலான போட்டித்தேர்வுகளில் விருப்பப்பாடமாக இடம்பெறுகின்ற தமிழ்நாகரிகமும் பண்பாடும் குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்

பாடத்திட்டப் பொதுநோக்கம்:

1. இந்தியக்குடியுரிமைப்பணி முதலான போட்டித்தேர்வுகளில், விருப்பப்பாடமாக இடம்பெறுகின்ற, 'தமிழ்இலக்கியவரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத்தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
3. தமிழின்வளர்ச்சித்துறையாகிய, 'அறிவியல்தமிழ்'; 'இணையதமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச்சிந்தனை மேம்பாடு.
4. வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
5. சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப்பேணுவதற்குக்கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மைவளர்ச்சி. மொழிபெயர்ப்புத்துறை சார்ந்த வேலைவாய்புத்திறன் பெற்றிருத்தல்.

அலகு:1 தமிழர் மரபு

மரபு-விளக்கம்-சங்ககால தமிழர் மரபு – திணைப்பகுப்பும் தமிழர் மரபும்-உலகப்பொதுமை – அகத்திணை மரபு – புறத்திணை மரபு- இடைக்காலத்தமிழர் மரபு – பிற்கால மரபும் மாற்றமும் – தற்கால தமிழர்மரபு - வளர்ச்சி.

அலகு: 2 தமிழர் பண்பாடு

பண்பாடு – விளக்கம் – பழந்தமிழர் பண்பாடு – இயற்கை சார்ந்த வாழ்வியல் – தமிழர் சமயம் – அரசியல் நிலை–சமூகப் பழக்கவழக்கங்கள் – நம்பிக்கைகள் – வாழ்வியல் அறங்கள் – வணிகம் போன்றவை.

அலகு:3 தமிழர் கலைகள்

தமிழகத்தில் கலைகளின் வளர்ச்சி – சிற்பக்கலை வளர்ச்சி –கோயில் கலை – கற்கோவில்கள் - ஓவியக்கலை – அழகுக்கலைகள் - கூத்துக்கலை – மருத்துவக்கலை – நாடகக்கலை– இசைக்கலை போன்றவை.

அலகு: 4 தமிழர் சமயம்

பழந்தமிழரின் சமயம் – சங்ககால சமயம் – தொல்காப்பியத்தில் சமயம் – சைவ சமயம் – வைணவம் – தமிழ்ப் பண்பாட்டில் பௌத்தம் – தமிழ்ப் பண்பாட்டில் சமணத்தின் தாக்கம்–தமிழ்ப் பண்பாட்டில் இசுலாம் மற்றும் கிறித்துவ சமயத்தின் தாக்கம்- தமிழர் பண்பாட்டில் விழாக்கள்- கோயில்களும் விழாக்களும்- சமூக ஒருங்கிணைப்பில் விழாக்களின் பங்கு-சங்க இலக்கியத்தில் விழாக்கள் பற்றிய குறிப்புகள்-இடைக்கால இலக்கியங்களில் விழாக்கள் பற்றிய செய்திகள் – விழாக்களின் சமூகப்பங்களிப்பு – தற்காலத்தில் தமிழர் விழாக்கள் - விளையாட்டும் விழாக்களும்.

அலகு: 5 இலக்கியங்களில் தமிழர் பண்பாட்டுப் பதிவுகள்

சங்க இலக்கியமும் வாழ்வியலும்-திருக்குறளில் வாழ்வியல் நெறிகள் – இரட்டைக் காப்பியங்களும் வாழ்வியலும் – சிற்றிலக்கியங்களில் வாழ்வியல் பதிவுகள்-இக்கால இலக்கியமும் வாழ்வியலும்.

பார்வைநூல்கள்:

1. *தமிழ் இலக்கிய வரலாறு – தமிழண்ணல், மீனாட்சி புத்தக நிலையம்- மதுரை-இரண்டாம் பதிப்பு-ஜூலை – 2000.*
2. *தமிழர் நாகரிகமும் பண்பாடும், அ. தட்சிணாமூர்த்தி, ஐந்திணைப் பதிப்பகம், சென்னை, திருத்திய பதிப்பு – 2022.*
3. *தமிழர் வரலாறும் பண்பாடும், நா. வானமாமலை, நியூசெஞ்சுரி புக் ஹவுஸ், சென்னை, ஆறாம்பதிப்பு - 2007 .*
4. *தமிழக வரலாறு மக்களும் பண்பாடும், கே.கே. பிள்ளை, உலகத் தமிழராய்ச்சி நிறுவனம், சென்னை.*

23BECC201C **SEMESTER-II**

TRANSFORMS AND ITS APPLICATIONS **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:

The goal of this course is for students:

- To make the students to understand the concept of periodic function and represent them in Fourier series.
- To make the students to understand the applications of partial differential equations.
- To acquaint the students with the concepts of Fourier transform techniques.
- To impart knowledge in Laplace, transform techniques and its applications.
- To provide knowledge about solving ordinary differential equations using the Inverse Laplace transform.

COURSE OUTCOMES:

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

- Illustrate Fourier series representation of periodic functions.
- Apply Fourier series in one dimensional heat flow and wave equation.
- Make use of Fourier transform for converting elementary functions into frequency domain.
- Utilize Laplace Transform to convert time-domain systems into frequency-domain systems.
- Apply Inverse Laplace Transform in linear differential equations.

UNIT I FOURIER SERIES 12

Dirichlet's conditions – General Fourier series in the interval *(0,2l) & (-l,l)* – Half range sine series –Half range cosine series –Harmonic analysis.

UNIT II APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Fourier series solution for one dimensional wave equation – Fourier series solution for one dimensional heat equation with zero end conditions.

UNIT III FOURIER TRANSFORMS 12

Fourier transform pair – Complex form of Fourier transform- Fourier sine and cosine transforms – Convolution theorem – Parseval's identity of Fourier transforms.

UNIT IV LAPLACE TRANSFORM 12

Transforms of standard functions – Properties of Laplace transform – Transforms of derivatives and integrals –Initial and final value theorem – Transforms of periodic functions.

UNIT V INVERSE LAPLACE TRANSFORM 12

Inverse Laplace transforms of standard functions – Inverse Laplace transform using second shifting theorem – Method of partial fractions– Solution of ordinary differential equations with constant coefficients using Laplace transforms

TOTAL: 45+15

TEXT BOOKS:

1. John W. Miles Integral Transforms in Applied Mathematics Cambridge University Press 2008
2. Erwin Kreyszig Advanced Engineering Mathematics John Wiley and Sons, Tenth Edition 2017

REFERENCE BOOKS:

1. Eric W Hansen Fourier Transforms: Principles and Applications John Wiley 2014
2. N.W. McLachlan Laplace Transforms and Their Applications to Differential Equations Dover Publications Inc. 2014
3. Richard Haberman Applied Partial Differential Equations with Fourier Series and Boundary Value Problems Pearson, Fifth edition 2021

Web URL:

1. www.nptel.ac.in/courses/111106111
2. www.nptel.ac.in/courses/111107111
3. www.nptel.ac.in/courses/111102129
4. www.nptel.ac.in/courses/111106139
5. www.archive.nptel.ac.in/courses/111/105/111105123/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C201.1	2	1	-	-	-	-	-	-	-	-	-	1	1	-
C201.2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C201.3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C201.4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C201.5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
AVG	**2.80**	**1.80**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**1.00**	**-**

23BEME202 **SEMESTER-II**

PHYSICS FOR MECHANICAL ENGINEERS **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 to

- Understand the basic physics principles, concepts of materials and their mechanical applications
- Introduce the essential theorems, principles and its applications of Motion
- Impart the basic knowledge about ultrasonics and its applications.
- Disseminate the magnetic and super conducting properties of materials and their applications.
- Introduce the essential principles of dielectric materials for engineering applications

COURSE OUTCOMES:

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

- Classify the motion, system of particles and collision.
- Utilize the properties of sound and its nondestructive testing of materials.
- Illustrate the properties of magnetic and superconducting materials.
- Infer the types of polarization and dielectric breakdown.
- Outline the properties of low dimensional materials and its fabrication methods.

UNIT I MOTION AND SYSTEM OF PARTICLES **9**

Motion: Rectilinear motion, Equation of motions, Expression for distance travelled. Drag force & Drag Coefficient - derivation for velocity and position - System of particles: Newton's law for a system of particles - Linear momentum for a particle and a system of particles - Conservation of linear momentum - Single Stage Rocket : Motion, Velocity & Acceleration – Collisions: Elastic and inelastic collisions.

UNIT II PRINCIPLES & APPLICATIONS OF ULTRASONICS **9**

Physics of Sound - Classification of sound - loudness and intensity - standard intensity and intensity level – decibel - Ultrasonics fundamentals - Ultrasonics production: Magnetostriction and Piezoelectric methods - industrial applications – Non-destructive testing - pulse echo system through transmission and reflection modes – scan displays.

UNIT III MAGNETIC & SUPERCONDUCTING MATERIALS **9**

Magnetic moment – Bohr magneton – magnetic dipole - Dia, Para, Ferromagnetic materials, Ferromagnetism – types of energy – hysteresis – soft and hard magnetic materials – ferrites. Superconductivity – properties of superconductors – type I and type II superconductors, BCS theory, High T_c superconductors, applications.

UNIT IV DIELECTRIC MATERIALS **9**

Electrical Susceptibility – dielectric constant - Polarization – types of polarization – total polarization - Lorentz field – derivation to find local field - Clausius – Mossotti Relation– frequency effects on polarization – dielectric loss - dielectric breakdown – insulating materials – Ferroelectricity - applications of dielectric materials.

UNIT V NANOMATERIALS **9**

Density of states in 2D, 1D and 0D (qualitatively), Practical examples of low-dimensional systems such as quantum wells, wires, and dots – Nanostructures: Fabrication technique (Chemical vapour deposition, Pulsed laser deposition), Properties and its applications – Carbon nanotubes: Properties and applications.

TOTAL HOURS: 45

TEXT BOOKS:

1. Bhattacharya D.K. & Poonam T., Engineering Physics, Oxford University Press, (2015).
2. Halliday. D. Resnick R. & Walker. J, Principles of Physics, Wiley, (2015).
3. D.S. Mathur, Mechanics, S. Chand & Company Ltd., New Delhi –(1990).
4. K N Sreenivasa Rao, Classical Mechanics, Universities Press- Orient Longman (2003 ed)
5. Mechanics- Berkeley Physics Course Vol (1)- SI units Charles Kittel et al, McGraw Hill Education (India) 2e (2011).
6. Kulkarni, Sulabha K, Nanotechnology: Principles and Practices, Springer International Publishing, (2015).

JOURNALS

1. Journal of Applied Mechanics (ASME)
2. Journal of Alloys and Compounds (ELSEVIER)
3. Ceramics International (ELSEVIER)
4. Magnetism and Magnetic Materials (ELSEVIER)
5. IEEE Transactions on Magnetics (IEEE)
6. Journal of Superconductor and Novel Magnetism (SPRINGER)

WEB LINKS

1. www.nptel.ac.in/courses/122104014/
2. www.nptel.ac.in/courses/118104008/
3. www.nptel.ac.in/courses/115101012/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C202.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C202.2	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C202.3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C202.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C202.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME203 **SEMESTER-II**

ENGINEERING CHEMISTRY **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:

- To learn the basics of Periodic properties, Intermolecular forces
- To infer the terminologies of electrochemistry and to analyze about energy storage devices
- To build the concept of corrosion and its prevention
- To summarize the basic water technology and its purification.
- To develop an understanding of the range and uses of analytical methods in chemistry

COURSE OUTCOMES:

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

- Identify periodic properties of elements.
- Apply the concepts of electrochemistry in storage devices.
- Illustrate the types of corrosion and its prevention.
- Identify the quality of water and its treatment methodologies.
- Explain the principle and working of spectroscopic techniques.

UNIT I - PERIODIC PROPERTIES, INTERMOLECULAR FORCES 9

Introduction to Periodic Properties- atomic and ionic sizes, ionization energies, electron affinity and electronegativity, effective nuclear charge. Penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations. Polarizability, oxidation states, coordination numbers. Ionic, dipolar and van Der Waals interactions.

UNIT II ELECTROCHEMISTRY AND STORAGE DEVICE 9

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 discharging reactions.

UNIT III CORROSION AND ITS CONTROL 9

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 9

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 9

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

TOTAL HOURS: 45

TEXT BOOKS:

1. P C Jain & Monica Jain, (2015). Engineering Chemistry, 18th edition, Dhanpat Rai Publishing Company
2. B. H. Mahan, (2010).University chemistry, Pearson Education.
3. M. J. Sienko and R. A. Plane,(1976) Chemistry: Principles and Applications. 5th edition, McGraw-Hill Higher Education.
4. C. N. Banwell, (2001) Fundamentals of Molecular Spectroscopy, McGraw-Hill.
5. B. L. Tembe, Kamaluddin and M. S. Krishnan, Engineering Chemistry (NPTEL Web-book)
6. P. W. Atkins, (2009).Physical Chemistry, Oxford University Press.
7. K. P. C. Volhardt and N. E. Schore, (2014).5th Edition, Organic Chemistry: Structure and Function, W.H. Freeman Publications.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C203.1	3	2	-	-	-	1	1	1	-	1	-	1	-	-
C203.2	3	2	-	-	-	1	1	1	-	1	-	1	-	-
C203.3	2	1	-	-	-	1	1	1	-	1	-	1	-	-
C203.4	3	2	-	-	-	1	1	1	-	1	-	1	-	-
C203.5	2	1	-	-	-	1	1	1	-	1	-	1	-	-
AVG	**2.60**	**1.60**	**-**	**-**	**-**	**1.00**	**1.00**	**1.00**	**-**	**1.00**	**-**	**1.00**	**-**	**-**

23BEME241A **SEMESTER-II**

DATA STRUCTURES AND ALGORITHMS (THEORY AND LABORATORY) **6H-5C**

Instruction Hours/week: L:4 T:0 P:2 **Marks:** Internal**:40** External**:60** Total**:100**

End Semester Exam: 3 Hours

PRE-REQUISITES: Programming in C

(i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students**:**

- To understand the concepts of ADTs.
- To learn linear data structures – lists, stacks, and queues.
- To interpret non-linear data structures – trees and graphs.
- To implemented sorting, searching and hashing algorithms.
- To apply Tree and Graph structures to real world scenario.

COURSE OUTCOMES:

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

- Build abstract data types for linked list data structure.
- Apply the concepts of stack, queue and its applications.
- Experiment with operations on binary trees.
- Identify the traversal techniques of graphs and its applications.
- Inspect sorting, searching and hashing techniques.

UNIT I LISTS **9**

Abstract Data Types (ADTs) – Elementary Data types–List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Doubly-linked lists – Circularly linked lists – Applications of lists – Polynomial ADT –Multilists–Sparse Matrices.

UNIT II STACKS AND QUEUES **9**

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – Deque – Applications of Queues.

UNIT III TREES **9**

Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees –Red-Black Trees – Priority Queue (Heaps) – Binary Heap.

UNIT IV MULTIWAY SEARCH TREES AND GRAPHS **9**

B-Tree – B+ Tree – Tries – Graph Definition – Representation of Graphs – Types of Graphs - Breadth-first traversal – Depth-first traversal – Bi-connectivity – Euler circuits – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching – Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Quick Sort – Merge Sort – Heap Sort – Radix Sort – Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45

TEXT BOOKS:

1. Mark Allen Weiss," Data Structures and Algorithm Analysis in C", Pearson Education, Second Edition, 2005
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein," Introduction to Algorithms", Mcgraw Hill/ MIT Press, Fourth Edition,2022

REFERENCE BOOKS

1. Narasimha Karumanchi," Data Structures and Algorithms Made Easy", CareerMonk Publications, First Edition,2016
2. Langsam, Augenstein and Tanenbaum, "Data Structures Using C", Pearson Education, Second Edition,2015
3. Kamthane," Introduction to Data Structures in C", Pearson Education, First Edition,2007
4. Kruse," Data Structures and Program Design in C", Pearson Education, Second Edition,2003

WEBSITES

1. www.nptel.ac.in/courses/106106145
2. www.nptel.ac.in/courses/106102064
3. www.coursera.org/learn/data-structures
4. www.edx.org/learn/data-structures
5. www.cs.usfca.edu/~galles/visualization/Algorithms.html

(ii) LABORATORY

LIST OF EXPERIMENTS:

1. Array implementation of Stack, Queue and Circular Queue ADTs
2. Implementation of Singly Linked List
3. Linked list implementation of Stack and Linear Queue ADTs
4. Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion
5. Implementation of Binary Search Trees and AVL Trees
6. Implementation of Heaps using Priority Queues
7. Implementation of Dijkstra's Algorithm
8. Implementation of Prim's Algorithm
9. Implementation of Linear Search and Binary Search
10. Implementation of Insertion Sort and Selection Sort
11. Implementation of Merge Sort and Quick Sort
12. Implementation of Open Addressing (Linear Probing and Quadratic Probing)

TOTAL: 30

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C241A.1	3	2	1	-	-	-	-	-	2	2	-	2	2	-
C241A.2	3	2	1	-	-	-	-	-	2	2	-	2	2	-
C241A.3	3	2	1	-	-	-	-	-	2	2	-	2	2	-
C241A.4	3	2	1	-	-	-	-	-	2	2	-	2	2	-
C241A.5	3	3	2	1	-	-	-	-	2	2	-	2	2	-
AVG	**3.00**	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**-**	**2.00**	**2.00**	**-**	**2.00**	**2.00**	**-**

23BEME241B **SEMESTER-II**

OBJECT ORIENTED PROGRAMMING WITH PYTHON 6H-5C
(THEORY AND LABORATORY)

Instruction Hours/week: L:4 T:0 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 the students**:**

- To learn basic python language syntax, semantics and control structures.
- To apply list, tuple, set and dictionary to handle data.
- To solve the problems using functions and modules.
- To infer the object-oriented programming concepts in python.
- To interpret inheritance and exception handling in python.

COURSE OUTCOMES:

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

- Apply python control flow statements to solve problems.
- Model data structures for string, tuple, list, set, and dictionary.
- Identify Python built-in functions to write user defined functions.
- Apply object-oriented programming concepts in python.
- Analyze the concepts of exception handling to a real world scenario.

UNIT I PYTHON FUNDAMENTALS **9**

Introduction to Python – language classification - python language syntax - keywords - identifiers - indentation - comments - input - output - escape characters – variables – operators - Control Statements.

UNIT II DATA STRUCTURES IN PYTHON **9**

String - Mutable vs immutable types – indexing and slicing – String functions - Tuple - Tuple operations– List - List operations – List as array – List comprehension - Set - Set operations – Dictionary – Dictionary operations.

UNIT III FUNCTIONS AND MODULES **9**

Python built in functions - User defined functions - Creating function – Invoking functions – Types of function arguments – Recursion and lambda or anonymous functions - Defining, Creating and Accessing a Package, importing packages and user defined modules.

UNIT IV CLASSES AND OBJECTS **9**

Object Oriented terminologies (class, object, method, inheritance, abstraction, encapsulation, polymorphism) – UML Class diagram - access specifiers – Creating classes – Creating object – Accessing members - __init__() method - instance, static and class methods - Importance of self – Implementing encapsulation.

UNIT V INHERITANCE, POLYMORPHISM AND EXCEPTION HANDLING **9**

Implementing inheritance – Types of inheritance – Implementing Polymorphism - Method overloading – Method overriding – Operator overloading - Abstract Classes - Association and Aggregation - Errors vs exceptions – Handling exceptions – Raising exception – Creating user defined exception.

TOTAL: 45

TEXT BOOKS:

1. Think Python: How to Think Like a Computer Scientist Anany Levitin, Allen B. Downey Second Edition, O'Reilly, 2016.
2. Python 3 Object-oriented Programming, Dusty Phillips, Third Edition,Packet Publishing, 2018.

REFERENCES BOOKS

1. The Absolute Beginner's Guide to Python Programming, Kevin Wilson, Apress Media LLC, First Edition, 2022.
2. Python 3 The Comprehensive Guide, Johannes Ernesti, Peter Kaiser, Rheinwerk Publishing Inc., First Edition, 2022
3. Fundamentals of Python Programming, Richard L. Halterman, Southern Adventist University, First Edition, 2019

WEBSITES:

1. www.docs.python.org/3/
2. www.programiz.com/python-programming
3. www.scaler.com/topics/python/
4. www.geeksforgeeks.org/python-oops-concepts/
5. www.edureka.co/blog/object-oriented-programming-python/

(ii) LABORATORY

LIST OF EXPERIMENTS:

1. Programs using operators and control structures.
2. Programs using string functions.
3. Programs using tuple.
4. Programs using list.
5. Programs using set.
6. Programs using dictionary.
7. Programs using built-in functions.
8. Implementing user defined functions with various parameter options
9. Implementation of class & objects.
10. Implementation of inheritance and association.
11. Implementation of overloading and overriding.
12. Implementation of exception handling.

TOTAL: 30

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C241B.1	3	2	1	-	-	-	-	-	2	2	-	2	1	2
C241B.2	3	2	1	-	-	-	-	-	2	2	-	2	1	2
C241B.3	3	2	1	-	-	-	-	-	2	2	-	2	1	2
C241B.4	3	2	1	-	-	-	-	-	2	2	-	2	1	2
C241B.5	3	3	2	1	-	-	-	-	2	2	-	2	1	2
AVG	**3.00**	**2.20**	**1.20**	**1.00**	-	-	-	-	**2.00**	**2.00**	-	**2.00**	**1.00**	**2.00**

SEMESTER-II

23BEME211 ENGINEERING GRAPHICS II 4H-3C

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

End Semester Exam: 3Hours

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Develop a clear understanding of plane geometry, solid geometry to improve the visualization skills.
- Develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces
- Introduce CAD software for the creation of 3D models and 2D engineering drawings.
- Comprehend general projection theory, with emphasis on orthographic projection to represent three-dimensional objects in two-dimensional views.
- Develop isometric drawings and convert isometric views of simple objects to orthographic views.

COURSE OUTCOMES:

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

- Construct the projections of simple solids
- Construct the true shape of sectioned solid cylinders, prisms and pyramids.
- Develop the lateral surfaces of simple and truncated solids.
- Develop 2D and 3D sketches of engineering components using CAD software.
- Construct the isometric projections of simple and truncated solids.

UNIT I PROJECTION OF SOLIDS 9

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method (By using CAD software).

UNIT II SECTION OF SOLIDS 9

Sectioning of Prism, Cylinder, Pyramid, and Cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section (By using CAD software).

UNIT III DEVELOPMENT OF SURFACES 9

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis (By using CAD software).

UNIT IV COMPUTER GRAPHICS – 3D 9

Introduction to 3D modeling packages. Drafting practices – 3D modeling of simple engineering components, Assembly and Dismantling of components – sections and extraction of 2D drawings.

UNIT V ISOMETRIC PROJECTIONS 9

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

TOTAL: 45 Hrs.

TEXT BOOKS:

1. Venugopal K and Prabhu Raja V, (2021), Engineering Graphics, New Age International Publishers.
2. James D. Bethune, (2020), Engineering Graphics with AutoCAD, Macromedia Press.
3. C M Agrawal and Basant Agrawal, (2019), Engineering Graphics, Tata McGraw Hill, New Delhi.

REFERENCE BOOKS:

1. Annaiah M.H., Prem Kumar, Chandrappa C N, (2022), Computer Aided Engineering Drawing, New Age International Private Limited.
2. Narayana, K.L. and P Kannaiah, (2021), Text book on Engineering Drawing, Scitech Publications (India) Pvt. Ltd.
3. Shah, M.B. and Rana B.C., (2010), Engineering Drawing and Computer Graphics, Pearson Education.
4. Bhatt N.D., Panchal V.M. and Ingle P.R, (2019), Engineering Drawing, Charotar Publishing House.

WEBSITES:

1. https://onlinecourses.nptel.ac.in/noc21_me128
2. https://www.mygreatlearning.com/academy/learn-for-free/courses/engineering-graphics-drawing
3. https://www.autodesk.in/solutions/technical-drawing

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C211.1	3	2	1	-	2	1	-	-	-	3	-	1	2	-
C211.2	3	2	1	-	2	1	-	-	-	3	-	1	2	-
C211.3	3	2	1	-	2	2	-	-	-	3	-	2	2	-
C211.4	3	2	2	-	2	2	-	-	-	3	-	3	2	-
C211.5	3	2	2	-	2	2	-	-	-	3	-	3	2	-
AVG	**3.00**	**2.00**	**1.40**	**-**	**2.00**	**1.6**	**-**	**-**	**-**	**3.00**	**-**	**2.00**	**2.00**	**-**

		SEMESTER-II
23BEME212	**WORKSHOP PRACTICES**	**4 H – 2 C**

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

COURSE OBJECTIVES

The goal of this course is for the students to built

- To prepare the students to gain the knowledge about various manufacturing methods.
- To impart knowledge on the operations in CNC machining.
- To prepare the students to use the techniques, skills, and modern engineeringtools necessary for engineering practice.
- To provide practical knowledge on the use of Basic Mechanical Components.
- To provide practical knowledge on the use of Mechanical components.

COURSE OUTCOMES

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

- Experiment with lathe machine.
- Identify tools and techniques used for sheet metal fabrication, fitting, foundry and carpentry practices.
- Apply the concepts of electrical wiring and study of electronic components.
- Utilize welding equipment to join the structures.
- Demonstrate plumbing requirements of domestic buildings.

(i) LECTURES and VIDEOS:

Detailed contents

1. Study on various manufacturing methods- Casting and Forming.
2. Study on Machining and Welding.
3. Study on Job fitting.
4. Study on CNC machine operation.
5. Study on Fitting operations and power tools.

(ii) WORKSHOP PRACTICE:

1. Fitting shop – Filing and Matting practices.
2. Welding shop – Arc welding practices.
3. Casting - Foundry practices.
4. Machine shop – Identifying components of Lathe machine and various Lathe operations.
5. Plumbing Exercises – Identifying Plumbing components.

TEXT BOOKS:

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,2019.

REFERENCE BOOKS:

1. Choudhry S K, Elements of workshop technology, Vol 2, 13th edition, Indian book distributing company,Kolkatta, 2020.
2. D K Singh, Manufacturing Technology, 2nd edition, Pearson Education, 2018.

WEBSITES:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=86
2. https://engg.kkwagh.edu.in/workshop_about_engg

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C212.1	3	2	1	-	-	1	-	1	1	1	-	2	2	-
C212.2	3	2	1	-	-	1	-	1	1	1	-	2	2	-
C212.3	3	2	1	-	-	1	-	1	1	1	-	2	2	-
C212.4	3	2	1	-	-	1	-	1	1	1	-	2	2	2
C212.5	2	1	-	-	-	1	-	1	-	1	-	2	2	-
AVG	**2.80**	**1.80**	**1.00**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**1.00**	**-**	**2.00**	**2.00**	**2.00**

23BEMC251 **SEMESTER-II**

SOFT SKILLS **1H - 0C**

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Encourage all round development of the students by focusing on soft skills.
- Make the students aware of critical thinking and problem-solving skills.
- Develop leadership skills and organizational skills through group activities.
- Function effectively with heterogeneous teams.
- Develop social and work-life skills as well as personal and emotional well-being.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Memorize various elements of effective communicative skills.
- Interpret people at the emotional level through emotional intelligence.
- Apply critical thinking skills in problem solving.
- Analyze the needs of an organization for team building.
- Judge the situation and take necessary decisions as a leader.

UNIT I COMMUNICATION SKILLS

Introduction, meaning, significance of soft skills –definition, significance, types of communication skills -Intrapersonal & Inter-personal skills

UNIT II CRITICAL THINKING

Active Listening –Observation –Curiosity –Introspection –Analytical Thinking –Open-mindedness – Creative Thinking- Public Speaking

UNIT III PROBLEM SOLVING & DECISION MAKING

Meaning & features of Problem Solving –Managing Conflict –Conflict resolution –Methods of decision making –Effective decision making in teams –Methods & Styles - Time Management

TEXT BOOKS

1. Personality Development and Soft Skills (English, Paperback, Mitra Barun K.) Publisher: Oxford University Press; Pap/Cdr edition (July 22, 2012)
2. Personality Development and Soft Skills: Preparing for Tomorrow, Dr Shikha Kapoor Publisher : I K International Publishing House; 0 edition (February 28, 2018)
3. Soft skills: personality development for life success by Prashant Sharma, BPB publications 2018.

23BEMC252 **SEMESTER-II**

WOMEN SAFETY AND SECURITY **1H - 0C**

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Highlight the social construction of gender in Indian society and the role of social institutions in the socialization process.
- Make aware about the practical issues concerning gender and politics.
- Classify the students in engendering national policies and programmes.
- Observe the liability of women and women's work in the context of globalization.
- Acquaint knowledge about the political participation of women and the gendered structures of governance and polity.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Infer into the basic concepts related to sex, gender, femininity etc.
- Demonstrate the rationale for women's studies
- Compare Gender Equality Issues and Movements in Women's Studies
- Summarize the Social construction of Gender, Gender Roles and Gender stereotyping.
- Illustrate Social Structures, Changing Status of Women in India.

UNIT I FUNDAMENTAL CONCEPTS OF WOMEN'S STUDIES

Definition- Objectives of Women's Studies; Importance of Women's Studies; Women's Studies as an Academic Discipline; Role of UGC Centre for Women's Studies

UNIT II SOCIAL EMPOWERMENT

Women in Higher Education; Gender issues in Health, Environment, Family welfare Measures, Indecent representation of Women in media; Women in Difficult circumstances; Constitutional.

UNIT III POLITICAL EMPOWERMENT

Women leaders in politics- Women in Local Governance- Barriers- Reservation policies- Women's Political Rights, Property Rights - Violence against Women - Women's work

TEXT BOOKS:

1. Amy S. Wharton. (2005). "The Sociology of Gender: An Introduction to Theory and Research". (KeyThemes in Sociology) Blackwell Publishing, UK, Indian Reprint, Kilaso Books, New Delhi.
2. Devaki Jain and Pam Rajput (Ed). (2003). "Narratives from the Women‟s Studies Family: Recreating Knowledge, Sage, and New Delhi.
3. Jasbir Jain (Ed). (2005). "Women in Patriarchy: Cross Cultural". Rawat Publication Jaipur.

SEMESTER – III

23BEME301B NUMERICAL METHODS 4 H – 4C

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

COURSE OBJECTIVES:

The goal of this course is for students:

- To inculcate the basic concepts of solving algebraic and transcendental equations.
- To understand the numerical techniques of interpolation in various intervals
- To provide the knowledge of numerical differentiation and integration
- To provide the knowledge of solving ordinary differential equations numerically
- To inculcate various techniques of solving partial differential equations numerically.

COURSE OUTCOMES:

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

- Solve the systems of linear and nonlinear equations by iterative methods.
- Make use of interpolation methods for finding the missing terms.
- Apply numerical methods for finding differentiation and integration of a given function.
- Solve ordinary differential equations using Euler's, Taylor's, Runge Kutta and Milne Thomson's method.
- Utilize implicit and explicit methods in heat and wave equations.

UNIT I SOLUTION OF EQUATIONS 12

Regula Falsi Method - Newton Raphson method for solving algebraic and transcendental equations - Solution of system of linear equations - Gauss elimination method - Gauss Jordan method -Gauss Seidel method

UNIT II INTERPOLATION 12

Interpolations with unequal intervals-Lagrange's interpolation -Newton's divided interpolation - Interpolation with equal intervals-Newton's forward and backward interpolation

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using Newton's forward and backward interpolation - Numerical integration using Trapezoidal, Simpson's 1/3 and 3/8 rule

UNIT IV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Single step method- Euler's method-Taylor's series method-Fourth order Runge – Kutta method –Multi step method-Milne's predictor corrector method

UNIT V NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Solutions of one dimensional heat equation by Bender-Schmidt and Crank Nicholson methods – Numerical solutions of one dimensional wave equation by explicit method

TOTAL: 60

TEXT BOOKS:

1. Chapra, Steven C. Numerical methods for engineers. Mcgraw-hill, 2010.
2. Gerald, Curtis F. Applied numerical analysis. Pearson Education India, 2004.

REFERENCE BOOKS:

1. Burden, Richard L., J. Douglas Faires, and Annette M. Burden. Numerical analysis. Cengage learning, Brooks/Cole, 4th edition 2012.
2. Kreyszig, Erwin, K. Stroud, and G. Stephenson. "Advanced engineering mathematics." Integration 9.4, John Wiley and Sons, Tenth Edition (2011).

WEB URLs:

- https://archive.nptel.ac.in/courses/111/107/111107105/
- https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/resources/lecture-2-eulers-numerical-method-for-y-f-x-y/
- http://www.infocobuild.com/education/audio-video-courses/mathematics/numerical-analysis-iit-madras.html
- http://www.infocobuild.com/education/audio-video-courses/mathematics/NumericalMethods-FiniteDifference-IIT-Roorkee/lecture-06.html.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C301B.1	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C301B.2	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C301B.3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C301B.4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
C301B.5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
AVG	**3.00**	**2.00**	**1.00**	-	-	-	-	-	-	-	-	**1.00**	**1.00**	-

SEMESTER – III

23BEME302 ENGINEERING MECHANICS 4 H – 4C

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

End Semester Exam :3 Hours

COURSE OBJECTIVES:

The goal of this course is for students

- To apply basic principles and laws to solve resultant force.
- To apply Varignon's theorem to solve parallel and non-parallel force system.
- To identify center of gravity and moment of inertia for the given area and mass.
- To apply friction concepts to solve friction problems.
- To identify projectile motion parameters using the motion concept

COURSE OUTCOMES:

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

- Solve resultant force in concurrent force system.
- Apply Varignon's theorem in parallel and non-parallel force system.
- Identify center of gravity and moment of inertia for the given section.
- Apply dry friction concepts on wedge and ladder friction.
- Identify projectile motion parameters using the motion concept.

UNIT I STATICS OF PARTICLES 9+3

Fundamental Concepts and Principles, Systems of Units, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES 9+3

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces.

UNIT III CENTROIDS, CENTRE OF GRAVITY AND MOMENT OF INERTIA 9+3

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass.

UNIT IV FRICTION 9+3

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES 9+3

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL: 45+15

TEXT BOOK

1. Ferdinand P. Beer, J.R Russell Johnston, David F. Mazurek, S. Brian and Dr. Sanjeev Sanghi, Vector Mechanics for Engineers–Statics and Dynamics, 12th Edition, Tata Mc Graw Hill Publishing Co. Ltd., NewDelhi, 2020
2. N. Kottiswaran, Engineering Mechanics, 4th edition, Sri Balaji Publications Pvt. Ltd., New Delhi, 2018.

REFERENCE BOOK

1. Young D H and Timashenko S, Engineering Mechanics, 5th Edition, Tata McGraw–Hill, New Delhi, 2015
2. N H Dubey, Engineering Mechanics: Statics and Dynamics, 1st Edition, Tata McGraw–Hill, New Delhi, 2017.

WEBSITES:

1. https://archive.nptel.ac.in/courses/112/106/112106286/
2. https://onlinecourses.nptel.ac.in/noc23_me74/preview

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C302.1	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C302.2	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C302.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C302.4	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C302.5	3	2	1	-	-	-	-	-	-	1	-	1	1	-
AVG	**3.00**	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

SEMESTER III

23BEME303 MANUFACTURING TECHNOLOGY 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:

The goal of this course is for the students to

- Familiarize the foundry practices.
- Develop the understanding of various types of metal joining processes.
- Explain the fundamentals of bulk deformation processes.
- Provide an overview on various sheet metal operations.
- Explain about different stages of powder metallurgy process.

COURSE OUTCOMES:

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

- Select molding and casting methods for given component.
- Identify welding process and process parameters for joints.
- Utilize bulk-forming process for a given application.
- Choose sheet metal forming process for a given application.
- Explain the stages of powder metallurgy process.

UNIT I CASTING PROCESSES 9

Sand Casting: Sand Mould – Pattern making: Pattern Materials, Pattern types and Pattern allowances – Moulding Sand properties and testing – Cores –Types and applications. Melting Furnaces: Cupola, Electric and Induction Furnaces. Melting temperature of different metals, Special Casting Processes: Shell - Investment – Die casting - Centrifugal Casting – Stir casting. Casting Defects and Inspection of Casting: Destructive and Non-Destructive Testing (NDT) Methods.

UNIT II JOINING PROCESSES 9

Basics of Welding – Classification of welding methods. Gas welding - Types – Flame characteristics. Arc Welding: Manual Metal Arc Welding – MIG and TIG Welding – Submerged arc welding –Operating principle and applications of: Resistance Welding - Plasma Arc welding– Electron Beam welding - Soldering and Brazing- Weld Defects. Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Weld defects – inspection and remedies – Brazing - soldering – Adhesive bonding.

UNIT II METAL FORMING PROCESSES 9

Hot working and cold working of metals – Forging processes – Open and Closed Die Forging – Forging operations. Rolling: Types of Rolling Mills -Applications – Forming defects and Defects in rolled parts. Extrusion – Forward and Backward Extrusion, Applications. Drawing: Wire drawing – Tube Drawing- Applications.

UNIT IV SHEET METAL OPERATIONS 9

Sheet metal characteristics – Operations: Shearing, Bending and Drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes-Working principle and applications – Hydro forming – Metal spinning – Explosive forming: Confined and Unconfined system- Magnetic pulse forming, peen forming, Super plastic forming – Micro forming – Incremental forming.

UNIT V POWDER METALLURGY PROCESS 9

Introduction to Powder Metallurgy process – Preparation of powders – types and functions of binders – blending - green compaction – sintering process and its effect on the product. Applications.

TOTAL: 45

TEXT BOOKS:

1. Serope Kalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education, Inc., New Delhi, 2014
2. P.N. Rao, Manufacturing Technology: Vol I, 4th edition, Tata McGraw–Hill Publishing Limited, New Delhi, 2013
3. P.C. Sharma, A text book of production technology, 4thEdition, S. Chand and Company, New Delhi, 2014

REFERENCE BOOKS:

1. D. K. Singh, Manufacturing Technology, 2nd edition, Pearson Education, Inc., New Delhi, 2008
2. Phillip F. Ostwald, Jairo Munoz, Manufacturing Processes and Systems, 9th edition, John Wiley and Sons, 2005.

WEBSITES:

1. https://www.afsinc.org/
2. https://weldguru.com/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C303.1	3	2	1	-	-	1	1	-	-	1	-	2	3	2
C303.2	3	2	1	-	-	1	1	-	-	1	-	2	3	-
C303.3	3	2	1	-	-	1	-	-	-	1	-	2	3	-
C303.4	3	2	1	-	-	1	-	-	-	1	-	2	3	2
C303.5	3	2	1	-	-	1	-	-	-	1	-	2	3	2
AVG	**3.00**	**2.00**	**1.00**	-	-	**1.00**	**1.00**	-	-	**1.00**	-	**2.00**	**3.00**	**2.00**

SEMESTER-III

23BEME304 THERMODYNAMICS 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:

The goal of this course is for the students to:

- To understand the Model of physical systems into relevant thermodynamic system and apply energy balance equation for closed and open system.
- To provide knowledge on entropy change in thermodynamic processes.
- To Study and acquire knowledge on various thermodynamic properties of pure substances in real time problems.
- To establish the basic thermodynamic relations and properties of ideal and real gases for physical systems.
- To facilitate the understanding of properties of air using psychometric chart.

COURSE OUTCOMES:

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

- Make use of first law of thermodynamics to open and closed systems
- Apply entropy change in thermodynamic processes.
- Identify the thermodynamic properties of pure substances.
- Explain the importance of availability concept and thermodynamic relations of systems.
- Distinguish the properties of air using psychometric chart.

UNIT I BASIC CONCEPTS 9

Basic concepts - Classical and Statistical approaches - Thermodynamic systems - closed, open, isolated. Property – State -Process-adiabatic - Quasi-static process – Cycle - Point and Path function – Energy - Work transfer - Concept of temperature and heat- Zeroth law of thermodynamics - Concept of ideal gases - First law of thermodynamics –PMM1, internal energy, specific heat capacities, enthalpy, and its application to closed system and open system-steady flow energy equation for turbine, compressor, boiler and condenser.

UNIT II SECOND LAW AND ENTROPY 9

Physical description of the second law - Kelvin-Planck and Clausius statements –Equivalence - Reversible processes and cycles- Carnot cycle – Corollaries - Absolute temperature scale – Clausius Theorem, inequality - Entropy- Principle, transfer, generation, balance - Third law of thermodynamics

UNIT III PROPERTIES OF PURE SUBSTANCE AND GAS MIXTURES 9

Pure substance - Phase change process - Property diagrams - PVT surface - Steam – types, dryness fraction - Avogadro's law - Ideal Gas - Equations of state-Vander Waal's equation - Real Gas - Compressibility and its chart - Mixtures of Gases – Properties.

UNIT IV THERMODYNAMIC AVAILABILITY AND RELATIONS 9

Basics-Dead state, quality of energy, degradation of energy - Reversible processes – Maximum work - Exergy – Closed system - Steady flow system – Irreversibility - Exergy Balance - Second law efficiency – Exact differentials - Tds Relations - Maxwell's Relation – Clausius – Clapeyron Equation - Joule-Thompson Coefficient.

UNIT V PSYCHROMETRY 9

Psychrometry - Psychrometric charts - Property calculations of air vapour mixtures- Psychrometric Process-Adiabatic mixing - Evaporative cooling, Comfort chart.

TOTAL: 45

TEXT BOOKS:

1. Nag P K, Engineering Thermodynamics, 6 th Edition, Tata McGraw-Hill, New Delhi, 2017
2. Yunus A. Cengel and Michael A. Boles, Thermodynamics-An Engineering Approach, 8 th Edition, Tata McGraw-Hill, New Delhi, 2015

REFERENCE BOOKS:

1. C P Arora, Thermodynamics, 12 th Reprint, McGraw-Hill, NewDelhi, 2007
2. Kothandaraman C P and Domkundwar S, A Course in Thermal Engineering, Dhanpat Rai and Company (P) Limited, New Delhi, 2010.

WEBSITES:

1. https://archive.nptel.ac.in/courses/112/105/112105123/
2. http://home.iitk.ac.in/~gtm/thermodynamics/ui/TOC.htm

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C304.1	3	2	1	-	-	-	-	-	-	1	-	2	2	-
C304.2	3	2	1	-	-	-	-	-	-	1	-	2	2	-
C304.3	3	2	1	-	-	-	-	-	-	1	-	2	2	-
C304.4	2	1	-	-	-	-	-	-	-	1	-	2	2	-
C304.5	3	3	2	-	-	-	-	-	-	1	-	2	2	-
AVG	**2.80**	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**2.00**	**2.00**	**-**

SEMESTER - III

23BEME341 FLUID MECHANICS AND FLUID MACHINES 5H-4C

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

End Semester Exam: 3Hours

COURSE OBJECTIVES:

The goal of this course is for the students to:

- To outline the various fluid properties
- To identify different types of fluid flow and calculate Major and minor loses in pipes.
- To Categorize concepts of Buckingham's π theorem for different parameters
- To categorize the working of different turbines.
- To explain the working of different pumps

COURSE OUTCOMES:

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

- Explain the basics of fluid properties
- Identify the types of flow and loses in pipes.
- Apply Buckingham's π theorem for dimensional analysis.
- Inspect the performance characteristics of turbines.
- Compare the performance characteristics of pumps.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Fluid properties: Mass density, weight density, specific gravity, viscosity, compressibility, surface tension and capillarity, Vapour Pressure. Pressure – Atmospheric, Gauge and Vacuum pressure, Buoyancy and floatation– Metacentre and Metacentric height. Flow characteristics: concepts of system and control volume, application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation.

UNIT II FLOW THROUGH CIRCULAR PIPES 9

Hydraulic and energy gradient – Types of fluid flow – Types of flow line – Laminar flow through circular conduits – Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation – friction factor – Moody diagram – commercial pipes – minor losses – Flow through pipes in series and parallel.

UNIT III DIMENSIONAL ANALYSIS 9

Dimension and units, dimensional homogeneity, Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV HYDRAULIC TURBINES 9

Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Modern Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

UNIT V HYDRAULIC PUMPS 9

Classification of pumps – centrifugal pump–working principle–head, discharge, efficiencies and losses – performance curves – specific speed. Reciprocating pump–components and working–slip–indicator diagram – air vessel – Jet pump – Mono block pump – Submersible pump.

TOTAL: 45

TEXT BOOKS:

1. Bansal. R.K, A Text book of Fluid Mechanics and Hydraulics Machines, 10th edition, Laxmi publications (P) Ltd, New Delhi, 2018
2. White. F.M, Fluid Mechanics, 8thedition, Tata McGraw–Hill, New Delhi, 2016
3. Victor L Streeter, E. Benjamin Wylie and K.W. Bedford, Fluid Mechanics, 9e, McGraw–Hill, New Delhi, 2010

REFERENCE BOOKS:

1. Prof. Kumar K.L, Engineering Fluid Mechanics, 1st Edition, S. Chand publishers, 2016.
2. Fox and McDonald, Fluid Mechanics, 8thediton, John Wiley, 2015.

WEBSITES:

1. https://archive.nptel.ac.in/courses/112/105/112105171/
2. https://www.freebookcentre.net/physics-books-download/Fluid-Mechanics-by-NPTEL.html

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump
6. Conducting experiments and drawing the characteristic curves of submersible pump
7. Conducting experiments and drawing the characteristic curves of reciprocating pump.
8. Conducting experiments and drawing the characteristic curves of Gear pump.
9. Conducting experiments and drawing the characteristic curves of Pelton wheel.
10. Conducting experiments and drawing the characteristics curves of Francis turbine

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS O2
C341.1	2	1	-	-	-	-	-	-	-	1	-	1	2	-
C341.2	3	2	1	-	-	-	-	-	2	2	-	1	2	-
C341.3	3	2	1	-	-	-	-	-	-	1	-	1	2	-
C341.4	3	3	2	1	-	-	-	-	2	2	-	1	2	-
C341.5	3	3	2	1	-	-	-	-	2	2	-	1	2	-
AVG	**2.80**	**2.20**	**1.50**	**1.00**	**-**	**-**	**-**	**-**	**2.00**	**1.60**	**-**	**1.00**	**2.00**	**-**

SEMESTER - III

23BEME342 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING 6H-5C

(THEORY & LAB)

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

EndSemesterExam:3Hours

i) THEORY

COURSE OBJECTIVES:

The goal of this course is for the students to:

- To impart the basic knowledge about the Electric circuits.
- To understand the concept of Electrical Machines and Transformers.
- To understand the working of Semiconductor devices and Digital Circuits.
- To impart the basic knowledge of Measuring Instruments and Electrical Installation.
- Know the fundamentals of Electrical Engineering and Practical.

COURSE OUTCOMES:

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

- Apply basic laws and theorems for a given DC circuit
- Solve single phase and three phase AC circuits
- Explain the construction and working of induction motor, DC motor and transformers
- Illustrate Bipolar Junction Transistor, Operational Amplifier and logic gates
- Outline the operations of measuring instruments and components of electrical installation.

UNIT I DC CIRCUITS 9

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

UNIT II AC CIRCUITS 9

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 9

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 9

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 9

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 BOOKS

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
4. VN Mittle and Arvind Mittal, (2006), Basic Electrical Engineering, McGraw Hill.

5. A.Sudhaka and Shyammohan S Palli, (2013), Circuits and Networks, McGraw Hill.

WEB LINKS:

1. www. nptel.ac.in.
2. encyclopedia-magnetica.com/doku.php/co energy.
3. https://en.wikibooks.org/wiki/electronics/measuringinstruments.

ii) LABORATORY

LIST OF EXPERIMENTS

1. Experimental verification of electrical circuit problems using Ohms law
2. Experimental verification of electrical circuit problems using Kirchhoff's Voltage law.
3. Experimental verification of electrical circuit problems using Kirchhoff'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.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C342.1	3	2	1	-	-	-	-	-	2	2	-	1	1	-
C342.2	2	1	1	-	-	-	-	-	2	2	-	1	1	-
C342.3	3	2	-	-	-	-	-	-	2	2	-	1	1	-
C342.4	2	1	-	-	-	-	-	-	2	2	-	1	1	-
C342.5	2	1	-	-	-	-	-	-	2	2	-	1	1	-
AVG	**2.40**	**1.40**	**1.00**	**-**	**-**	**-**	**-**	**-**	**2.00**	**2.00**	**-**	**1.00**	**1.00**	**-**

23BEME311 **SEMESTER – III**

MACHINE 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:

The goal of this course is for the students to:

- Acquaint the skills in standard drawing practices.
- Understand the representation of details in machine drawing.
- Introduce tolerances and fits of machine elements.
- Equip the skills to construct various machine components.
- Equip the skills to construct an assembly drawing of machine components using CAD software.

COURSE OUTCOMES:

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

- Explain the importance of machine drawing and GD&T.
- Build drawings of standard machine components
- Identify the representation of limits, fits and tolerances in the drawing.
- Construct the assembly drawing from the part drawings using CAD software.
- Dissect the assembly drawings into cross sectional views.

UNIT I INTRODUCTION 6

Introduction to machine drawing. Importance of sectional views. Computer-aided drafting. Introduction to Geometric dimensioning and tolerancing – Terms and definitions – Common symbols and terminology – Fundamental rules (drawing) – Feature definition.

UNIT II CONVENTIONS 6

Code of practice for engineering drawing – conventional representation of details – drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways. Conventions to represent standard components – bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges.

UNIT III FITS AND TOLERANCES 6

Introduction to limits, fits and tolerances – need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances. Geometric tolerance – uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings. Surface finish symbols – methods of indicating the surface roughness.

UNIT IV SUB ASSEMBLY DRAWING PRACTICE 12

Making free hand sketches of typical subassemblies – flange coupling, stuffing box, journal bearings, rolling element bearings, keyed joints, cotter joints.

UNIT V ASSEMBLY DRAWING PRACTICE USING CAD SOFTWARE 15

Assembly drawing – sectioning and bill of materials. Drawings of assemblies: Lathe tailstock, machine vice, pedestal bearing and Plummer block.

TOTAL: 45

TEXT BOOKS:

1. Gopalakrishna K R, Machine Drawing, Subhas Stores, Bangalore, 2017.
2. Bhatt N D and Panchal V M, Machine Drawing, Charotar Publishing House, Chennai, 2016.

REFERENCE BOOKS:

1. Ajeet Singh, Machine Drawing: Includes AutoCAD, Tata McGraw Hill, New Delhi, 2012.
2. Goutam Pohit and Goutam Ghosh, Machine Drawing with AutoCAD, Pearson Education, Chennai, 2004.
3. Narayana K L, Kannaiah P, Venkata Reddy K, Machine Drawing, New Age International Publishers, New Delhi, 2019.

WEBSITES:

1. https://www.unm.edu/~bgreen/autocad/autocad.htm
2. https://www.mycadsite.com/tutorials.html
3. https://tutorial45.com/autocad-tutorial/
4. https://www.javatpoint.com/autocad

CO-PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C311.1	3	2	-	-	-	2	-	3	2	2	-	2	2	-
C311.2	3	2	-	-	-	2	-	3	2	2	-	2	2	-
C311.3	3	2	-	-	-	2	-	3	2	2	-	2	2	-
C311.4	3	2	1	-	3	2	-	3	2	2	-	2	2	-
C311.5	3	3	2	-	3	2	-	3	2	2	-	2	2	-
AVG	**3.00**	**2.00**	**1.00**	**-**	**3.00**	**2.00**	**-**	**3.00**	**2.00**	**2.00**	**-**	**2.00**	**2.00**	**-**

SEMESTER – III

23BEME391 FIELD PROJECT / INTERNSHIP 2 H – 1C

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

Students need to complete minimum 30 working days industrial internship during his/her first-year summer and winter vacation of UG program. Students may plan accordingly to avail industrial internship during summer and winter vacation except regular class days. And students should submit valid certificate and report for internal committee evaluation on his/her third semester.

SEMESTER-III

23BEMC351	**APTITUDE AND REASONING**	**1H-0C**
Instruction Hours/week: L:1 T:0 P:0	**Marks:** Internal**:100** Total**:100**	

COURSE OBJECTIVES:

The goal of this course is for the students to

- Categorize, apply, and use thought processes to distinguish between concepts of Quantitative methods.
- Prepare and explain the fundamentals related to various possibilities and probabilities related to quantitative aptitude.
- Critically evaluate numerous possibilities related to puzzles.
- Understand and solve puzzle-related questions from specific and other competitive tests.
- Solve questions related to Time and distance and time and work etc.

COURSE OUTCOMES:

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

- Explain the basics of quantitative ability.
- Solve Logaraithm, Permutation and Combinations, Probability, Basic Accountancy, Time, Speed, distance, work, Ratio and area.
- Utilize satisfactory competency in Verbal Reasonings.
- Solve campus placements aptitude papers covering Quantitative Ability and verbal skills.
- Apply Quantitative and Verbal reasoning in puzzle-related questions.

UNIT - I 1. Quantitative Ability (Basic Mathematics)

1.1. Number Systems
1.2. LCM and HCF
1.3. Decimal Fractions
1.4. Simplification
1.5. Square Roots and Cube Roots
1.6. Problems on Ages
1.7. Surds & Indices
1.8. Percentages

UNIT – II 2. Quantitative Ability (Applied & Engineering Mathematics)

2.1. Logarithm
2.2. Permutation and Combinations
2.3 Probability
2.4 Profit and Loss
2.5 Simple and Compound Interest
2.6. Time, Speed and Distance
2.7. Time & Work
2.8. Ratio and Proportion
2.9. Area
2.10 Mixtures and Allegation

UNIT – III 3. Verbal - Aptitude

a. Words
b. Idioms
c. Phrases in Context
d. Reading comprehension techniques
e. Narrative sequencing
f. Data interpretation

Textbooks:

1. A Modern Approach to Verbal &Non-Verbal Reasoning by R S Agarwal
2. Analytical and Logical Reasoning by Sijwali B S
3. Quantitative aptitude for Competitive examination By R S Agarwal
4. Analytical and Logical Reasoning for CAT and other management entrance tests By Sijwali B S
5. Quantitative Aptitude by Competitive Examinations by Abhijit Guha 4th edition

WEBSITES

1. https://prepinsta.com/
2. https://www.indiabix.com/
3. https://www.javatpoint.com/

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C351.1	2	1	-	-	-	-	-	-	-	-	-	3	-	-
C351.2	3	2	1	-	-	-	-	-	-	-	-	3	-	-
C351.3	3	2	1	-	-	-	-	-	-	-	-	3	-	-
C351.4	3	2	1	-	-	-	-	-	-	-	-	3	-	-
C351.5	3	2	1	-	-	-	-	-	-	-	-	3	-	-
Average	**3.00**	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	-	-	**3.00**	-	-

SEMESTER-III

23BTMC352A	**FOREIGN LANGUAGE –GERMAN**	**1H-0C**
Instruction Hours/week: L:1 T:0 P:0		**Marks:** Internal**:100** Total**:100**
		End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Learn design thinking concepts and principles
- Use design thinking methods in every stage of the problem
- Learn the different phases of design thinking
- Apply various methods in design thinking to different problems
- Identify a solution to any problem of life and business

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Demonstrate the critical theories of design, systems thinking, and design methodologies
- Define key concepts of design thinking
- Practice design thinking in all stages of problem solving
- Apply design thinking approach to real world problems
- Use the concept of design thinking in their business world.

UNIT I: Herzlich willkommen! -Wie ist dein Name ? -Ich trinke gern Kaffee.-Wir konjugieren die Verben.

UNIT II: A bit of history and ZAHLEN - Verben, W-Fragen, Ja-Nein Fragen, Imperativ-das Alphabet, die Woche, das Jahr -Was sind deine Hobbys ? Formular ausfÃ¼llen

UNIT III: Mein Lehrbuch | Meine persÃ¶nlichen Daten-Mein Arbeitsbuch -Wir beginnen Lektion -Wir lesen Lektion 3

UNIT IV: formeller Brief- Wie lernst du Deutsch ? -Wir hÃ¶ren ein deutsches Lied- Wir lernen HÃ¶rverstÃ¤ndnis | Wir beginnen Lektion

UNIT V: Eine E-Mail schreiben | Eine Wohnung beschreiben- Im Kaufhaus | Welche/Diese-Gesund und munter

TEXT BOOKS:

1. NETZWERK Deutsch als Fremdsprache A1(Goyal, New Delhi, 2015)
2. Schulz-Griesbach: Deutsch als Fremdsprache. Grundstufe in einem Band (for Grammar)

WEBSITES:

1. https://www.tatsachen-ueber-deutschland.de/en
2. https://www.goethe.de/en/spr/kup/prf/prf/sd1/ueb.html

SEMESTER-III

23BTMC352B	**FOREIGN LANGUAGE – FRENCH**	**1H-0C**
Instruction Hours/week: L:1 T:0 P:0		**Marks:** Internal**:100** Total**:100**
		End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Learn design thinking concepts and principles
- Use design thinking methods in every stage of the problem
- Learn the different phases of design thinking
- Apply various methods in design thinking to different problems
- Identify a solution to any problem of life and business

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Demonstrate the critical theories of design, systems thinking, and design methodologies
- Define key concepts of design thinking
- Practice design thinking in all stages of problem solving
- Apply design thinking approach to real world problems
- Use the concept of design thinking in their business world.

UNIT I

Recognize the French letters, Identify the letter-combinations that are characteristic of the French language, Identify the remaining letter-combinations that are characteristic of the French language,

UNIT II

Use the imperative in the affirmative form, Say the time in French, Talk about the weather in French, .Talk about actions that just happened, Speak about actions that are yet to happen

UNIT III

Learn a few basic and commonly used 2nd group verbs, Understand the concept of French ‘modal verb, Learn a few basic and commonly used 3rd group verbs, Learn what reflexive verbs, Distinguish between moods and tenses

UNIT IV

Place an order in a restaurant, Learn a third past tense, Identify a direct object, Identify an indirect object, Use direct and indirect objects pronouns in a single sentence

TEXT BOOKS:

1. Alter Ego - Méthode de Français, A1 (2006): Berthet, Hugot et al., Hachette
2. Alter Ego – Cahier d’activités, A1 (2006): Berthet, Hugot et al., Hachette
3. Écho - Méthode de Français, A1 (2013): Girardet, Pecheur, CLE International

WEBSITES:

1. www.leo.org
2. www.nptel.com

SEMESTER – IV

23BEME401 KINEMATICS OF MACHINERY 4 H – 4 C

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

End Semester Exam :3 Hours

COURSE OBJECTIVES

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

- To define four bar mechanism.
- To illustrate displacement, velocity, and acceleration at any point in a link using the graphical method.
- To apply cam-follower principles for practical applications.
- To select appropriate gear trains for engineering applications.
- To apply friction concepts in machine drive units.

COURSE OUTCOMES

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

- Explain the kinematics mechanisms and its inversions.
- Apply graphical method in simple mechanisms for velocity and acceleration polygon.
- Develop cam profiles for follower motions.
- Apply tooth actions and terminology for gear trains.
- Apply friction principles on friction drives.

UNIT I BASICS OF MECHANISMS 12

Terminology and Definitions–Degree of Freedom – Mobility–Kutzbach criterion – Grashoff's law–Kinematic Inversions of four bar chain and slider crank –Mechanical Advantage–Transmission angle – Single, double and offset slider mechanisms – Quick return mechanisms – Ratchets and escapements – Indexing Mechanisms – Straight line generators.

UNIT II KINEMATICS 12

Displacement, velocity and acceleration – analysis in simple mechanisms – Graphical Method –velocity and acceleration polygons – Kinematic analysis by Complex Algebra methods–Vector Approach, Instantaneous center – Coriolis Acceleration.

UNIT III KINEMATICS OF CAM 12

Classifications – Displacement diagrams–parabolic, Simple harmonic and Cycloidal motions – Layout of plate cam profiles – Derivatives of Follower motion – High speed cams – circular arc and tangent cams – Standard cam motion – Pressure angle and undercutting.

UNIT IV GEARS 12

Spur gear - Terminology and definitions–Fundamental Law of toothed gearing and involute gearing–Interchangeable gears–gear tooth action – Terminology – Interference and undercutting–Nonstandard gear teeth–Helical, Bevel, Worm, Rack and Pinion gears (Basics only)–Gear trains–Parallel axis gear trains– Epicyclic gear trains.

UNIT V FRICTION IN DRIVES 12

Surface contacts–Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt and rope drives, Friction aspects in Brakes.

TOTAL : 60

TEXT BOOK

1. Rattan S.S, Theory of Machines, 5th edition, Tata McGraw–Hill Publishing Company Ltd., New Delhi,2019
2. Shigley J.E, Uicker J.J, Theory of Machines and Mechanisms, 4th edition, Oxford University Press, New York, 2010.
3. Rao J.S., Dukkipati R.V, Mechanism and Machine Theory, 2nd edition, New Age International publishers, 2014.

REFERENCE BOOK

1. Charles E. Wilson, Kinematics and Dynamics of Machinery, 3rd edition, Pearson Education Ltd, 2008

2. R. S. Khurmi, J. K. Gupta, Theory of Machines, 14rd edition, S Chand and Co Ltd, 2005.

WEBSITES:

1. https://onlinecourses.nptel.ac.in/noc22_me25/preview
2. https://www.udemy.com/course/kinematics-of-machines-part-i

CO-PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C401.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C401.2	3	2	1	1	-	-	-	-	-	1	-	1	1	-
C401.3	3	2	1	1	-	-	-	-	-	1	-	1	1	-
C401.4	3	2	1	1	-	-	-	-	-	1	-	1	1	-
C401.5	3	2	1	1	-	-	-	-	-	1	-	1	1	-
AVG	**2.80**	**1.80**	**1.00**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

SEMESTER - IV

23BEME402 ENGINEERING MATERIALS AND METALLURGY 3H-3C

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

End Semester Exam: 3Hours

COURSE OBJECTIVES:

The goal of this course is for the students to:

- To familiarize the concept of phase diagram.
- To develop the understanding of various types of heat treatment processes.
- To explain the fundamentals of ferrous and non-ferrous materials for various applications.
- To provide an overview on non-metallic materials.
- To explain the concept of strengthening mechanisms for Non-ferrous alloys.

COURSE OUTCOMES:

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

- Identify the binary alloy system's invariant reaction.
- Select heat treatment process for a give sample.
- Identify ferrous and non-ferrous metals with its microstructure
- Explain non-metallic materials and its applications
- Examine the material properties using material testing methods.

UNIT I ALLOYS AND PHASE DIAGRAMS 9

Solid solutions and its types and intermediate phases - Hume Rothery's rule - solidification of metals and alloys, cooling curves, concepts of phase diagrams, coring and segregation as applied to various binary systems, ternary systems, Iron – Iron carbide equilibrium diagram.

UNIT II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalising, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on TTT diagram, CCT - Hardenability, Jominy end quench test – Austempering, martempering – case hardening - carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening, Microstructure study and specimen preparation.

UNIT III FERROUS AND NON FERROUS METALS 9

Effect of alloying additions on steel- α and β stabilizers - stainless and tool steels – HSLA - maraging steels – Gray, White malleable, Spheroidal Graphite irons - Copper and Copper alloys – Brass, Bronze and Cupronickel – Aluminum and Al-Cu – precipitation, strengthening treatment – Bearing alloys, Applications of Ferrous and Non-Ferrous Metals.

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and Applications of thermoplastics (PP, PVC, ABS, and PMMA) and thermosetting plastics (PF, UF, MF) –Engineering Ceramics. Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites Materials - Classifications - Metal Matrix and FRP - Applications of Composites.

UNIT V TESTING OF MATERIALS 9

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep test, S-N curve.

Non Destructive Testing: Non Destructive Testing basic principles and testing ethod of Radiographic testing,Ultrasonic testing, Magnetic particle test and Liquid penetrant test, Eddy current testing.

TOTAL: 45

TEXT BOOKS:

1. R Srinivasan, "Engineering Materials and Metallurgy", McGraw Hill Education, New Delhi, 2009
2. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian Edition 2014
3. Kenneth G.Budinski and Michael K.Budinski, Engineering Materials: Properties and Selection, 9th Edition, Prentice-Hall of India Private Limited, New Delhi, 2010

REFERENCE BOOKS:

1. William D. Callister and David G. Rethwisch, Fundamentals of Materials Science and Engineering: An Integrated Approach, 5thedition, International Student Version, John Wiley and Sons, Inc., 2016.
2. Raghavan. V, Materials Science and Engineering, 6thedition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. James F. Shackelford, Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers, 6th edition, Pearson Education, India, 2014.

WEBSITES:

1. https://www.digimat.in/nptel/courses/video/113102080/L01.html
2. https://www.digimat.in/113.html

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C402.1	3	2	1	-	-	-	-	-	-	1	-	1	2	-
C402.2	3	2	1	-	-	-	-	-	2	2	-	1	2	2
C402.3	3	2	1	-	-	-	-	-	2	2	-	1	2	2
C402.4	2	1	-	-	-	-	-	-	-	1	-	1	2	-
C402.5	3	3	2	1	-	-	-	-	2	2	-	1	2	2
AVG	**2.80**	**2.00**	**1.00**	**1.00**	**-**	**-**	**-**	**-**	**2.00**	**1.60**	**-**	**1.00**	**2.00**	**2.00**

SEMESTER – IV

23BEME441 MANUFACTURING TECHNOLOGY II 5 H – 4C

(Theory and Laboratory)

Instruction hours / week L :3 T : 0 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 the students to

- Understand the fundamentals of metal cutting and cutting tools.
- Understand the constructional features of different conventional machine tools and their operations.
- Introduce about CNC machines and CNC programming.
- Understand the principles of different abrasive-based machining processes.
- Understand the principles of different electrical and chemical energy-based machining processes.

COURSE OUTCOMES:

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

- Identify the chip formation mechanism in metal cutting
- Distinguish the constructional features and working of conventional machine tools.
- Develop manual CNC part program for machining simple components.
- Experiment with abrasive-based machining and finishing processes for a given application.
- Apply electrical and chemical energy-based machining processes for a given application.

UNIT I THEORY OF METAL CUTTING 9

Mechanics of chip formation, cutting forces during machining, Types of Chips, cutting tools– Single point and multipoint cutting tools: Tool angles and Nomenclature of cutting tools. Orthogonal and Oblique cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish - cutting fluids: Types, characteristics, functions. Machinability: Definition and Factors influencing machinability.

UNIT II CONVENTIONAL MACHINE TOOLS 9

Lathes: Working principle, constructional details, specification, operations – Taper turning -Thread cutting methods - Special attachments - Capstan and Turret Lathes – Automats. Construction, working principle and types of operations of: Shaper, Planer, Slotting machine -, Drilling Machine - Milling Machine

UNIT III CNC MACHINING 9

Numerical Control (NC) machine tools – Computer Numerical Control (CNC) Machines: Types, Constructional details, special features - Machining Centre - Part programming fundamentals CNC Manual part programming – micromachining – wafer machining, Five and six axis CNC machines.

UNIT IV ABRASIVE PROCESSES 9

Abrasive Processes: Grinding: Principle of grinding, grinding machine parts, types, grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centerless grinding - Typical applications – concepts of surface integrity- Broaching machines: Broach construction – push, pull, surface and continuous broaching machines. Surface finishing methods: Lapping, Honing and Super finishing. Abrasive Jet Machining – Water Jet Machining –Abrasive Water Jet Machining - Working Principle and Construction - Applications.

UNIT V ELECTRICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM)- Working Principle- EDM equipment's parts - electrode / Tool – Dielectric – Flushing– Wire cut EDM - Electroplating process – Applications. Chemical machining and Electro-Chemical machining (CHM and ECM) - Etchants – Maskant - techniques of applying maskants - Applications. Principles of ECM- equipment's-Surface Roughness and material removal rate. Electrochemical Grinding and Electrochemical Honing - Applications.

TOTAL: 45

TEXT BOOKS:

1. P.N. Rao, Manufacturing Technology: Vol I, 4th edition, Tata McGraw–Hill Publishing Limited, New Delhi, 2013
2. P.C. Sharma, A text book of production technology, 4thEdition, S. Chand and Company, New Delhi, 2014
3. S. K. Hajra Choudhury, Elements of Workshop Technology Vol– II, 13th edition, Media Promotors Pvt Ltd., Mumbai, 2010
4. Hassan El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, 1st edition, McGraw–Hill, 2005

REFERENCE BOOKS:

1. Hindustan Machine Tools, Production Technology, 1st edition, Tata McGraw–Hill, 2001
2. Phillip F. Ostwald, Jairo Munoz, Manufacturing Processes and Systems, 9th edition, John Wiley and Sons, 2005.
3. Steve F. Krar, Arthur R. Gill and Peter Smid, Technology of Machine Tools, 7th edition, Tata McGraw– Hill, 2013

WEBSITES:

1. https://academy.titansofcnc.com/
2. http://web.mit.edu/2.810/www/files/lectures/lec5-machining-2018.pdf

(ii) LABORATORY

LIST OF EXERCISES

1. Exercises in shaping.
2. Exercises in Milling.
3. Exercises in slotting.
4. Exercises in Drilling / Tapping / Reaming.
5. Exercises in Surface grinding and cylindrical grinding process.
6. Exercises in Tool grinding – single point and multi point tools.
7. Exercises in Capstan and Turret Lathe.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C441.1	3	2	1	-	-	1	1	-	2	2	-	2	3	-
C442.2	3	3	2	-	-	1	-	-	2	2	-	2	3	-
C442.3	3	2	1	-	-	1	-	-	-	1	-	2	3	2
C442.4	3	2	1	-	-	1	-	-	2	2	-	2	3	-
C442.5	3	2	1	-	-	1	1	-	-	1	-	2	3	-
AVG	**3.00**	**2.20**	**1.20**	**-**	**-**	**1.00**	**1.00**	**-**	**2.00**	**1.60**	**-**	**2.00**	**3.00**	**2.00**

SEMESTER – IV

23BEME442 APPLIED THERMODYNAMICS 5 H – 4C

(Theory and Laboratory)

Instruction hours / week L : 2 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 the students to

- To guide the students to apply the laws of thermodynamics in applications of thermal systems.
- To help students gain essential and basic knowledge of various types of internal and external combustion engines, so as to equip them with knowledge required for the design of engines and power plants.
- To train the students with the procedures for the testing of engines and fuels.
- To equip the students to analyze various components of HVAC system.
- To impart knowledge in the design of refrigeration and air –conditioning systems.

COURSE OUTCOMES

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

- Analyze the efficiency of gas power cycles under given conditions
- Apply principles of thermodynamics to boilers
- Model the fluid flow characteristics for steam turbines and nozzles
- Identify the performance characteristics of compressors
- Apply the concepts of refrigeration and air-conditioning for low temperature devices

UNIT I STEAM POWER CYCLES AND STEAM NOZZLES 9

Introduction to steam power cycle – Application of Steady Flow Energy Equation - Formation of Steam – PVT behaviour of pure substance, Rankine cycle, Reheated Rankine cycle, Regenerated Rankine cycle. Steam nozzles – flow through steam nozzles, effect of friction, critical pressure ratio, super saturated flow.

UNIT II GAS POWER CYCLES 9

Otto, Diesel, Dual, Brayton cycles – actual and theoretical PV and TS diagram – Calculation of mean effectivepressure and air standard efficiency, Brayton cycle with non-isentropic flow in compressors and turbines. Performance comparisons for Otto, Diesel, and Dual cycle considering compression ratio, cutoff ratio and pressure ratio.

UNIT III REFRIGERATION AND AIR CONDITIONING 9

Fundamentals of refrigeration – COP, Vapor compression refrigeration system (VCRS), cycle - p–h chart-Performance analysis for VCRS, Vapor absorption refrigeration system (VARS), Comparisons between VCRS and VARS, Fundamentals of air conditioning system-Study of Psychrometry-Conditioned air property calculation, Summer and winter air-conditioning systems.

UNIT IV HEATING AND VENTILATION 9

Fundamentals of heating and ventilation, Effect of heating on air density and air quality, Efficiency calculation for heat pump, Free air deliver, effect of infiltration on air quality, Need for ventilation, Ventilation standards for commercial hubs such as hospitals, malls, theaters and industrial sectors. Study on air filters used in ventilation ducts. Air handling and distribution through duct.

UNIT V BATTERY THERMAL MANAGEMENT 9

Fundamentals of Li-ion and Lead-acid batteries. Causes of heat generation in battery. Effect of heat on life of battery, Passive cooling – PCM systems-Active cooling – Liquids and air systems, High temperature batteries for back-up applications- Zebra cell-Li-iron sulfide cells-Li-S cells, Regulations and Safety Aspects of High Voltage and High Temperature Batteries**.**

(Permitted to use standard thermodynamic table, Mollier diagram, Psychometric chart and Refrigeration property table in the examination)

TOTAL: 45

TEXT BOOKS:

1. Rajput R.K, Thermal Engineering, 10th Edition, Laxmi Publications, New Delhi, 2018
2. Arora C.P, Refrigeration and Air conditioning, 3rd edition, Tata McGraw–Hill, New Delhi, 2008
3. Kothandaraman C.P, and Domkundwar A.V, A course in Thermal Engineering, 5thEdition, Dhanpat Rai and Sons,Delhi, 2006.

REFERENCE BOOK

1. Ganesan V, Internal Combustion Engines, 4thedition, Tata McGraw–Hill, New Delhi, 2012
2. Yunus A Cengel, Thermodynamics' an Engineering Approach, 9thedition, Tata McGraw Hill, New Delhi, 2019.
3. Davide Andrea, Battery Management Systems for Large Li-ion battery packs, Artech House, 2010.

(ii) LABORATORY

LIST OF EXPERIMENTS I C ENGINES AND FUELS

1. Valve Timing and Port Timing Diagrams.
2. Performance Test on 4–stroke CI Engine.
3. Heat Balance Test on 4–stroke CI Engine.
4. Load test on 4–stroke CI Engine.
5. Retardation Test to find Frictional Power of a CI Engine.
6. Determination of Viscosity – Red Wood Viscometer.
7. Determination of Flash Point and Fire Point.
8. Performance test on single/two stage reciprocating air compressor.
9. Determination of COP of a refrigeration system
10. Experiments on air–conditioning system.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C442.1	3	3	2	-	-	-	-	-	2	2	-	1	2	-
C442.2	3	2	1	-	-	-	-	-	-	1	-	1	2	-
C442.3	3	2	1	-	-	-	-	-	-	1	-	1	2	-
C442.4	3	2	1	-	-	-	-	-	2	2	-	1	2	-
C442.5	3	2	1	-	-	-	1	1	2	2	-	1	2	-
AVG	**3.00**	**2.20**	**1.20**	**-**	**-**	**-**	**1.00**	**1.00**	**2.00**	**1.60**	**-**	**1.00**	**2.00**	**-**

SEMESTER - IV

23BEME443 STRENGTH OF MATERIALS 5H-4C

(Theory and Laboratory)

Instruction Hours/week: L: 2 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 the students to:

- Analyze stress, strain, and deformation in solids using mathematical models.
- Determine loads, stresses, and relationships in beams.
- Evaluate the deflection and slope of beams and apply principles to columns.
- Investigate torsion in bars, shafts, and springs.
- Examine shells, principal stresses, and strain energy in cylindrical and spherical shells.

COURSE OUTCOMES:

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

- Apply the concepts of stress and strain for simple and compound bars.
- Analyze the shear force and bending moment for beams
- Evaluate beam deflection and slope through Macaulay method
- Determine maximum shear stress in helical coil springs.
- Utilize concepts of biaxial stresses in 2D shells

UNIT I STRESS, STRAIN, AND DEFORMATION OF SOLIDS 9

Rigid and Deformable bodies – Strength, Stiffness, and Stability – Stresses; Tensile, Compressive, and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energyand unit strain energy – Strain energy in uniaxial loads.

UNIT II BEAMS – LOADS AND STRESSES 9

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Relationship between load, shear force and bending moment – Stresses inbeams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shapeof beam section on stress-induced – Shear stresses in beams – Shear flow.

UNIT III BEAM DEFLECTION 9

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Macaulay Method – Columns – End conditions – Equivalent length of a column – Euler equation – Slendernessratio – Rankine's formula for columns

UNIT IV TORSION 9

Analysis of torsion of circular bars – Torsional Shear stress – Bars of solid and hollow circular section – Steppedshaft –Torsional rigidity – Compound shafts – Fixed and simply supported shafts – Application to close–coiledhelical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads

UNIT V SHELLS AND PRINCIPAL STRESSES 9

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr's circle forbiaxial stresses – Maximum shear stress – Strain energy in bending and torsion.

TOTAL: 45

(ii) LABORATORY

LIST OF EXPERIMENTS

1. Tensile test on metals–stress-strain characteristics
2. Hardness test on metals–Brinell and Rockwell Hardness tests.
3. Impact test on metals–Charpy, Izod impact tests.
4. Shear test on metals–direct shear strength, single shear, double shear.
5. Tests on helical springs–compression, tension springs–load-deformation characteristics, stiffness, shearstress, modulus of rigidity, and energy.
6. Torsion test on beams–torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.
7. Microscopic examination of i) Hardened samples and ii) Hardened and tempered samples.
8. Tempering – Improvement of Mechanical properties –Comparison for i) Unhardened specimen ii) Quenched specimen iii) Quenched and tempered specimen.
9. Study of low carbon steel and medium carbon steel.

TEXTBOOKS:

1. Dr. R. K. Bansal, A Textbook of Strength of Materials, 6th edition, Lakshmi Publications Ltd,Chennai, 2019.
2. S S Rattan, Strength of materials, 3rd edition, Tata McGraw-Hill Publishing Co, 2016

REFERENCE BOOKS:

1. U C Jindal, Strength of Materials, 2nd edition, Pearson Education, 2018.
2. Ferdinand Beer and E. Johnston and John DeWolf and David Mazurek, Mechanics of Materials, 8th edition,Tata McGraw-Hill Publishing Co, 2019
3. R S Khurmi and N. Khurmi, A Textbook of Strength of Materials (Mechanics of Solids), 26th Edition, S. ChandPublications, 2019.

WEBSITES:

1. https://www.engineeringtoolbox.com/mechanics-materials-t_8.html)
2. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-001-unified-engineering-i-ii-iii-iv-fall-2005-spring-2006/mechanics-and-materials-i/)

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C443.1	3	2	1	1	-	-	-	-	2	2	-	2	2	1
C443.2	3	2	1	1	-	-	-	-	2	2	-	2	2	-
C443.3	3	3	3	2	-	-	-	-	2	2	-	2	2	-
C443.4	3	3	2	1	-	-	-	-	2	2	-	2	2	-
C443.5	3	2	1	1	-	-	-	-	2	2	-	2	2	-
AVG	**3.00**	**2.40**	**1.60**	**1.20**	**-**	**-**	**-**	**-**	**2.00**	**2.00**	**-**	**2.00**	**2.00**	**1.00**

SEMESTER – IV

23BEME444 INDUSTRIAL METROLOGY 4 H – 3 C

(Theory and Laboratory)

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:

The goal of this course is for the students to:

- To find the correct procedure to be adopted to measure the dimension of the components.
- To Illustrate the principles of measuring instruments and gauges
- To examine the spur gear and thread element parameters.
- To inspect the dimensions using linear measurements using various measuring instruments
- To judge erecting machineries alignment and structure.

COURSE OUTCOMES:

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

- Explain the basics of measurements and quality standards.
- Make use of linear measurement devices for inspection.
- Identify dimensions using angular measuring devices.
- Identify dimensions of screw thread and spur gear
- Apply erection and commissioning procedure for installation of machineries.

UNIT I BASICS OF MEASUREMENT, DEVICES AND QUALITY STANDARDS 9

Definition of metrology, economics of measurement, measurement as a comparative process, dimensional properties, terminology and accuracy of measurement, measuring errors, Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.

UNIT II LINEAR MEASUREMENTS 9

Material length standards –line and end measurement – calibration of end bars, datum and reference surfaces, surface plates, gauges – feeler gauges, micrometers, dial test indicator, slip gauges, care of gauge blocks, Comparators- mechanical, electrical, optical and pneumatic, optical projector.

UNIT III GEOMETRICAL MEASUREMENT AND ADVANCES IN METROLOGY 9

Angular measurement – plain Vernier and optical protractors, sine bar, optical instruments, flatness, parallelism and roundness measurement, need for limit gauge, design of plug gauge. Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting. Basic concept of CMM – Types of CMM.

UNIT IV METROLOGY OF MACHINE ELEMENTS

Types of screw threads, terminology, proportions of ISO metric thread, measurement of major, minor and effective diameters. Gear terminology and standard proportions, spur gear measurement, checking of composite errors, base pitch measurement, clean room environment.

UNIT V MACHINE INSTALLATION AND TESTING

Equipment erection, commissioning, testing procedure for lathe, milling, continuous process line. First aid, safety precautions in installation of equipment, protocol for repair and testing, inspection check list.

TOTAL: 45

TEXT BOOKS:

1. Jain R.K, Engineering Metrology, 21st edition, Khanna Publishers, Delhi, 2018 reprint
2. Alan S. Morris, The Essence of Measurement, 1st edition, Prentice Hall of India, New Delhi, 1996
3. N.V. Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, 1st edition, OxfordUniversity press of India, 2013.
4. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

REFERENCE BOOKS:

1. R.K. Jain, Mechanical and Industrial Measurements, 12th edition, Khanna Publishers, 1995.
2. J P Holman, Experimental Methods for Engineers, 1st edition, Tata McGraw Hill Education, 2007
3. Beckwith T.G and N. Lewis Buck N, Mechanical Measurements, 6thedition,Addison Wesley, New york,2006.

WEBSITES:

1. https://nptel.ac.in/courses/112106179
2. https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-me105/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C444.1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
C444.2	3	2	1	-	-	-	-	1	2	2	-	2	2	-
C444.3	3	2	1	-	-	-	-	1	2	2	-	2	2	-
C444.4	3	2	1	-	-	-	-	1	2	2	-	2	2	-
C444.5	3	2	1	-	-	-	-	1	-	1	-	2	2	-
AVG	**2.80**	**1.80**	**1.00**	**-**	**-**	**-**	**-**	**1.00**	**2.00**	**1.60**	**-**	**2.00**	**2.00**	**-**

		SEMESTER-IV
23BEMC451	**FOUNDATION OF ENTREPRENEURSHIP**	**1H-0C**
Instruction Hours/week: L:1 T:0 P:0		**Marks:** Internal**:100** Total**:100**
		End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Equip and develop the learners' entrepreneurial skills and qualities essential to undertake¬ business.
- Impart the learners' entrepreneurial competencies needed for managing business efficiently and¬ effectively.
- Understand basic concepts in the area of entrepreneurship
- Develop personal creativity and entrepreneurial initiative
- Adopt the key steps in the elaboration of business idea

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Gain entrepreneurial competence to run the business efficiently.
- Undertake businesses in the entrepreneurial environment
- Prepare business plans and undertake feasible projects.
- Be efficient in launching and develop their business ventures successfully
- Monitor the business effectively towards growth and development

UNIT I ENTREPRENEURAL COMPETENCE

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful Entrepreneurs – Knowledge and Skills of an Entrepreneur.

UNIT II ENTREPRENEURAL ENVIRONMENT

Business Environment - Role of Family and Society - Entrepreneurship Development

UNIT III BUSINESS PLAN PREPARATION

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership

UNIT IV LAUNCHING OF SMALL BUSINESS

Finance and Human Resource Mobilization - Operations Planning - Market and Channel Selection - Growth Strategies

UNIT V MANAGEMENT OF SMALL BUSINESS

Monitoring and Evaluation of Business - Effective Management of small Business - Case Studies.

TEXT BOOKS:

1. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2016.
2. R.D.Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2018.
3. Rajeev Roy ,Entrepreneurship, Oxford University Press, 2nd Edition, 2011.
4. Donald F Kuratko,T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning, 2012.

SEMESTER-IV

23BEMC452	ESSENCE OFTRADITIONAL INDIAN KNOWLEDGE AND HERITAGE	1H-0C

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

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to

- Impart a holistic understanding about Indian Culture and Thoughts from a Historical perspective.
- Encourage critical appreciation of the Indian thoughts and cultural manifestations.
- Introduce the students to important concepts from the diverse intellectual traditions of India.
- Make use of Indian cultural heritage and various epistemological inquiries.
- Gain knowledge of Indian heritage.

COURSE OUTCOMES:

Upon completion of this course the students will be able to

- Understand the cultural diversity
- Infer the need of cultural unity
- Know the Dravidian culture
- Realize the power of Indian educational system called gurukul
- Come to know the concepts of vedic thought

UNIT I INTRODUCTION TO INDIAN THOUGHT AND CULTURE

Plurality of Indian culture - Cultural Diversity and Cultural Unity -Different manifestations of Indian Culture: Indus valley culture -Vedic culture and Dravidian culture-The Medieval Bhakti Culture

UNIT II TRADITIONAL KNOWLEDGE SYSTEMS OF INDIA

Introduction to the Traditional Indian Education system of Gurukul - Parampara -Understanding Indian Philosophy: Vedic thought and the nine schools of philosophy - Indigenous Knowledge and Women in India

TEXT BOOKS:

1. Chatterjee, Satishchandra and Dhirendramohan Datta. (2007) Introduction to Indian Philosophy. Rupa Publications, New Delhi.
2. Husain,S. Abid. (2003). The National Culture of India. National Book Trust, New Delhi.

SEMESTER - V

23BEME501 **DESIGN OF MACHINE ELEMENTS** **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:

The goal of this course is for the students to:

- Analyze and calculate steady and variable stresses in machine members.
- Design shafts, couplings, and fasteners based on strength and critical speed.
- Design welded joints for pressure vessels and structures.
- Design various types of springs under different load conditions & Design flywheels to store and release energy effectively.
- Select and design bearings for different applications and Design levers for mechanical advantage in simple systems.

COURSE OUTCOMES:

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

- Identify the stresses and deflections in machine members under loading conditions.
- Design shafts and couplings to meet given requirements.
- Design threaded and welded joints for the structures.
- Make use of the design procedure for spring and flywheel.
- Choose a bearing for a given applications.

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE 9

Introduction to the design process – factors influencing machine design, selection of materials based on mechanical properties – Factor of safety. Direct, Bending, and torsional stress equations – Impact and shock loading – calculation of principal stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame – theories of failure – stress concentration – design for variable loading – Soderberg, Goodman, and Gerber relations.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength, rigidity, and critical speed – Design of keys and keyways, Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings – design of knucklejoints.

UNIT III DESIGN OF FASTENERS AND WELDED JOINTS 9

Threaded fasteners – Design of bolted joints including eccentric loading – Design of welded joints for pressurevessels and structures – theory of bonded joints.

UNIT IV DESIGN OF SPRINGS AND FLYWHEEL 9

Design of helical, leaf, disc, and torsional springs under constant loads and varying loads – Concentric torsion springs – Belleville springs – Design of flywheels involving stresses in rim and arm.

UNIT V DESIGN OF BEARINGS AND LEVERS 9

Selection of bearings – sliding contact and rolling contact types – Cubic mean load – Selection of journal bearings – McKee's equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of Levers – Simple Levers.

***(Permitted to use of PSG design data book in the examination*)**

TOTAL: 45

TEXTBOOKS:

1. Bhandari V.B, Design of Machine Elements, 4e, Tata McGraw–Hill Book Co, New Delhi, 2016
2. R S Khurmi and J. K. Gupta, A Textbook of Machine Design, 34th edition, S. Chand Publishing, 2019

REFERENCE BOOKS:

1. Juvinall R.C and Marshek K.M, Machine Component Design, 5th Edition, John Wiley and Sons, New Delhi, 2016
2. Spotts M.F, Design of Machine Elements, 8th edition, Pearson Education, New Delhi, 2019
3. Design Data: Data Book of Engineers by PSG College-Kalaikathir Achchagam – Coimbatore
4. V B Bhandari, Machine Design Data Book, 2nd Edition, Tata McGraw Hill Publishing Co, 2019.

WEBSITES:

1. https://www.me.iitb.ac.in/~ramesh/courses/ME423/shafts.pdf
2. https://web.itu.edu.tr/~halit/Makel/Ch_11_slides_m.pdf

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C501.1	3	2	1	-	-	-	-	1	-	1	-	2	3	-
C501.2	3	3	3	2	-	-	-	1	-	1	-	2	3	-
C501.3	3	3	3	2	-	-	-	1	-	1	-	2	3	-
C501.4	3	2	1	-	-	-	-	1	-	1	-	2	3	-
C501.5	3	2	1	-	-	-	-	1	-	1	-	2	3	-
AVG	**3.00**	**2.40**	**1.80**	**2.00**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**-**	**2.00**	**3.00**	**-**

SEMESTER – V

23BEME502 RENEWABLE ENERGY SOURCES 3 H – 3 C

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

- To understand the different energy resources and their impacts of environment.
- To analyze energy production from solar plants.
- To impart knowledge on wind mills, tide and geo thermal energy productions.
- To provide basic knowledge on production of biomass energy.
- To understand the performance analysis of an OTEC power plant.

COURSE OUTCOMES

Upon completion of this course, the students can able to

- Outline the need for harnessing the renewable energy.
- Classify solar energy extraction techniques
- Interpret the energy generation capacity of wind, tide and geo thermal power plants.
- Identify bio energy extraction system for harvesting energy from biomass and bio-wastes.
- Explain modern renewable energy harvesting technologies.

UNIT I ENERGY AND ENVIRONMENT 9

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. Economics of Renewable Energy Systems.

UNIT II SOLAR ENERGY 9

Principles of solar energy collection – solar radiation – measurements – instruments – data and estimation– typesof collectors – characteristics and design principles of different type of collectors – performance of collectors –testing of collectors. Solar thermal applications – water heaters and air heaters – performance and applications –simple calculations – solar cooling – solar drying – solar ponds – solar tower concept – solar furnace.

UNIT III WIND, TIDAL AND GEO THERMAL ENERGY 9

Energy from the wind – general theory of windmills – design aspects of horizontal axis windmills – applications,performance and site selection of windmills. Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants – power from geothermal energy – principle of working of geothermal power plants.

UNIT IV BIO ENERGY 9

Energy from bio mass and bio gas plants – pyrolysis, gasification, combustion and fermentation – various types

– design principles of biogas plants – applications. Utilization of industrial and municipal wastes – energy fromthe agricultural wastes.

UNIT V OTHER RENEWABLE ENERGY SOURCES 9

Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) – thermoelectric generators – thermionic generators – fuel cells – solar cells – types, Emf generated, power output, losses and efficiency and applications. Hydrogen conversion and storage systems

TOTAL : 45 HOURS

TEXT BOOKS:

1. R K Bansal, A Non-Conventional Energy sources, 1st edition, Vikas Publishing house, New Delhi, 2014
2. John A. Duffie, William A. Beckman, Solar Engineering of Thermal Processes, 4thEdition, John Wiley and Sons, Inc ,2013.

REFERENCE BOOKS:

1. S. P. Sukhatme and J K Nayak, Solar Energy: Principles of Thermal Collection and Storage, 3rd edition,Tata McGraw Hill, New Delhi, 2008
2. Ashok V Desai, Non–conventional Energy, 1st edition, New Age International (P) Ltd., 2011.

WEB REFERENCES

1. https://nptel.ac.in/courses/121106014/
2. https://www.studentenergy.org/topics/renewable-energy

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C502.1	2	1	-	-	-	2	2	-	-	1	-	2	1	-
C502.2	2	1	-	-	-	2	2	-	-	1	-	2	1	-
C502.3	2	1	-	-	-	2	2	-	-	1	-	2	1	-
C502.4	3	2	1	-	-	2	2	-	-	1	-	2	1	-
C502.5	2	1	-	-	-	2	2	-	-	1	-	2	1	-
AVG	**2.20**	**1.20**	**1.00**	**-**	**-**	**2.00**	**2.00**	**-**	**-**	**1.00**	**-**	**2.00**	**1.00**	**-**

SEMESTER V

23BEME503 ADDITIVE MANUFACTURING 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 the students to:

- Understand the need and impact of additive manufacturing in product development.
- Explain about various stages of additive manufacturing processes.
- Explain the fundamentals of liquid and solid based additive manufacturing processes.
- Explain the fundamentals of powder based additive manufacturing processes.
- Provide an overview on medical and bio additive manufacturing.

COURSE OUTCOMES:

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

- Explain the need for additive manufacturing and its impact on product development.
- Build product from a given design using additive manufacturing technology
- Identify liquid and solid based additive manufacturing processes.
- Make use of powder based additive manufacturing processes for product development.
- Summarize the application of additive manufacturing in medical field.

UNIT I INTRODUCTION TO ADDITIVE MANUFACTURING 9

Overview – History - Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling - Applications.

UNIT II CAD AND REVERSE ENGINEERING 9

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Software's for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEM 9

Classification – Liquid based system – Stereo lithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 9

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three-Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT V MEDICAL AND BIO-ADDITIVE MANUFACTURING 9

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

TOTAL: 45

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S, Rapid prototyping: Principles and applications, 3rd edition, World Scientific Publishers, 2010
2. Gebhardt A, Rapid prototyping, 1st edition, Hanser Publications, 2003
3. Frank W. Liou, Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development, 2nd edition, CRC Press, 2019.

REFERENCE BOOKS:

1. Kamrani, Ali K., Nasr, Emad Abouel, Rapid Prototyping: Theory and practice, 1st edition, Springer, 2015
2. Peter Hilton, Rapid Tooling: Technologies and Industrial Applications, 1st edition, CRC Press, 2000.

WEBSITES:

1. https://patents.google.com/patent/US10974460B2/en
2. https://www.materialise.com/en/healthcare/mimics-innovation-suite/mimics
3. https://www.materialise.com/en/industrial/software/magics-data-build-preparation
4. https://labs.wsu.edu/mpml/bio-additive-manufacturing/
5. https://iubmb.onlinelibrary.wiley.com/doi/abs/10.1042/BA20030108

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C503.1	2	1	-	-	-	1	-	-	-	1	-	1	2	-
C503.2	3	2	1	1	-	1	-	-	-	1	-	1	2	-
C503.3	3	2	1	-	-	1	-	-	-	1	-	1	2	-
C503.4	3	2	1	-	-	1	-	-	-	1	-	1	2	-
C503.5	2	1	-	-	-	1	-	-	-	1	-	1	2	-
AVG	**2.60**	**1.60**	**1.00**	**1.00**	**-**	**1.00**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**2.00**	**-**

SEMESTER – V

23BEME541 **HEAT AND MASS TRANSFER** 5 H – 4 C

(Theory and Laboratory)

Instruction hours / week L : 2 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 impart a comprehensive knowledge of various modes of heat transfer.
- To empower the students for solving heat transfer problems in the industry.
- To equip the student in the design of heat exchangers.
- To recognize the importance of radiation heat transfer.
- To study about the basic concepts of mass transfer.

COURSE OUTCOMES

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

- Analyze the mechanism of conductive heat transfer.
- Compare the heat transfer phenomenon of natural and forced convection.
- Evaluate the performance of the heat exchangers.
- Estimate the radiative heat loss from hot surfaces.
- Analyze the coefficient of mass transfer in convection.

UNIT I CONDUCTION 9

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation – General Differentialequation of Heat Conduction – Fourier Law of Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems

– Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Use of Heisler's Chart.

UNIT II CONVECTION 9

Basic Concepts – Convective Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection –External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Combined Laminar and Turbulent – Flow over Bank of tubes – Free Convection –Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Nusselt's theory of condensation–pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – LMTD Method of heat Exchanger Analysis – Effectiveness – NTU method of Heat Exchanger Analysis – Overall Heat Transfer Coefficient – Fouling Factors.

UNIT IV RADIATION 9

Basic Concepts, Laws of Radiation – Stefan Boltzmann Law, Kirchoff Law –Black Body Radiation –Grey body radiation - Shape Factor Algebra – Electrical Analogy – Radiation Shields – Introduction to Gas Radiation.

UNIT V MASS TRANSFER 9

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

(Permitted to use standard Heat and Mass Transfer Table in the examination)

TEXT BOOK

1. Sachdeva R.C, Fundamentals of Engineering Heat and Mass Transfer, 4th edition, New Age International, New Delhi,2017
2. Frank P. Incropera and David P. DeWitt, Fundamentals of Heat and Mass Transfer, 7th edition, John Wiley and Sons,New Delhi, 2011.

REFERENCE BOOK

1. Jack P. Holman, Heat Transfer, 10th edition, McGraw–Hill Book Co, New Delhi, 2017
2. Kothandaraman C.P, Fundamentals of Heat and Mass Transfer, 4th Edition, New Age International, New Delhi, 2015

WEBSITES

1. https://www.techscience.com/journal/fhmt
2. https://www.thermalfluidscentral.org/journals/index.php/Heat_Mass_Transfer

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C541.1	3	3	2	1	-	-	-	-	2	2	-	1	3	-
C541.2	3	3	2	1	-	-	-	-	2	2	-	1	3	-
C541.3	3	3	3	2	-	-	-	-	2	2	-	1	3	-
C541.4	3	3	3	2	-	-	-	-	2	2	-	1	3	-
C541.5	3	3	2	1	-	-	-	-	-	1	-	1	3	-
AVG	**3.00**	**3.00**	**2.40**	**1.40**	**-**	**-**	**-**	**-**	**2.00**	**1.80**	**-**	**1.00**	**3.00**	**-**

SEMESTER – V

23BEME542 DYNAMICS OF MACHINERY 5 H – 4 C

(Theory and Laboratory)

Instruction hours / week L: 2 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 the students to:

- Analyze and solve force-related problems in machinery dynamics.
- Apply balancing principles to minimize vibrations in rotating machinery.
- Evaluate and determine the natural frequencies and damping characteristics of vibrating systems.
- Analyze forced vibrations in machinery and implement measures for vibration control.
- Explain and apply control mechanisms like governors and gyroscopes in machinery.

COURSE OUTCOMES:

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

- Utilize D'Alembert's principle for dynamic analysis problems
- Experiment with Static and dynamic balancing.
- Solve the transmissibility concepts using free vibrations
- Utilize amplitude transmissibility concepts for force transmission.
- Classify the governors and gyroscopes and its effects.

UNIT I FORCE ANALYSIS 9

Rigid Body dynamics in general plane motion – Equations of motion – Dynamic force analysis – Inertia force and Inertia torque – D'Alembert's principle – The principle of superposition – Dynamic Analysis in Reciprocating Engines – Gas Forces – Equivalent masses – Bearing loads – Crank shaft Torque – Turning moment diagrams – Fly wheels.

UNIT II BALANCING 9

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder Engine – Balancing Multi–cylinder Engines – Partial balancing in locomotive Engines.

UNIT III FREE VIBRATION 9

Basic features of vibratory systems – idealized models – Basic elements and lumping of parameters – Degrees of freedom – Single degree of freedom – Free vibration – Equations of motion – natural frequency – Damping Types of Damping – Damped vibration, critical speeds of simple shaft.

UNIT IV FORCED VIBRATION AND TORSIONAL VIBRATION 9

Response to periodic forcing – Harmonic Forcing – Forcing caused by unbalance – Support motion – Force transmissibility and amplitude transmissibility – Vibration isolation.

Torsional systems; Natural frequency of free torsional vibrations, Natural frequency of two and three rotor systems.

UNIT V MECHANISMS FOR CONTROL 9

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling Force – other Governor mechanisms.

Gyroscopes – Gyroscopic forces and Torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes

TOTAL: 45

(ii) LABORATORY

LIST OF EXPERIMENTS

1. Governors – Determination of sensitivity, effort, etc. for Watt, Porter, Proell, and spring-controlled governors
2. Cam – Determination of jump speed and profile of the cam.
3. Motorized Gyroscope–Verification of laws –Determination of gyroscopic couple.
4. Whirling of the shaft–Determination of the critical speed of the shaft with concentrated loads.
5. Balancing of rotating and reciprocating masses.
6. Determination of moment of inertia by oscillation method for connecting rod and flywheel.
7. Vibrating system – spring mass system – Determination of damping coefficient of single degree of freedom system
8. Determination of torsional frequencies for compound pendulum and flywheel system with the lumped moment of inertia.
9. Transverse vibration –free– Beam. Determination of natural frequency and deflection of beam.

TEXTBOOKS:

1. Rattan S.S, Theory of Machines, 5th edition, Tata McGraw–Hill Publishing Company Ltd., New Delhi, 2019
2. R. S. Khurmi, J. K. Gupta, Theory of Machines, 14rd edition, S Chand and Co Ltd, 2005.

REFERENCE BOOKS:

1. Shigley J.E, Uicker J.J, Theory of Machines and Mechanisms, 4th edition, Oxford University Press, New York, 2010.
2. Rao J.S., Dukkipati R.V, Mechanism and Machine Theory, 2nd edition, New Age International publishers, 2014
3. Charles E. Wilson, Kinematics and Dynamics of Machinery, 3rd edition, Pearson Education Ltd, 2008

WEBSITES:

1. https://nptel.ac.in/courses/112101096
2. https://archive.nptel.ac.in/courses/112/106/112106270/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C542.1	3	2	1	1	-	-	-	1	2	2	-	1	3	-
C542.2	3	2	1	1	-	-	-	1	2	2	-	1	3	-
C542.3	3	2	1	1	-	-	-	1	2	2	-	1	3	-
C542.4	3	2	1	1	-	-	-	1	2	2	-	1	3	-
C542.5	3	3	2	1	-	-	-	1	2	2	-	1	3	-
AVG	**3.00**	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**1.00**	**2.00**	**2.00**		**1.00**	**3.00**	**-**

23BE_____ OPEN ELECTIVE – I 3 H – 3 C

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

End Semester Exam :3 Hours

Students will select the open elective course from the set of open electives offered by various departments which are listedin the table of curriculum.

SEMESTER – V

23BEME591 FIELD PROJECT / INTERNSHIP 0 H – 1C

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

Students need to complete minimum 30 working days industrial internship during his/her Second year summer and winter vacation of UG program. Students may plan accordingly to avail industrial internship during summer and winter vacation except regular class days. And students should submit valid certificate and report for internal committee evaluation on his/her third semester.

SEMESTER-V

23BEMC551 CYBER SECURITY 1H-0C

Instruction Hours/week: L:1 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:

- To understand the field of digital security and concepts of access control mechanism.
- To introduce keywords and jargons involved in securing browser
- To understand network basic and familiarize on security of network protocols
- To understand cyber-attacks and data privacy
- To learn the tools and methods used in cyber security

COURSE OUTCOMES:

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

- Infer the importance of a network basics and brief introduction on security of network protocols
- Apply a solid foundation in digital security and measures taken to protect device from threats.
- Discuss about cyber-attacks and data privacy issues and preventive measures.
- Make use of tools and methods used in cyber security.
- Explain Cyber security organizational implications.

UNIT I NETWORKING BASICS 9

Networking basics (home network and large-scale business networks), Networking protocols, Security of protocols, sample application hosted on-premises.

UNIT II BASICS OF DIGITAL SECURITY 9

Basics of digital security, protecting personal computers and devices, protecting devices from Virus and Malware, Identity, Authentication and Authorization, need for strong credentials, keeping credentials secure, protecting servers using physical and logical security, World Wide Web (www), the Internet and the HTTP protocol, security of browser to web server interaction

UNIT III INTRODUCTION TO CYBER-ATTACKS 9

Introduction to cyber-attacks, application security (design, development and testing), operations security, monitoring, identifying threats and remediating them, Principles of data security - Confidentiality, Integrity and Availability, Data Privacy, Data breaches, preventing attacks and breaches with security controls, Compliance standards, Computer Ethics.

UNIT IV TOOLS AND METHODS 9

Tools and methods used in cyber security: Proxy servers and anonymizers – Phishing – Password cracking – Keyloggers and spywares – Virus and worms – Trojan horse – Stegnography – DoS and DDoS attack – SQL Injection – Buffer overflow – Attacks on wireless networks – Phishing and Identity theft.

UNIT V CYBER SECURITY ORGANIZATIONAL IMPLICATIONS 9

Cyber security organizational implications: Cost of cyber crimes and IPR – Web threads for organizations – Security and privacy implications – Social media marketing – Incident handling – Forensics best practices for organization.

TEXT BOOKS:

1. Sammons, John, and Michael Cross. The basics of cyber safety: computer and mobile device safety made easy. Elsevier, 2016.
2. Nina Godbole and Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley Publisher, First Edition, 2011

REFERENCES BOOKS:

1. Charles P. Pfleeger, Shari Lawrence, Pfleeger Jonathan Margulies; Security in Computing, Pearson Education Inc . 5th Edition, 2015
2. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cyber security essentials. John Wiley & Sons, 2018
3. Harish Chander, Cyber Laws and IT Protection, PHI Learning, First Edition, 2012
4. James Graham, Ryan Olson and Rick Howard, Cyber Security Essentials, CRC Press, First Edition, CRC Press, First Edition

WEBSITES:

1. https://www.cybersecurityservices.com/
2. https://www.nist.gov/cybersecurity

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C551.1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
C551.2	3	2	2	2	-	2	-	-	-	-	-	2	2	2
C551.3	3	3	2	2	-	2	-	-	-	-	-	2	2	2
C551.4	3	3	2	2	-	2	-	-	-	-	-	2	2	2
C551.5	3	2	2	2	-	2	-	-	-	-	-	2	2	2
AVG	**3**	**2.6**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

SEMESTER - VI

23BEME601 DESIGN OF TRANSMISSION SYSTEMS 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:

The goal of this course is for the students to:

- Analyze and design transmission systems for flexible elements (V belts, flat belts, wire ropes, transmission chains).
- Design spur and helical gears considering speed ratios, tooth stresses, fatigue strength, and power rating.
- Design bevel and worm gears, considering forces, stresses, efficiency, and thermal capacity.
- Design gearboxes, clutches, and brakes using appropriate techniques for different gear systems.
- Analyze and design transmission systems in electric vehicles, including single-speed and multi-speed setups.

COURSE OUTCOMES:

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

- Make use of design concepts for belt drives, rope drives, and chain drives.
- Model spur and helical gears based on speed ratios, strength, and materials.
- Choose bevel and worm gears, based on forces, materials, and efficiency.
- Construct ray diagram and kinematic layout for a gearbox.
- Classify clutch and brake system.

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 9

Design of V belts and pulleys – Selection of Flat belts and pulleys – Wire ropes and pulleys – Selection ofTransmission chains and Sprockets – Design of sprockets.

UNIT II DESIGN OF SPUR AND HELICAL GEARS 9

Gear Terminology – Speed ratios and number of teeth–Force analysis – Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Module and Face width–power rating calculations based on strength and wear considerations – Parallel axis Helical Gears and cross helical gears - Terminology– Pressureangle in the normal and transverse plane– Equivalent number of teeth– forces, and stresses – Estimating the size of the helical and cross helical gears.

UNIT III DESIGN OF BEVEL AND WORM GEARS 9

Straight bevel gear: Tooth terminology, tooth forces, and stresses, an equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits– terminology – Thermal capacity, materials–forces and stresses, efficiency, estimating the size of the worm gear pair.

UNIT IV DESIGN OF GEARBOXES, CLUTCHES, AND BRAKES 9

Geometric progression – Standard step ratio – Ray diagram, kinematics layout –Design of sliding mesh gear box – Constant mesh gearbox. – Design of multi-speed gearbox. Design of plate clutches –axial clutches–cone clutches–internal expanding rim clutches–internal and external shoe brakes.

UNIT V TRANSMISSION SYSTEM IN E-VEHICLE 9

Introduction, Single Speed Transmission, Multi-Speed Transmission, Comparison between Single speed and Multispeed Transmission, Comparison of Single speed and Multispeed Transmission - Torque Verses Speed, Efficiency, Design of Two Speed Transmission System.

Total: 45

(Permitted to use of PSG design data book in the examination)

TEXTBOOKS:

1. Bhandari V.B, Design of Machine Elements, 4e, Tata McGraw–Hill Book Co, New Delhi, 2016
2. R S Khurmi and J. K. Gupta, A Textbook of Machine Design, 34th edition, S. Chand Publishing, 2019

REFERENCE BOOKS:

1. Juvinall R.C and Marshek K.M, Machine Component Design, 5th Edition, John Wiley and Sons, New Delhi, 2016
2. Design Data: Data Book of Engineers by PSG College-Kalaikathir Achchagam – Coimbatore
3. Design 2-Speed Transmission for Compact Electric Vehicle Using Dual Brake System, 2019.

WEBSITES:

1. https://archive.nptel.ac.in/courses/112/105/112105234/
2. https://www.me.iitb.ac.in/~ramesh/courses/ME423/Gears.pdf

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C601.1	3	2	1	-	-	1	-	2	-	1	-	1	2	-
C601.2	3	2	1	-	-	1	-	2	-	1	-	1	2	-
C601.3	3	2	1	-	-	1	-	2	-	1	-	1	2	-
C601.4	3	2	1	-	-	1	-	2	-	1	-	1	2	-
C601.5	3	3	2	-	-	1	-	2	-	1	-	1	2	-
Average	**3.00**	**2.20**	**1.20**	**-**	**-**	**1.00**	**-**	**2.00**	**-**	**1.00**	**-**	**1.00**	**2.00**	**-**

SEMESTER – VI

23BEME6E__ PROFESSIONAL ELECTIVE - I 3 H – 3 C

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

End Semester Exam :3 Hours

PROFESSIONAL ELECTIVE - II SEMESTER – VI

23BEME6E__ 3 H – 3 C

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

End Semester Exam :3 Hours

PROFESSIONAL ELECTIVE - III SEMESTER – VI

23BEME6E__ 3 H – 3 C

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

End Semester Exam :3 Hours

22BE_____ OPEN ELECTIVE - II SEMESTER – VI

3 H – 3 C

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

End Semester Exam :3 Hours

23BEME611	COMPUTER AIDED MODELING LABORATORY	SEMESTER - VI 4 H – 2 C

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

End Semester Exam :3 Hours

COURSE OBJECTIVE

The goal of this course is for the students to:

- Demonstrate proficiency in 3D modelling of machine elements using a variety of modelling options.
- Develop skills in creating assemblies by incorporating individual parts and applying assembly constraints.
- Acquire the ability to convert 3D solid models into 2D drawings, including different views, sections, isometric view, and dimensioning.
- Gain an understanding of surface modelling techniques and their application in computer-aided design.
- Familiarize students with file import and export operations, specifically using formats such as DXF, IGES, STL, and STEP.

COURSE OUTCOMES:

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

- Model mechanical components using CAD software
- Apply commands in SolidWorks for modeling a given mechanical component.
- Make use of assembly module to assemble machine components.
- Develop manufacturing drawings from the created models.
  Utilize MAT Lab for simulating hydraulic and pneumatic systems.

COMPUTER AIDED DESIGN

1. 3D modeling of various machine elements using various options like protrusion, cut, sweep, draft, loft, blend, rib.
2. Assembly – creating assembly from parts – assembly constraints.
3. Conversion of 3D solid model to 2D drawing – different views, sections, isometric view and dimensioning.
4. Introduction to Surface Modeling.
5. Introduction to File Import, Export – DXF, IGES, STL, STEP.

Note: Any one of the 3D MODELING software's like SOLIDWORKS, CREO, CATIA, NX Software, AutoCAD etc.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C611.1	3	2	1	-	3	-	-	1	2	2	-	3	2	-
C611.2	3	2	1	-	3	-	-	1	2	2	-	3	2	-
C611.3	3	2	1	-	3	-	-	1	2	2	-	3	2	-
C611.4	3	2	1	-	3	-	-	1	2	2	-	3	2	-
C611.5	3	2	1	-	3	-	-	1	2	2	-	3	2	-
AVG	**3.00**	**2.00**	**1.00**	**-**	**3.00**	**-**	**-**	**1.00**	**2.00**	**2.00**	**-**	**3.00**	**2.00**	**-**

SEMESTER - VI

23BEME691 MINI PROJECT WORK 2 H – 1 C

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

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Cultivate skills to innovate new ideas and select a suitable problem.
- Equip to apply subject knowledge to obtain solutions to real-world problems.
- Equip to explore the various solutions and propose a solution based on findings.
- Develop skills in project planning, scheduling, handling technical challenges and completing the project under constraints.
- Develop skills to document the significant findings and outcomes.

COURSE OUTCOMES:

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

- Identify a problem in industry.
- Apply subject knowledge to fabricate equipment.
- Analyze the data collected and interpret the findings/ solutions /improvements.
- Choose the best solution based on the evaluation criteria.
- Summarize technical findings effectively.

COURSE DESCRIPTION:

The students in a group consisting of a maximum of four students work on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on the oral presentation and the project report by internal examiners constituted by the Head of the Department.

CO-PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C691.1	3	2	1	-	-	2	1	1	2	2	2	2	2	2
C691.2	3	2	1	-	-	2	1	1	2	2	2	2	2	2
C691.3	3	3	2	1	-	2	1	1	2	2	2	2	2	2
C691.4	3	2	1	-	-	2	1	1	2	2	2	2	2	2
C691.5	2	1	-	-	-	2	1	1	2	2	2	2	2	2
AVG	**2.80**	**2.00**	**1.25**	**1.00**	**-**	**2.00**	**1.00**	**1.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**

SEMESTER-VI

23BEMC651 UNIVERSAL HUMAN VALUES 1H-0C

Instruction Hours/week: L:1 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 the students to

- To help students to understand the need, basic guidelines, content and process of value education.
- To help students distinguish between values and skills
- To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
- To help students understand the meaning of happiness within their selves.
- To help students understand the meaning of happiness and prosperity for a human being.

COURSE OUTCOMES:

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

- Understand the significance of value inputs in a classroom, distinguish between values and skills.
- Understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
- Distinguish between the Self and the Body; understand the meaning of Harmony in the Self the Co-existence of Self and Body.
- Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships.
- Explore their role in ensuring a harmonious society.

UNIT I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP

Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi,

Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family!

TEXT BOOKS:

1. R R Gaur, R Sangal and G P Bagaria(2009).“A Foundation Course in Human Values and Professional Ethics”
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
3. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome’s report, Universe Books.
6. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
7. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
8. A N Tripathy, 2003, Human Values, New Age International Publishers.

SEMESTER VII

23BEME701 PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS 3 H – 3 C

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

End Semester Exam :3 Hours

COURSE OBJECTIVE:

The goal of this course is for the students to:

- To have a clear understanding of the managerial functions like planning, organizing, staffing, leading and controlling.
- To study the evolution of management.
- To study the functions and principles of management.
- To learn the plans by directing and controlling.
- To learn the application of the principles in an organization.

COURSE OUTCOME

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

- Explain the managerial functions.
- Compare the functions and principles of management theories.
- Interpret the engineering ethics in an organization.
- Illustrate the social factors and social changes.
- Outline the safety responsibilities and ethics.

UNIT I HISTORICAL DEVELOPMENT, PLANNING, ORGANISING 9

Definition of Management – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies and Planning Premises– Forecasting – Decision–making – Formal and informal organization – Organization Chart.

UNIT II DIRECTING AND CONTROLLING 9

Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment –Process of Communication – System and process of Controlling – Requirements for effective control – Control of Overall Performance – Direct and Preventive Control – Reporting

UNIT III ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – variety of moral issued – types of inquiry – moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – consensus and controversy – Models of Professional Roles – theories about right action – Self–interest – customs and religion – uses of ethical theories.

UNIT IV FACTORS OF CHANGES 9

Forces that shape culture, social control – Meaning, Agencies, Institution, Customs, Values, Folkways, Norms and Laws. Social changes – Meaning and nature – Theories.

UNIT V SAFETY RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination – Global issues - Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social.

TOTAL: 45

TEXT BOOKS:

1. Harold Kooritz and Heinz Weihrich, Essentials of Management, Tata McGraw Hill, New Delhi, 2010.
2. Khanka S.S, Entrepreneurial Development, S.Chand and Co. Ltd., New Delhi, 2006.
3. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw–Hill, NewYork, 2005.

REFERENCE BOOKS

1. Khanka S.S, Entrepreneurial Development,4thEdition, S.Chand and Co. Ltd., NewDelhi,2006.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw–Hill, NewYork, 2005.
3. Charles E Harris, and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning,New Delhi, 2013.

CO-PO MAPPING

CO	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2
C701.1	2	1	-	-	-	2	-	2	-	1	-	1	1	-
C701.2	2	1	-	-	-	2	-	2	-	1	-	1	1	-
C701.3	2	1	-	-	-	2	-	2	-	1	-	1	1	-
C701.4	2	1	-	-	-	2	-	2	-	1	-	1	1	-
C701.5	2	1	-	-	-	2	-	2	-	1	-	1	1	-
AVG	**2.00**	**1.00**	**-**	**-**	**-**	**2.00**	**-**	**2.00**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

SEMESTER – VII

23BEME741 FINITE ELEMENT METHOD 5 H – 4 C

(Theory and Laboratory)

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

End Semester Exam :3 Hours

(i) THEORY

COURSE OBJECTIVE

The goal of this course is for the students to:

- Understand the fundamental concepts and historical background of the finite element method (FEM) and its application to continuum problems.
- Develop the ability to discretize continuum problems and apply matrix algebra techniques for solving them.
- Gain proficiency in formulating and solving one-dimensional FEM problems using the potential energy and Galerkin approaches.
- Acquire the necessary skills to model and analyze two-dimensional continuum problems using FEM, including the solution of scalar-valued equations and stress calculations.
- Explore the axisymmetric formulation of FEM and its applications in solving problems related to cylindrical structures under different conditions.

COURSE OUTCOME

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

- Apply FEM concepts to provide preliminary results of nodal force and displacements.
- Evaluate the static structural and thermal analysis using FEM.
- Examine the results obtained by Two-dimensional continuum
- Utilize the axisymmetric continuum on body forces and temperature effects
- Examine the results obtained by iso-parametric elements.

UNIT I INTRODUCTION 12

Historical background – Matrix approach–Application to the continuum – Discretization – Matrix algebra – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Ritz method.

UNIT II ONE DIMENSIONAL PROBLEMS 12

Finite element modeling – Coordinates and shape functions– Potential energy approach – Galerkin approach – Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to plane trusses.

UNIT III TWO-DIMENSIONAL CONTINUUM 12

Introduction – Finite element modeling – Scalar valued problem – Poisson equation –Laplace equation – Triangular elements – Element stiffness matrix – Force vector – Galerkin approach – Stress calculation – Temperature effects.

UNIT IV AXISYMMETRIC CONTINUUM 12

Axisymmetric formulation – Element stiffness matrix and force vector – Galerkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures.

UNIT V ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL CONTINUUM 12

The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Numerical integration – Stiffness integration – Stress calculations – Four node quadrilateral element.

TEXT BOOKS:

1. Rao S.S, The Finite Element Method in Engineering, 4th Edition, Butter worth Heinemann imprint, USA,2011
2. Daryl L. Logan, A First course in the Finite Element Method, 5th Edition, Cengage Learning, Stamford,USA, 2011

REFERENCE BOOKS

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering:International Edition, 4th Edition, Pearson Education Limited, 2014
2. David V Hutton, Fundamentals of Finite Element Analysis, 1st Edition, Tata McGraw–Hill Education,2005

WEBSITES

1. https://quickfem.com/
2. https://onlinecourses.nptel.ac.in/noc22_me43/preview

LIST OF EXPERIMENTS
(Simple Analysis using ANSYS Tool)

1. Structural Analysis (Static)1d and 2d analysis of
   - Bar and truss,
   - Beams and frames,
   - Plate and shell structures
2. Structural vibration analysis (Dynamic)
   - Modal analysis
   - Frequency response analysis
   - Transient response analysis
3. Thermal analysis – simple problems
4. Fluid Analysis – simple problems
5. Failure analysis – simple problems

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C741.1	3	2	1	-	2	-	-	-	2	2	-	2	2	-
C741.2	3	3	3	2	2	-	-	-	2	2	-	2	2	-
C741.3	3	3	2	1	2	-	-	-	2	2	-	2	2	-
C741.4	3	2	1	-	2	-	-	-	2	2	-	2	2	-
C741.5	3	3	2	1	2	-	-	-	2	2	-	2	2	-
AVG	**3.00**	**2.60**	**1.80**	**1.33**	**2.00**	**-**	**-**	**-**	**2.00**	**2.00**	**-**	**2.00**	**2.00**	**-**

SEMESTER – VII

23BEME7E__ **PROFESSIONAL ELECTIVE – IV** **3 H – 3 C**

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

SEMESTER – VII

23BEME7E___ **PROFESSIONAL ELECTIVE – V** **3 H – 3 C**

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

SEMESTER – VII

23BEME7E___ **PROFESSIONAL ELECTIVE – VI** **3 H – 3 C**

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

SEMESTER – VII

23BEME711 **CAM LABORATORY** **4 H – 2C**

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

End Semester Exam :3 Hours

COURSE OBJECTIVES

- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre.
- To create part programming involving different motions.
- To understand the working of standard canned cycles.

COURSE OUTCOMES

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

- Compile manual part programming using G and M codes
- Distinguish the Siemens and Fanuc modern control systems.
- Outline the application of CNC and VMC machines
- Develop the part programming involving motions.
- Explain the working of standard canned cycles.

LIST OF EXPERIMENTS

- Manual Part Programming (Using G and M Codes) in CNC Machine.
- Part programming for Linear, Circular interpolation, and Contour motions.
- Part programming using standard canned cycles for Thread cutting, Drilling, Peck drilling, and Boring.
- NC code generation using software's like Edge CAM, CREO, etc.
- CNC Controllers like FANUC, Siemens, and Hiedenhain etc.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C711.1	3	3	3	2	2	-	-	-	2	2	-	3	3	-
C711.2	3	3	2	1	1	-	-	-	2	2	-	3	3	-
C711.3	2	1	-	-	1	-	-	-	2	2	-	3	3	-
C711.4	3	3	3	2	2	-	-	-	2	2	-	3	3	-
C711.5	2	1	-	-	1	-	-	-	2	2	-	3	3	-
AVG	**2.60**	**2.20**	**2.67**	**1.67**	**1.40**	**-**	**-**	**-**	**2.00**	**2.00**	**-**	**3.00**	**3.00**	**-**

SEMESTER – VII

23BEME791 PROJECT WORK PHASE – I 8 H – 4 C

Instruction hours / week L : 0 T : 0 P : 8 **Marks:** Internal **:100** External **: --**Total**: 100**

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Cultivate skills to innovate new ideas and select a suitable problem.
- Equip to apply subject knowledge to obtain solutions to real-world problems.
- Equip to explore the various solutions and propose a solution based on findings.
- Develop skills in project planning, scheduling, handling technical challenges and completing the project under constraints.
- Develop skills to document the significant findings and outcomes.

COURSE OUTCOMES:

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

- Outline the literature review.
- Apply subject knowledge to identify research gab.
- Identify the problem for research work.
- Explain the objectives.
- Build aim and title of the project work.

COURSE DESCRIPTION:

The students in a group consisting of a maximum of four students work on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on the oral presentation and the project report by internal examiners constituted by the Head of the Department.

CO-PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C791.1	2	1	-	-	1	1	1	1	2	2	-	2	2	-
C791.2	3	2	1	-	1	1	1	1	2	2	-	2	2	-
C791.3	3	2	1	-	1	1	1	1	2	2	-	2	2	-
C791.4	2	1	-	-	1	1	1	1	2	2	-	2	2	-
C791.5	3	2	1	-	1	1	1	1	2	2	-	2	2	-
AVG	**2.60**	**1.60**	**1.00**	**-**	**1.00**	**1.00**	**1.00**	**1.00**	**2.00**	**2.00**	**-**	**2.00**	**2.00**	**-**

SEMESTER - VIII

23BEME891 PROJECT WORK PHASE – II 16 H – 8 C

Instruction hours / week L : 0 T : 0 P : 16 **Marks:** Internal **: 120** External **:180** Total**: 100**

End Semester Exam :3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Cultivate skills to innovate new ideas and select a suitable problem.
- Equip to apply subject knowledge to obtain solutions to real-world problems.
- Equip to explore the various solutions and propose a solution based on findings.
- Develop skills in project planning, scheduling, handling technical challenges and completing the project under constraints.
- Develop skills to document the significant findings and outcomes.

COURSE OUTCOMES:

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

- Plan methodology according to research problem.
- Apply research knowledge to solve the problem.
- Analyze the data collected findings/ solutions /improvements
- Examine newer techniques to improve the performance of a device/system.
- Develop power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION:

The students in a group consisting of a maximum of four students work on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on the oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

CO-PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C891.1	3	2	1	-	2	2	1	1	3	3	2	2	3	2
C891.2	3	2	1	-	2	2	1	1	3	3	2	2	3	2
C891.3	3	3	2	1	2	2	1	1	3	3	2	2	3	2
C891.4	3	3	2	1	2	2	1	1	3	3	2	2	3	2
C891.5	3	2	1	-	2	2	1	1	3	3	2	2	3	2
AVG	**3.00**	**2.40**	**1.40**	**1.00**	**2.00**	**2.00**	**1.00**	**1.00**	**3.00**	**3.00**	**2.00**	**2.00**	**3.00**	**2.00**

PROFESSIONAL ELECTIVE I

23BEME6E01 COMPOSITE MATERIALS AND MECHANICS 3 H – 3 C

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 the students to:

- Understand the fundamentals of composite material and its mechanical behavior.
- Understand the analysis of fiber reinforced laminate design
- Gain knowledge of different failure criteria for laminated composites.
- Understand thermo-mechanical behavior and residual stresses in laminates.
- Understand the structural characteristics of laminated flat plates.

COURSE OUTCOMES:

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

- Classify the composite materials.
- Solve lamina stresses within laminates.
- Analyze lamina strength using criterions.
- Compare thermal behavior of composite laminates.
- Analyze static bending, Buckling and free vibration in laminated flat plate.

UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS and MANUFACTURING 9

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes

UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 9

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT III LAMINA STRENGTH ANALYSIS 9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

UNIT IV THERMAL ANALYSIS 9

Assumption of Constant C.T. E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T. E's. C.T. E's for special Laminate Configurations –Unidirectional, Off- axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

UNIT V ANALYSIS OF LAMINATED FLAT PLATES 9

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

TOTAL: 45

TEXT BOOKS:

1. Jones R. M., "Mechanics of Composite Materials", Hemisphere Publishing Corporation, New York
2. Agarwal B. D. and Broutmen L. J. "Analysis and performance of Fiber Composites", John Wiley and Sons, New York 1990

REFERENCE BOOKS:

1. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984.
2. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition – 2007

WEBSITES:

1. http://www.eng.usf.edu/~kaw/class/composites/
2. https://nptel.ac.in/courses/101104010

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C6E01.1	2	1	-	-	-	-	-	-	-	1	-	1	2	-
C6E01.2	3	2	1	-	-	-	-	-	-	1	-	1	2	-
C6E01.3	3	3	2	1	-	-	-	-	-	1	-	1	2	-
C6E01.4	3	3	2	1	-	-	-	-	-	1	-	1	2	-
C6E01.5	3	3	2	1	-	-	-	-	-	1	-	1	2	-
AVG	**2.80**	**2.40**	**1.75**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**2.00**	**-**

23BEME6E02 DESIGN CONCEPTS IN ENGINEERING 3 H – 3 C

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 the students to:

- To study the various design requirements and get acquainted with the processes involved in product development.
- To study the design processes to develop a successful product.
- To learn scientific approaches to provide design solutions.
- Designing solution through relate the human needs and provide a solution.
- To study the principles of material selection in design.

COURSE OUTCOMES

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

- Explain the design terminology.
- Develop a process for a successful product.
- Apply scientific approaches to provide solutions.
- Organize solution for product development with considering human needs.
- Apply the principles of material selection in design process.

UNIT I DESIGN TERMINOLOGY 9

Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.

UNIT II INTRODUCTION TO DESIGN PROCESSES 9

Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering -customer requirements- Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions- Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation

UNIT III CREATIVITY IN DESIGN 9

Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks- Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.

UNIT IV HUMAN AND SOCIETAL ASPECTS IN PRODUCT DEVELOPMENT 9

Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects

UNIT V MATERIAL AND PROCESSES IN DESIGN 9

Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly (DFA).

TOTAL 45 HOURS

TEXT BOOKS:

1. Dieter. G. N., Linda C. Schmidt, "Engineering Design", McGraw Hill, 2013.
2. Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.
3. Dhillon, B. S., Advanced Design Concepts for Engineers, Technomic Publishing Co., 1998.
4. Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, "Integrated Product and Process Design and Development", CRC Press, 2009.

REFERENCE BOOK

1. James Garratt, "Design and Technology", Cambridge University Press, 1996.
2. Joseph E. Shigley, Charles R.Mische, and Richard G. Budynas, "Mechanical Engineering Design", McGraw Hill Professional, 2003.
3. Sumesh Krishnan and Mukul Sukla, Concepts in Engineering Design, Notion Press, 2016.

WEBSITES:

1. https://www.mcgill.ca/engineeringdesign/step-step-design-process
2. https://www.concurrent-engineering.co.uk/

CO PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C6E02.1	2	1	-	-	-	2	-	2	-	1	-	1	2	-
C6E02.2	3	2	1	-	-	2	-	2	-	1	-	1	2	-
C6E02.3	3	2	1	-	-	2	-	2	-	1	-	1	2	-
C6E02.4	3	2	1	-	-	2	-	2	-	1	-	1	2	-
C6E02.5	3	2	1	-	-	2	-	2	-	1	-	1	2	-
AVG	**2.80**	**1.80**	**1.00**	**-**	**-**	**2.00**	**-**	**2.00**	**-**	**1.00**	**-**	**1.00**	**2.00**	**-**

23BEME6E03 MODERN ROBOTICS 3 H – 3 C

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

- To introduce definition, history of robotics and robot anatomy.
- To learn the simulation of robot kinematics
- To study the grasping and manipulation of robots.
- To study about mobile robot and manipulation.
- To study the applications of industrial service robot.

COURSE OUTCOMES

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

- Summarize history of robotics and robot anatomy.
- Develop simulation of robot kinematics.
- Outline the grasping and manipulation of robots.
- Explain mobile robot and manipulation.
- Outline the applications of industrial service robots.

UNIT I INTRODUCTION 9

Robot: Definition, History of Robotics, Robot Anatomy, Co-ordinate systems, types and classification, Configuration space and degrees of freedom of rigid bodies and robots, Configuration space topology and representation; configuration and velocity constraints; task space and workspace, Rigid-body motions, rotation matrices, angular velocities, and exponential coordinates of rotation, Homogeneous transformation matrices.

UNIT II SIMULATION OF ROBOT KINEMATICS 9

Robot kinematics, Forward and inverse kinematics (two three four degrees of freedom), Forward and inverse kinematics of velocity, Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg (D-H) transformation, Dynamics of Open Chains, Trajectory Generation, motion planning, robot control: First- and second-order linear error dynamics, stability of a feedback control system.

UNIT III GRASPING AND MANIPULATION OF ROBOTS 9

Kinematics of contact, contact types (rolling, sliding, and breaking), graphical methods for representing kinematic constraints in the plane, and form-closure grasping, Coulomb friction, friction cones, graphical methods for representing forces and torques in the plane, End effectors, grippers, types of gripper, gripper force analysis, and examples of manipulation and grasping.

UNIT IV MOBILE ROBOTS 9

Mobile robot, Wheeled Mobile Robots: Kinematic models of omnidirectional and non-holonomic wheeled mobile robots, Controllability, motion planning, feedback control of non-holonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation. Reference Trajectory generation, feed forward control

UNIT V APPLICATIONS OF ROBOTS 9

Application of robotic: industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare

TOTAL: 45

TEXT BOOKS:

1. Modern Robotics: Mechanics, Planning, and Control, by Kevin M. Lynch , Frank C. Park , Cambridge University Press; 1st edition (25 May 2017), ISBN-10 : 110715.
2. Modern Robotics: Mechanics, Systems and Control, by Julian Evans, Larsen and Keller Education (27 June 2019), ISBN-10 : 1641720751.

REFERENCE BOOKS

1. Modern Robotics: Designs, Systems and Control, by Jared Kroff, Willford Press (18 June 2019)ISBN-10 : 1682856763.
2. Advanced Technologies in Modern Robotic Applications, by ChenguangYang , Hongbin Ma, Mengyin Fu, Springer; Softcover reprint of the original 1st ed. 2016 edition (30 May 2018), ISBN- 10 : 981109263X.

WEBSITES

1. http://hades.mech.northwestern.edu/index.php/Modern_Robotics
2. https://www.coursera.org/specializations/modernrobotics

CO PO MAPPING

CO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
C6E03.1	2	1	-	-	-	-	-	-	-	1	-	1	-	1
C6E03.2	3	2	1	-	-	-	-	-	-	1	-	1	-	1
C6E03.3	2	1	-	-	-	-	-	-	-	1	-	1	-	1
C6E03.4	2	1	-	-	-	-	-	-	-	1	-	1	-	1
C6E03.5	2	1	-	-	-	-	-	-	-	1	-	1	-	1
AVG	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**-**	**1.00**

23BEME6E04 HYDRAULICS AND PNEUMATICS POWER CONTROL 3 H – 3 C

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

- To recognize symbols and fundamentals in fluid power generation and distribution.
- To identify power source for hydraulic systems.
- To select appropriate components used in various hydraulic systems.
- To design hydraulic circuits for given applications
- To distinguish the components used in pneumatic circuits.

COURSE OUTCOMES:

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

- Summarize properties of hydraulic fluids and fluid power symbols.
- Select hydraulic power source and actuator for a given hydraulic systems.
- Model hydraulic circuits for given application.
- Distinguish the components used in pneumatic circuits.
- Develop pneumatic circuits for given application.

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid powersystems, Properties of hydraulic fluids and air – selection of hydraulic fluids – components of fluid power system

– Fluid power symbols. Applications of Pascals Law– Losses in pipe, valves and fittings – comparison betweenhydraulic and pneumatics.

UNIT II HYDRAULIC POWER SOURCES AND ACTUATORS 9

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, Pressure boosting pumps, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Doubleacting special cylinders like tanden, Rodless, Telescopic, Cushioning mechanism, Construction of double actingcylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors, Rotary distributor.

UNIT III HYDRAULIC CONTROL VALVES AND COMPONENTS 9

Construction of Control Components : Direction control valve – 3/2 way valve – 4/2 way valve – Shuttle valve

– check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier

– Intensifier circuit.

UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS 9

Pneumatic Components: Compressors – Filter, Regulator and Lubricator UNIT Air control valves, Quick exhaustvalves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumohydraulic circuit, Sequential circuit design for simple applications using cascade method.

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

TOTAL 45 HOURS

TEXT BOOKS:

1. Anthony Esposito, Fluid Power with Applications, 1st edition, Pearson Education, New Delhi, 2013
2. Majumdar S. R, Oil Hydraulic Systems: Principles and Maintenance, 1st edition, Tata McGraw–Hill, NewDelhi, 2000.

REFERENCE BOOKS

1. IlangoSivaraman, Introduction To Hydraulics And Pneumatics, 3rdedition,, PHI Learning Pvt. Ltd, NewDelhi, 2017.
2. Michael J, Prinches and AshbyJ.G, Power Hydraulics, 1st edition, Prentice Hall of India, New Delhi, 2007(digital).

WEBSITES

1. https://www.iqsdirectory.com/articles/hydraulics/difference-between-hydraulics-and-pneumatics.html
2. https://www.worlifts.co.uk/expert-guides/hydraulics-and-pneumatics-whats-the-difference-and-why-the-confusion/

CO PO MAPPING

CO	PO1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2
C6E04.1	2	1	-	-	-	-	-	-	-	1	-	1	-	1
C6E04.2	3	2	1	-	-	-	-	-	-	1	-	1	-	1
C6E04.3	3	2	1	-	-	-	-	-	-	1	-	1	-	1
C6E04.4	3	2	1	-	-	-	-	-	-	1	-	1	-	1
C6E04.5	3	3	2	1	-	-	-	-	-	1	-	1	-	1
AVG	**2.80**	**2.00**	**1.25**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**-**	**1.00**

PROFESSIONAL ELECTIVE II

23BEME6E05 REFRIGERATION AND AIR CONDITIONING 3 H – 3 C

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 the students to:

- Apply the underlying principles of operations in different Refrigeration and Air conditioning systems and components.
- Demonstrate the design aspects of refrigeration and air conditioning systems
- Apply the variable conditions of air and water vapor in air conditioning systems.
- Learn various aspects of cooling load for a given system.
- Apply knowledge on the air conditioning systems.

COURSE OUTCOMES:

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

- Summarize the basic principles of refrigeration system.
- Classify refrigerants, system components design for a given application.
- Make use of psychrometric principles for industrial applications.
- Solve the overload conditions in refrigeration and air condition systems.
- Outline components of air conditioning system and its applications.

UNIT I REFRIGERATION CYCLE 9

Review of thermodynamic principles of refrigeration. Concept of refrigeration system. Vapour compression refrigeration cycle – use of P–H charts – multistage and multiple evaporator systems – cascade system – COP comparison. Vapor absorption refrigeration system. Ammonia water and Lithium Bromide water systems. Steamjet refrigeration system

UNIT II REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING 9

Compressors – reciprocating and rotary (elementary treatment.) – Condensers – evaporators – cooling towers. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Refrigeration plant controls – testingand charging of refrigeration units. Balancing of system components. Applications to refrigeration systems – iceplant – food storage plants – milk –chilling plants – refrigerated cargo ships.

UNIT III PSYCHROMETRY 9

Psychrometric processes– use of psychrometric charts – Grand and Room Sensible Heat Factors – bypass factor – requirements of comfort air conditioning – comfort charts – factors governing optimum effective temperature, recommended design conditions and ventilation standards

UNIT IV COOLING LOAD CALCULATIONS 9

Types of loads – design of space cooling load – heat transmission through building. Solar radiation – infiltration – internal heat sources (sensible and latent) – outside air and fresh air load – estimation of total load – Domestic,commercial and industrial systems – central air conditioning systems.

UNIT V AIRCONDITIONING 9

Air conditioning equipment – air cleaning and air filters – humidifiers – dehumidifiers – air washers – condenser cooling tower and spray ponds – elementary treatment of duct design – air distribution system. Summer, winter and
year-round air-conditioning system, Thermal insulation of air conditioning systems. – Applications: car, industry, stores,and public buildings.

TOTAL: 45

TEXT BOOKS:

1. Manohar Prasad, Refrigeration and Air Conditioning, 3rd edition, New Age International Ltd, New Delhi,2015.
2. Arora. C.P, Refrigeration and Air Conditioning, 3rd edition, Tata McGraw–Hill, New Delhi, 2008

REFERENCE BOOKS:

1. Roy.JDossat, Principles of Refrigeration, 4th edition, Prentice Hall of India PVT Ltd., New Delhi, 1998
2. Jordon and Prister, Refrigeration and Air Conditioning, 2nd edition, Prentice Hall of India PVT Ltd., NewDelhi,1982
3. StoeckerN.W and Jerold W.Jones, Refrigeration and Air Conditioning, 2nd edition, McGraw Hill, NewDelhi,2007

WEBSITES:

1. https://archive.nptel.ac.in/courses/112/105/112105129/
2. https://www.ashrae.org/technical-resources/refrigeration

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C6E05.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E05.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E05.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E05.4	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E05.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.40**	**1.40**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME6E06 ADVANCED MANUFACTURING PROCESSES 3 H – 3 C

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 the students to

- Explain about different stages of powder metallurgy process.
- Develop the understanding of various advanced metal joining processes.
- Provide an overview on various advanced sheet metal operations.
- Understand the fundamentals of various advanced machining processes.
- Understand the need for additive manufacturing and its processes.

COURSE OUTCOMES:

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

- Outline the concepts and processing parameters of powder metallurgy process.
- Summarize the principles of advanced welding operations.
- Explain the principles of advanced sheet metal forming operations.
- Relate the principles of nontraditional machining processes.
- Compare the need and principles of additive manufacturing processes.

UNIT I POWDER METALLURGY AND FOUNDRY TECHNIQUES 9

Introduction to powder metallurgy process – preparation of powders – types and functions of binders – green compaction – sintering process and its effect on the product. High pressure moulding, Squeeze casting, Vacuum castings

UNIT II ADVANCED WELDING PROCESSES 9

Percussion Welding– Electro Slag Welding, Plasma Arc Welding – Thermit Welding – Electron Beam Welding – Friction and Inertia Welding – Friction Stir Welding – Under Water Welding Process.

UNIT III SHEET METAL AND FORMING PROCESS 9

Sheet metal process –Laser welding and Cutting, Working principle and application of special forming process – Hydro Forming– Rubber Pad Forming– Explosive Forming – Magnetic Pulse Forming– Peen Forming – Super Plastic Forming – Deep Drawing Process.

UNIT IV ADVANCED MACHINING PROCESS 9

Modern machining process: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, Electro chemical Machining, Electro chemical Grinding, Electro Discharge Machining, wire cut EDM, Electron Beam Machining, plasma arc machining, Laser Beam Machining. Ultrasonic Machining, High speed machining process – deep hole drilling process

UNIT V RAPID PROTOTYPING 9

Introduction to Rapid Prototyping – Need for RPT and 3D printing– Stereo–lithography – Selective Laser Sintering, Fused Deposition Modeling, Laminated Object Manufacturing, Solid Ground Curing, Ballistic Particle Manufacturing.

TOTAL: 45

TEXT BOOKS:

1. O. P. Khanna, A Textbook of Welding Technology, 1st edition, Dhanpat Rai Publications Pvt Ltd, 2012
2. P.N. Rao, Manufacturing technology Volume I, 4th edition, Tata McGraw Hill Education, 2013

REFERENCE BOOKS:

1. Singh, M.K, Unconventional Manufacturing Process, 1st edition, New age international, 2019.
2. Vijay.K Jain, Advanced Machining Processes, 1st edition, Allied Publishers Pvt. Ltd, 2010

WEBSITES:

1. https://nptel.ac.in/courses/112107078/
2. https://archive.nptel.ac.in/courses/112/103/112103306/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C6E06.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E06.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E06.3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E06.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E06.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME6E07 DESIGN OF PRESSURE VESSELS 3 H – 3 C

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

End Semester Exam :3 Hours

COURSE OBJECTIVE

The goal of this course is for students

- To introduce the Mathematical knowledge to design pressure vessels
- To introduce the Mathematical knowledge to design piping system.
- To learn the ability to carry of stress analysis in pressure vessels and piping
- To study the design of vessels and theory of reinforcement.
- To study buckling and fracture analysis in vessels.

COURSE OUTCOMES

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

- Solve stresses and Ligament efficiency for a given application.
- Analyze stress in pressure vessels.
- Distinguish stress in piping system.
- Construct the pressure vessel for a given application.
- Analyze the buckling and fracture effects in vessels

UNIT I INTRODUCTION 9

Methods for determining stresses – Terminology and Ligament Efficiency – Applications

UNIT II STRESSES IN PRESSURE VESSELS 9

Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF VESSELS 9

Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS 9

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick-walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V PIPING 9

Introduction – Flow diagram – piping layout and piping stress Analysis.

TEXT BOOKS:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.
2. Theory And Design Of Pressure Vessels (Pb 2001) by HARVEY J.F. | 1 January 2001.
3. Henry H. Bedner, “Pressure Vessels, Design Hand Book", CBS publishers and Distributors,1987.

REFERENCE BOOKS:

1. Stanley, M. Wales, “Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
2. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME-Pressure Vessels and Piping Conference, 1997.

WEBSITES

1. https://whatispiping.com/basics-of-pressure-vessels/
2. https://www.udemy.com/course/design-of-pressure-vessels-chemical-engineering-oil-gas/

CO PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO1	PSO2
C6E07.1	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E07.2	3	3	2	1	-	-	-	-	-	1	-	1	1	-
C6E07.3	3	3	2	1	-	-	-	-	-	1	-	1	1	-
C6E07.4	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E07.5	3	3	2	1	-	-	-	-	-	1	-	1	1	-
AVG	**3.00**	**2.60**	**1.60**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME6E08 ADVANCED VEHICLE TECHNOLOGY 3 H – 3 C

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 the students to:

- To introduce the basic concepts of electric vehicle and their characteristics.
- To introduce different types of motors and the selection of motor for vehicle applications.
- To acquaint the student with different sensors and systems used in autonomous.
- To acquaint the student with different sensors and systems used in connected vehicles.
- To introduce the modern methods of diagnosing on-board the vehicle troubles.

COURSE OUTCOMES

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

- Summarize the importance of electric vehicles in automotive field.
- Outline the characteristics of traction motor.
- Compare the vehicle-to-vehicle autonomy.
- Explain the networking of various modules in automotive systems.
- Explain the networking of communication protocols.

UNIT I ELECTRIC VEHICLES 9

EV architectures, advantages and disadvantages, Electrical and mechanical energy storage technologies, battery management. Performance of Electric Vehicles, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving.

UNIT II ELECTRIC VEHICLE MOTORS 9

Electric Propulsion basics, motor capacity determination, Induction motor, DC motor, Permanent Magnet Motor, Switch Reluctance Motor, Configuration, Characteristics, Performance and control of Drives.

UNIT III AUTONOMOUS AND CONNECTED VEHICLES 9

Vehicle-to-Vehicle Technology, Vehicle to Road and Vehicle to Vehicle Infrastructure, Basic Control System, Surroundings Sensing Systems, Role of Wireless Data Networks, Advanced Driver Assistance Systems, Basics of Radar System, Ultrasonic Sonar Systems, Lidar System, Camera Technology, Basics of Wireless Technology, Receiver System.

UNIT IV AUTOMOTIVE NETWORKING 9

Bus Systems – Classification, Applications in the vehicle, Coupling of networks, networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.

UNIT V ON-BOARD TESTING 9

Integration of Sensor Data to On-Board Control Systems (OBD), OBD requirements, certification, enforcement, systems, testing, Catalytic converter and Exhaust Gas Recirculation system monitoring, Introduction to Cyber-physical system.

.

TOTAL 45 HOURS

TEXT BOOKS:

1. John G Hayes and G Abaas Goodarzi, Electric Powertrain -, 1st Edition, John Wiley and Sons Ltd., 2018.
2. Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, Connected and Autonomous Vehicles in Smart Cities, CRC Press, 1st Edition, 2020.

REFERENCE BOOKS:

1. Hong Cheng, ―Autonomous Intelligent Vehicles: Theory, Algorithms and amp; Implementation Springer, 2018.
2. Advanced Technology Vehicles Manufacturing (ATVM) Loan Program by Andrew M Wright and Harrison R Scott | 5 September 2019.

WEBSITES:

1. https://www.cloudkampus.com/clp/electric-technology_core_components
2. https://alison.com/course/diploma-in-electric-vehicle-technology

CO-PO MAPPING

CO	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
C6E08.1	2	1	-	-	-	1	-	-	-	1	-	1	1	-
C6E08.2	2	1	-	-	-	1	-	-	-	1	-	1	1	-
C6E08.3	2	1	-	-	-	1	-	-	-	1	-	1	1	-
C6E08.4	2	1	-	-	-	1	-	-	-	1	-	1	1	-
C6E08.5	2	1	-	-	-	1	-	-	-	1	-	1	1	-
AVG	**2.00**	**1.00**	**-**	**-**	**-**	**1.00**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

PROFESSIONAL ELECTIVE III

23BEME6E09 DESIGN FOR MANUFACTURE AND ASSEMBLY 3 H – 3 C

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

- To study the various factors influencing the manufacturability of components and the use of tolerances in manufacturing.
- To understand the importance of the DFM approach and guidelines.
- To enrich the understanding of the selective assembly and Datum systems.
- To introduce the concepts of demonstrate true Position tolerancing theory.
- To develop an understanding of the standard techniques and redesigning cast members using weldments and plastic component manufacturing.

COURSE OUTCOMES

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

- Outline the importance of DFMA in industrial scenario.
- Apply the tolerance principle for assembly.
- Identify types of tolerance allocation methods.
- Distinguish the geometric dimensioning and tolerances.
- Apply the tolerance charting technique in drawings

UNIT I DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS 9

DFM approach, DFM guidelines, standardization, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poke – Yoke principle; 6σ concept; Tolerance Analysis: Process capability, process capability metrics, Cp, Cpk , cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law.

UNIT II SELECTIVE ASSEMBLY 9

Interchangeable and selective assembly, deciding the number of groups, Model–I: group tolerances of mating parts equal; Model–II: total and group tolerances of shaft, control of axial play.

Datum Systems: Grouped datum systems–different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, and tongue–slot pair, computation of translational and rotational accuracy.

UNIT III TRUE POSITION TOLERANCING THEORY 9

Comparison between co–ordinate and convention method of feature location tolerancing and true position tolerancing, zero true position tolerance, virtual size concept, floating and fixed fasteners, projected tolerance zone, functional gauges, paper layout gauging, compound assembly, examples.

UNIT IV FORM DESIGN OF CASTINGS AND WELDMENTS 9

Redesign of castings based on parting line considerations, minimizing core requirements, redesigning cast members using weldments, use of welding symbols – design considerations for plastic component manufacturing.

UNIT V TOLERANCE CHARTING 9

Tolerance Charting Technique: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining. Datum features – functional and manufacturing, component design–machining considerations, redesign for manufacture, examples.

TEXT BOOKS:

1. Harry Peck, Designing for Manufacture, 1st edition, Pitman Publications, London, 1973
2. Gerhard Pahl, Wolfgang Beitz, Engineering Design – A Systematic Approach, 3rd Edition, Springer Science and Business Media, 2007.
3. Spotts M F, Dimensioning and Tolerance for Quantity Production, 1st edition, Prentice Hall Inc., New Jersey, USA,2008 (Digital)
4. Oliver R Wade, Tolerance Control in Design and Manufacturing, 1st edition, Industrial press Inc., New York, 2008.

REFERENCE BOOK

1. James G Bralla, Hand Book of Product Design for Manufacturing, 1st edition, McGraw Hill Publications, New Delhi,2000 (Digital)
2. Clyde M. Creveling, Tolerance Design – A Hand Book for Developing Optimal Specifications, 1st edition, PrenticeHall, 2012.

WEBSITES

1. https://engineeringproductdesign.com/knowledge-base/
2. https://en.wikipedia.org/wiki/DFMA

CO PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO1	PSO2
C6E09.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E09.2	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E09.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E09.4	3	3	2	1	-	-	-	-	-	1	-	1	1	-
C6E09.5	3	2	1	-	-	-	-	-	-	1	-	1	1	-
AVG.	**2.80**	**2.00**	**1.25**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME6E10 COMPUTATIONAL FLUID DYNAMICS 3 H – 3 C

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 the students to:

- Apply governing equations in CFD simulations for fluid dynamics problems.
- Use finite difference, control volume, and spectral methods to solve fluid flow problems.
- Implement FEM techniques in CFD for boundary formulations and variational solutions.
- Solve conduction, convection, and diffusion problems using finite difference and volume methods.
- Analyze flow fields with staggered grid, pressure corrections, and turbulence models.

COURSE OUTCOMES:

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

- Apply CFD techniques with governing equations and boundary conditions.
- Apply numerical methods for solving fluid flow problems.
- Utilize FEM techniques for boundary formulations and CFD simulations.
- Solve conduction, convection, and diffusion problems using FEM.
- Analyze flow fields with staggered grid, pressure corrections and turbulence models.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time–averaged equations for Turbulent flow – Turbulence –Kinetic –Energy Equations – mathematical behavior of PDEs on CFD: Elliptic, Parabolic and Hyperbolic equations.

UNIT II DISCRETIZATION AND SOLUTION METHODOLOGIES 9

Methods of Deriving the Discretization Equations – Taylor Series formulation – Finite difference method – Control volume Formulation – Spectral method.

Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

UNIT III FEM TECHNIQUES 9

FEM techniques in CFD, strong and weak boundary, Value problem, Weighted residual formulation, Galerkin foundation, variational formulation, implementation of FEM.

UNIT IV HEAT CONDUCTION, CONVECTION, AND DIFFUSION 9

Finite difference and finite volume formulation of steady/transient one–dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three-dimensional conduction problems. Finite volume formulation of steady one–dimensional convection and Diffusion problems, Central, upwind, hybrid, and power–law schemes – Discretization equations for two-dimensional convection and diffusion.

UNIT V CALCULATION OF FLOW FIELD 9

Representation of the pressure – gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and velocity corrections – Pressure – Correction equation, a SIMPLE algorithm, and its variants. Turbulence models: mixing length model, two equation (k–ε) models.

TOTAL: 45

TEXTBOOK:

1. Versteeg H.K and Malalasekera. W, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 2nd edition, Pearson education, 2008

REFERENCE BOOKS:

1. Muralidhar K and Sundarajan T, Computational Fluid Flow and Heat Transfer, 2nd edition, Narosa publication, 2014
2. Fletcher C.A.J., Computational Technique for Fluid Dynamics, Vol I and Vol II., springer-vorlag. berlin-2012.

WEBSITES:

1. https://nptel.ac.in/courses/112105045
2. https://archive.nptel.ac.in/courses/112/107/112107079/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C6E10.1	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E10.2	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E10.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E10.4	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E10.5	3	3	2	1	-	-	-	-	-	1	-	1	1	-
Average	**3.00**	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME6E11 ENERGY CONSERVATION METHODS AND ENERGY AUDIT 3 H – 3 C

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 the students to:

- Demonstrate and analyze the concept of energy conservation and audit
- Examine energy accounting and balancing of industrial boilers
- Organize energy audit and suggest methodologies for energy savings of furnaces
- Find energy conservation opportunities of electrical components
- Identify energy efficiency, scope, conservation and technologies

COURSE OUTCOMES:

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

- Choose the energy utilization and perform combustion analysis.
- Explain the energy conservation opportunities in industrial boilers.
- Explain the energy conservation opportunities in industrial furnaces.
- Outline the energy conservation opportunities in electrical components
- Choose energy audit method for economic and cost benefit analysis

UNIT I ENERGY SCENARIO 9

Present status, rate of growth, energy utilization (sector wise), concept of energy conservation, energy economics.

COMBUSTION: Fuel analysis, combustion calculations, air requirements, theoretical and excess air requirements, excess air control, flue gas analysis and measurement, types of draught, draught calculations, chimney size calculations. F.D and I.D fan draught requirements and power requirements, furnace pressure requirements.

UNIT II INDUSTRIAL BOILERS 9

Types and characteristics of industrial boilers, heat balance in boilers, efficiency trials in boilers, energy conservation opportunities in boilers operation and maintenance, water treatment requirements, soot blowing requirements, super heaters and superheat controls, waste heat recovery systems.

STEAM: Distribution requirements of steam and steam lines, efficient utilization of steam, steam trapping and air venting, flash steam recovery, condensate recovery, thermal insulation for systems including HVAC, steam balance calculations.

UNIT III INDUSTRIAL FURNACES 9

Furnace types and characteristics, heat balance in furnaces, furnace efficiency calculations, energy conservation opportunities in furnaces, refractories types and properties, waste heat recovery system, insulating refractories, ceramic fibers, heat loss reduction calculations, wall and stored heat loss reduction.

UNIT IV ENERGY CONSERVATION OF ELECTRICAL COMPONENTS 9

Working principle of pump, fan and compressor – classification - performance analysis - energy conservation opportunities.

UNIT V ENERGY AUDIT AND APPLICATIONS 9

Types, methodology, questionnaire development, specific energy consumption (unitwise/section wise), identification of energy conservation measures/ technologies, economic and cost benefit analysis, case studies, Energy rating for thermal equipment, Energy saving measurement – Star status –National awards.

TOTAL: 45

TEXT BOOKS:

1. Turner, W. C., Doty, and Truner, W. C, Energy Management Hand book, 9th edition, Fairmont Press / CRC press,2018.
2. Barun Kumar De., Energy Management audit and Conservation, 2nd edition, Vrinda Publication, 2014.
3. W. Trinks, M. H. Mawhinney, Industrial Furnaces, 6th edition, John Wiley Publications, London, 2006.

REFERENCE BOOKS:

1. K V Sharma P Venkataseshaiah, Energy Management and Conservation, I K International Publishing House, 2011.
2. B. P. Patil, Energy Conservation and Audit, Nirali Prakashan, 2018.
3. Prabir Basu, Cen Kefa, Louis Jestin, Boilers and Burners Design and Theory, 1st edition, Springer Publications, New Delhi, 2000.

WEBSITES:

1. www.bee-india.nic.in
2. www.greenbusiness.com
3. www.worldenergy.org
4. https://onlinecourses.nptel.ac.in/noc20_mm20/preview

CO-PO MAPPING

CO	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
C6E11.1	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E11.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E11.3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E11.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E11.5	3	2	1	-	-	1	-	-	-	1	-	1	1	-
AVG	**2.40**	**1.40**	**1.00**	**-**	**-**	**1.00**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME6E12 MATERIAL HANDLING AND SOLID PROCESSING EQUIPMENT 3 H – 3 C

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

- To provide knowledge on materials handling equipment.
- To provide knowledge on Industrial Vehicles
- To provide knowledge on conveyor equipment.
- To provide knowledge on Auxiliary Equipment.
- To provide knowledge on Hoisting Equipment.

COURSE OUTCOMES:

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

- Classify the material handling equipment.
- Explain the basic working principles of industrial Vehicles.
- Choose conveyor system for a given application.
- Outline the usage of Auxiliary equipment.
- Explain the working principles of Hoisting equipment.

UNIT I INTRODUCTION TO MATERIALS HANDLING 9

Introduction to material handling and its benefits – examples and its classification of material handling equipment – selection of material handling equipment – guidelines for effective utilization of material handling equipment -unit load concept.

UNIT II INDUSTRIAL VEHICLES 9

Introduction and types - Hand trucks - Two-wheel Hand Trucks - Multiple wheel Hand Trucks - Hand Lift Trucks - Power Trucks - Fixed Platform Truck - Platform Lift Truck - Pallet Lift Truck - Walkie Truck - Straddle Carrier - Fork Lift Trucks - Specifications of FLT - FLT Attachments - Tractors - Industrial Tractor-Trailer-Self-propelled trucks and fork trucks - Automated guided vehicles Theory

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UNIT III CONVEYORS 9

Classification of conveyors- Definition - Description - General Characteristics - types and uses of belt Conveyors - Roller conveyors - Haulage Conveyors - Screw Conveyors - Bucket Conveyors - Chain Conveyors - Cable Conveyors - Pneumatic and Hydraulic conveyors - Computer controlled conveyor system.

UNIT IV AUXILIARY EQUIPMENTAND HOISTING EQUIPMENT 9

Jib cranes, wheel trucks and bogeys, Hoppers - Gates- Feeders- Chutes-positioners- Ball Table-Weighing and Control Equipment- Pallet loaders and unloaders -applications and advancements. - Hoisting Equipment - parts of hoisting equipment - Description and uses of hoists - Description and uses of ropes - description and purpose of crane hooks - Elevators - Cranes - Derricks - and its types

UNIT V BULK HANDLING EQUIPMENT AND SYSTEMS 9

Special materials handling equipments, Storage of bulk solids - bulk handling equipment - Robotic handling - Materials handling at the workplace. Robots and their classification - Major components of a robot - classification of Robotic manipulators - Robotic handling applications

TOTAL: 45

TEXT BOOKS:

1. Allegri (Sr.), T.H., Material Handling – Principles and Practices, CBS Publishers and Distributors, Delhi, 1987.
2. Siddharta Ray, Introduction to Materials Handling, New Age International Publishers.
3. Bolz, H. A and Hagemann, G. E (ed.), ‘‘Materials Handling Handbook’’, Ronald Press.

REFERENCE BOOKS:

1. Apple, J.A., ‘‘Material Handling System Design’’, John Wiley and Sons.
2. Theodore H., Allegre Sr., Material Handling Principles and Practice, CBS Publishers and Distributors.
3. Immer J. R., Material Handling, Tata McGraw Hill Publication.

WEBSITES:

1. https://www.youtube.com/watch?v=guYD2zyUT6o
2. https://www.youtube.com/watch?v=Up1oSSJn6oM

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C6E12.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E12.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E12.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C6E12.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C6E12.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

PROFESSIONAL ELECTIVE IV

23BEME7E01 ROTATING MACHINERY DESIGN 3 H – 3 C

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

- To provide an overview of the different operational regimes for gas turbine applications.
- To comprehend the fundamentals of creep and fatigue damage mechanisms in gas turbine components.
- To familiarize students with experimental and test procedures used to characterize creep.
- To analyze the various loads, forces, and stresses acting on gas turbine engines, including rotational inertia, flight forces, pressure gradients, torsion, and other relevant loadings on rotating components and pressure casing components.
- To explore failure criteria in gas turbine components, including monotonic failure criteria, theories of failure under bi-axial loads, and specific failure mechanisms such as creep and fatigue.

COURSE OUTCOMES:

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

- Explain the operational regimes and requirements of gas turbines.
- Summarize the requirements of gas turbine components.
- Analyze the stresses, failure criteria and factors of safety used in gas turbine engines.
- Construct the discs and blade of gas turbine.
- Solve the creep and fatigue damage of gas turbine components.

UNIT I INTRODUCTION 9

Overview of the different operational regimes for gas turbine applications: base load, peak load, standby and backup operations, alongside their individual operational requirements. Fundamentals of Creep and Fatigue damage mechanisms. Material, design and operational parameters that affect creep and fatigue. Experimental and test procedures to characterize creep and fatigue damage.

UNIT II DESIGNING FORCES 9

Loads/forces/stresses in gas turbine engines: loads - rotational inertia, flight, precession of shafts, pressure gradient, torsion, seizure, blade release, engine mountings and bearings-Discussion of major loadings-rotating components and pressure casing components.

UNIT III FAILURE CRITERIA 9

Monotonic failure criteria: proof, ultimate strength. Theories of failure - bi-axial loads. Other failure mechanisms - gas turbine engines including creep and fatigue. Fatigue properties - SN and RM diagrams. Stress concentration, mean stress, Cumulative fatigue, Goodman diagram and safety factor for gas turbine components. Larson-Miller time-temperature parameter.

UNIT IV BLADE DESIGN 9

Design of discs, blades. Illustration of magnitude stresses in conventional axial flow blades- simple desk-top method -effects of leaning the blade. Design of flanges and bolted structures. Leakages through a flanged joint and failure from fatigue.

UNIT V BLADE VIBRATIONS AND DAMAGE MECHANISMS 9

Natural frequencies turbomachine blades. Blade twist, centrifugal stiffening, Sources of blade excitation, Stationary flow disturbance, rotating stall and flutter. Campbell diagram and troublesome resonances. Allowances for temperature, pre-twist and centrifugal stiffening. Methods for dealing with resonances.

TEXT BOOKS:

1. A S Rangawala, Turbomachinery Dynamics-Design and operations, McGraw-Hill, 2015.
2. P.P Walsh and P. Peletcher, Gas Turbine Performance' Blackwell Science, 2018.

REFERENCE BOOKS:

1. Turbines, Compressors and Fans S. M. Yahya Tata McGraw Hill Co. Ltd 2nd edition, 2020.
2. Fluid Mechanics and Thermodnamics of Turbo machines S. L. Dixon Elsevier 2020.
3. Shaft Alignment Handbook (Mechanical Engineering) by John Piotrowski | 2 November 2016.
4. Principles of Turbo machines D. G. Shepherd the Macmillan Company 2016.

WEBSITES

1. https://www.matweb.com/
2. https://www.asminternational.org/materials-resources/topics/gas-turbine-materials

CO PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO1	PSO2
C7E01.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E01.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E01.3	3	3	2	1	-	-	-	-	-	1	-	1	1	-
C7E01.4	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E01.5	3	2	1	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.60**	**1.80**	**1.33**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME7E02 POWER PLANT ENGINEERING 3H-3C

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

End Semester Exam: 3Hours

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Understand exposure to accessories and layout required for a steam power plant depending upon the requirements.
- Analyze performance of steam power plant and emission control devices.
- Understand the knowledge of working of nuclear and hydel power plant.
- Analyze features of gas turbine power plant.
- Perform economics of the power plant.

COURSE OUTCOMES:

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

- Relate power cycles and components of boilers
- Explain the working of steam power plant.
- Interpret the fusion and fission reaction in nuclear power plant.
- Select engine and gas turbine for thermoelectric power plant
- Analyze the safety and economic aspects of electrical energy

UNIT I STEAM POWER PLANT 9

Introduction to Power Plants – Steam Boilers– High Pressure and Super Critical Boilers – Fluidized Bed Boilers – Industrial Standards for boiler. Comparison and Selection of boiler, Fuel and Ash Handling, Combustion, Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Cooling Towers.

UNIT II SOLAR AND WIND POWER PLANT 9

Introduction to solar power plant - types of solar power plant - selection of site and shadow analysis - selection of PV module tilt angle - site survey and plant assessment - type of solar radiation - types of solar inverter – selection of string /central / off grid inverter - sizing of solar inverter for roof top and grid. Introduction to wind power plant - overview of wind turbine components - design aspects of wind turbine types of wind turbine blade, non-crimp fabric in blade, drive train concepts of wind turbine - wind turbine gear box - wind turbine generator.

UNIT III NUCLEAR AND HYDEL POWER PLANTS 9

Nuclear Energy – Fission, Fusion Reaction, Types of Reactors, pressurized water reactor, Boiling Water Reactor, Waste Disposal and safety. Hydel Power Plant – Essential Elements, Selection of Turbines, Governing of Turbines– Micro Hydel developments.

UNIT IV DIESEL AND GAS TURBINE POWER PLANT 9

Types of Diesel Plants, Components, Selection of Engine Type, Applications Gas Turbine Power Plant – Fuels– Gas Turbine Material – Open and Closed Cycles – Reheating – Regeneration and Intercooling – Combined Cycle.

UNIT V OTHER POWER PLANTS AND ECONOMICS OF POWER PLANT 9

Geo thermal –OTEC – Tidel – Pumped storage Safety aspects and Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs – Economics of load sharing, comparison of economics of various power plants.

TOTAL: 45

TEXT BOOKS:

1. Arora S.C and Domkundwar S, A course in Power Plant Engineering, 8 th edition, Dhanpatrai Publishers, New Delhi, 2016
2. Nag P.K, Power plant Engineering, 4 th edition, Tata McGraw Hill, New Delhi, 2017

REFERENCE BOOKS:

1.Rajput R.K, Power Plant Engineering, 4 th edition, Laxmi Publications, Chennai, 2016
2. Md. Rabiul Islam, Faz Rahman, and Wei Xu, Advances in Solar Photovoltaic Power Plants, 1 st edition, Springer. 2018.

WEBSITES:

1. https://archive.nptel.ac.in/courses/112/107/112107291/
2. https://onlinecourses.nptel.ac.in/noc22_me73/preview

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C7E02.1	2	1	-	-	-	-	-	-	-	1	-	1	2	-
C7E02.2	2	1	-	-	-	-	-	-	-	1	-	1	2	-
C7E02.3	2	1	-	-	-	1	1	-	-	1	-	1	2	-
C7E02.4	3	2	1	-	-	-	-	-	-	1	-	1	2	-
C7E05.5	3	3	2	1	-	1	1	-	-	1	2	1	2	-
AVG	**2.40**	**1.60**	**1.50**	**1.00**	**-**	**1.00**	**1.00**	**-**	**-**	**1.00**	**2.00**	**1.00**	**2.00**	**-**

23BEME7E03 DYNAMICS OF GROUND VEHICLES 3 H – 3 C

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

- Understand the fundamental concepts of vibration, including the different types of vibrations, modeling.
- To gain knowledge about the design and performance of tires, including the tire axis system, tire forces and moments, rolling resistance, tractive and cornering properties, and the effects of tire structure on ride quality and wet surface performance.
- To learn about the vertical dynamics of vehicles, including human response to vibration, suspension requirements, state space representation, and the design and analysis of passive, semi-active, and active suspensions.
- To acquire knowledge about the longitudinal dynamics and control of vehicles, including aerodynamic forces, load distribution, estimation of center of gravity location, driveline dynamics, and the use of ABS, stability control, and traction control systems.
- To Understand the lateral dynamics of vehicles, including steady-state and transient handling characteristics, steering dynamics, stability on banked roads, and the effects of suspension on cornering.

COURSE OUTCOMES

Upon completion of this course, the students can able to

- Explain the model vibrations in mechanical systems.
- Outline the tyre performance and resistance on wet surfaces.
- Develop the suspension systems for vehicles.
- Relate the longitudinal dynamics and performance of vehicles.
- Explain the lateral dynamics and handling characteristics of vehicles.

UNIT I CONCEPT OF VIBRATION 9

Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility ratio, Base excitation. Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed

UNIT II TYRES 9

Tyre axis system, tyre forces and moments, tyre marking, tyre structure, hydroplaning, wheel and rim. Rolling resistance, factors affecting rolling resistance, Longitudinal and Lateral force at various slip angles, Tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tyres. Various test carried on a tyre.

UNIT III VERTICAL DYNAMICS 9

Human response to vibration, Sources of Vibration. Suspension requirements – types. State Space Representation. Design and analysis of Passive, semi active and Active suspension using Quarter car, Bicycle Model, half car and full car vibrating model. Influence of suspension stiffness, suspension damping, and tire stiffness. Control law. Suspension optimization techniques. Air suspension system and their properties.

UNIT IV LONGITUDINAL DYNAMICS AND CONTROL 9

Aerodynamic forces and moments. Equation of motion. Load distribution for three-wheeler and four-wheeler. Calculation of maximum acceleration, tractive effort and reaction forces for different drive vehicles. Power limited acceleration and traction limited acceleration. Estimation of CG location. Stability of vehicles resting on slope. Driveline dynamics. Braking and Driving torque. Prediction of Vehicle performance. ABS, stability control, Traction control.

UNIT V LATERAL DYNAMICS 9

Steady state handling characteristics. Steady state response to steering input – Yaw velocity gain, Lateral acceleration gain, curvature response gain. Testing of handling characteristics. Transient response characteristics. Steering dynamics. Direction control of vehicles. Roll center, Roll axis. Stability of vehicle on banked road, during turn. Effect of suspension on cornering. Minuro Plot for Lateral Transient Response.

TEXT BOOKS:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics," Society of Automotive Engineers Inc, 2014
2. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", Second Edition, CRC Press, 2013
3. R. Nakhaie Jazar, "Vehicle Dynamics: Theory and Application", Second edition, Springer, 2013
4. J. Y. Wong, "Theory of Ground Vehicles", Fourth Edition, Wiley-Interscience, 2018.

WEBSITES

1. https://www.tireindustry.org/
2. https://www.nhtsa.gov/

CO PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO1	PSO2
C7E03.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E03.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E03.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E03.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E03.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME7E04 OPERATIONS RESEARCH 3 H – 3 C

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 the students to:

- To provide students the knowledge of optimization techniques and approaches.
- To enable the students, apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
- To understand the Engineering and Managerial situations in Transportation.
- To make the student acquire sound knowledge on sequences to perform operation among various alternatives.
- To teach students about networking, inventory, queuing, decision and replacement models.

COURSE OUTCOMES

At the end of the course, student will be able to

- Solve Linear programming technique in industrial optimization problems.
- Examine transportation problems using OR techniques.
- Explain various OR models for optimization.
- Make use of OR tools in industrial applications.
- Identify the advanced techniques for group replacement.

UNIT I INTRODUCTION TO OPERATIONS RESEARCH 9

Operations research and decision–making – types of mathematical models and constructing the model – Role of computers in operations research –Linear Programming Techniques: Formulation of linear programming problem, applications and limitations, graphical method, simplex method – The Big –M method – the two– phase method.

UNIT II TRANSPORTATION PROBLEMS 9

Least cost method, North west corner rule, Vogel's approximation method, modified distribution method, unbalance and degeneracy in transportation model, shortest route algorithm – dijkestra algorithm.

UNIT III ASSIGNMENT MODELS AND SCHEDULING 9

Assignment models - Hungarian algorithm, unbalanced assignment problems - maximization case in assignment problems, traveling salesman problem. Scheduling – processing n jobs through two machines, processing n jobs through three machines, processing two jobs through 'm' machines, processing n jobs through m machines.

UNIT IV INVENTORY CONTROL AND QUEUING THEORY 9

Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, multi-item deterministic model.
Queuing Models: Queues – Notation of queues, performance measures, The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns.

UNIT V PROJECT MANAGEMENT AND REPLACEMENT MODELS 9

Basic terminologies, constructing a project network, network computations in CPM and PERT, cost crashing Replacement Models: Replacement of Items due to deterioration with and without time value of Money,Group replacement policy, Staff replacement

TOTAL 45 HOURS

TEXT BOOKS

1. Kanti Swarup, Operations Research, 12th edition, Sultan Chand and Sons, New Delhi, 2010.
2. Viswanathan N and Narahari Y, Performance Modeling of Automated Manufacturing Systems,2nd edition,Prentice Hall of India, New Delhi, 2005.

REFERENCE BOOK

1. Prem Kumar Gupta and Hira D.S, Operation Research, 1st edition, S Chand and Company Limited, NewDelhi, 2017.

WEBSITES

1. https://www.techtarget.com/whatis/definition/operations-research-OR
2. https://en.wikipedia.org/wiki/Operations_research

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C7E04.1	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E04.2	3	3	2	1	-	-	-	-	-	1	-	1	1	-
C7E04.3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E04.4	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E04.5	3	2	1	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.80**	**2.00**	**1.25**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

PROFESSIONAL ELECTIVE V

23BEME7E05 POWER GENERATION EQUIPMENT DESIGN 3 H – 3 C

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 the students to:

- Explain the power generation equipments, types and layouts of working cycles
- Identify the fuels, combustion and burning methods of combustion system
- Compare the various boilers and its parts of steam power plant
- Define the basics of nuclear fuels and reactor classification
- Explain the techno economics, operating cost and safety of power plant

COURSE OUTCOMES:

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

- Compare the types of layouts of working cycles
- Summarize the fuels and burning methods of combustion system
- Outline the types of steam generators and parts of steam power plant
- Explain the basics of nuclear fuels and types of nuclear reactors
- Relate the economics, cost, safety and environmental impacts of power plant.

UNIT I INTRODUCTION 9

Introduction to types, layouts and working cycles - Layouts of diesel-electric, hydro-electric, nuclear, gas turbine, steam, cogeneration, MHD and other power plants - Site selection - Reheat and regenerative steam cycles - Binary vapour cycle - Combined cycle - Topping cycle - Power plant instrumentation and control - air flow, furnace pressure, steam temperature control system - Governing system - Steam turbine.

UNIT II COMBUSTION SYSTEM 9

Fuels, combustion and burning methods - Fuel classification - Solid, liquid and gaseous - Compositions and heating values - Classification of coal - Combustion process, atmosphere and control - ESP Furnace construction - Stokers - suspension firing - pulverised fuel firing - oil and gas burners and systems - Fuel control - Burner management system - FSSS - Ash handling system.

UNIT III STEAM POWER PLANT 9

Steam generators - fire tube, water tube, forced circulation, once through, super charged, super critical, Lamont, Loeffler, Schmide, Hortmen and Velox boilers, Fluidised Bed and Circulated Fluidised Bed boilers - Natural, artificial, balanced and steam jet drafts - Simple problems - Functions of super heaters, economisers, air-heaters, deaerators, feed heaters, air ejectors - Feed pumps - Injectors - Feed water control- Condensers – Jet and surface type - Simple problems - Cooling towers.

UNIT IV NUCLEAR POWER PLANT 9

Nuclear power plant - Basics of nuclear fuels - Fission and chain reaction - Reactor classification - Boiling water, pressurised water, homogeneous, gas cooled breeding and metal cooled.

UNIT V TECHNO ECONOMICS OF POWER PLANT 9

Economics and safety - Actual load curves - Fixed and operating costs - Tariff methods for electrical energy - Peak load and variable load operations - Selection of generation type and general equipment. Introduction to safety aspects in power plants - Environmental impacts - assessment for thermal power plant.

TOTAL: 45

TEXT BOOKS:

1. Nag P.K, Power plant Engineering, 4th edition, Tata McGraw Hill, New Delhi, 2017.
2. Rajput R.K, A Text book of Power Plant Engineering, 4th edition, Laxmi Publications, Chennai, 2016.
3. Arora S.C and Domkundwar S, A course in Power Plant Engineering, 8th edition, Dhanpatrai Publishers, NewDelhi, 2016.

REFERENCE BOOKS:

1. Dilip Vairagkar, Power Plant Engineering, Dreamtech Press,2019.
2. Everett B. Woodruff, Herbert B. Lammers, Thomas F. Lammers, Steam-plant Operation, 1992.
3. Malik Monu, Saini R P, A Techno-Economic Analysis of Solar Thermal Power Plant, 2012.

WEBSITES:

1. http://www.power-eng.com/
2. http://www.plantengineering.com/
3. http://www.iaea.org/
4. https://onlinecourses.nptel.ac.in/noc22_me73/preview

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C7E05.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E05.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E05.3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E05.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E05.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME7E06 ADVANCED I.C. ENGINES 3 H – 3 C

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 the students to:

- Illustrate the underlying principles of operation of different SI Engines and components.
- Recall the underlying principles of operation of different CI Engines and components.
- Relate the mechanism of pollutant formation, control.
- Explain the benefits for substitution of conventional fuels with the aid of alternative renewable fuels.
- Make use of recent trends associated with IC engines.

COURSE OUTCOMES:

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

- Explain the construction and operational principles SI engines.
- Illustrate the construction and operational principles CI engines.
- Interpret strategies for pollution control.
- Outline the need for alternative fuels.
- Utilize the recent trends associated with IC engines.

UNIT I SPARK IGNITION ENGINES 8

Mixture requirements – Fuel injection systems – Mono-point, Multipoint and Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers.

UNIT II COMPRESSION IGNITION ENGINES 8

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirectinjection systems – Combustion chambers – Fuel Spray behavior – Spray structure and spray penetration – Airmotion - Introduction to Turbocharging.

UNIT III POLLUTANT FORMATION AND CONTROL 11

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction andParticulate Traps – Methods of measurement – Emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUELS 9

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability,Merits and Demerits - Engine Modifications.

UNIT V RECENT TRENDS 9

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - OnboardDiagnostics.

TOTAL: 45

TEXT BOOKS:

1. V. Ganesan, Internal Combustion Engines, 4th edition, Tata McGraw Hill Education, 2012
2. John Heywood, Internal Combustion Engine Fundamentals, 1st edition, Tata McGraw Hill Education,2011.

REFERENCE BOOKS:

1. Mathur. R.B. and R.P. Sharma, Internal Combustion Engines, Dhanpat Rai and Sons, 2007
2. Duffy Smith, Auto Fuel Systems, 1st edition, The Goodheart Willcox Company, Inc., 2011 (Digital)
3. Eric Chowenitz, Automobile Electronics, 1st edition, Newnes Publications, 1995.

WEBSITES:

1. https://archive.nptel.ac.in/courses/112/103/112103262/
2. https://ocw.mit.edu/courses/2-61-internal-combustion-engines-spring-2017/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C7E06.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E06.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E06.3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E06.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E06.5	3	2	1	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME7E07 NON-DESTRUCTIVE TESTING 3 H – 3 C

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 the students to:

- The main objectives of this course are to introduce the concept of non-destructive testing among the students and make them understand various types of non-traditional practices available for manufacturing industry.
- To provide in-depth knowledge on various techniques of non-destructive testing.
- To provide an overview of destructive and non-destructive tests and state their applications.
- To study the features of NDT techniques for various products and to understand the established NDE techniques and basic familiarity of emerging NDE techniques.
- To expose students to skills needed for selection of appropriate NDT technique(s) for new inspection jobs.

COURSE OUTCOMES

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

- Summarize the codes, standards and specifications related to NDT.
- Classify the destructive and non-destructive tests and their applications.
- Develop NDT techniques for mechanical components.
- Compare the eddy current and visual testing methods.
- Explain the NDE techniques and its applications.

UNIT I INTRODUCTION 9

Properties of Engineering Materials – Types of Defects – Surface and Sub-Surface of a component – Characteristics of Ferrous, Non-ferrous and Alloys. Classification of Destructive testing and Non-Destructive testing – Uses and applications. Codes, Standards and Specifications of NDT (ASME, ASTM, AWS etc.). Importance and Scope of NDT, Non-destructive testing methods.

UNIT II PENETRANT TESTING AND MAGNETIC PARTICLE INSPECTION 9

Introduction to Penetrant Testing – Liquid Penetrants and Dye Penetrants - Apparatus required for LPT - An Illustration of Penetrant Testing, Application, Advantages and Disadvantages of Penetrants Testing. Introduction to Magnetic Particle Inspection – MPT Equipments and devices - An Illustration of Magnetic Particle Inspection, Application, Advantages and Disadvantages of Magnetic Particle Crack Detection.

UNIT III ULTRASONIC FLAW DETECTION AND RADIOGRAPHY INSPECTION 9

Introduction to Ultrasonic Flaw Detection, UT Equipments and devices, An Illustration of Ultrasonic Flaw Detection, Application, Advantages and Disadvantages of Ultrasonic Flaw Detection. Principle of Radiography Inspection, RT Equipments and devices Radiation sources, uses of x-rays and gamma rays Attenuation in the specimen, Radiographic imaging, Inspection Techniques, Application and limitations, Safety from Radiation.

UNIT IV EDDY CURRENT TESTING AND VISUAL TESTING METHODS 9

Introduction to Eddy Current Testing. ECT Equipments and devices, An Illustration of Eddy Current Testing Equipment, Application, Advantages and Disadvantages of Eddy Current Testing. Introduction to visual testing method, Equipments required for VT - An Illustration of visual testing method, Application, Advantages and Disadvantages of visual testing method.

UNIT V NON-DESTRUCTIVE INSPECTION(NDI) AND ITS APPLICATIONS 9

Inspection of Raw Products, Inspection for In-Service Damage, Power Plant Inspection, Storage Tank Inspection, Automobile component Inspection, Jet Engine Inspection, Pressure Vessel Inspection, Bridge Inspection, Pipeline Inspection.

TOTAL: 45

TEXT BOOKS:

1. Sadashiva. M – Non - Destructive Testing Paperback – 15 July 2021.
2. Ramachandran. S and Anderson. A - Non-Destructive Testing – Kindle Edition – 2018.

REFERENCE BOOKS:

1. J. Prasad and C. G. Krishnadas Nair - Non-Destructive Test and Evaluation of Materials Hardcover – 2017.
2. Lari and Kumar - Basics of Non - Destructive Testing Paperback – 1 January 2013.

WEBSITES:

1. https://ndttrainingonline.com
2. https://onlinendts.com/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
C7E07.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E07.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E07.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E07.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E07.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME7E08 INDUSTRIAL SAFETY ENGINEERING 3 H – 3 C

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

End Semester Exam : 3 Hours

COURSE OBJECTIVE

The goal of this course is for the students to:

- To provide in-depth knowledge on various techniques of non-destructive testing.
- To acquaint the student with the need and awareness of the safety concepts.
- To understand the importance of various safety techniques involved in industrial sector.
- To introduce the concepts of accident zone and prepare reports related to it.
- To develop an understanding of safety monitoring.

COURSE OUTCOME

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

- Explain the need for safety.
- Outline the safety techniques involved in industrial sector.
- Develop the report for the accident zones.
- Inspect the safety strategies in industrial sector.
- Illustrate training sessions based on safety.

UNIT I CONCEPTS OF SAFETY ENGINEERING 9

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNIT II TECHNIQUES OF SAFETY ENGINEERING 9

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accidentprevention, 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 PERFORMANCE MONITORING 9

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 AND TRAINING 9

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice – motivation – communication – role of government agenciesand 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. Modern safety equipment and technics – Case study.

TOTAL: 45

TEXT BOOKS:

1. Accident Prevention Manual for Industrial Operations,3rd edition, N.S.C.Chicago, 2020 (digital).
2. Heinrich H.W. "Industrial Accident Prevention", 2ndedition, Tata McGraw-Hill, NewYork, 2017.

REFERENCE BOOKS:

1. Krishnan N.V, Safety Management in Industry,1st edition, Jaico Publishing House, Bombay, 2017.
2. John R Ridley, Safety at Work,3rd edition, Elsevier, 2019.

WEBSITES:

1. https://onlinecourses.nptel.ac.in/noc19_me40/preview
2. https://www.studocu.com/in/document/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
C7E08.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E08.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E08.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E08.4	3	3	2	1	-	-	-	-	-	1	-	1	1	-
C7E08.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.40**	**1.60**	**1.50**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

PROFESSIONAL ELECTIVE VI

23BEME7E09 QUALITY CONTROL AND RELIABILITY ENGINEERING 3 H – 3 C

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 the students to:

- understand the concept of SQC.
- enrich the understanding of control charts to analyze for improving the process quality.
- familiarize the students to understand different sampling plans
- understand the importance of need and types of life testing.
- introduce the reliability of a system.

COURSE OUTCOMES:

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

- Explain the concepts of statistical quality control
- Construct control charts for improving the process quality.
- Solve sampling plans for given sample
- Summarize the needs and types of life testing
- Examine the reliability of a system.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost–Variation in process– factors – process capability – process capability studies and simple problems – Theory of control chart– uses of control chart – Control chart for variables – X chart, R chart and σ chart.

UNIT II PROCESS CONTROL FOR ATTRIBUTES 9

Control chart for attributes –control chart for proportion or fraction defectives – P chart and NP chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

UNIT III ACCEPTANCE SAMPLING 9

Lot by lot sampling – Types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts–standard sampling plans for AQL and LTPD– uses of standard sampling plans.

UNIT IV LIFE TESTING – RELIABILITY 9

Life testing – objective: – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABLITY 9

Reliability improvements – techniques– use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles – Maintenance.

TOTAL: 45

TEXT BOOKS:

1. Montgomery D. C. – 'Introduction to Statistical Quality Control' – John Wiley – 2010
2. Ebeling C. – 'An Introduction to Reliability and Maintainability Engineering' – Tata McGraw Hill Publishing Company Ltd. – 2004

REFERENCE BOOKS:

1. Eugene Grant and Richard Leavenworth, Statistical Quality Control, 7th edition, Tata McGraw–Hill, NewDelhi, 2017
2. Srinath L.S, Reliability Engineering, 4th edition, Affiliated East west press New Delhi, 2005.

WEBSITES:

1. https://nptel.ac.in/courses/110105039/
2. https://www.qualitygurus.com

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C7E09.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E09.2	3	2	1	-	-	-	-	1	-	1	-	1	1	-
C7E09.3	3	2	1	-	-	-	-	1	-	1	-	1	1	-
C7E09.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E09.5	3	3	2	-	-	-	-	-	-	1	-	1	1	-
Average	**2.60**	**1.80**	**1.33**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME7E10 COGENERATION AND WASTE HEAT RECOVERY SYSTEMS **3 H – 3 C**

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 the students to:

- Explain the understanding of thermodynamics, heat transfer, and fluid mechanics principles
- Define the concepts of cogeneration, its types and probable areas of applications
- Find the operational issues and challenges in cogeneration technologies
- Classify the various waste heat recovery systems and its devices
- Analyze the waste heat recovery systems and carry out its economic analysis

COURSE OUTCOMES:

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

- Apply thermodynamics, heat transfer, and fluid mechanics principles in emerging technology
- Identify the areas of applications and methods of cogeneration
- Illustrate the challenges and operational issues in cogeneration technologies
- Choose waste heat recovery technologies
- Explain the cost and economic analysis of cogeneration.

UNIT I INTRODUCTION **9**

Introduction – principles of thermodynamics – cycles – topping - bottoming – combined cycle - organic Rankine cycles – performance indices of cogeneration systems – waste heat recovery – sources and types – concept of tri generation.

UNIT II COGENERATION TECHNOLOGIES **9**

Configuration and thermodynamic performance – steam turbine cogeneration systems – gas turbine cogeneration systems – reciprocating IC engines cogeneration systems – combined cycles cogeneration systems – advanced cogeneration systems: fuel cell, Stirling engines etc.

UNIT III ISSUES AND APPLICATIONS OF COGENERATION TECHNOLOGIES **9**

Cogeneration plants electrical interconnection issues – utility and cogeneration plant interconnection issues – applications of cogeneration in utility sector – industrial sector – building sector – rural sector – impacts of cogeneration plants – fuel, electricity and environment.

UNIT IV WASTE HEAT RECOVERY SYSTEMS **9**

Election criteria for waste heat recovery technologies - recuperators - Regenerators - Economizers - plate heat exchangers - thermic fluid heaters - Waste heat boilers classification, location, service conditions, design Considerations - fluidized bed heat exchangers - heat pipe exchangers - heat pumps – sorption systems.

UNIT V ECONOMIC ANALYSIS **9**

Investment cost – economic concepts – measures of economic performance – procedure for economic analysis–examples – procedure for optimized system selection and design – load curves - sensitivity analysis – regulatory and financial frame work for cogeneration and waste heat recovery systems.

TOTAL: 45

TEXT BOOKS:

1. M.P. Boyce, Handbook for cogeneration and combined cycle power plants, 2nd edition, ASME Press, 2010.
2. B.F.Kolanowski, Small-scale cogeneration handbook, 3rd edition, Fairmont Press, 2008.
3. Khartchenko N.V. Green Power: Eco-Friendly Energy Engineering, Tech Books, New Delhi, 2004

REFERENCE BOOKS:

1. R.Kehlhofer, B. Rukes, F. Stirnimann, Combined-cycle gas and steam turbine power plants, 3rd edition, PennWell Books, 2009.
2. A.Thumann, D. Paul Mehta, Handbook of energy engineering, 6th edition, The Fairmont Press Inc, 2008.
3.. Meckler, M., Hyman L.B. Sustainable on-Site CHP Systems, McGraw-Hill, 2010.

WEBSITES:

1. https://onlinecourses.nptel.ac.in/noc20_mm20/preview
2. https://onlinecourses.nptel.ac.in/noc23_me122/preview
3. https://beeindia.gov.in/sites/default/files/2Ch7.pdf
4. https://beeindia.gov.in/sites/default/files/2Ch8.pdf

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C7E10.1	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E10.2	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E10.3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
C7E10.4	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E10.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.60**	**1.60**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME7E11 LOGISTICS AND SUPPLY CHAIN MANAGEMENT 3 H – 3 C

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 the students to:

- Understand supply chain management concepts and objectives for global optimization.
- Analyze logistics networks and apply solution techniques for effective data management.
- Explore inventory management principles and forecasting methods in supply chain operations.
- Evaluate the value of information and technology in supply chain integration and demand-driven strategies.
- Examine strategic alliances and their role in procurement, outsourcing, and partnerships.

COURSE OUTCOMES:

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

- Apply supply chain management for global operations.
- Choose logistics networks for data analysis and modelling techniques.
- Select inventory management strategies to minimize costs.
- Utilize information and technology for supply chain integration.
- Develop strategic alliances to enhance procurement, distribution, and outsourcing.

UNIT I INTRODUCTION TO SUPPLY CHAIN MANAGEMENT 9

Definition, global optimization, Objectives of SCM. Logistics networks– data collection, model and data elevation, solution techniques.

UNIT II INVENTORY MANAGEMENT 9

Introduction, single warehouse, Inventory examples, economic lot size model, effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting.

UNIT III VALUE OF INFORMATION 9

Bullwhip effect, information and supply chain technology. Supply chain integration– push, pull and push–pull system. Demand driven strategies, impact of internet on SCM, distribution strategies.

UNIT IV STRATEGIC ALLIANCES 9

Framework for strategic alliance, third party logistics, retailer, supplies partnership, distributor–integration, procurement and out servicing strategies.

UNIT V INTERNATIONAL ISSUES IN SCM 9

Introduction, risks and advantages– design for logistics, supplies integration into to new product development, mass customization. Issues in customer value. Information technology for SCM: Goals, standardization, infrastructure.

TOTAL: 45

TEXT BOOKS:

1. Simchi – Levi David, Kaminsky Philip and Simchi–Levi Edith, Designing and Managing the SupplyChain, 3rd edition, Tata M.Graw– Hill Publishing Company Ltd, New Delhi, 2007
2. Sunil Chopra and Peter Meindl, Supply Chain Management – Strategy, Planning and Operation, 2ndedition, Prentice Hall, New Delhi, 2005

REFERENCE BOOKS:

1. Ayers J.B, Hand book of Supply Chain Management, 1st edition, The St. Lenciepress, New York, 2000
2. Raghuram G and Rangaraj N, Logistics and Supply Chain Management: Cases and Concepts, 2nd edition,Macmillan, New Delhi, 2009

WEBSITES:

1. https://old.mu.ac.in/wp-content/uploads/2021/02/Logistics-and-Supply-Chain-Management-Martin-Christopher.pdf
2. https://ebooks.lpude.in/management/mba/term_4/DMGT523_LOGISTICS_AND_SUPPLY_CHAIN_MANAGEMENT.pdf

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C7E11.1	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E11.2	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E11.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E11.4	3	2	1	-	-	-	-	-	-	1	-	1	1	-
C7E11.5	3	2	1	-	-	-	-	-	-	1	-	1	1	-
AVG	**3.00**	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEME7E12 BATTERY MANAGEMENT SYSTEM 3 H – 3 C

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 the students to:

- Demonstrate familiarity with alternative energy sources and their role in sustainability.
- Analyze energy requirements for different hybrid and electric vehicles.
- Examine the principles and components of lithium-ion batteries.
- Explore advancements in battery technologies.
- Apply knowledge of battery management systems and ensure safety in high-voltage batteries.

COURSE OUTCOMES:

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

- Apply the alternative energy and sustainability to electric transportation.
- Analyze energy needs for hybrid and electric vehicles.
- Choose the manufacturing operation of lithium-ion batteries.
- Outline the advancements in battery technology.
- Utilize battery management system and prioritize safety in high-voltage batteries.

UNIT – I ENERGY STORAGE SYSTEMS 9

General background on alternative energy sources and sustainability, Introduction to electric-basedtransportation, Overview of on-road vehicle electrification, EVs configuration, Energy and power requirements for various HEVs and EVs Vehicle performance and driving cycles.

UNIT – II LITHIUM BATTERIES 9

Li-ion batteries - Principle of operation, Battery components and design Electrode, cell and battery fabrications, Building block cells, battery modules and packs and applications. All solid-state batteries and future developments, Li-Sulphur battery, Li-Air battery, Sodium-battery, Magnesium battery, Aluminium battery, Silicon battery.

UNIT – III HIGH TEMPERATURE BATTERIES FOR BACK-UP APPLICATIONS 9

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 scalegrid application, Ni-H_2 cells for space applications.

UNIT – IV FUEL CELLS AND BATTERY RECYCLING TECHNOLOGY 9

Introduction to fuel cells, Proton-exchange membrane and alkaline fuel cells for transportation, Solid oxide fuel cells, Technology and economic aspects of battery recycling, Environmental effect and controlling of poisonous chemicals contamination.

UNIT – V BATTERY MANAGEMENT 9

Fundamentals of battery management systems and controls, Battery Thermal Management - Passive cooling,Active cooling -Liquids and air systems. Regulations and Safety Aspects of High Voltage Batteries, Code and Standards, Safe handling of LithiumBatteries, Safety of high voltage battery.

TOTAL: 45

TEXT BOOKS:

1. Gerardus Blokdyk, Battery Management System a Complete Guide, Springer, 2019 Edition.
2. Reiner Korthauer, Lithium-Ion Batteries: Basics and Applications, 1st Edition. Springer, 2018

REFERENCE BOOKS:

1. Alfred Rufer, Energy Storage: Systems and Components, 1st Edition, CRC Press, 2017.
2. Arno Kwade and Jan Diekmann, Recycling of Lithium-Ion Batteries: The LithoRec Way (SustainableProduction, Life Cycle Engineering and Management), 1st Edition. Springer, 2018.

WEBSITES:

1. https://nptel.ac.in/courses/108/103/108103009/
2. https://web1.eng.famu.fsu.edu/~patelsa/Files/FinalReport.pdf

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C7E12.1	3	2	1	-	-	1	1	-	-	1	-	1	1	-
C7E12.2	3	3	2	1	-	1	1	-	-	1	-	1	1	-
C7E12.3	3	2	1	-	-	1	1	-	-	1	-	1	1	-
C7E12.4	3	2	1	-	-	1	1	-	-	1	-	1	1	-
C7E12.5	3	2	1	-	-	1	1	-	-	1	-	1	1	-
AVG	**3.00**	**2.20**	**1.20**	**1.00**	**-**	**1.00**	**1.00**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

OPEN ELECTIVES
COURSES OFFERED BY OTHER DEPARTMENTS

23BESHOE__ GREEN CHEMISTRY 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 the students to:

- To make the students conversant about the green chemistry
- To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
- To acquaint the student with concepts of green technology.
- To develop an understanding of the basic concepts of renewable energy resources.
- To acquaint the students with the basics information on catalysis.
- To apply the concepts of green catalysts in the synthesis.

COURSE OUTCOMES:

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

- Outline the basic principles of green chemistry.
- Explain the chemical synthesis in terms of atom efficiency.
- Relate the concepts of green chemistry in biotechnology.
- Illustrate the importance of renewable feedstocks.
- Extend the phenomena of catalysis in green synthesis.

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.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Sanjay K. Sharma, Ackmez Mudhoo (2010) Green Chemistry for Environmental Sustainability CRC. Press , London
2. Chandrakanta Bandyopadhyay (2019) An Insight into Green Chemistry, Books and Allied (P) Ltd, Kolkata.
3. Ahluwalia V. K. (2018) Green Chemistry A Textbook 4th Reprint Narosa Publishing House Pvt. Ltd, New Delhi.
4. Ahluwalia V. K. and M.Kidwai (2007) New Trends in Green Chemistry 2nd edition Anamaya publishers., New Delhi.
5. Dr. Sunita Ratan (2012) A Textbook of Engineering Chemistry S.K. Kataria and Sons., New Delhi
6. Mukesh Doble. Ken Rollins, Anil Kumar (2007) Green Chemistry and Engineering, 1st edition Academic Press, Elesevier., New Delhi.
7. Desai K. R. (2005) Green Chemistry Himalaya Publishing House, Mumbai.

WEBSITES:

1. www.organic-chemistry.org/topics/green-chemistry.shtm
2. www.essentialchemicalindustry.org/processes/green-chemistry.html
3. www.chm.bris.ac.uk/webprojects2004/vickery/green_solvents.html
4. www.epa.gov/research/greenchemistry/
5. www.amazon.in/Green-Chemistry-Catalysis

CO PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	2	3	-	1	-	2	-	-
CO2	3	2	-	-	-	2	2	3	-	1	-	2	-	-
CO3	2	1	-	-	-	2	2	3	-	1	-	2	-	-
CO4	2	1	-	-	-	2	2	3	-	1	-	2	-	-
CO5	2	1	-	-	-	2	2	3	-	1	-	2	-	-
AVG	**2.2**	**1.2**	**-**	**-**	**-**	**2**	**2**	**3**	**-**	**1**	**-**	**2**	**-**	**-**

23BESHOE__ MATERIAL SCIENCES 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 the students to:

- To inculcate the fundamental principles and concepts of magnetic materials for different engineering applications.
- To impart basic knowledge of superconductivity and associated applications.
- To serve the fundamental concepts of dielectric materials for diverse applications in energy engineering.
- To divulge the basics of crystals, their structures and different crystal growth techniques.
- To make the students familiar in the fundamentals of ceramics, composites and nonmaterial's.

COURSE OUTCOMES:

Upon the successful completion of this course

- Illustrate the theory of magnetism and magnetic properties of the materials
- Explain the theory of superconductivity and its application in SQUID
- Infer the types of polarization and dielectric breakdown
- Outline the basics of crystals, structures and its defects
- Summarize the types of ceramics, metallic glsses and alloys

UNIT I MAGNETIC MATERIALS

Origin of magnetic moment; Bohr magneton; comparison of Dia, Para and Ferro magnetism; Langevin theory of diamagnetism and paramagnetism; Quantum theory of paramagnetism; Curie-Weiss law; Temperature dependence of saturation magnetization; Domain theory; Hysteresis; soft and hard magnetic materials; antiferromagnetic materials; Ferrites and its applications.

UNIT II SUPERCONDUCTING MATERIALS

Superconductivity, properties; Meissner effect; Type I and Type II superconductors; London equation; BCS theory of superconductivity(Qualitative), Flux quantization; High Tc superconductors; Josephson superconductor tunnelling, DC and AC Josephson effect; Applications of superconductors, SQUID, cryotron, magnetic levitation.

UNIT III DIELECTRIC MATERIALS

Electrical susceptibility, dielectric constant; electronic, ionic, orientational and space charge polarization; frequency and temperature dependence of polarisation; internal field;Clausius -Mossotti relation (derivation); dielectric loss; dielectric breakdown, uses of dielectric materials (capacitor and transformer); ferroelectricity and applications.

UNIT IV CRYSTAL PHYSICS

Lattice, Unit cell, Bravais lattice; Lattice planes; Miller indices; d spacing in cubic lattice; Calculation of number of atoms per unit cell, Atomic radius, Coordination number, Packing factor for SC, BCC, FCC and HCP structures; Crystal imperfections; Crystal growth techniques; solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative).

UNIT V NEW MATERIALS

Ceramics; types and applications; composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics; metallic glasses: types , glass forming ability of alloys, melt spinning process, applications; shape memory alloys: phases, shape memory effect, applications; nanomaterials: preparation (bottom up and top down approaches), properties and applications.

TEXT BOOKS:

1. C. Kittel, Introduction to Solid State Physics, 7th Edition, Wiley Eastern, New Delhi, 2006.
2. A. J. Dekker, Solid State Physics, Published by Macmillan India, 2000
3. William D CallisterJr, "Materials Science and Engineering – An Introduction", John Wiley and Sons Inc.,7th edition, New York, 2006
4. S.O. Pillai, Solid State Physics. New Age International(P) Ltd., publishers, 2009
5. M.A. Wahab, Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009.
6. M. Arumugam, Materials Science. Anuradha publishers, 2010.

JOURNALS

1. Nature Physics
2. Journal of Applied Mechanics (ASME)
3. Journal of Electronic Materials (IEEE/TMS)
4. Applied Thermal Engineering (Elsevier)
5. Physical Review B (American Physical Society).
6. Nature Nanotechnology

WEBLINKS

1. https://nptel.ac.in/courses/122/103/122103011/
2. https://nptel.ac.in/courses/113/104/113104081/
3. https://nptel.ac.in/courses/108/108/108108122/
4. http://hyperphysics.phy-astr.gsu.edu/hbase/optmod/lascon.html

CO-PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO1 2	PSO 1	PSO2
CO1	2	1	-	-	-	-	-	-	-	1	-	1	-	-
CO2	2	1	-	-	-	-	-	-	-	1	-	1	-	-
CO3	2	1	-	-	-	-	-	-	-	1	-	1	-	-
CO4	2	1	-	-	-	-	-	-	-	1	-	1	-	-
CO5	2	1	-	-	-	-	-	-	-	1	-	1	-	-
AVG	**2.0**	**1.0**	-	-	-	-	-	-	-	**1.0**	-	**1.0**	-	-

23BEEEOE__ HYBRID ELECTRIC VEHICLES 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 the students to:

- To understand the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
- To familiarize the plug – in hybrid electric vehicle architecture, design and component sizing and the power electronics devices used in hybrid electric vehicles.
- To analyze various electric drives suitable for hybrid electric vehicles.
- To discuss different energy storage technologies used for hybrid electric vehicles and their control.
- To demonstrate different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components and design optimization and energy management.

COURSE OUTCOMES

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

- Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals
- Analyze the use of different power electronics devices and electrical machines in hybrid electric vehicles.
- Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration.
- Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
- Analysis the performance of Energy Management strategies in HEVs.

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.

Total : 45 Hours

TEXT BOOKS:

1. C.Mi, M.A. Masrur and D.W.Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S.Onori, L.Serrao and G.Rizzoni,"Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. M.Ehsani, Y.Gao, S.E.Gay andA.Emadi,"Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press,2004.
4. T.Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

WEBLINKS:

1. https://www.energy.gov/eere/electricvehicles/electric-vehicle-basics
2. https://swayam.gov.in/nd1_noc20_ee18/preview3.https://nptel.ac.in/courses/108103009/
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106105166/lecpdf
4. https://nptel.ac.in/courses/106105166/
5. https://nptel.ac.in/courses/108108098/

CO-PO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	2	1	-	-	-	-	1	2	1
CO2	3	3	2	2	2	-	1	-	-	-	-	1	2	1
CO3	2	2	1	1	1	-	1	-	-	-	-	1	2	1
CO4	3	3	2	2	2	-	1	-	-	-	-	1	2	1
CO5	3	3	2	2	2	-	1	-	-	-	-	1	2	1
Avg.	**2.6**	**2.6**	**1.6**	**1.6**	**1.6**	**0.4**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**1**

23BTFTOE__ PROCESSING OF FOOD 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

The goal of this course is for students to,

- To explain the milling, extraction and manufacture of tremendous products fromcereals, pulses and oil seeds.
- To summarize the production and processing methods of fruits and vegetables.
- To infer the chemical composition, processing, production, spoilage and qualityof milk and milk products.
- To outline the overall processes involved in the production of meat, poultry and fish products.
- To review the production and processing methods of plantation and spice products.

Course Outcomes

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

- Infer the basics of food processing.
- Demonstrate the various processing technologies involved in fruits andvegetables, dairy, cereals, meat, fish, egg and plantation products.
- Infer the basics on microbiology of food products.
- Describe the process of manufacture of various food products.
- Outline the various methods of food preservation.

UNIT I - CEREAL, PULSES AND OIL SEEDS TECHNOLOGY 9

Rice milling, Pulse milling, Wheat milling – Recent trends in milling process- Oil extraction – different methods in 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 9

Production of Fruits and vegetables in India, Maturity standards, Cause for heavy losses, preservation treatments - Basics of Canning, Minimal processing and Hurdle technologyas applied to Vegetable and Fruit processing, Processing of fruit juices, Dehydration, Aseptic processing- Indian Food Regulation and Quality assuranceFruit Juice / pulp/ Nectar/Drinks, concentrates.

UNIT III – DAIRY PROCESSING 9

Basic dairy terminology, composition, General tests at reception, Dairy Processing - Method of manufacture of Standardized, toned and double toned milk, milkpowder - Equipments - Pasteurizers, homogenizers and pumps - Method of manufactureof dairy products - Ice-cream, Cheese, Paneer, Yoghurt - Pasteurization and microorganisms involved in spoilage of milk – Major pathogens, Plant construction, Sanitation management, Cleaning equipment.

UNIT IV - MEAT, POULTRY AND FISH PROCESSING 9

Meat composition from different sources, Definitions and measurements, Carcass Processing, Meat Products, Processing of Poultry Products, Common pathogens, Sanitation management, Sanitizers for meat & poultry plants, Fish and other Marine Products Processing, Sources of sea food contamination.

UNIT V - PLANTATION PRODUCT TECHNOLOGY 9

Processing of Tea, Coffee and Cocoa - Outline of the methods of manufacture of - greentea, black tea, instant tea, Instant coffee, Cocoa and Chocolate. Outline of the methods ofprocessing of Pepper, cardamom, ginger, vanilla and turmeric. By products fromplantation crops and spices.

TOTAL: 45

TEXT BOOKS:

1. Srivastava R.P. and Kumar S. Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Co. Lucknow. 3rd Edition. 2010.
2. Chakraverty A., Mujumdar A.S., Raghavan G.S.V and Ramaswamy H.S. Handbook of Post-harvest Technology: Marcel Dekker Press. USA. 1st Edition. 2003.

REFERENCE BOOKS:

1. Sukumar De. Outlines of Dairy Technology. Oxford University Press. New Delhi. 23rd impression. 2016.
2. James G. Brennan. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH& Co. KGaA, Weinheim, Germany.

WEB REFERNCES

1. https://www.intechopen.com/chapters/86251
2. https://ifst.onlinelibrary.wiley.com/journal/17454549

CO PO Mapping

CO	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	2	1	-	2	2	2	-	-	2	2
CO2	1	2	1	3	2	1	-	2	2	2	-	-	2	2
CO3	1	2	1	3	2	1	-	2	-	-	-	-	2	2
CO4	1	2	1	3	2	1	-	2	-	-	2	-	2	2
CO5	1	2	1	3	2	1	-	2	-	2	-	-	2	2
AVG	**1**	**2**	**1**	**3**	**2**	**1**		**2**	**2**	**2**	**2**	**-**	**2**	**2**

23BTFTOE__ 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 Hour

Course Objectives

The goal of this course is for students,

- To classify the types of agricultural wastes.
- To outline the production and utilization of biomass.
- To explain the various parameters considered to be important in the designing ofbiogas units.
- To outline the methods employed in the production of alcohol from agricultural wastes/byproducts.
- To summarize the overall aspects involved in the production of paperboards and particleboards from agricultural wastes.

Course Outcomes

Upon successful completion of this, students will be able to,

- Outline the types of agricultural wastes.
- Illustrate the collection and generation of value-added products from agricultural wastes
- Demonstrate the techniques involved in the production and utilization of biomass.
- Infer the various parameters considered to be important in the designing of biogas units.
- Illustrate the various methods employed in the production of alcohol from thebyproducts of agricultural wastes.

UNIT I - TYPES OF AGRICULTURAL WASTES

Introduction and Background Agricultural Waste, Crop Waste, Agricultural Residues (annual crops), Technical terms, properties of agricultural waste- storage and handling

- rice by-products utilization-rice bran and germ, rice bran oil, economic products from agriculture waste/by-products.

UNIT II - BIOMASS PRODUCTION AND UTILIZATION

Biomass – types – production and utilization 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 – factors affecting the efficiency; 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 PAPERBOARD AND PARTICLEBOARDS FROM AGRICULTURAL WASTE

Biodegradable packing materials: merits and demerits, 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.

TOTAL: 45

TEXT BOOKS:

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).

REFERENCE BOOKS:

1. 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).
2. Albert Howard, Yashwant Wad. The Waste Products of Agriculture. BenedictionClassics, 1st Edition, 2011. (ISBN-13: 9781849025).

WEB REFERENCES:

1. https://www.researchgate.net/publication/308880744_AGRICULTURAL_WASTE_CONCEPT_GENERATION_UTILIZATION_AND_MANAGEMENT
2. https://bioresourcesbioprocessing.springeropen.com/articles/10.1186/s40643-017-0187-z

CO PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	3	-	1	3	2	2	2	-	-	2	2
CO2	1	2	1	3	-	1	3	2	2	2	-	-	2	2
CO3	1	2	1	3	-	1	3	2	-	-	-	-	2	2
CO4	1	2	1	3	-	1	3	2	-	-	2	-	2	2
CO5	1	2	1	3	-	1	3	2	-	2	-	-	2	2
AVG	**1**	**2**	**1**	**3**	**-**	**1**	**3**	**2**	**2**	**2**	**2**	**-**	**2**	**2**

23BECEOE__ HOUSING PLAN AND MANAGEMENT 3 H – 3 C

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 the students to:

- To examine the role and tasks of basic housing policies and building bye laws
- Understand the process of integrated service delivery in the context of economic, social, environmental, and institutional factors.
- Analyze the Innovative construction methods and Materials.
- Analyze city management strategies and strengthen the urban governance through a problem solving approach.
- To know the Importance of basic housing policies and building bye laws

COURSE OUTCOMES

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

- Know the Importance of basic housing policies and building bye laws.
- Use Housing Programmes and Schemes
- Plan and Design of Housing projects
- Examine Innovative construction methods and Materials.
- Know Housing finance and loan approval procedures.

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, Byelaws 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 of 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,Mumbai (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.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	-	-	2	-	2	2	2	2
CO2	3	3	3	3	3	2	-	-	2	-	2	2	2	2
CO3	3	3	2	2	2	2	-	-	2	-	2	2	2	2
CO4	3	3	3	3	2	2	-	-	2	-	2	2	2	2
CO5	3	3	2	2	2	2	-	-	2	-	2	2	2	2
AVG	**3**	**3**	**2.6**	**2.4**	**2.2**	**2**	**-**	**-**	**2**	**-**	**2**	**2**	**2**	**2**

23BECEOE__ COMPUTER-AIDED CIVIL ENGINEERING DRAWING 3 H – 3 C

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 the students to:

- Develop Parametric design and the conventions of formal engineering drawing
- Produce and interpret 2D & 3D drawings
- Communicate a design idea/concept graphically/ visually
- 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.
- Get a Detailed study of an engineering artifact.

COURSE OUTCOMES:

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

- Develop Parametric design and the conventions of formal engineering drawing
- Produce and interpret 2D & 3D drawings
- Communicate a design idea/concept graphically/ visually
- 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.
- Get a Detailed study of an engineering artifact.

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; Introductionto 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. Foundationplan. 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 AUTOCAD200I", Tata- Mc Graw-Hill Company Limited, NewDelhi

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO.1	3	2	-	2	1	2	1	-	2	-	1	2	1	-
CO.2	3	2	-	2	1	2	1	-	2	-	1	2	1	-
CO.3	3	2	-	2	1	2	1	-	2	-	1	2	1	-
CO.4	3	2	-	2	1	2	1	-	2	-	1	2	1	-
CO.5	3	2	-	2	1	2	1	-	2	-	1	2	1	-
AVG	**3**	**2**	**-**	**2**	**1**	**2**	**1**	**-**	**2**	**-**	**1**	**2**	**1**	**-**

23PHPOE301 MATERIALS CHARACTERIZATION 3H--2C

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 the students to:

- To Study materials is always important, for any application, including fabrication of satellites.
- To introduce various methods available for characterizing the materials. The characterization of materials specifically addresses that portfolio with which researchers and educators must have working familiarity.
- To provide an introduction to materials characterization and its importance
- To discuss different types of characterization techniques and their uses.
- To introduce the students to the principles of optical and electron microscopy, X-ray diffraction and various spectroscopic techniques Introduction:

Course Outcomes (COs)

After completing the course the students will / can able to

- Handle with X-ray, thermal, microscopic, and electrical methods of characterization.
- Understand and describe the fundamental principles behind the methods of characterization which are included in the curriculum
- Analyze, interpret and present observations from the different methods.
- Evaluate the uncertainty of observations and results from the different methods.
- Understand the history of materials science with basic understanding of metals, binary alloys, magnetic materials, dielectric materials and polymers

UNIT 1 X-ray techniques for materials characterization X-ray diffraction: Principle, measuring system and applications for characterization of powdered materials. X-ray diffraction profile and analysis: FWHM and line broadening, Crystallite size effect and Scherrer formula, Effect of strain (tensile vs compressive, uniform vs. non-uniform) Introduction to Extended X-ray absorption fine structure (EXAFS), Surface extended X-ray absorption (SEXAFS).

UNIT II Microscopic techniques Principles, instrumentations and applications of Optical microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) for characterization of different samples. Energy dispersive X-ray microanalysis (EDS) - Basic aspects of Atomic force microscopy (AFM).

UNIT III Spectroscopic methods Principle, instrumentation and applications of UV-Visible Diffuse Reflectance (UV-Vis DRS) spectroscopy, Ft-Ir, Raman and Fluorescence spectroscopy. Hand of experience on operation of UV-Vis-DRS, FT-IR, Raman and data analysis..

UNIT IV Thermoanalytical Methods Principle, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Temperature Analysis (DTA) and Differential Scanning Calorometry (DSC). Factors affecting the TGA/DTA/DSC results and their interpretations. Hand on on experience of operation of TG/DSC and data analysis.

UNIT V Electroanalytical Techniques Voltammetric principles, hydrodynamic voltammetry, stripping voltammetry, cyclic voltammetry, criteria of reversibility of electrochemical reactions, quasi-reversible and irreversible processes, qualitative and quantitative analysis current-potential relation applicable for Linear Sweep Voltammetry (LSV) and Cyclic Voltammetry (CV), interpretation of cyclic voltammograms and parameters obtainable from voltammograms. Hand on experience on operation of

CV and data analysis.

TEXTBOOKS:

1. Theory and Applications of UV Spectroscopy, H.H.Jaffe and M.Orchin, IBH-Oxford.
2. Inorganic spectroscopic methods, A.K. Brisdon, Oxford Chem. Primers, 1997, New York.
3. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L.Ho, Wiley Inter science.
4. Introduction to Spectroscopy, Pavia, Brooks/Cole Cenage, 4th edition, 2009, Belmont.
5. Introduction to Photoelectron Spectroscopy, P.K.Ghosh, John Wiley.
6. Fundamental of Molecular Spectroscopy, C. N. Banwell and E. McCash, Tata McGraw Hill, 4th edition, 1994, New Delhi.

CO-PO MAPPING

CO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	2	-	-	-	-
CO4	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	3	-	3	-	-	-	-	-	-	-	-	-	-	-
Average	**1.8**	**0.5**	**0.5**	**0.6**	**0.5**	**-**	**-**	**-**	**-**	**0.3**	**-**	**-**	**-**	**-**

23CAPOE301 ROBOTICS PROCESS AUTOMATION 3H-2C

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 the students to:

- Learn the concepts of RPA, its benefits, types and models
- Gain the knowledge in application of RPA in Business Scenarios
- Identify measures and skills required for RPA
- Adopt to the implementations of Automation
- Able to process information and draw inference

Course Outcomes (COs)

Upon completion of this course students will be able to:

- Demonstrate the benefits and ethics of RPA
- Understand the Automation cycle and its techniques
- Draw inferences and information processing of RPA
- Understand the Automation concepts
- Implement & Apply RPA in Business Scenarios

UNIT I INTRODUCTION

Introduction to RPA - Overview of RPA - Benefits of RPA in a business environment - Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA - Centre of Excellence – Types and their applications - Building an RPA team - Approach for implementing RPA initiatives.

UNIT II AUTOMATION

Role of a Business Manager in Automation initiatives - Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people

UNIT III AUTOMATION IMPLEMENTATION

Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows

UNIT IV ROBOT

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

UNIT V ROBOT SKILL

Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.

TEXTBOOKS:

1. Tom Taulli, February 2020. “The Robotic Process Automation Handbook” Apress , Reference Books 1 Steve Kaelble” Robotic Process Automation” John Wiley & Sons, Ltd.
2. Alok Mani Tripathi, March 2018. “Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool”, Packet Publishing Limited

Websites

1. https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm
2. https://www.javatpoint.com/rpa 3 https://onlinecourses.nptel.ac.in/noc19_me74/preview

CO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	--	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	3	2	-	-	-	-	-	-	-	-	-	-
CO5	-	-	3	-	-	-	-	-	2	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	3	-	-	-	-
Average	**1.5**	**0.5**	**1**	**0.3**	**-**	**-**	**-**	**-**	**0.3**	**0.5**	**-**	**-**	**-**	**-**

COURSES OFFERED TO OTHER DEPARTMENTS

23BEMEOE01 BATTERY MANAGEMENT SYSTEM 3 H – 3 C

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 the students to:

- Demonstrate familiarity with alternative energy sources and their role in sustainability.
- Analyze energy requirements for different hybrid and electric vehicles.
- Examine the principles and components of lithium-ion batteries.
- Explore advancements in battery technologies.
- Apply knowledge of battery management systems and ensure safety in high-voltage batteries.

COURSE OUTCOMES:

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

- Apply the alternative energy and sustainability to electric transportation.
- Analyze energy needs for hybrid and electric vehicles.
- Choose the manufacturing operation of lithium-ion batteries.
- Outline the advancements in battery technology.
- Utilize battery management system and prioritize safety in high-voltage batteries.

UNIT I ENERGY STORAGE SYSTEMS 9

General background on alternative energy sources and sustainability, Introduction to electric-based transportation, Overview of on-road vehicle electrification, EVs configuration, Energy and power requirements for various HEVs and EVs Vehicle performance and driving cycles.

UNIT II LITHIUM BATTERIES 9

Li-ion batteries - Principle of operation, Battery components and design Electrode, cell and battery fabrications, Building block cells, battery modules and packs and applications. All solid-state batteries and future developments, Li-Sulphur battery, Li-Air battery, Sodium-battery, Magnesium battery, Aluminium battery, Silicon battery.

UNIT III HIGH TEMPERATURE BATTERIES FOR BACK-UP APPLICATIONS 9

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 IV FUEL CELLS AND BATTERY RECYCLING TECHNOLOGY 9

Introduction to fuel cells, Proton-exchange membrane and alkaline fuel cells for transportation, Solid oxide fuel cells, Technology and economic aspects of battery recycling, Environmental effect and controlling of poisonous chemicals contamination.

UNIT V BATTERY MANAGEMENT 9

Fundamentals of battery management systems and controls, Battery Thermal Management - Passive cooling, Active cooling -Liquids and air systems. Regulations and Safety Aspects of High Voltage Batteries, Code and Standards, Safe handling of Lithium Batteries, Safety of high voltage battery.

TOTAL: 45

TEXT BOOKS:

1. Gerardus Blokdyk, Battery Management System A Complete Guide, Springer, 2019 Edition.
2. Reiner Korthauer, Lithium-Ion Batteries: Basics and Applications, 1st Edition. Springer, 2018

REFERENCE BOOKS:

1. Alfred Rufer, Energy Storage: Systems and Components, 1st Edition, CRC Press, 2017.
2. Arno Kwade and Jan Diekmann, Recycling of Lithium-Ion Batteries: The LithoRec Way (SustainableProduction, Life Cycle Engineering and Management), 1st Edition. Springer, 2018.

WEBSITES:

1. https://nptel.ac.in/courses/108/103/108103009/
2. https://web1.eng.famu.fsu.edu/~patelsa/Files/FinalReport.pdf

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
COE01.1	3	2	1	-	-	1	1	-	-	1	-	1	1	-
COE01.2	3	3	2	1	-	1	1	-	-	1	-	1	1	-
COE01.3	3	2	1	-	-	1	1	-	-	1	-	1	1	-
COE01.4	3	2	1	-	-	1	1	-	-	1	-	1	1	-
COE01.5	3	2	1	-	-	1	1	-	-	1	-	1	1	-
AVG	**3.00**	**2.20**	**1.20**	**1.00**	**-**	**1.00**	**1.00**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEMEOE02 INDUSTRIAL SAFETY AND ENVIRONMENT 3 H – 3 C

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

End Semester Exam : 3 Hours

COURSE OBJECTIVE

The goal of this course is for the students to:

- To provide in-depth knowledge on various techniques of non-destructive testing.
- To acquaint the student with the need and awareness of the safety concepts.
- To understand the importance of various safety techniques involved in industrial sector.
- To introduce the concepts of accident zone and prepare reports related to it.
- To develop an understanding of safety monitoring.

COURSE OUTCOME

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

- Explain the need for safety.
- Outline the safety techniques involved in industrial sector.
- Develop the report for the accident zones.
- Inspect the safety strategies in industrial sector.
- Illustrate training sessions based on safety.

UNIT I CONCEPTS OF SAFETY ENGINEERING 9

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNIT II TECHNIQUES OF SAFETY ENGINEERING 9

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accidentprevention, 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 PERFORMANCE MONITORING 9

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 AND TRAINING 9

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice – motivation – communication – role of government agenciesand 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. Modern safety equipment and technics – Case study.

TOTAL: 45

TEXT BOOKS:

1. Accident Prevention Manual for Industrial Operations,3rd edition, N.S.C.Chicago, 2020 (digital).
2. Heinrich H.W. "Industrial Accident Prevention", 2nd edition, Tata McGraw-Hill, NewYork, 2017.

REFERENCE BOOKS:

1. Krishnan N.V, Safety Management in Industry,1st edition, Jaico Publishing House, Bombay, 2017.
2. John R Ridley, Safety at Work,3rd edition, Elsevier, 2019.

WEBSITES:

1. https://onlinecourses.nptel.ac.in/noc19_me40/preview
2. https://www.studocu.com/in/document/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
COE02.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
COE02.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
COE02.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
COE02.4	3	3	2	1	-	-	-	-	-	1	-	1	1	-
COE02.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.40**	**1.60**	**1.50**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEMEOE03 NON-DESTRUCTIVE TESTING 3 H – 3 C

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

End Semester Exam : 3 Hours

COURSE OBJECTIVE

The goal of this course is for the students to:

- The main objectives of this course are to introduce the concept of non-destructive testing among the students and make them understand various types of non-traditional practices available for manufacturing industry.
- To provide in-depth knowledge on various techniques of non-destructive testing.
- To provide an overview of destructive and non-destructive tests and state their applications.
- To study the features of NDT techniques for various products and to understand the established NDE techniques and basic familiarity of emerging NDE techniques.
- To expose students to skills needed for selection of appropriate NDT technique(s) for new inspection jobs.

COURSE OUTCOME

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

- Summarize the codes, standards and specifications related to NDT.
- Classify the destructive and non-destructive tests and their applications.
- Develop NDT techniques for mechanical components.
- Compare the eddy current and visual testing methods.
- Explain the NDE techniques and its applications.

UNIT I INTRODUCTION 9

Properties of Engineering Materials – Types of Defects – Surface and Sub-Surface of a component – Characteristics of Ferrous, Non-ferrous and Alloys. Classification of Destructive testing and Non-Destructive testing – Uses and applications. Codes, Standards and Specifications of NDT (ASME, ASTM, AWS etc.). Importance and Scope of NDT, Non-destructive testing methods.

UNIT II PENETRANT TESTING AND MAGNETIC PARTICLE INSPECTION 9

Introduction to Penetrant Testing – Liquid Penetrants and Dye Penetrants - Apparatus required for LPT - An Illustration of Penetrant Testing, Application, Advantages and Disadvantages of Penetrants Testing. Introduction to Magnetic Particle Inspection – MPT Equipments and devices - An Illustration of Magnetic Particle Inspection, Application, Advantages and Disadvantages of Magnetic Particle Crack Detection.

UNIT III ULTRASONIC FLAW DETECTION AND RADIOGRAPHY INSPECTION 9

Introduction to Ultrasonic Flaw Detection, UT Equipments and devices, An Illustration of Ultrasonic Flaw Detection, Application, Advantages and Disadvantages of Ultrasonic Flaw Detection. Principle of Radiography Inspection, RT Equipments and devices Radiation sources, uses of x-rays and gamma rays Attenuation in the specimen, Radiographic imaging, Inspection Techniques, Application and limitations, Safety from Radiation.

UNIT IV EDDY CURRENT TESTING AND VISUAL TESTING METHODS 9

Introduction to Eddy Current Testing. ECT Equipments and devices, An Illustration of Eddy Current Testing Equipment, Application, Advantages and Disadvantages of Eddy Current Testing. Introduction to visual testing method, Equipments required for VT - An Illustration of visual testing method, Application, Advantages and Disadvantages of visual testing method.

UNIT V NON-DESTRUCTIVE INSPECTION(NDI) AND ITS APPLICATIONS 9

Inspection of Raw Products, Inspection for In-Service Damage, Power Plant Inspection, Storage Tank Inspection, Automobile component Inspection, Jet Engine Inspection, Pressure Vessel Inspection, Bridge Inspection, Pipeline Inspection.

TEXT BOOKS:

1. Sadashiva. M – Non - Destructive Testing Paperback – 15 July 2021.
2. Ramachandran. S and Anderson. A - Non-Destructive Testing – Kindle Edition – 2018.

REFERENCE BOOKS:

1. J. Prasad and C. G. Krishnadas Nair - Non-Destructive Test and Evaluation of Materials Hardcover – 2017.
2. Lari and Kumar - Basics of Non - Destructive Testing Paperback – 1 January 2013.

WEBSITES:

1. https://ndttrainingonline.com
2. https://onlinendts.com/

CO-PO MAPPING

CO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
COE03.1	2	1	-	-	-	-	-	-	-	1	-	1	1	-
COE03.2	2	1	-	-	-	-	-	-	-	1	-	1	1	-
COE03.3	3	2	1	-	-	-	-	-	-	1	-	1	1	-
COE03.4	2	1	-	-	-	-	-	-	-	1	-	1	1	-
COE03.5	2	1	-	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.20**	**1.20**	**1.00**	**-**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**

23BEMEOE04 OPERATIONS RESEARCH 3 H – 3 C

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

COURSE OBJECTIVE

The goal of this course is for the students to:

- To provide students the knowledge of optimization techniques and approaches.
- To enable the students, apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
- To understand the Engineering and Managerial situations in Transportation.
- To make the student acquire sound knowledge on sequences to perform operation among various alternatives.
- To teach students about networking, inventory, queuing, decision and replacement models.

COURSE OUTCOME

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

- Solve Linear programming technique in industrial optimization problems.
- Examine transportation problems using OR techniques.
- Explain OR models for optimization.
- Make use of OR tools in industrial applications.
- Identify the advanced techniques for group replacement.

UNIT I INTRODUCTION TO OPERATIONS RESEARCH 9

Operations research and decision–making – types of mathematical models and constructing the model – Role of computers in operations research –Linear Programming Techniques: Formulation of linear programming problem, applications and limitations, graphical method, simplex method – The Big –M method – the two– phase method.

UNIT II TRANSPORTATION PROBLEMS 9

Least cost method, North west corner rule, Vogel's approximation method, modified distribution method, unbalance and degeneracy in transportation model, shortest route algorithm – dijkestra algorithm.

UNIT III ASSIGNMENT MODELS AND SCHEDULING 9

Assignment models - Hungarian algorithm, unbalanced assignment problems - maximization case in assignment problems, traveling salesman problem. Scheduling – processing n jobs through two machines, processing n jobs through three machines, processing two jobs through 'm' machines, processing n jobs through m machines.

UNIT IV INVENTORY CONTROL AND QUEUING THEORY 9

Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, multi-item deterministic model.

Queuing Models: Queues – Notation of queues, performance measures, The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns.

UNIT V PROJECT MANAGEMENT AND REPLACEMENT MODELS 9

Basic terminologies, constructing a project network, network computations in CPM and PERT, cost crashing Replacement Models: Replacement of Items due to deterioration with and without time value of Money,Group replacement policy, Staff replacement

TEXT BOOKS:

1. Kanti Swarup, Operations Research, 12th edition, Sultan Chand and Sons, New Delhi, 2010.
2. Viswanathan N and Narahari Y, Performance Modeling of Automated Manufacturing Systems,2nd edition,Prentice Hall of India, New Delhi, 2005.

WEBSITES

1. https://www.techtarget.com/whatis/definition/operations-research-OR
2. https://en.wikipedia.org/wiki/Operations_research

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
COE04.1	3	2	1	-	-	-	-	-	-	1	-	1	1	-
COE04.2	3	3	2	1	-	-	-	-	-	1	-	1	1	-
COE04.3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
COE04.4	3	2	1	-	-	-	-	-	-	1	-	1	1	-
COE04.5	3	2	1	-	-	-	-	-	-	1	-	1	1	-
AVG	**2.80**	**2.00**	**1.25**	**1.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	**1.00**	**1.00**	**-**