

**B.E ELECTRICAL AND ELECTRONICS
ENGINEERING
CURRICULUM & SYLLABI 2021
(REGULAR PROGRAMME)**

**Department of Electrical and Electronics
Engineering**

FACULTY OF ENGINEERING



KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act 1956)

**Pollachi Main Road, Eachanari Post,
Coimbatore- 641 021,India.**

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

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

1. ADMISSION

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

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

(OR)

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

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

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

(OR)

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

1.3 Lateral Entry Admission

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

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

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

		Chemical Engg
10.	B. Tech Food Technology	Diploma in Food Technology/Chemical Engineering / Leather Technology / Diploma in Petrochemical Engg.

1.4 Migration from other University

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

2 . PROGRAMMES OFFERED

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

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

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

3. MODE OF STUDY

3.1 Full-Time:

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

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

3.3 Change from one programme to another is not permitted.

4. STRUCTURE OF PROGRAMMES

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

- (i) General core courses comprising Mathematics, Basic Sciences, Engineering Sciences and Humanities.
- (ii) Core courses of Engineering/Technology.
- (iii) Elective courses for specialization in related fields.
- (iv) Workshop practice, computer practice, engineering graphics, laboratory work, in-plant training, seminar presentation, projectwork, industrial visits, camps, etc.

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

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

(V) Choice Based Credit System

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

4.2 Each course is normally assigned certain number of credits.

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

4.3 In every semester, the curriculum shall normally have a blend of theory courses not exceeding 6 and practical courses not exceeding 3. However, the total number of courses per semester shall not exceed 8.

4.4 The prescribed credits required for the award of the degree shall be within the limits 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. (H. Sc. Candidates)	8	14
B. E./B. Tech. (Lateral Entry Candidates)	6	12

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

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

6. REQUIREMENTS FOR COMPLETION OF THE SEMESTER

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

6.2 A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed attendance requirements and shall be permitted to appear for the Examination on the recommendation of the Head of the Department concerned and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean. However, the candidate has to pay prescribed condonation fees.

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

7. CLASS ADVISOR

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

8. CLASS COMMITTEE

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

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

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

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

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

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

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

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

9. COURSE COMMITTEE FOR COMMON COURSES

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

10. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

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

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

THEORY COURSES:

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

*Evaluation shall be made by a committee.

PATTERN OF TEST QUESTION PAPER (Test I & II)

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

PATTERN OF TEST QUESTION PAPER(Test III)

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

PRACTICAL COURSES:

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

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

INTEGRATED THEORY AND PRACTICAL COURSES:

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

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

10.3 ATTENDANCE

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

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

10.4 PROJECT WORK/ INTERNSHIPS:

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

10.5 CERTIFICATION COURSES :

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

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

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

12. END SEMESTER EXAMINATION

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

PATTERN OF ESE QUESTION PAPER:

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

13. PASSING REQUIREMENTS

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

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

13.2 If the candidate fails to secure a pass in a particular course ESE, it is 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 advise 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:

- The list of courses enrolled during the semester and the grade scored,
- The Grade Point Average (**GPA**) for the semester and
- 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.

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

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

14.3 REVALUATION

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

14.4 TRANSPARENCY AND GRIEVANCE COMMITTEE

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

15. ELIGIBILITY FOR AWARD OF DEGREE

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

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

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

16. CLASSIFICATION OF THE DEGREE AWARDED

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

16.2 A regular candidate or a lateral entrant is eligible to register for BE(Honors), B.Tech(Honors). If, he / she has passed all the courses in the first appearance and holds / maintains a CGPA of 7.5 at VI Semester. He / she has to take an additional 20 credits by studying online courses through Swayam/NPTEL . Such a candidate is eligible for the award of BE (Honor), B.Tech(Honor). However, if 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.

16.3A A candidate who qualifies for the award of the Degree (vide Clause 15) having passed the Examination in all the courses within the specified minimum number of semesters (vide Clause 5.1) plus one year (two semesters), securing CGPA of not less than **6.5** shall be declared to have passed the Examination in First Class.

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

17. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

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

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

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

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

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

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

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

18. PROVISION FOR AUTHORISED BREAK OF STUDY

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

18.2 The total number of semesters for completion of the programme from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum no. of semesters specified in Clause 5.1 irrespective of the period of break of study (vide Clause 18) in order that he/she may be eligible for the award of the degree (vide Clause 15). The candidate thus permitted to rejoin the programme at the commencement of the semester after the break shall be

governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the curriculum and regulations in force at that period of time.

18.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause 17). 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' (Clause 18 and 18 respectively).

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

20. INDUSTRIAL VISIT

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

21. DISCIPLINE

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

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

22. REVISION OF REGULATION AND CURRICULUM

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

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING
FACULTY OF ENGINEERING
UG PROGRAM (CBCS) – B.E –EEE (FULL TIME)
(2021–2022 Batch and onwards)**

Course Code	Name of the course	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PEO	PO& PSO	L	T	P		CIA	ES E	Total	
									40	60	100	
SEMESTER I												
21BECC101	English	HSMC	2	g,j,k,l	2	0	2	3	40	60	100	10
21BECC102	Mathematics -I	BSC	2	h,i,j	3	1	0	4	40	60	100	12
21BECC141	Engineering Physics	BSC	1	a,g,j,k,l	3	1	2	5	40	60	100	14
21BECC142	Engineering Chemistry	BSC	1	a,k,l	3	0	4	5	40	60	100	17
21BECC143	Python Programming	ESC	1	a,g,k	2	0	2	3	40	60	100	20
21BEEE111	Workshop Practices	ESC	2	h,j,k	1	0	4	3	40	60	100	24
Semester Total					14	2	14	23	240	360	600	
SEMESTER II												
21BECC201	Communicative English	HSMC	2	g,j,k,l	2	0	2	3	40	60	100	26
21BEEE202	Mathematics – II (Transform Calculus and Numerical Methods)	BSC	1,3	a,b,j,k	3	1	0	4	40	60	100	28
21BECC203	Semiconductor Physics	BSC	1,2	a,d,k,l	3	0	0	3	40	60	100	30
21BEEE241	Basic Electrical and Electronics Engineering	ESC	1,2	a,k	3	1	2	5	40	60	100	32
21BEEE242	C Programming	ESC	1,2	a,k,l	3	0	4	5	40	60	100	35
21BEEE211	Engineering Graphics	ESC	1	a,g,k	1	0	4	3	40	60	100	38
Semester Total					15	2	12	23	240	360	600	

Course code	Name of the course	Category	Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks			PAGE NO
			PEOs	POs	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER – III												
21BEEE301	Electrical Circuit Analysis	PCC	1	a,b,d	3	1	0	4	40	60	100	40
21BEEE302	Analog Electronics	PCC	2	a,c,e	3	0	0	3	40	60	100	42
21BEEE303	Electrical Machines – I	PCC	1	a,b,d,i	3	0	0	3	40	60	100	44
21BEEE304	Electromagnetic Field	PCC	1	a,b,f	3	1	0	4	40	60	100	46
21BEEE305	Environmental Studies	HSMC	2	a,c,e	3	0	0	3	40	60	100	48
21BEEE311	Analog Electronics Laboratory	LC	2	a,c,e	0	0	2	1	40	60	100	51
21BEEE312	Electrical Machines Laboratory – I	LC	1	a,b,i,j	0	0	2	1	40	60	100	52
21BEEE351	Constitution of India	MC	1	i,l	1	0	0	0	100	0	100	53
Semester Total					16	2	4	19	380	420	800	
SEMESTER – IV												
21BEEE401	Mathematics – III (Probability and Statistics)	BSC	1	a,b,d,i	3	1	0	4	40	60	100	55
21BEEE402	Electrical Machines – II	PCC	1	a,b,d,i	3	0	0	3	40	60	100	57
21BEEE403	Power Electronics	PCC	2	a,c,i	3	0	0	3	40	60	100	59
21BEEE404	Signals and Systems	PCC	1	a,b,d,i	2	1	0	3	40	60	100	61
21BEEE405	Digital Electronics	PCC	2	a,b,d	3	0	0	3	40	60	100	63
21BEEE411	Digital Electronics Laboratory	LC	2	a,b,d	0	0	2	1	40	60	100	65
21BEEE412	Power Electronics Laboratory	LC	2	a,c,i	0	0	2	1	40	60	100	66
21BEEE413	Electrical machines Laboratory-II	LC	1	a,b,d,i	0	0	2	1	40	60	100	67
21BEEE451	Essence of Indian Knowledge Tradition	MC	1	c,l	1	0	0	0	100	0	100	68
Semester Total					15	2	6	19	420	480	900	

Course code	Name of the course	Category	Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks			PAGE NO
			PEOs	POs	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER – V												
21BEEE501	Power Systems-I	PCC	2	a,b,d,i	3	0	0	3	40	60	100	69
21BEEE502	Control Systems	PCC	1	a,c,i	3	0	0	3	40	60	100	71
21BEEE503	Microprocessors and Microcontrollers	PCC	1	a,b,d	3	0	0	3	40	60	100	73
21BEEE504	Special Electrical Machines	PCC	2	a,b,d,i	3	0	0	3	40	60	100	75
21BEEE5E_ _	Program Elective - I	PEC	1	g,j,k	3	0	0	3	40	60	100	
21BEEE511	Control Systems Laboratory	LC	1	a,c,i	0	0	2	1	40	60	100	77
21BEEE512	Microprocessors and Microcontrollers Laboratory	LC	1	a,b,d	0	0	2	1	40	60	100	78
21BEEE551	PCB design	MC	1	k,l	1	0	0	0	100	0	100	80
Semester Total					16	0	4	17	380	420	800	
SEMESTER – VI												
21BEEE601	Engineering Economics and Financial Management	HSMC	1	a,c,d	3	0	0	3	40	60	100	81
21BEEE602	Power Systems-II	PCC	1	a,c,d	3	0	0	3	40	60	100	82
21BEEE641	Measurements and Instrumentation	PCC	1	a,c,i	3	0	2	4	40	60	100	84
21BEEE6E_ _	Program Elective - II	PEC	1	g,j,k	3	0	0	3	40	60	100	
21BEEE6E_ _	Program Elective - III	PEC	1	g,j,k	3	0	0	3	40	60	100	
21BE_ _6OE_ _	Open Elective-I	OEC	1	i,k	3	0	0	3	40	60	100	
21BEEE611	Power Systems Laboratory	LC	1	a,b,d,i	0	0	2	1	40	60	100	87
21BEEE612	Electronics Design Laboratory	LC	2	a,b,d	1	0	4	3	40	60	100	88
21BEEE651	Basics of Arduino Microcontroller	MC	1	d,k,l	1	0	0	0	100	0	100	89
Semester Total					20	0	8	23	420	480	900	

Course code	Name of the course	Category	Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks			PAGE NO
			PEOs	POs	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER – VII												
21BEEE701	Professional Ethics And Entrepreneurship Development	HSMC	-	a,b,d	3	0	0	3	40	60	100	90
21BEEE702	Industrial Automation	PCC	1	a,c,d,m,n	3	0	0	3	40	60	100	92
21BEEE703	Smart Grid	PCC	2	a.b.d	3	0	0	3	40	60	100	94
21BEEE7E__	Program Elective -IV	PEC	1	g,j,k	3	0	0	3	40	60	100	
21BEEE7E__	Program Elective -V	PEC	1	g,j,k	3	0	0	3	40	60	100	
21BE__7OE__	Open Elective-II	OEC	1	i,k	3	0	0	3	40	60	100	
21BEEE791	Project Work Phase-I	PROJ			0	0	6	3	80	120	200	96
Semester Total					18	0	6	21	320	480	800	
SEMESTER – VIII												
21BEEE8E__	Program Elective -VI	PEC	1	g,j,k	3	0	0	3	40	60	100	
21BEEE8E__	Program Elective-VII	PEC	1	i,k	3	0	0	3	40	60	100	
21BEEE8E__	Program Elective-VIII	PEC	1	i,k	3	0	0	3	40	60	100	
21BEEE891	Project Work Phase-II & Viva -Voce	PROJ			0	0	16	8	80	120	200	97
Semester Total					9	0	16	17	200	300	500	
Program Total					123	8	70	162	2600	3300	5900	

TOTAL CREDITS: 162

PROFESSIONAL ELECTIVE COURSES

SEMESTER V												
Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			PAGE NO
			PEO	PO	L	T	P		CIA	ESE	Total	
									40	60	100	
21BEEE5E01	Electrical Machine Design	PEC	1	a,b,c,i	3	0	0	3	40	60	100	98
21BEEE5E02	Sensor and Transducer	PEC	1	a,b,c,i	3	0	0	3	40	60	100	100
SEMESTER VI												
Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			PAGE NO
			PEO	PO	L	T	P		CIA	ESE	Total	
									40	60	100	
21BEEE6E01	Digital Signal Processing	PEC	1	b,d,i,j,m	3	0	0	3	40	60	100	102
21BEEE6E02	Computer Architecture	PEC	1	a,b,c,k	3	0	0	3	40	60	100	104
21BEEE6E03	Industrial Electrical Systems	PEC	1	a,b,d	3	0	0	3	40	60	100	106
21BEEE6E04	High Voltage Engineering	PEC	2	a,d,f,h	3	0	0	3	40	60	100	108
21BEEE6E05	Electrical Energy Conservation and Auditing	PEC	2	a,c,j,k,n	3	0	0	3	40	60	100	110

SEMESTER VII												
Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			PAGE NO
			PEO	PO	L	T	P		CIA	ESE	Total	
									40	60	100	
21BEEE7E01	Wind and Solar Energy Systems	PEC	2	a,b,d	3	0	0	3	40	60	100	112
21BEEE7E02	Electric Hybrid Vehicles	PEC	2	a,c,d,h,m,n	3	0	0	3	40	60	100	114
21BEEE7E03	Power System Protection	PEC	2	b,d,h,i	3	0	0	3	40	60	100	116
21BEEE7E04	HVDC Transmission Systems	PEC	2	a,c,d,i	3	0	0	3	40	60	100	118
21BEEE7E05	Communication Engineering	PEC	2	a,c,d,h	3	0	0	3	40	60	100	120
SEMESTER VIII												
Course Code	Course Title	Category	Objectives & Outcomes		Instruction hours/week			Credits	Maximum Marks			PAGE NO
			PEO	PO	L	T	P		CIA	ESE	Total	
									40	60	100	
21BEEE8E01	Advanced Electric Drives	PEC	1	b,d,h,i	3	0	0	3	40	60	100	122
21BEEE8E02	Power Generation Systems	PEC	2	a,b,c,i	3	0	0	3	40	60	100	124
21BEEE8E03	Power System Operation and Control	PEC	1	a,b,d	3	0	0	3	40	60	100	126
21BEEE8E04	Power Quality and FACTS	PEC	2	a,b,d	3	0	0	3	40	60	100	128

LIST OF OPEN ELECTIVES
COURSE OFFERED BY OTHER DEPARTMENT

SUB. CODE	TITLE OF THE COURSE	Category	L	T	P	C	CIA	ESE	TOTAL	PAGE NO
BIOMEDICAL ENGINEERING										
21BEBMEOE01	Robotics in medicine	OEC	3	0	0	3	40	60	100	130
21BEBMEOE02	Artificial organs and Implants	OEC	3	0	0	3	40	60	100	132
CHEMICAL ENGINEERING										
21BTCEOE01	Energy Management in Chemical Industries	OEC	3	0	0	3	40	60	100	134
21BTCEOE02	Industrial waste water treatment	OEC	3	0	0	3	40	60	100	136
CIVIL ENGINEERING										
21BECEOE01	Housing, Plan and Management	OEC	3	0	0	3	40	60	100	138
21BECEOE02	Building Services	OEC	3	0	0	3	40	60	100	140
COMPUTER SCIENCE AND ENGINEERING										
21BECSEOE01	Internet Programming	OEC	3	0	0	3	40	60	100	142
21BECSEOE02	Machine Learning	OEC	3	0	0	3	40	60	100	144
ELECTRONICS AND COMMUNICATION ENGINEERING										
21BEECOE01	Neural Networks And Its Applications	OEC	3	0	0	3	40	60	100	146
21BEECOE02	Principles of Modern Communication System	OEC	3	0	0	3	40	60	100	148
MECHANICAL ENGINEERING										
21BEMEOE01	Computer Aided Design	OEC	3	0	0	3	40	60	100	150
21BEMEOE02	Industrial Safety and Environment	OEC	3	0	0	3	40	60	100	152
COURSES OFFERED TO OTHER DEPARTMENT										
21BEEEOE01	Electric Hybrid Vehicle	OEC	3	0	0	3	40	60	100	154
21BEEEOE02	Renewable Energy Resources	OEC	3	0	0	3	40	60	100	156

PROGRAM OUTCOMES: On successful completion of the programme,

a	Apply the Mathematical knowledge and the basics of Science and Engineering to solve the problems pertaining to Electronics and Instrumentation Engineering.
b	Identify and formulate Electrical and Electronics Engineering problems from research literature and be able to analyze the problem using first principles of Mathematics and Engineering Sciences.
c	Come out with solutions for the complex problems and to design system components or process that fulfill the particular needs taking into account public health and safety and the social, cultural and environmental issues.
d	Draw well-founded conclusions applying the knowledge acquired from research and research methods including design of experiments, analysis and interpretation of data and synthesis of information and to arrive at significant conclusion.
e	Form, select and apply relevant techniques, resources and Engineering and IT tools for Engineering activities like electronic prototyping, modeling and control of systems and also being conscious of the limitations.
f	Understand the role and responsibility of the Professional Electrical and Electronics Engineer and to assess societal, health, safety issues based on the reasoning received from the contextual knowledge.
g	Be aware of the impact of professional Engineering solutions in societal and environmental contexts and exhibit the knowledge and the need for Sustainable Development.
h	Apply the principles of Professional Ethics to adhere to the norms of the engineering practice and to discharge ethical responsibilities.
i	Function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.
j	Communicate efficiently the engineering facts with a wide range of engineering community and others, to understand and prepare reports and design documents; to make effective presentations and to frame and follow instructions.
k	Demonstrate the acquisition of the body of engineering knowledge and insight and Management Principles and to apply them as member / leader in teams and multidisciplinary environments.
l	Recognize the need for self and life-long learning, keeping pace with technological challenges in the broadest sense.

PROGRAM SPECIFIC OUTCOMES:

m	Analyze and design controllers for electrical system using analog and digital electronic circuits and systems.
n	Graduates will be motivated for continuous self learning in engineering practice and pursue research in advanced areas of Electrical Engineering in order to offer engineering services to the society, ethically.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Have successful technical and professional careers in their chosen fields such as circuit theory, Field theory, control theory and computational platforms.
PEO 2	Engross in life long process of learning to keep themselves abreast of new developments in the field of Electronics and their applications in power engineering

MAPPING:

PEO \PO	a	b	c	b	e	f	g	h	i	j	k	l	m	n
PEO1	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓
PEO2	✓	✓	✓	✓	✓	✓		✓		✓			✓	✓

****--Skill Development**

****--Employability**

****--Entrepreneurship**

Semester-I**21BECC101****English****4H-3C**

Instruction Hours/week: L:2 T:0 P:2**Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****Course Objectives**

- To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
- To help students acquire their ability to speak effectively in real life situations.
- To inculcate the habit of reading and to develop their effective reading skills.
- To ensure that students use dictionary to improve their active and passive vocabulary.
- To enable students to improve their lexical, grammatical and communicative competence.

Course Outcomes

Students undergoing this course will be able to

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

Unit: I - Basic Writing Skills

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

Unit: II - Vocabulary Building

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

Unit: III - Grammar and Usage

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

Unit: IV - Listening and Reading Skills

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

Unit: V.-Writing Practices

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

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

SUGGESTED READINGS

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

Course Objectives

The goal of this course is for the students

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To understand geometrical aspects of curvature and elegant application of differential calculus which are needed in Engineering applications.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model Engineering problems.
- To familiarize the student with functions of several variables which is the foundation for many branches of Engineering.
- To introduce sequence and series which is central to many applications in Engineering.

Course Outcomes

Upon completion of this course the students will be able

1. To solve the rank, Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices and the students will be able to use matrix algebra techniques for practical applications.
2. To equip the students to have basic knowledge and understanding in one field of materials, differential calculus
3. To solve simple standard examples using the ideas of differential equations.
4. To apply various techniques to solve Partial Differential Equations
5. To develop the tool of power series for learning advanced Engineering Mathematics.
6. To apply the knowledge acquired to solve various Engineering problems.

UNIT I - Matrices

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

UNIT II – Differential Calculus

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

UNIT III - Differential Equations

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

UNIT IV –Functions of Several Variables

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

UNIT V - Sequences and series

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

Total : 60

Suggested Readings:

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

Websites :

1. www.efunda.com
2. www.mathcentre.ac.uk
3. www.intmath.com/matrices-determinants
4. [www. Intmath.com/calculus/calculus-intro.php](http://www.Intmath.com/calculus/calculus-intro.php)

(i)Theory**Course Objectives**

The Goal of this course is for students to

- Inculcate the basics of properties of matter, sound and its applications.
- 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

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

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

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

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

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

Light – interference – reflection, refraction – Air wedge - LASER- Principle – characteristics - emission and absorption process - Einstein's coefficients derivation. Types of LASER - Nd:YAG, CO₂, Semiconductor LASER- Applications of LASER in industry and medicine.

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

UNIT III – THERMAL PHYSICS**9**

Introduction– thermal expansion of solids and liquids – expansion joints – bimetallic strips – Mode of heat transfer - heat conduction in solids – thermal conductivity – derivation, Phonons - Forbe's and Lee's disc method: theory and experiment – conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV – QUANTUM PHYSICS

9

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

UNIT V – CRYSTAL PHYSICS

9

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

SUGGESTED READINGS

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

JOURNALS

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

WEBLINKS

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

(ii)Laboratory

Course Objective:

- To learn the basic concepts in physics relevant to different branches of Engineering and Technology.

Course Outcome:

- To familiarize the properties of material and basic concepts in physics.

LIST OF EXPERIMENTS – PHYSICS (Any 10 Experiments)

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

21BECC142

ENGINEERING CHEMISTRY

7H-5C

(Theory & Lab.)

Instruction Hours/week: L:3 T:0 P:4

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

(i) Concepts in chemistry for engineering**Course Objective****The goal of this course is for students to**

- Study the basics of Periodic properties, Intermolecular forces
- Understand the terminologies of electrochemistry and to study about energy storage devices
- Understand the concept of corrosion and its prevention
- Comprehend the basic water technology and its purification.
- Study about spectroscopic technique

Course Outcomes**Upon completion of the course the students will be able to**

1. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
2. Analyse the mechanism of different energy storage devices.
3. Rationalise different types of corrosion and its prevention.
4. List the various methods in the purification of water.
5. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I - Periodic properties, Intermolecular forces

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

UNIT II – Electrochemistry and Storage Devices

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

UNIT III – Corrosion and its control

Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion - Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings – Organic coatings-Paints - Constituents and functions –Inorganic coatings- Metallic coatings - Electroplating (Au) and Electro less plating (Ni) - Surface conversion coating - Hot dipping

UNIT IV – Water Technology

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

UNIT V - Spectroscopic techniques and applications

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

SUGGESTED READINGS

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

(ii) Chemistry Laboratory

Course Objectives

The goal of this course is for students to

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.

Course Outcomes

Upon completion of the course the students will be able to

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

Choice of 10 experiments from the following:

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

21BECC143**PYTHON PROGRAMMING****4H-3C****(Theory & Lab.)****Instruction Hours/week: L:2 T:0 P:2****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****(i) Theory****COURSE OBJECTIVES:**

Students undergoing this course are exposed to:

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

COURSE OUTCOMES:

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

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

UNIT I INTRODUCTION**(9)**

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

UNIT II CONDITIONAL STATEMENT & STRING HANDLING

(9)

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

UNIT III OBJECT ORIENTED PROGRAMMING WITH PYTHON

(9)

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

UNIT IV IMAGE PROCESSING WITH PYTHON

(9)

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

UNIT V NETWORKING WITH PYTHON

(9)

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

Total Hours : 45

TEXT BOOK:

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

REFERENCE BOOKS :

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

WEBSITES:

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

(ii) Laboratory

PYTHON PROGRAMMING

COURSE OBJECTIVES:

Students undergoing this course are exposed to:

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

COURSE OUTCOMES:

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

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

LIST OF EXPERIMENTS:

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

COURSE OBJECTIVES

- to prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice

COURSE OUTCOMES

1. Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
2. Students will be able to fabricate components with their own hands.
3. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
4. By assembling different components, they will be able to produce small devices of their interest.

(i) Lectures & videos:**Detailed contents**

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Electrical & Electronics
5. Carpentry
6. Plastic molding, glass cutting
7. Metal casting
8. Welding
- 9.

(ii) Workshop Practice:

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

SUGGESTED READINGS

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

21BECC201**Communicative English****4H-3C****Instruction Hours/week: L:2 T:0 P:2****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****Course Objectives****The goal of this course is for students to**

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

Course Outcomes

Students undergoing this course will be able to

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

Unit: I - Communication Skills:

Communication Skills: Introduction, Definition, The Importance of Communication

The Communication Process – Source, Message, Encoding, Channel, Decoding Receiver, Feedback, Context

Barriers to Communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional Barriers

Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective-Past Experiences, Prejudices, Feelings, Environment

Unit:II - Elements of Communication Introduction, Face to Face Communication- Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.

Communication Styles: Introduction, The Communication Styles Matrix with example for each - Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style.

Unit: III - Basic Listening Skills

Introduction, Self-Awareness, Active Listening, Becoming anActive Listener, Listening in Difficult Situations.

Effective Written Communication: Introduction, When and When Not to Use Written Communication-Complexity of the Topic, Amount of Discussion's Required, Shades of Meaning, Formal Communication.

Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience
Organization of the Message.

Unit: IV - Interview Skills and Giving Presentations

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

Unit: V.-Writing Practices

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

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

SUGGESTED READINGS

1. SanjayKumar,Pushpalata, (2011),Communicationskills,1st EditionOxfordPress.
2. Konarnira, (2011), Communication Skills forprofessionals,2nd EditionNew arrivals.
3. JohnAdair,4th Edition, (2009), . Effectivecommunication, 1st Edition CengageLearning
4. Indiapvt.ltd
5. ButterField, (2011), Softskillforeveryone, Macmillan.
6. Stephen.P.Robbins, (2013).Communicationskills, OxfordPress

Mathematics -II
(Transform Calculus and Numerical Methods)

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 acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To calculate and establish identities connecting these quantities, to evaluate line, surface and volume integrals in simple coordinate systems and to use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.
- To enable the students to apply the knowledge of Mathematics in various Engineering fields by making them to identify the functions in engineering problems as analytic function and their study as a function of a complex variables.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, to specify some difficult integration that appear in applications can be solved by complex integration in application areas such as fluid dynamics and flow of the electric current.
- To use Laplace transforms efficiently for solving the problems that occur in various branches of engineering disciplines.

Course Outcomes:

Upon completion of this course the students will be able

- To apply integration to compute multiple integrals, area, volume, integrals in polar and Cartesian coordinates, in addition to change of order and vector integration.
- To acquaint the student with the concepts of vector calculus, needed for problems in all Engineering disciplines
- To find the Analytic functions using the Cauchy Riemann equations and they will learn mapping properties of elementary functions and mapping properties of some special transcendental functions.
- To understand relations between conformal mappings and quadratic differentials and how geometric structures are changing under conformal mappings.
- To evaluate complex integrals using the Cauchy integral formula and the residue Theorem and to appreciate how complex methods can be used to prove some important theoretical results.
- To evaluate Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

UNIT I - Multiple Integrals

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

UNIT II- Vector Calculus

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

UNIT III-Analytic Functions

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

UNIT IV-Complex Integration

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

UNITV-Laplace Transform

Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Initial and final value theorems. Inverse Laplace transforms – Convolution theorem (statement only) – Solution of Ordinary Differential Equations with constant coefficients using Laplace transforms – Transform of periodic functions. Total : 60

Suggested Readings:

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

Websites:

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

21BECC203**Semiconductor Physics****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 fundamentals of electrons flow and band structure.
- Inculcate the characteristics of electronic materials through basics.
- Divulge knowledge on the basics of semiconducting materials for diode applications.
- Introduce the features of light interaction with semiconductor for optoelectronic applications.
- Impart the basic knowledge of new semiconducting materials for engineering applications.

Course Outcomes

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

- Acquire knowledge on the transport of electrons and various bands in solid structure.
- Get the fundamental concepts semiconductors for device fabrication process.
- understand the magnetic, dielectric and superconducting properties for various engineering applications.
- Have sound knowledge on interaction of light with semiconductor for different optoelectronic device applications.
- Acquire the knowledge on basic properties of modern electronic materials and their engineering applications.
- 6. Understand the various properties of semiconductors and diverse applications.

Unit 1 - Electronic materials**9**

Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass.

Unit 2 - Semiconductors**9**

Intrinsic and extrinsic semiconductors – carrier concentration, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and

recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Hall effect – Determination of Hall coefficient.

Unit 3- Magnetic, Dielectric, superconducting Properties of Materials

9

Magnetism in materials - magnetic field and induction - magnetization, magnetic permeability and susceptibility, types of magnetic materials - Ferromagnetism: origin and exchange interaction, Domain Theory, soft and Hard magnetic materials - Dielectric materials: Polarization, Types - dielectric loss, internal field, Clausius - Mosotti relation, dielectric breakdown - Superconductors – properties – Applications.

Unit 4 - Light-semiconductor interaction

9

Optical

transitions in bulk semiconductors - Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model - Principle, construction, working and applications of LED, Solar cell, photo diode, QLED (Quantum dot LED).

Unit 5 - Engineered semiconductor materials

9

Density of states in 2D, 1D and 0D (qualitatively). Practical examples of low-dimensional systems such as quantum wells, wires, and dots- Nanostructures - design, fabrication, methods of fabrication (anyone physical and chemical method) – Carbon nanotubes - Coulomb blockade, single electron transistor, Giant magneto resistance (GMR), spintronics.

SUGGESTED READINGS

1. Bhattacharya D.K. & Poonam T., Engineering Physics, Oxford University Press, (2015).
2. J Donald Neamen, Dhrubis Biswas Semiconductor Physics And Devices, McGraw Hill Education; 4 edition, (2017).
3. S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, wiley Publishers, (2006).
4. Leszek Malkinski, Advanced Magnetic Materials , Published by InTech, (2012).
5. Michael Shur, Physics of Semiconductor Devices, Published by Pearson Education; First edition, (2019).
6. Kulkarni, Sulabha K , Nanotechnology: Principles and Practices, Springer International Publishing, (2015).

JOURNALS:

1. IEEE Transactions for Semiconductor Manufacturing (IEEE).
2. Materials Science in Semiconductor Processing (Elsevier).
3. Semiconductor Science and Technology (Institute of Physics).
4. Journal of Electronic Materials (IEEE/TMS).
5. Nature Nanotechnology.

WEB LINKS

1. <https://nptel.ac.in/courses/115102025/>
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/lecture-notes/MIT6_012F09_lec01.pdf

21BEEE241 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**End Semester Exam:3 Hours****(i) Theory****Course Objectives**

- To impart the basic knowledge about the DC Electric circuits.
- To impart the basic knowledge about the AC Electric circuits
- To understand the working of Electrical Machines and Transformers.
- To understand the working of various Semiconductor devices and Digital Electronics.
- To study the various types of measuring instruments.
- To understand the working of low-voltage electrical installations.

Course Outcomes

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

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

UNIT I - DC Circuits**(9)**

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

UNIT II - AC Circuits**(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 BOOK

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

REFERENCES

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

WEBSITES:

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

(ii) Laboratory

Course Objective

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

Course Outcomes (Cos)

At the end of this course, students will be able

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

List of Experiments

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

21BEEE242**C PROGRAMMING****7H-5C****(Theory and Lab)****Instruction Hours/week: L:3 T:0 P:4****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****i)Theory****Course Objectives**

Students undergoing this course are exposed to:

- To Identify and understand the working of key components of a computer program.
- To Identify and understand the various kinds of keywords and different data types of C programming
- To Understand, analyze and implement software development tools like algorithm,
- To develop pseudo codes and programming structures.
- To Study, analyze and understand logical structure of a computer program, and different constructs to develop a program in “C” language.

Course Outcomes(COs)

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

- Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion
- Decompose a problem into functions and synthesize a complete program using divide and conquer approach
- Use arrays, pointers and structures to formulate algorithms and programs
- Apply programming to solve matrix addition and multiplication problems and searching and sorting problems
- Apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration.

Unit I – Introduction to Programming**(9)**

Introduction to components of a computer system - Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart / Pseudocode with examples. Structure of C Program, Character Set, Variables And Identifiers, Keywords- Built-In Data Types- Arithmetic Operators

And Expressions, Constants And Literals, Simple Assignment Statement- Basic Input/Output Statement- Simple 'C' Programs, usage of const keyword

Unit II – Arithmetic expressions, precedence, Conditional Branching and Loops (9)

Conditional Branching-simple If, If...Else, Nested If...Else, Switch Case, Break, Continue, return- Loops-While, do...while, for, goto-Writing and evaluation of conditionals and consequent branching- Iteration and loops.

Unit III - Array and Basic Algorithms (9)

One Dimensional Arrays- Array Manipulation; Searching, Insertion, Deletion Of An Element From An Array- Finding The Largest/Smallest Element In An Array- Two Dimensional Arrays, -Addition / Multiplication Of Two Matrices- Strings As Array Of Characters. Basic Sorting Algorithms-Bubble, Insertion and Selection sorting, Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

Unit IV - Function and Recursion (9)

Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays Example Problems- Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion.

Unit V - Structure, Pointers and File Handling (9)

Structures – initialization - nested structures – structures and arrays – structures and pointers - union – typedef and enumeration types - bit fields - File Management in C – Files and Streams – File handling functions – Sequential access file- Random access file – Command line arguments.

TEXT BOOKS:

1. E. Balagurusamy, Computing Fundamentals and C Programming, TMH Education, 5th Edition, (2017).
2. E. Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 7th Edition, (2017).

REFERENCES:

3. Byron Gottfried, Schaum's, Outline of Programming with C, McGraw-Hill, 3rd Edition, (2017).
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India, 2nd Edition, (2015).

WEBSITES:

- 1) <https://www.coursera.org/learn/problem-solving>
- 2) <https://www.edx.org/learn/problem-solving>
- 3) <https://www.udemy.com/topic/problem-solving/>
- 4) https://swayam.gov.in/nd1_noc19_cs43/preview

(ii) Laboratory

COURSE OBJECTIVES:

Students undergoing this course are exposed to:

- To develop programs in C using basic constructs.
- To develop applications in C using file processing
- To provide an awareness to Computing and C Programming
- To learn to develop algorithm for simple problem solving
- To write programs to solve mathematical problems.
- To develop applications in C using strings, pointers, functions, structures

COURSE OUTCOMES:

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

- Formulate the algorithms for simple problems
- Translate given algorithms to a working and correct program
- Correct syntax errors as reported by the compilers
- Identify and correct logical errors encountered at run time
- Write iterative as well as recursive programs
- Represent data in arrays, strings and structures and manipulate them through a program
- Declare pointers of different types and use the mind defining self- referential structures.
- Create, read and write to and from simple text files.

LIST OF EXPERIMENTS:

1. Programs using I/O statements and expressions.
2. Programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Check whether a given number is Armstrong number or not?
6. Populate an array with height of persons and find how many persons are above the average height.
7. Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
8. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
9. From a given paragraph perform the following using built-in functions:
 - a. Find the total number of words.
 - b. Capitalize the first word of each sentence.
 - c. Replace a given word with another word.
10. Sort the list of numbers using pass by reference.
11. Generate salary slip of employees using structures and pointers.
12. Compute internal marks of students for five different subjects using structures and functions.

Total hours:30

Instruction hours / week L : 1 T : 0 P:4**Marks: Internal : 40 External : 60 Total:100****End Semester Exam :3Hours****Course Objectives**

1. To make the students to design a system, component, or process to meet desired needs.
2. To prepare the students to design the components with realistic constraints.
3. To make the students to consider economic, environmental, ethical, health and safety when they design.
4. To make the students to design the components with considering manufacturability, and sustainability
5. To prepare the students to communicate effectively use the techniques, skills, and modern engineering tools.
6. To make the students to understand to use necessary for engineering practice.

Course Outcomes

On completion of this course, students will be able to

1. Introduction to engineering design and its place in society
2. Exposure to the visual aspects of engineering design and engineering graphics standards
3. Exposure to engineering communication effectively.
4. Exposure to 3D free hand sketching.
5. Acquired the knowledge of projections of points, lines and plane surfaces.
6. Understand the basic concept of projection of solids.

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

UNIT IV Projection of Points, Lines And Plane Surfaces

(9)

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

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

SUGGESTED READINGS:

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

WEBSITES:

1. www.mit.edu.
2. www.nptel.com

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

- To gain knowledge on the principles and procedure for the Analysis of Circuits.
- To enable the students to understand the DC circuit analysis and network theorems.
- To learn the Sinusoidal steady state analysis.
- To understand transients and resonance in RLC circuits and coupled circuits.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Apply network theorems for the analysis of electrical circuits.
2. Obtain the solution of first and Second order system
3. Analyse the electrical circuits using Laplace Transforms.
4. Obtain the transient and steady-state response of electrical circuits.
5. Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
6. Analyse two port circuit behavior.

UNIT I NETWORK THEOREMS (12)

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

UNIT II SOLUTION OF FIRST AND SECOND ORDER NETWORKS (12)

Solution of first and second order differential equations for Series and parallel R-L, R-C, RL-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT III SINUSOIDAL STEADY STATE ANALYSIS (12)

Representation of sine function as rotating phasor, phasor diagrams, Impedance and Admittance, Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

UNIT-IV ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS (12)

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

UNIT- V TWO PORT NETWORK AND NETWORK FUNCTIONS (12)

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

SUGGESTED READINGS

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 2010.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 2006.

WEB LINKS

- 1.<https://nptel.ac.in/courses/117106108/>
- 2.<https://nptel.ac.in/courses/108102042/>

21BEEE302	Semester – III ANALOG ELECTRONICS	3H-3C
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Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To study diodes, BJT and its applications.
- To study the MOSFET and its applications.
- To study amplifiers and operational amplifiers.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Illustrate the structure, operation and characteristics of PN junction diode and its applications
2. Understand the characteristics of transistors and its applications.
3. Obtain the MOSFET working.
4. Understand the functioning of OP-AMP and design OP-AMP based application circuits.

UNIT I BJT CIRCUITS**(9)**

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, Analysis of h-parameters, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

UNIT II MOSFET CIRCUITS**(9)**

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

UNIT-III DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS **(9)**

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

UNIT- IV LINEAR AND NON LINEAR APPLICATIONS OF OP-AMP **(9)**

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion. Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

UNIT V SPECIAL FUNCTION ICs

(9)

Astable and Monostable Multivibrators using 555 Timer, Voltage regulators-linear and switched mode types, Switched capacitor filter, Frequency to Voltage converters, Tuned amplifiers, Power amplifiers and Isolation Amplifiers, Video amplifiers, Fiber optic ICs and Opto-couplers - Ambient Sensors and Accelerometers.

Web links:

1. <https://archive.org/details/ApplicationsOfOperationalAmplifiers3rdGenerationTechniques>
2. <http://ocw.mit.edu/resources/res-6-010-electronic-feedbacksystems-spring-2013/textbook/>
3. <http://www.nptel.ac.in/courses/117106088/1>
4. <http://analogcorner.net/>
<https://nptel.ac.in/courses/117101106/>
5. http://www.owl.net.rice.edu/~dodds/Files331/analog_notes.pdf
6. <http://www.ee.iitm.ac.in/~ani/2012/ec5135/lectures.html>

Semester – III

21BEEE303

ELECTRICAL MACHINES-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

- To study the working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.
- To Study the construction details of DC machines with back EMF equation and torque equation.
- To acquire the knowledge on working principles of DC machines as Generator types, determination of their no- load/load characteristics, starting and methods of speed control of motors.
- To estimate various losses taking place in D.C. Motor and to study the different testing methods to arrive at their performance.
- To familiarize the constructional details, the principle of operation, prediction of performance, the methods of testing the single phase transformers.
- To acquire the knowledge of constructional details, the principle of operation, prediction of performance, the methods of testing the three phase transformers and autotransformer.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of magnetic fields
2. Understand the concepts of magnetic circuits.
3. Understand the operation of dc machines.
4. Analyse the differences in operation of different dc machine configurations.
5. Analyse the single phase transformers circuits.
6. Analyse the three phase transformers circuits.

UNIT I MAGNETIC FIELDS AND MAGNETIC CIRCUITS (9)

Review of magnetic circuits, review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines. B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element.

UNIT II DC MACHINES (9)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per

pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

UNIT-III DC MACHINE - MOTORING AND GENERATION (9)

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

UNIT- IV SINGLE PHASE TRANSFORMERS (9)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses. Parallel operation of single phase transformers.

UNIT V THREE PHASE TRANSFORMERS (9)

Three-phase transformer - construction, types of connection and their comparative features. Parallel operation of three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

SUGGESTED READINGS

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

WEB LINKS

1. <https://nptel.ac.in/courses/108105155/>
2. <https://nptel.ac.in/courses/108/105/108105155/>

21BEEE304	Semester – III ELECTROMAGNETIC FIELD	4H-4C
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Instruction Hours / week: L: 3 T: 1 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of electrostatics, electrical potential, energy density and their applications.
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
- To impart knowledge on the concepts of Faraday's law, induced emf and Maxwell's equations
- To impart knowledge on the concepts of Concepts of electromagnetic waves and Pointing vector.

Course Outcomes (COs)

At the end of the course, students will demonstrate the ability

- 1.To understand the basic laws of electromagnetism.
- 2.To obtain the electric and magnetic fields for simple configurations under static conditions.
- 3.To understand the concept of Conductors, Dielectrics and Capacitance.
- 4.To analyse time varying electric and magnetic fields.
- 5.To understand Maxwell's equation in different forms and different media.
- 6.To understand the propagation of EM waves.

UNIT I REVIEW OF VECTOR CALCULUS AND STATIC ELECTRIC FIELD (12)

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another. Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

UNIT II CONDUCTORS, DIELECTRICS AND CAPACITANCE (12)

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

UNIT-III STATIC MAGNETIC FIELDS

(12)

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

UNIT- IV MAGNETIC FORCES, MATERIALS AND INDUCTANCE

(12)

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

UNIT V TIME VARYING FIELDS AND MAXWELL'S EQUATIONS

(12)

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions. Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

SUGGESTED READINGS

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.

WEB LINKS

- 1.<https://nptel.ac.in/courses/117103065/>
- 2.<https://nptel.ac.in/courses/108106073/>

Semester-III		
21BEEE305	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.

Course Outcomes (COs)

Upon completion of the course the students will be able to

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
7. Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners.

Unit I – INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS

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

Unit II - NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES

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

resources. Equitable use of resources for sustainable lifestyles.

Unit III - BIODIVERSITY AND ITS CONSERVATION

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

Unit IV - ENVIRONMENTAL POLLUTION

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

Unit V - SOCIAL ISSUES AND THE ENVIRONMENT

Concept of sustainability and sustainable development. Water conservation - Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (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., CNG vehicles in Delhi). Human population growth: Impacts on environment, human health and welfare.

Suggested Readings

1. Anonymous. 2004. A text book for Environmental Studies, University Grants Commission and Bharat Vidapeeth Institute of Environmental Education Research, New Delhi.
2. Anubha Kaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
4. Daniel, B. Botkin., and Edward, A. Keller. 1995. Environmental Science John Wiley and Sons, Inc., New York.
5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S.Chand & Company Pvt. Ltd., New Delhi.
6. Odum, E.P., Odum, H.T. and Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
7. Rajagopalan, R. 2016. Environmental Studies: From Crisis to Cure, Oxford University Press.
8. Sing, J.S., Sing, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.

9. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
10. Tripathy. S.N., and Sunakar Panda. (2004). Fundamentals of Environmental Studies (2nd ed.). Vrianda Publications Private Ltd, New Delhi.
11. Verma, P.S., and Agarwal V.K. 2001. Environmental Biology (Principles of Ecology). S. Chand and Company Ltd, New Delhi.
12. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, New Delhi.

21BEEE311	Semester – III ANALOG ELECTRONICS LABORATORY	2H-1C
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Instruction Hours / week: L: 0 T: 0 P: 2

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To understand Basic Analog Circuits and their applications using Active Devices
- To learn basic function of single stage amplifier, multistage amplifier and power Amplifier and their working principle.
- To understand basic construction of feedback circuits and their application in Oscillators
- Understand basic amplifier and oscillator circuits and their application in analog circuits.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Determine the output wave forms of Full Wave Rectifiers.
2. Draw the equivalent circuit of MOSFET and sketch the V-I characteristics.
3. Design the Darlington amplifier and develop the circuit.
4. Compare the theoretical and practical frequency response of Wein bridge oscillators.
5. Design of Op-Amp based circuits
6. Design of clipper and clamper.

List of Experiments

1. Design of Half Wave and Full Wave Rectifiers, Filters, Power supplies.
2. Design MOSFET as an Amplifier.
3. To study the I-V characteristics for Common Emitter Configuration using BJT.
4. Design Differential Amplifiers- Transfer characteristic, CMRR Measurement.
5. Design Clipper. Clamper and Wave Shaping circuits.
6. Design Wein Bridge Oscillator using op-amp.
7. Design Triangular Wave Generator using op-amp.
8. Design of Inverting and non-inverting amplifiers using Op-Amps.
9. Design of Integrator and Differentiator using Op-Amps.
10. Design of Astable multivibrator and Monostable Multivibrator using 555 timer.

Semester – III**21BEEE312****ELECTRICAL MACHINES LABORATORY –I****2H-1C****Instruction Hours / week: L: 0 T: 0 P: 2****Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objectives**

- To experimentally verify the principle of operation, performance and characteristics of DC Motors, DC Generators and Transformers.
- To study the operation of DC motor starters, different connections of Transformers.

Course Outcomes (COs)

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

1. Analyze the characteristics of DC shunt generator DC compound generator and calculate critical resistance and critical speed
2. Examine load characteristics of DC shunt, series and compound motor and identify its maximum efficiency operating point
3. Estimate the efficiency of DC machines in different methods
4. Sketch the load characteristics of single phase transformer, separate the different losses and find the efficiency
5. Predetermine the equivalent circuit parameters of single phase transformer in two different methods and compare the results
6. Estimate the efficiency of transformer.

LIST OF EXPERIMENTS

1. Open circuit characteristics and load test on separately excited DC generator.
2. Open circuit characteristics and load test on DC compound generator.
3. Open circuit characteristics and load test on DC shunt generator.
4. Load test on DC shunt motor.
5. Load test on DC series motor.
6. Load test on DC compound motor.
7. Swinburne's test and speed control on DC shunt motor.
8. OC and SC tests on single phase transformer.
9. Load test on single phase transformer.
10. Sumpner's test.

Semester – III**21BEEE351****CONSTITUTION OF INDIA****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 for students is :

- To know about Indian constitution.
- To study about central and state government functionalities in India.
- To understand about Indian society.
- To understand the functions of Governor and Chief Minister
- To know about the culture among the people.
- To acquire knowledge on constitutional remedies for citizens

Course Outcomes

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

- Identify functions of the state and central government.
- Understand and abide the rules of the Indian constitution.
- Appreciate different culture among the people.
- Understand the functions of Governor and Chief Minister
- Appreciate the working of Parliamentary System in India.
- Gain knowledge on right for women, children, scheduled castes, scheduled tribes and other Weaker Sections.

UNIT I INTRODUCTION

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.

UNIT II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III STRUCTURE AND FUNCTION OF STATE GOVERNMENT

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV CONSTITUTION FUNCTIONS

Indian Federal System – Center – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNIT V INDIAN SOCIETY

Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

Suggested Readings

1. Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India, New Delhi 2008
2. R.C.Agarwal, (1997).Indian Political System ,S.Chand and Company, New Delhi,
3. Maciver and Page, Society: An Introduction Analysis, Mac Milan India Ltd, New Delhi
4. K.L.Sharma(1997)., Social Stratification in India: Issues and Themes , Jawaharlal Nehru University, New Delhi,
5. Sharma, Brij Kishore,(2011)., Introduction to the Constitution of India, Prentice Hall of India, New Delhi,
6. U.R.Gahai, (1998).Indian Political System, New Academic Publishing House, New Delhi,.

Web links:

1. https://en.wikipedia.org/wiki/Constitution_of_India

21BEEE401	SEMESTER IV	
	Mathematics –III	
	(Probability And Statistics)	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

- This course aims at providing the required skill to apply the statistical tools in Engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two-dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

Course Outcomes:

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

1. Explain the fundamental concepts of probability and standard distributions which can describe real life phenomenon.
2. Explain the basic concepts of one- and two-dimensional random variables and their applications in engineering.
3. Apply the concept of testing of hypothesis for small and large samples in real life problems.
4. Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
5. Discuss the notion of sampling distributions and statistical techniques used in engineering and management problems.
6. Discuss about the techniques in quality control that model engineering problems.

UNIT I –Probability and Random Variables**(12)**

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II –Two - Dimensional Random Variables**(12)**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression using SPSS tool– Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III –Testing Of Hypothesis (12)

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chisquare and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV –Design of Experiments (12)

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design using SPSS tool.

UNIT V –Statistical Quality Control (12)

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

Total: 60

Suggested Readings:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
4. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
5. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
6. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
7. Walpole. R.E., Myers. R.H., Myers.S.L. and Ye.K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
8. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
9. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
10. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Websites:

1. www.cut-the-knot.org/probability.shtml
2. www.mathworld.com Wolfram.com
3. www.mathcentre.ac.uk

21BEEE402	Semester – IV ELECTRICAL MACHINES – II	3H-3C
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Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- Construction and performance of salient and non-salient type synchronous generators.
- Principle of operation and performance of synchronous motor.
- Construction, principle of operation and performance of 3 Phase induction motors and its starting and speed control.
- Construction, principle of operation and performance of single phase induction motors and few special machines

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Understand the concept of AC machine windings.
2. Understand the concepts of rotating magnetic fields.
3. Understand the operation of ac machines.
4. Analyse performance characteristics Induction Machines.
5. To understand the different types of single phase induction motor based on its starting methods.
6. Understand the operation of synchronous motor and analyze the performance of motor under different loading and excitation conditions.

UNIT I FUNDAMENTALS OF AC MACHINE WINDINGS (9)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; singleturn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor.

UNIT II PULSATING AND REVOLVING MAGNETIC FIELDS (9)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current. Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

UNIT III INDUCTION MACHINES (9)

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter

variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

UNIT-IV SINGLE-PHASE INDUCTION MOTORS (9)

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Types of Single Phase Induction Motor, Split-phase starting methods and applications.

UNIT- V SYNCHRONOUS MACHINES (9)

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

SUGGESTED READINGS

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

WEB LINKS

1. <https://nptel.ac.in/courses/108106072/>
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108105131/lec84.pdf

21BEEE403	Semester – IV POWER ELECTRONICS	3H-3C
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Instruction Hours / week: L: 3 T: 0 P: 0**Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objectives**

- Different types of power semiconductor devices and their switching Operation, characteristics and performance parameters of controlled rectifiers
- Operation, switching techniques and basics topologies of DC-DC switching
- Different modulation techniques of pulse width modulated inverters and to regulators.
- Operation of AC voltage controller and various configurations
- Understand harmonic reduction methods.

Course Outcomes (COs)

At the end of this course students will demonstrate the ability to

1. Understand the differences between signal level .
2. Understand the differences between power level devices.
3. Analyse controlled rectifier circuits.
4. Analyse the operation of DC-DC choppers.
5. Analyse the operation of voltage source inverters.
6. Understand different modulation techniques.

UNIT I POWER SWITCHING DEVICES**(9)**

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT, Heatsinks.

UNIT II THYRISTOR RECTIFIERS**(9)**

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

UNIT III DC-DC BUCK AND BOOST CONVERTER**(9)**

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

UNIT- IV SINGLE-PHASE VOLTAGE SOURCE INVERTER**(9)**

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching

cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.

UNIT V THREE-PHASE VOLTAGE SOURCE INVERTER

(9)

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation, Cyclo converter

SUGGESTED READINGS

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.

WEB LINKS

1. <https://nptel.ac.in/courses/108105066/>
2. [https://nptel.ac.in/content/storage2/courses/108105066/PDF/L-34\(DP\)\(PE\)%20\(\(EE\)NPTEL\).pdf](https://nptel.ac.in/content/storage2/courses/108105066/PDF/L-34(DP)(PE)%20((EE)NPTEL).pdf)
3. <https://nptel.ac.in/content/storage2/courses/108103009/download/M4.pdf>

21BEEE404	Semester – IV SIGNALS AND 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

- To understand signal types, properties and analysis, demonstrate and understand the fundamental properties of linear time-invariant systems.

Course Outcomes (COs)

At the end of this course students will demonstrate the ability to

- Analyze different types of signals
- Represent continuous and discrete systems in time and frequency domain using different transforms
- Apply Fourier series and Transforms on signals
- Investigate whether the system is stable
- Sample and reconstruct a signal
- Apply Laplace and Z Transforms on signals

UNIT I INTRODUCTION TO SIGNALS AND SYSTEMS (9)

Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

UNIT II LTI SYSTEMS AND ANALYSIS (9)

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift invariant systems. System representation through differential equations and difference equations.

UNIT III FOURIER SERIES AND FOURIER TRANSFORM (9)

Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases,

UNIT IV LAPLACE TRANSFORM ANALYSIS (9)

The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.

UNIT V Z TRANSFORM AND SAMPLING

(9)

The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis. State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Suggested Readings

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar, "Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

WEB LINKS

1. <https://nptel.ac.in/courses/108104100/>
2. <https://nptel.ac.in/content/storage2/courses/117101055/downloads/Lec-32.pdf>
3. <https://nptel.ac.in/content/storage2/courses/117101055/downloads/Lec-24.pdf>

21BEEE405	Semester – IV DIGITAL ELECTRONICS	3H-3C
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Instruction Hours / week: L: 3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To familiarize with the design of various combinational digital circuits using logic gates
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
- To explain the various semiconductor memories and related technology
- To introduce the electronic circuits involved in the making of logic gates

Course Outcomes (COs)

1. At the end of this course, students will demonstrate the ability to Recall the use of number systems and its conversion and compare the operation, characteristics of digital logic families
2. Apply the minimal SOP and POS forms of logic expression using K map and implement it with the combinational logic
3. Analyze and design a synchronous sequential circuit to obtain a state table, state diagram for the time sequence of all the variables
4. Analyze and design an asynchronous sequential circuit and describe the race conditions, hazards and errors in digital circuits
5. Understanding the concepts of ROM, RAM and CAM
6. Understanding the concepts of PLD and CPLD.

UNIT I FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES (9)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic.

UNIT II COMBINATIONAL DIGITAL CIRCUITS (9)

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

UNIT III SEQUENTIAL CIRCUITS AND SYSTEMS (9)

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T and D type's flipflops, applications of flipflops, shift registers, applications of shift registers, serial to

parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

UNIT-IV A/D AND D/A CONVERTERS

(9)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

UNIT- V SEMICONDUCTOR MEMORIES AND PROGRAMMABLE LOGIC DEVICES.

(9)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Fundamentals of Field Programmable Gate Array (FPGA).

SUGGESTED READINGS

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

WEB LINKS:

1. <https://nptel.ac.in/courses/108/105/108105132/>
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/117101106/lec25.pdf

21BEEE411	Semester – IV DIGITAL ELECTRONICS LABORATORY	2H-1C
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Instruction Hours / week: L: 0 T: 0 P: 2

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- Understand combinational and logical digital circuits and their differences.
- Students will be introduced to Flip-flop, shifts register, counters.
- To learn symbol, working principle of basic Digital electronics circuits for data processing application.
- At the end of this course, students should be able to recognize and analyze the basic digital circuits.

Course Outcomes (COs)

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

1. Verify the truth table of Logic Gates and Flip Flops.
2. Apply Boolean functions to implement adder, subtractor circuits and convert Excess 3 to BCD, Binary to Gray code and vice versa.
3. Design parity generator, parity checker, encoder and decoder circuits.
4. Design and implement 4-bit modulo synchronous, Asynchronous counters and implement 4-bit shift registers in SISO, SIPO, PISO, PIPO modes.
5. Explain multiplexer, demultiplexer circuits and demonstrate 555 timer in Monostable and Astable operation.
6. Design and demonstrate inverting amplifier, non-inverting amplifier, adder, comparator, integrator and differentiator circuits using Op-Amp.

LIST OF EXPERIMENTS

1. Verification of truth table of Logic Gates.
2. Verification of truth table of Flip Flops.
3. Implementation of Boolean Functions, Adder and Subtractor circuits.
4. Code converters, Excess 3, 2's Complement, Binary to gray code, Parity generator and parity checker using suitable ICs.
5. Encoders and Decoders.
6. Counters: Design and implementation of 4-bit modulo counters as synchronous and asynchronous types using FF IC's and specific counter IC.
7. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.
8. Multiplexer and De-multiplexer (4:1, 8:1 and 1:4, 1:8).
9. Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters
10. Design and implementation of 3-bit synchronous up/down counter.

21BEEE412	Semester – IV POWER ELECTRONICS LABORATORY	2H-1C
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Instruction Hours / week: L: 0 T: 0 P: 2

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

To study the characteristics of switching devices and its applications in rectifier inverter, chopper and resonant converter.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. The students will be able to demonstrate the all power semiconductor devices.
2. To expose students to operation and characteristics of power semiconductor devices and passive components, their practical application in power electronics.
3. To provide a practical exposure to operating principles, design and synthesis of different power electronic converters.
4. To introduce students to industrial control of power electronic circuits as well as safe electrical connection and measurement practices.
5. Able to analyze power electronics circuits
6. Able to apply power electronic circuits for different loads

LIST OF EXPERIMENTS

1. Demonstrate the characteristics of SCR.
2. Demonstrate the characteristics of MOSFET.
3. Demonstrate the characteristics of IGBT.
4. Demonstrate the characteristics of TRIAC
5. Implementation of single phase half controlled converter using SCR.
6. Implementation of single phase fully controlled convertor using SCR
7. Implementation of DC-DC Boost convertor using MOSFET.
8. Implementation of DC-DC Buck convertor using MOSFET.
9. Implementation of Single phase induction motor using PWM inverter
10. Implementation of three phase induction motor using PWM inverter

Semester – IV

21BEEE413

ELECTRICAL MACHINES LABORATORY –II

2H-1C

Instruction Hours / week: L: 0 T: 0 P: 2

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To expose the students to the operation of synchronous machines and induction motors and give them experimental skills

Course Outcomes (COs)

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

1. Compare the different indirect testing methods to predetermine the voltage regulation of three phase salient and non-salient pole alternator
2. Determine the positive, negative and zero sequence impedance of alternators
3. Analyze the operation of synchronous motor on infinite bus for different excitation condition
4. Assess the performance of three phase induction motor by conducting direct and indirect testing
5. Assess the performance of single phase induction motor by conducting direct and indirect testing
6. Choose the appropriate induction motor starter for various industrial and commercial applications

LIST OF EXPERIMENTS

1. Regulation of Alternator by EMF and MMF Methods.
2. Load test on three phase Alternator.
3. Regulation of salient pole Alternator by Slip Test.
4. Regulation of Alternator by ZPF method.
5. Parallel operation of alternator with bus bar.
6. V and Inverted V curves of Synchronous Motor.
7. Equivalent Circuit of three phase Induction Motor.
8. Load Test on three phase Induction Motor.
9. Performance characteristics of three phase Induction Motor by Circle Diagram.
10. Load Test on single phase Induction Motor.
11. Speed control of Induction Motor.

Semester – IV

21BEEE451

ESSENCE OF INDIAN KNOWLEDGE TRADITION

0H-0C

Instruction Hours / week: L: 0 T: 0 P: 0

Marks: Internal: 100

External: 0 Total: 100

Course objective

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. This course focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course Contents

1. Basic structure of Indian Knowledge System: अ' दशिव -४वेद,४उपवेद (आयुवद, धनुवद, गववेद, ' थाप आद) ६वेदांग (शः, क, नः, करण, तष, छंद) ४ उपाङ्ग (धमःशाः, मीमांसा, पुराण, तकःशाः)
2. Modern Science and Indian Knowledge System
3. Yoga and Holistic Health care
4. Case studies

References

1. V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
4. Fritzof Capra, Tao of Physics
5. Fritzof Capra, The Wave of life
6. VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam
7. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
8. GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakashan, Delhi 2016
9. RN Jha, Science of Consciousness Psychotherapyand Yoga Practices, Vidyanidhi Prakashan, Delhi 2016
10. P B Sharma (English translation), Shodashang Hridayan

21BEEE501	SEMESTER – V POWER SYSTEMS-I	3H-3C
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Instruction Hours / week: L:3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
- To understand the mechanical design of transmission lines and to analyze the voltage distribution in insulator strings to improve the efficiency.
- To study about distribution systems, types of substations, methods of grounding, EHVAC, HVDC and FACTS.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Understand the importance and the functioning of transmission line parameters
2. Understand the concepts of Lines and Insulators.
3. Acquire knowledge on the performance of Transmission lines.
4. Understand the importance of distribution of the electric power in power system
5. Acquire knowledge on Underground Cables.
6. Become familiar with the function of different components used in Transmission and Distribution levels of power system and modelling of these components.

UNIT I	INTRODUCTION	(9)
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Structure of electric power system: Generation, transmission and distribution; HVDC and EHV AC transmission: comparison of economics of transmission, technical performance and reliability, application of HVDC transmission system.

UNIT II	TRANSMISSION LINE PARAMETERS	(9)
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Parameters of single and three phase transmission lines with single and double circuits: Resistance, inductance and capacitance of solid, stranded and bundled conductors: Symmetrical and unsymmetrical spacing and transposition; skin and proximity effects; interference with neighbouring communication circuits. Typical configuration, conductor types and electrical parameters of 400, 220, 110, 66 and 33 kV lines.

UNIT III	MODELING AND PERFORMANCE OF TRANSMISSION LINES	(9)
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Classification of lines: Short, medium and long line; equivalent circuits, attenuation constant, phase constant, surge impedance; transmission efficiency and voltage regulation; real and reactive power flow in lines: Power-angle diagram; surge-impedance loading, loadability limits based on thermal loading, angle and voltage stability considerations; shunt and series compensation; Ferranti effect and corona loss. Sag computations. FACTS (qualitative treatment only): SVC, TCSC, STATCOM and UPFC.

UNIT IV INSULATORS AND CABLES (9)

Insulators: Types, voltage distribution in insulator string and grading, improvement of string efficiency. Underground cables: Constructional features of LT and HT cables, capacitance, dielectric stress and grading, thermal characteristics.

UNIT V SUBSTATION, GROUNDING SYSTEM AND DISTRIBUTION SYSTEM (9)

Types of substations: bus-bar arrangements; substation bus schemes: single bus scheme, double bus with double breaker, double bus with single breaker, main and transfer bus, ring bus, breaker- and-a-half with two main buses, double bus-bar with bypass isolators. Resistance of grounding systems: Resistance of driven rods, resistance of grounding point electrode, grounding grids, design principles of substation grounding system; neutral grounding. Radial and ring-main distributors, interconnectors. AC distribution: AC distributor with concentrated load; three-phase four wire distribution system sub-mains; stepped and tapered mains.

SUGGESTED READINGS

1. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.
2. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009.
- 3.S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.
- 4.B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Fifth Edition, 2008.
- 5.Luces M.Fuallken berry, Walter Coffey, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
- 6.Arun Ingole, "power transmission and distribution" Pearson Education, 2017
- 7.J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.
- 8.G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press,2013.

WEB LINKS

- 1.<https://nptel.ac.in/courses/108105067/>
- 2.<https://nptel.ac.in/courses/108102047/>

21BEEE502	Semester – V CONTROL SYSTEMS	3H-3C
Instruction Hours / week: L:3 T: 0 P: 0	Marks: Internal: 40	External: 60 Total: 100
End Semester Exam: 3 Hours		

Course Objectives

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed-loop frequency responses of systems.
- To introduce stability analysis and design of compensators.
- To introduce state variable representation of physical systems.
- To develop state space models from transfer functions and appreciate its significance.

Course Outcomes (COs)

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

1. Demonstrate an understanding of the fundamentals of (feedback) control systems.
2. Determine the time -domain responses and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs.
3. Analyze the Performance of The given System using frequency response plots and root locus
4. Design the different types of compensators using frequency response plots to stabilize the control system.
5. Design a lag, lead, lag-lead compensators based on its specifications using root locus and bode plot approach and Explain the concept of P,PI and PID Controller .
6. Express and solve system equations in state-variable form (state variable models).

UNIT I INTRODUCTION TO CONTROL SYSTEM (9)

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

UNIT II TIME RESPONSE ANALYSIS (9)

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

UNIT III FREQUENCY-RESPONSE ANALYSIS

(9)

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

UNIT-IV INTRODUCTION TO CONTROLLER DESIGN

(9)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design.

Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

UNIT V STATE VARIABLE ANALYSIS AND NON LINEAR CONTROL (9)

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback.

Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

SUGGESTED READINGS

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.

WEB LINKS

1. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm
2. <https://www.electronicshub.org/control-system/>
3. <https://nptel.ac.in/courses/107106081/>

	Semester – V	
21BEEE503	MICROPROCESSORS AND MICROCONTROLLERS	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

- To study processor architecture and its programming
- To learn interfacing concepts
- To study advanced processor architecture

Course Outcomes

At the end of this course students will demonstrate the ability to

- Design ALP for different applications for 8085
- Write ALP for different applications for 8086
- Gain knowledge on advanced processors and controllers
- Interface memory and I/O device with controllers
- Gain knowledge about architectures of RISC and ARM processors
- Distinguish between advanced processors

UNIT I MICROPROCESSOR- 8085/8086 (9)

Introduction to 8085- Introduction to 8086 -Register Organization -Architecture- Signals-Memory Organization- Bus Operation-I/O Addressing-Minimum Mode-Maximum Mode-Timing Diagram- Interrupts - Service Routines – I/O and Memory Interfacing concepts.

UNIT II PROGRAMMING OF 8086 (9)

Instruction Format - Instruction set - Addressing Modes- -Assembly language programs in 8086, Strings, Procedures, Macros, Assembler Directives- Interrupts and Interrupt Applications.

UNIT III ADVANCED PROCESSOR AND MICROCONTROLLER (9)

Advanced coprocessor Architectures- 286, 486, Pentium architecture -Architecture of 8051 microcontroller, Register Set - I/O and memory addressing- Interrupts- Instruction set- Addressing modes.

UNIT IV INTERFACING WITH PERIPHERALS (9)

Timer, serial I/O, parallel I/O, A/D and D/A converters; Arithmetic Coprocessors; System level interfacing design, Concepts of virtual memory, Cache memory

UNIT V INTRODUCTION TO RISC AND ARM

(9)

Introduction to RISC processors; RISC architecture – Review of ARMv7 core and its architecture, introduction to ARM Programming - register configuration and instruction set – sample program. ARM microcontrollers interface designs.

Suggested Readings

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 2002.
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers 2018
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 2005.
4. Kenneth J. Ayala, The 8051 Microcontroller, Clifton Park, NY : Thomson Delmar Learning, 2005.
5. Jonathan W Valvano Introduction to Arm(r) Cortex-M Microcontrollers Createspace Independent Publisher 2012

Website Link

1. <https://nptel.ac.in/courses/108/105/108105102/>
2. <http://www.satishkashyap.com/2012/02/video-lectures-on-microprocessors-and.html>

	Semester – V	
21BEEE504	SPECIAL ELECTRICAL MACHINES	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**

- To expose the students to the concepts of special electrical machines and analyze their performance and to impart knowledge on
- To acquire the knowledge Construction details of synchronous reluctance motors and performance characteristics with its application.
- To demonstrate the working principle of stepper motor with its types and Dynamic characteristics of stepping motors.
- To describe the Construction, principle of operation and performance of switched reluctance motors.
- To provide adequate knowledge Construction, Principle and performance characteristics of permanent magnet brushless dc motors with its application.
- To describe the construction, principle of operation and performance of permanent magnet synchronous motors.

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Analyze and design controllers for special Electrical Machines.
2. Acquire the knowledge on construction and operation of stepper motor.
3. Understand the concept of construction and operation of stepper switched reluctance motors.
4. Acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
5. Acquire the knowledge on construction and operation of permanent magnet synchronous motors.
6. Determine a special Machine for a particular application.

UNIT I SYNCHRONOUS RELUCTANCE MOTORS**(9)**

Constructional features – Types – Axial and radial air gap motors – Operating principle – Reluctance – Phasor diagram – Characteristics – Vernier motor – Driver circuits – Applications of AC motors.

UNIT II STEPPING MOTORS**(9)**

Construction and Principle of operation – Types: Permanent Magnet, Hybrid and Variable reluctance motor – Single and multi stack configurations – Theory of torque predictions – Dynamic Characteristics – Driver circuits – Applications of stepper motors.

UNIT III SWITCHED RELUCTANCE MOTORS**(9)**

Construction and Principle of operation – Torque prediction – Power controllers – Non-linear analysis – Microprocessor based control – Characteristics – Driver circuits.

UNIT IV PERMANENT MAGNET BRUSHLESS DC MOTORS (9)

Construction and Principle of operation – Electronic Commutator – Difference between electronic and Mechanical Commutator – Types of PMSM motors – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control – Applications of DC motors.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS (9)

Construction and Principle of operation – EMF and torque equations – Torque-speed characteristics – Reactance – Phasor diagram – Power controllers – Volt-ampere requirements of Converter – Self, Vector and Current control schemes.

Suggested Readings

- 1.K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
- 2.E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.
- 3.R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
- 4.R.Srinivasan, 'Special Electrical Machines', Lakshmi Publications, 2013.

WEB LINKS

1. <https://nptel.ac.in/courses/108/102/108102156/>
2. https://www.youtube.com/playlist?list=PL_mruqjnuVd9ftLVehO6-P_HUCBICeBX3

21BEEE511	Semester – V CONTROL SYSTEMS LABORATORY	2H-1C
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Instruction Hours / week: L:0 T: 0 P: 2**Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours**

Course Objectives

- To provide a platform for understanding the basic concepts of linear control theory and its application to practical systems.

Course Outcomes (COs)

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

1. Determine the transfer function of DC Shunt Motor.
2. Ability to find the frequency response of different compensators
3. Ability to find the step response of P Controller.
4. Ability to find the step response of PI & PID Controller.
5. Ability to identify the type of damping from the given Characteristic equation.
6. Evaluate the speed control of Dc motor.

LIST OF EXPERIMENTS

1. Transfer function of separately Excited DC generator.
2. Transfer function of armature controlled DC shunt motor.
3. Transfer function of field controlled DC shunt motor.
4. Transfer function of AC servomotor.
5. Step response of P, PI, and PID controllers.
6. Identification of type of damping from the given characteristic equation of second order system.
7. Simulation of step response & step response of second order under damped system using 'C' and Scilab.
8. Frequency response of Lead compensator network.
9. Frequency response of Lag compensator network.
10. DC Motor speed control.

Semester – V**21BEEE512 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY****2H-1C****Instruction Hours / week: L:0 T: 0 P: 2****Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objectives**

On completion of the course, students are able to:

- To understand the basic architecture of 8- bit microprocessors.
- Able to write programs on 8085 microprocessor based systems.
- Identify the addressing modes of an instruction.
- Develop programming skills in assembly language.

Course Outcomes (COs)

1. Apply the basic arithmetic and logical operations using 8085 microprocessor with the help of assembly language programming
2. Analyze the performance of different weighted and non weighted codes, its conversions with logic diagram using 8085 microprocessor
3. Illustrate the interfacing of 8085 with various peripheral devices for serial and parallel communication of data
4. Demonstrate the basic instructions with 8051 microcontroller execution including conditional jumps, looping and calling subroutines
5. Make use of the basic conversion techniques of ADC and DAC to interface it with 8085 processor and 8051 microcontroller
6. Develop a model using processor to apply computing platform and software for engineering problems

LIST OF EXPERIMENTS**8-bit Microprocessor****8085 Microprocessor**

1. Simple arithmetic operations
 - Multi precision addition / subtraction / multiplication / division
2. Programming with control instructions
 - Increment / Decrement
 - Ascending / Descending order
 - Maximum / Minimum of numbers
 - Rotate instructions.
 - Hex / ASCII / BCD code conversions
3. Interface Experiments

- A/D Interfacing
- D/A Interfacing

4. Simple Interfacing experiments using 8279

8086 Microprocessor

- 5. Basic arithmetic and Logical operations
- 6. Floating point operations, string manipulations, sorting and searching

8051 Microcontroller

- 7. Demonstration of basic instructions with 8051 Micro controller execution, including
 - Conditional jumps, looping
 - Calling subroutines
- 8. Parallel port programming with 8051 using port 1 facility
 - Stepper motor
- 9. Flashing of LEDS using ARM
- 10. Implementing zigbee protocol with ARM.

21BEEE551	Semester – V PCB DESIGN	1H-0C
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Instruction Hours / week: L:1 T: 0 P: 0**Marks: Internal: 100****External: 0 Total: 100****Course Objectives**

This is a basic course for designing of PCB using software. PCB (Printed Circuit Board) designing is an integral part of each electronics products and this program is designed to make students capable to design their own projects PCB up to industrial grade.

Course Outcomes (COs)

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

1. Understand basics of PCB designing.
- 2 Apply advance techniques, skills and modern tools for designing and fabrication of PCBs.
- 3 Apply the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB.
- 4 Understand concepts of Packaging.

Course Contents

1. Introduction to PCB designing concepts.
2. Component introduction and their categories.
3. Introduction to Development Tools.
4. Detailed description and practical of PCB designing

Suggested Readings

1. Printed circuit Board Design and technology, Walter C. Bosshart
2. Printed Circuits Handbook, Sixth Edition, by Clyde F. Coombs, Jr, Happy T. Holden, Publisher: McGraw-Hill Education Year: 2016
3. Complete PCB Design Using OrCAD Capture and PCB Editor, Kraig Mitzner Bob Doe Alexander Akulin Anton Suponin Dirk Müller, 2nd Edition 2009.
4. Introduction to System-on-Package, Rao R Tummala & Madhavan Swaminathan, McGraw Hill, 2008.
5. EMC and Printed circuit board, Design theory and layout, Mark I Montrose IEEE Compatibility society
6. Flexible Printed circuit board Design and manufacturing, By Robert torzwell
7. Web-based Current literature

Semester – VI**21BEEE601 ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT 3H-3C****Instruction Hours / week: L:3 T: 0 P: 0****Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objectives**

- To know the fundamentals of cost analysis and economics.
- To learn about the basics of economics and cost analysis related to engineering so as to take economically sound decisions.
- To make the students to understand capital market, break even point analysis and depreciation

Course Outcomes (COs)

1. At the end of this course the student will be able to analyse the financial management, stock exchanges.

UNIT I FUNDAMENTALS OF ENGINEERING ECONOMICS (9)

Introduction to Engineering Economics – Definition and Scope – Significance of Engineering Economics- Demand and supply analysis-Definition – Law of Demand – Elasticity of Demand – Demand Forecasting. Supply – Law of supply – Elasticity of Supply.

UNIT II FINANCIAL MANAGEMENT (9)

Objectives and functions of financial management – financial statements, working capital management– factors influencing working capital requirements – estimation of working capital. Capital budgeting - Need for Capital Budgeting – Project Appraisal Methods - Payback Period – ARR – Time Value of Money.

UNIT III CAPITAL MARKET (9)

Stock Exchanges – Functions – Listing of Companies – Role of SEBI – Capital Market Reforms. Money and banking - Money – Functions –Inflation and deflation – Commercial Bank and its functions – Central bank and its functions.

UNIT IV NEW ECONOMIC ENVIRONMENT (9)

National Income – concepts – methods of calculating national income - Economic systems, economic Liberalization –Privatization – Globalization. An overview of International Trade – World Trade Organization – Intellectual Property Rights.

UNIT V COST ANALYSIS AND BREAK EVEN ANALYSIS (9)

Cost analysis - Basic cost concepts – FC, VC, TC, MC – Cost output in the short and long run. Depreciation - meaning – Causes – Methods of computing Depreciation (simple problems in Straight Line Method, Written Down Value Method). Meaning – Break Even Analysis - Managerial uses of BEA.

SUGGESTED READINGS

1. Ramachandra Aryasri .A, and V. V.Ramana Murthy Tata McGraw Hill,–,New Delhi 2007
2. Varshney R. L., and K.L Maheshwari Managerial Economics Sultan Chand & Sons, New Delhi 2001.
3. M.L.Jhingan Principles of Economics Konark Publications 2010.
4. Prasanna Chandra Fundamentals of Financial Management Tata McGraw Hill, New Delhi. 2007

21BEEE602	Semester – VI POWER SYSTEMS-II	3H-3C
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Instruction Hours / week: L:3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To model the power system under steady state operating condition.
- To understand and apply iterative techniques for power flow analysis.
- To model and carry out short circuit studies on power system.
- To model and analyze stability problems in power system.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Demonstrate the power system under steady state operating condition
2. Understand and apply iterative techniques for power flow analysis.
3. Model and carry out short circuit studies on power system.
4. Acquire knowledge on Fault analysis.
5. Understand various power system components and carry out power flow, short circuit and stability studies.

UNIT I THE POWER SYSTEM – AN OVERVIEW AND MODELING (9)

Modern Power System - Basic Components of a power system - Per Phase Analysis Generator model - Transformer model - line model. The per unit system -Change of base.

UNIT II POWER FLOW ANALYSIS (9)

Introduction - Bus Classification - Bus admittance matrix, Nodal method, Singular transformation method without mutual coupling - Solution of non-linear Algebraic equations - Gauss Seidal method - Newton Raphson method - Fast decoupled method - Flow charts and comparison of the three methods.

UNIT III FAULT ANALYSIS - BALANCED FAULT (9)

Introduction – Balanced three phase fault – short circuit capacity – systematic fault analysis using bus impedance matrix – algorithm for formation of the bus impedance matrix.

UNIT IV FAULT ANALYSIS – SYMMETRICAL COMPONENTS AND UNBALANCED FAULT (9)

Introduction – Fundamentals of symmetrical components – sequence impedances – sequence networks – single line to ground fault – line fault - Double line to ground fault – Unbalanced fault analysis using bus impedance matrix.

UNIT V POWER SYSTEM STABILITY (9)

Basic concepts and definitions – Rotor angle stability – Voltage stability – Mid Term and Long Term stability – Classification of stability – An elementary view of transient stability – Equal area criterion – Responses to a short circuit fault- factors influencing transient stability – Numerical

integration methods – Euler’s method – modified Euler’s method – Runge Kutta methods.

SUGGESTED READINGS

1. Pai M A, ‘Computer Techniques in Power System Analysis’, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
2. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ‘Power System Analysis & Design’, Cengage Learning, Fifth Edition, 2012.
3. Gupta B.R., ‘Power System - Analysis and Design’, S. Chand Publishing, 2001.
4. Kundur P., ‘Power System Stability and Control’, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

WEB LINKS

1. https://nptel.ac.in/content/storage2/courses/108104051/chapter_4/4_14.html
2. <https://nptel.ac.in/courses/108101005/>

Semester – VI**21BEEE641****MEASUREMENTS AND INSTRUMENTATION****5H-4C****(THEORY & LAB)**

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**

- To study the units, dimensions and standards.
- To study the different types of measuring instruments.
- To provide adequate knowledge in electrical and electronic measurement techniques and Instruments.
- To make the students to have a clear knowledge of the basic laws governing the operation of the instruments, relevant circuits and their working.
- Introduction to general instrument system, error, calibration etc.
- Emphasis is laid on analog and digital techniques used to measure voltage, current, energy
- and power, etc.

Course Outcomes (COs)

At the end of the course the students will have

1. Learn units, dimensions and standards.
2. Learn basics of different types of measuring instruments to measure different electrical quantities
3. Apply their knowledge to measure electrical quantities using standard analog and digital measuring instruments
4. basic knowledge of measurement systems towards measurements, including error analysis, interpretation, experimental uncertainty, calibration, etc.
5. To apply basic concepts of measurement systems with electrical signals, including signal conditioners (gain, attenuation), indicating and recording devices
6. Measure different electrical parameters using conventional bridges and acquire data through digital measuring instruments and interpret the data.

UNIT I INTRODUCTION**(9)**

Functional elements of an instrument – Units and standards of measurements – Static and dynamic characteristics – Sources of Errors in measurement – DC and AC bridges –Wheatstone, Kelvin's double, Maxwell, Anderson, Wien and Schering bridges–Measurement of high resistance – Standards and calibration.

UNIT II MEASURING INSTRUMENTS**(9)**

Classification of instruments – working principle of potentiometers – Principle of operation and construction of PMMC, MI, type instruments – Principle types and working of analog and digital voltmeters, ammeters and multimeters – Determination of B–H curve and measurement of iron loss – Instrument transformers – CT and PT – Instruments for measurement of frequency and phase.

UNIT III MEASUREMENT OF POWER AND ENERGY**(9)**

Dynamometer type wattmeter – Single and three phase wattmeters – Induction type instruments – Single and three phase energy meters – calibration of energy meters – direct and phantom loading–

Grounding techniques – Megger - Power factor meter- Principle of operation, construction and types of digital frequency meters, Digital Energymeters, Smart Energy meter.

UNIT IV STORAGE, DISPLAY DEVICES AND TRANSDUCERS (9)

Magnetic measurements – Magnetic disk and tape–recorders – Strip chart recorder – XY recorder. Digital plotters and printers – Cathode ray Oscilloscope– digital CRO and dot matrix display. Classification of transducers – Selection of transducers – Resistive – capacitive and inductive transducers – LVDT – Piezo-electric, optical and digital transducers.

UNIT V VIRTUAL INSTRUMENTATION (9)

Concept of VIs and sub VI - Display types – Digital – Analog – Chart and Graphs. Loops structures - Arrays – Clusters. Local and global variables – String and file I/O. Timers and dialog control.

SUGGESTED READINGS

1. Doebelin. E.O. Measurement Systems Application and Design Tata McGraw Hill Publishing Company, New Delhi. Tata McGraw Hill 2003.
2. Sawhney. A. K. A Course in Electrical and Electronic Measurements and Instrumentation Dhanpat Rai and Co., New Delhi. 2011
3. Sanjay Gupta and Joseph John Virtual Instrumentation using LabVIEW Tata McGraw Hill Publishing Company Ltd., 2nd Edition 2010.

WEB LINKS

1. <https://nptel.ac.in/courses/108105153/>
2. <https://nptel.ac.in/courses/108105064/>

ii) LABORATORY

Course Objectives

- To deal with measurement of inductance and capacitance.
- To deal with measurement of resistance.
- To deal with calibration of current transformer
- To deal with calibration of single phase energy meter.
- To get the knowledge of two watt meter method to measure 3 phase power and power factor
- To deal with calibration of voltmeter, ammeter and wattmeter.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Train the students in the measurement of displacement, resistance, inductance, torque and angle etc.,
2. Give exposure to ac, dc bridges
3. Give knowledge on transient measurement.
4. Understand the procedure and usage of instruments
5. Acquire knowledge of principle of calibration of a measuring instrument and Plotting of calibration curves
6. Acquire hand-on experience on measurement of parameters and verification of Laws of illumination

LIST OF EXPERIMENTS

1. Calibration of Pressure and Displacement Transducer.
2. Measurement of inductance & capacitance.
3. Measurement of resistance using wheatstone bridge
4. Calibration of current transformer and Study of instrument transformers.
5. Calibration of single phase energy meter.
6. Conversion of Galvanometer into Voltmeter and Ammeter.
7. Measurement of three phase power and power factor using two wattmeter method.
8. Measurements of resistance using Kelvin's bridge.
9. Calibration of Voltmeter, Ammeter and Wattmeter
10. Study of phantom loading.
11. Study of Smart Energy Meter.

Semester – VI

21BEEE611

POWER SYSTEMS LABORATORY

2H-1C

Instruction Hours / week: L:0 T: 0 P: 2

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To acquire software development skills and experience in the usage of standard package necessary for analysis and simulation of power system required for its planning, operation and control.

Course Outcomes (COs)

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

1. Analyze the various line parameters
2. Evaluate the voltage regulation and efficiency of different types of transmission lines.
3. Evaluate the Bus impedance Matrix.
4. Evaluate the Bus admittance Matrix.
5. Apply load flow analysis to an electrical power network and interpret the results using Gauss-Seidel and Newton Raphson Methods.
6. Apply load flow analysis to an electrical power network and interpret the results using Fast-Decoupled Methods.
7. Evaluate the Economic dispatch in power systems

LIST OF EXPERIMENTS

1. Computation of Line Parameters.
2. Find the Voltage Regulation And Efficiency Of A Medium Transmission Line Using Nominal T Method Through Scilab.
3. Find the Voltage Regulation And Efficiency Of A Medium Transmission Line Using Nominal Pi Method Through Scilab
4. Formation of Bus Impedance Matrix
5. Formation of Bus Admittance Matrix
6. Load Flow Analysis - I: Solution of Load Flow and related Problems using Gauss-Seidel Method
7. Load Flow Analysis - II: Solution of Load Flow and related Problems using Newton-Raphson and Fast-Decoupled Methods.
8. Load – Frequency Dynamics of single area and two-Area Systems
9. Economic Dispatch in Power Systems without considering transmission losses.
10. Economic Dispatch in Power Systems with transmission losses.

21BEEE612	Semester – VI ELECTRONICS DESIGN LABORATORY	5H-3C
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Instruction Hours / week: L: 1 T: 0 P: 4**Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objectives**

- To design electronics circuits for various applications.
- To develop electronic circuits for resistance measurement, DC power supply, timer, multiplier, sequence generator, regulators and AM transceivers.
- To develop Microcontroller based application.

Course Outcomes (COs)

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

1. Design DC Bridge & DC power supply circuits.
2. Design Voltage regulators
3. AM/FM transreceiver.
4. Know the design procedure of Instrumentation amplifier and Digital Indicator.
5. Learn PCB layout design.

LIST OF EXPERIMENTS

1. Designing DC bridge for Resistance Measurement (Quarter, Half and Full bridge)
2. Design of process control timer
Design a sequential timer to switch on & off at least 3 relays in a particular sequence using timer IC.
3. Microcontroller based systems design
Design of microcontroller based system for simple applications like security systems combination lock etc. using 89c series flash micro controller.
4. Design of DC power supply
5. Frequency Multiplier using PLL.
6. Sequence generator using Digital IC
7. PCB Design for simple circuits using suitable simulation software
8. Study and design of series linear regulators.
9. Design of AM transmitter using 555 timer.

21BEEE651	Semester – V BASICS OF ARDUINO MICROCONTROLLER	1H-0C
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Instruction Hours / week: L:1 T: 0 P: 0

Marks: Internal: 100

External: 0 Total: 100

Course Objectives

- To provide knowledge of different Smart System applications.
- To familiarize students with Arduino as IDE, programming language & platform.
- To provide knowledge of Arduino boards and basic components.
- Develop skills to design and implement various smart system application.

Course Outcomes (COs)

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

1. Learn the basics of electronics, including reading schematics (electronics diagrams).
2. Learn how to prototype circuits with a breadboard.
3. Learn the Arduino programming language and IDE.
4. Program basic Arduino examples.
5. Prototype circuits and connect them to the Arduino.

Course Contents

1. Introduction and Familiarization.
2. Code Building.
3. Analog & Digital communications.
4. Applications.
5. Introduction to IoT.

Suggested Readings

1. Arduino-Based Embedded Systems : By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury.
2. <https://www.arduino.cc/en/Tutorial/HomePage>.
3. Arduino Made Simple by Ashwin Pajankar.
4. Embedded C, Pont, Michael J.
5. ARM System Developer's Guide - Designing and Optimizing System Software by: Andrew N Sloss, Dominic Symes, Chris Wright; 2004, Elseiver.
6. ARM System - On - Chip Architecture, Furber, Steve.
7. Assembly Language Programming: ARM Cortex - M3: Mahout, Vincent.

Semester-VII**21BEEE701****PROFESSIONAL ETHICS AND
ENTREPRENEURSHIP DEVELOPMENT****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**

- To develop managerial and entrepreneurial skills.
- To have knowledge on the principles of management
- To outline the managerial functions
- To create an awareness and practice through engineering ethics and human values

Course Outcomes (COs)

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

- Advanced philosophical knowledge of the profession of recreation and leisure
- Synthesis of trends and issues as related to current professional practice
- Evaluation of organizational theories and human resource management principles
- Ethical practice and ethical management

UNIT I ENGINEERING ETHICS (9)

Senses of 'Engineering Ethics' – Variety of moral issues – 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 II HUMAN VALUES (9)

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT III GLOBAL ISSUES (9)

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 Responsibility

UNIT IV 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 V ENTREPRENEURSHIP DEVELOPMENT

(9) Entrepreneur

– Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth– Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self-rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives, Start-up – History of the start-up terminology, 5 Steps from Concept to Start-up, Special Considerations – Business Incubators: Meaning, Definition, Services, Development and Types.

Suggested Readings

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
3. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009
5. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
6. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001
7. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd., New Delhi 2013.
8. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011

web sources

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

21BEEE702	Semester – VII INDUSTRIAL AUTOMATION	3H-3C
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Instruction Hours / week: L:3 T: 0 P: 0**Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objectives**

- To study and gain knowledge about various sensors.
- To study and gain knowledge about controllers.

Course Outcomes (COs)

At the end of the course the student will be able to

1. Understand the concept of sensors,
2. Understand the concept of actuators
3. Analyse the various tuning controllers
4. Analyse the various advanced control techniques used in industrial automation

UNIT I SENSORS, ACTUATORS (9)

Sensors, Actuators and Signal conditioning Sensors: Displacement sensors, Force sensors, Ultrasonic sensors, Temperature sensors, Pressure sensors etc Actuators: Dcmotors, Servo motors, Stepper motors, Piezoelectric actuators, Pneumatic actuator setc. Signal Conditioning: Filtering, Amplifying, Isolation, ADC, DAC, Sensor protection circuits, Signal transmission and noise suppression, Estimation of errors and calibration.

UNIT II CONTROLLER TUNING (9)

PI controller, PD controller, PID controller and tuning methods: Ziegler-Nichols tuning method, Cohen coon tuning method, Implementation of PID controllers (digital and analog).

UNIT III PLC (9)

PLC (Programmable logic controllers): Overview, operation and architecture, PLC programming, Application examples. DCS (Distributed control systems): Overview, Advantages, Functional requirements of Distributed control systems, Communication for distributed control

UNIT IV SCADA (9)

Application examples SCADA (supervisory control and data acquisition): Introduction to SCADA, SCADA system components, architecture and communication, SCADA applications, Introduction to PLC.

UNIT V ADVANCED CONTROL TECHNIQUES (9)

Feed forward control, Ratio control, Cascade control, Adaptive control, Duplex or split range control, Override control, internal mode control.

SUGGESTED READINGS

1. Krishna Kant Computer-Based Industrial Control 2nd edition Prentice Hall of India Ltd 2003.
2. Stephanopoulous Chemical Process Control– Theory and Practice Prentice Hall of India Ltd 2014
3. Noble, David. Forces of production: A social history of industrial automation. Routledge, 2017.
4. Introduction to programmable logic controller by Gary dunning, Thomson Asia Pte Ltd. Publication, Singapore, Third Edition, 2016.

WEB LINKS

1. <https://nptel.ac.in/courses/108105088/>
2. <https://www.automationprogram.com/>

21BEEE703

Semester – VII
SMART GRID

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

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications.

Course Outcomes (COs)

At the end of the course the student will be able to

1. Gain the knowledge about Distributed Generations.
2. Acquire the knowledge about Island mode of operation.
3. Understand the basic knowledge about storage devices.

UNIT I INTRODUCTION : SMART GRID AND EMERGING TECHNOLOGIES**(09)**

Defining a smart grid – Characteristics of smart grid - Values of a smart grid – The economic Case – The environmental Case – Benefits to utilities – Benefits to consumers – Power system components – Power system protection: Traditional Vs Smart – Case study – Generation fundamentals – Traditional Generations – Distributed Generations – micro grid generation – Generator Protection – Challenges and Opportunities – Cost of smart grid – Government Regulations – Emerging Technologies - FACTS – optimizing integration systems – Multi generation buildings – Case study.

UNIT II SMART GRID: MODELS AND OPERATING PRINCIPLES**(09)**

Solar Photovoltaic models and grid Integration – Design of a 2 MVA PV station – DG system as part of utility power system – The smart grid PV - UPS DG system – Split DC Bus UPS – PV DG system – Island mode of operation – Parallel operation of Inverters – Power Quality. Wind turbine model and grid Integration – Micro turbine model & Grid Integration. Electric Vehicle model and Grid Integration.

UNIT III SMART GRID: DISTRIBUTED GENERATION SYSTEMS**(09)**

Power Converter System – Control System Development – Current limit and Saturation Control, Simulation using simulate and MATLAB. Inverter Parallel operation – Load sharing control Algorithm – Distributed Generation System and Newton Raphson method in power flow – Plant modeling and 3 phase 4 wire DG unit topology – Single distributed generation System –MIMO Linear system Stability robustness – PWM rectifier control – 3 Phase AC – DC – AC topology.

UNIT IV ENERGY STORAGE AND COMMUNICATION (09)

State-of-the art storage devices – Battery types – Ultra capacitors based Energy Storage System – Flywheel – Wide Area Network – Substation Information System – Wireless Networks – Distribution Automation – AMI Networks – Utility monitoring and Control – Inter-system Coordination – Industrial systems – Consumer Residential Systems – Network Protection – Channel model Fundamental – Low, medium, High voltage, main Topologies – Residential and Business Indoor wiring Topologies – The Power line Channel model – Digital Transmission Techniques - Threats – IEC61850 Considerations.

UNIT V SMART GRID: RELIABILITY, STABILITY AND COMPONENT INTEGRATION (09)

Smart Grid Programming – Virtual Power Producer – Intelligent reconfiguration using SCADA – Problems in distributed grids – Solutions. Integration of Mini – Micro generation in distribution Grids – Power supply Quality generic standards – Renewable Energies specific standards – Smart Grid stability analysis schemes – Supply guarantee and Power quality – Integration in power systems – Distributed Generation advantages and needs.

SUGGESTED READINGS

1. Stuart Borlase “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press 2012.
 2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley 2012.
 3. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, “Smart Grid Technologies: Communication Technologies and Standards” IEEE Transactions On Industrial Informatics, Vol.7, No.4, November 2011.
 4. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang “Smart Grid – The New and Improved Power Grid: A Survey”, IEEE Transaction on Smart Grids, vol.1 4, 2012.
- James Momohe “Smart Grid: Fundamentals of Design and Analysis,”, Wiley-IEEE Press, 2012.

WEB LINKS

1. <https://nptel.ac.in/courses/108/107/108107113/>
2. <http://npti.gov.in/smart-grid-technologies>

21BEEE791	Semester – VII Project Work Phase-I	6H-3C
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Instruction Hours / week: L:0 T: 0 P: 6	Marks: Internal: 80	External: 120 Total: 200

21BEEE891	Semester – VIII Project Work Phase-II & Viva-Voce	16H-8C
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Instruction Hours / week: L:0 T: 0 P: 16**Marks: Internal: 80****External: 120 Total: 200**

PROFESSIONAL ELECTIVE COURSES

B.E. Electrical and Electronics Engineering

2021-2022

21BEEE5E01

Semester – V
Electrical Machine Design

3H-3C

Instruction Hours / week: L:3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To study mmf calculation and thermal rating of various types of electrical machines.
- To design armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines.
- To design stator and rotor of synchronous machines and study their thermal behaviour.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Analysis and reproduce the construction of electrical machines.
2. Recognize the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
3. Reproduce the principles of electrical machine design
4. Compile out a basic design of an AC and DC machine.
5. Use software tools to do design calculations.
6. Analysis the performance characteristics of electrical machines

UNIT I INTRODUCTION (9)

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT II TRANSFORMERS (9)

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

UNIT III INDUCTION MOTORS (9)

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

UNIT- IV SYNCHRONOUS MACHINES

(9)

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

UNIT V COMPUTER AIDED DESIGN (CAD)

(9)

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

SUGGESTED READINGS

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Co, 2013.
2. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
3. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 2016.
4. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 2005.
5. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
6. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

WEB REFERENCES

1. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-685-electric-machines-fall-2013/index.htm>
2. <https://www.pragationline.com/engineering/principles-of-electrical-machine-design-bagale/>

21BEEE5E02

Semester – V
SENSOR AND TRANSDUCER

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

- It deals with various types of Sensors & Transducers and their working principle
- It deals with Resistive, Capacitive and Inductive transducers
- It deals with some of the miscellaneous transducers
- It deals with characteristics of transducers

Course Outcomes (COs)

At the end of the course the student will be able to

1. Justify the concept and working principle of different transducers and sensors
2. Justify the transducers that will be utilised in the electrical industries
3. Identify recent developments in transducer domain
4. Discover the knowledge for small technology up gradations in it

UNIT I INTRODUCTION OF TRANSDUCERS (9)

Transducer – Classification of transducers – Basic requirement of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS (9)

Static characteristics – Dynamic characteristics – Mathematical model of transducer – Zero, first order and second order transducers – Response to impulse, step, ramp and sinusoidal inputs.

UNIT III RESISTIVE TRANSDUCERS (9)

Potentiometer –Loading effect – Strain gauge – Theory, types, temperature compensation – Applications – Torque measurement – Proving Ring – Load Cell – Resistance thermometer – Thermistors materials – Constructions, Characteristics – Hot wire anemometer.

UNIT IV INDUCTIVE AND CAPACITIVE TRANSDUCER (9)

Self inductive transducer – Mutual inductive transducers– LVDT Accelerometer – RVDT – Synchros – Microsyn – Capacitive transducer – Variable Area Type – Variable Air Gap type – Variable Permittivity type – Capacitor microphone.

UNIT V MISCELLENEOUS TRANSDUCERS (9)

Piezoelectric transducer – Hall Effect transducers – Smart sensors – Fiber optic sensors – Film sensors – MEMS – Nano sensors, Digital transducers.

SUGGESTED READINGS

1. Sawhney A.K, A Course in Electrical and Electronics Measurements and Instrumentation, 18th Edition, Dhanpat Rai & Company Private Limited, 2007
2. Renganathan. S, Transducer Engineering, Allied Publishers, Chennai, 2003.
3. Doebelin. E.A, Measurement Systems – Applications and Design, Tata McGraw Hill, New York, 2000
4. Patranabis. D Sensors and Transducers PHI Learning Pvt. Ltd. 2003
5. John. P, Bentley Principles of Measurement Systems III Edition, Pearson Education 2000

WEBSITES

1. <http://home.iitk.ac.in/~vyas/WILD/transducer.html>
2. <https://nptel.ac.in/courses/108105064/>

High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

UNIT V APPLICATIONS OF DIGITAL SIGNAL PROCESSING

(9)

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

SUGGESTED READINGS

1. S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schaffer, “Discrete Time Signal Processing”, 3rd Edition Prentice Hall, 2009.
3. J. G. Proakis and D.G. Manolakis, “Digital Signal Processing: Principles, Algorithms And Applications”, 4th Edition, Prentice Hall, 2007.
4. L. R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Pearson India, 2015.
5. J. R. Johnson, “Introduction to Digital Signal Processing”, PHI Learning, 2009.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, “Digital Signal Processing”, Wiley India Pvt Ltd, 2009.

WEB REFERENCES :

1. <https://nptel.ac.in/courses/108/106/108106151/>
2. <https://studentsfocus.com/it6502-dsp-notes-digital-signal-processing-lecture-notes-cse-6th-sem-anna-university/>

Semester – VI

21BEEE6E02

Computer Architecture

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:

- To study the various representations of data, register transfer language for micro-operations and organization and design of a digital computer.

Course Outcomes(Cos)

At the end of this course, students will demonstrate the ability to

1. Reproduce the concepts of microprocessors, their principles and practices.
2. Describe efficient programs in assembly language of the 8086 family of microprocessors.
3. Point out a modern computer system and be able to relate it to real examples.
4. Discover the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
5. Compute embedded applications using ATOM processor.

UNIT I Introduction to computer organization**(9)**

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

UNIT II Memory organization**(9)**

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

UNIT III Input – output Organization**(9)**

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

UNIT IV 16 and 32 microprocessors

(9)

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

UNIT V Pipelining

(9)

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

SUGGESTED READINGS

1. V. Carl, G. Zvonko and S. G. Zaky, “Computer organization”, 5th Edition, McGraw Hill, 2001.
2. B. Brey and C. R. Sarma, “The Intel microprocessors”, Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, “Computer Architecture A Quantitative Approach”, Morgan Kauffman, 2011.
4. W. Stallings, “Computer organization”, 9th Edition, PHI, 2012.
5. P. Barry and P. Crowley, “Modern Embedded Computing”, Morgan Kaufmann, 2012.
6. N. Mathivanan, “Microprocessors, PC Hardware and Interfacing”, Prentice Hall, 2004

WEB REFERENCES

1. <https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/>
2. <https://www.smartzworld.com/notes/computer-organization-pdf-notes-co/>

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

- To study the electrical wiring system used in various sectors.
- To study the Electrical System components used in industrial.
- To study the Illumination Systems used in industrial.
- To study the electrical system application in industrial sectors.

Course Outcomes (Cos)

At the end of this course, students will demonstrate the ability to

- 1.Reproduce the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- 2.Reproduce various components of industrial electrical systems.
- 3.Recognize and select the proper size of various electrical system components.
- 4.Summarize the concepts in various industrial applications
- 5.Discover the technical reason behind every practical operations of the systems

UNIT I Electrical System Components**(9)**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

UNIT II Residential and Commercial Electrical Systems**(9)**

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

UNIT III Illumination Systems

(9)

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

UNIT IV Industrial Electrical Systems I

(9)

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

UNIT V Industrial Electrical Systems II

(9)

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

SUGGESTED READINGS

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
- 3.. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co.,2014.
- 4.. Web site for IS Standards.
5. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

WEBSITES

- 1.https://swayam.gov.in/nd1_noc20_me39/preview
2. <https://www.larsentoubro.com/electrical-automation/products-services/products/low-voltage-products/motor-protection-circuit-breakers/>

21BEEE6E04	Semester – VI High Voltage Engineering	3H-3C
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Instruction Hours / week: L:3 T: 0 P: 0	Marks: Internal: 40	External: 60 Total: 100
		End Semester Exam: 3 Hours

Course Objectives

- To reproduce the various types of over voltages in power system and Protection methods.
- To study about generation of over voltages in laboratories.
- To know about measurement of over voltages.
- To study about the nature of Breakdown mechanism in solid, liquid and gaseous dielectrics - discussion on commercial insulates.
- To study about testing of power apparatus and insulation coordination

Course Outcomes (COs)

At the end of the course, the student will demonstrate

1. Identify the causes of over voltages and its effects and estimate the reflection and refractions of travelling waves in transmission lines
2. Describe the various types of breakdown mechanisms and analyze the breakdown mechanisms in solid, liquid, gases and composite dielectrics
3. Point out the generation and design of different types of Generating circuits for high voltage and currents of AC, DC and impulse
4. Operate AC and DC high voltage and current using high resistance with series ammeter, dividers, peak voltmeter and generating voltmeters
5. Describe the testing methodologies related to various high voltage equipment with reference to national and international standards
6. Compute the AC and DC high voltage and current using CVT, electrostatic voltmeters, sphere gaps, high current shunts and digital techniques in high voltage measurement

UNIT I BREAKDOWN IN GASES (9)

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge. Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

UNIT II GENERATION OF HIGH VOLTAGES (9)

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT- III MEASUREMENTS OF HIGH VOLTAGES AND CURRENTS (9)

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

UNIT IV LIGHTNING AND SWITCHING OVER-VOLTAGES (9)

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching overvoltages, Protection against over-voltages, Surge diverters, Surge modifiers.

UNIT V HIGH VOLTAGE TESTING OF ELECTRICAL APPARATUS AND HIGH VOLTAGE LABORATORIES (9)

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

SUGGESTED READINGS

1. M. S. Naidu and V. Kamaraju, “High Voltage Engineering”, McGraw Hill Education, 2013.
2. C. L. Wadhwa, “High Voltage Engineering”, New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers, 2007.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication, 2000.
5. R. Arora and W. Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley & Sons, 2011.

WEB REFERENCES

1. <https://nptel.ac.in/courses/108/104/108104048/>
2. <https://www.smartzworld.com/notes/high-voltage-engineering-pdf-notes-hve-notes-pdf/>

21BEEE6E05	Semester – VI Electrical Energy Conservation and Auditing	3H-3C
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Instruction Hours / week: L:3 T: 0 P: 0**Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objectives**

- To gain the knowledge about energy management.
- To understand the basic concepts in economic analysis in energy management.
- To understand the basic principles of energy audit.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Identify and reproduce the current energy scenario and importance of energy conservation.
2. Explain the concepts of energy management.
3. Analyse the methods of improving energy efficiency in different electrical systems.
4. Reproduce the concepts of different energy efficient devices.

UNIT I: Energy Scenario**(9)**

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

UNIT II: Basics of Energy and its various forms**(9)**

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

UNIT III: Energy Management & Audit**(9)**

Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

UNIT IV: Energy Efficiency in Electrical Systems

(9)

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

UNIT V: Energy Efficiency in Industrial Systems

(9)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

SUGGESTED READINGS

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 2003.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

WEB REFERENCES

1. <https://www.sciencedirect.com/topics/engineering/energy-conservation>
2. <http://www.faadooengineers.com/threads/44370-Free-Download-Energy-Audit-and-Management-Notes>

21BEEE7E01	Semester – VII Wind and Solar Energy Systems	3H-3C
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Instruction Hours / week: L:3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- Understanding basic characteristics of renewable sources of energy and technologies for their utilization.
- Awareness about renewable Energy Sources and technologies.
- Adequate inputs on a variety of issues in harnessing renewable Energy.
- Recognize current and possible future role of renewable energy sources

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Evaluate an initial design of a renewable energy system.
2. Reproduce the energy scenario and the consequent growth of the power generation from renewable energy sources.
3. Reproduce the basic physics of wind and solar power generation.
4. Summarize the power electronic interfaces for wind and solar generation.
5. Recognize the issues related to the grid-integration of solar and wind energy systems.
6. Illustrate the changes in functionality in a component and how its affect the other components of the system.

UNIT I PHYSICS OF WIND POWER**(9)**

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

UNIT II WIND GENERATOR TOPOLOGIES**(9)**

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Power electronics converters. Capital expenses and operation expenses in Wind energy Conversion System.

UNIT III THE SOLAR RESOURCE AND SOLAR THERMAL POWER GENERATION (9)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability, Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

UNIT- IV SOLAR PHOTOVOLTAIC

(9)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control. Capital expenses and Operation expenses in Solar Photovoltaic System Field visit to 50 KW solar panel in KAHE.

UNIT V NETWORK INTEGRATION ISSUES

(9)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

SUGGESTED READINGS

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.
3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, 3rd Edition, McGraw Hill, 2008.
4. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, 4th Edition, John Wiley & Sons, 2013.

WEB REFERENCES

1. <https://www.loc.gov/rr/scitech/tracer-bullets/solartb.html>
2. <https://nptel.ac.in/courses/108/108/108108078/>

Course Objectives

- To study the basic concepts of electric hybrid vehicles.
- To study about energy storage system for hybrid vehicle.
- To study about energy management strategies

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

At the end of this course, students will demonstrate the ability to

- 1.Reproduce the models to describe hybrid vehicles and their performance.
2. Reproduce the concept of Electric Trains.
3. Recognize the different possible ways of energy storage.
4. Illustrate the different strategies related to energy storage systems.
5. Compute the different strategies related to energy management systems.
6. Demonstrate the concept of different Motor drive.

UNIT I INTRODUCTION**(9)**

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**(9)**

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**(9)**

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**(9)**

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

(9)

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

SUGGESTED READINGS

1. 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 and A. 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.

WEBSITES

1. <https://www.energy.gov/eere/electricvehicles/electric-vehicle-basics>
2. https://swayam.gov.in/nd1_noc20_ee18/preview
3. <https://nptel.ac.in/courses/108103009/>

21BEEE7E03	Semester – VII Power System Protection	3H-3C
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Instruction Hours / week: L:3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To understand the current interruption in Power System and study the various switchgears.
- Discussion on various earthing practices, usage of symmetrical components to estimate fault current and fault MVA.
- Study of Relays, protection scheme, and solid state relays.
- To understand the method of circuit breaking, various arc theories, Arcing phenomena capacitive and inductive breaking, Types of circuit breakers.
- To expose the students to the various faults in power system and learn the various methods of protection scheme

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Reproduce the different components of a protection system.
2. Evaluate fault current due to different types of fault in a network.
3. Justify the protection schemes for different power system components.
4. Reproduce the basic principles of digital protection.
5. Identify and justify the various system protection schemes, and the use of wide-area measurements.

UNIT I INTRODUCTION AND COMPONENTS OF A PROTECTION SYSTEM (9)

Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers. Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

UNIT II EQUIPMENT PROTECTION SCHEMES (9)

Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

UNIT- III DIGITAL PROTECTION (9)

Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

UNIT IV MODELING AND SIMULATION OF PROTECTION SCHEMES (9)

CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

UNIT V SYSTEM PROTECTION

(9)

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

SUGGESTED READINGS

1. J. L. Blackburn, "Protective Relaying: Principles and Applications", 4th Edition, Marcel Dekker, New York, 2014.
2. Y. G. Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.
3. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", 2nd Edition, John Wiley & Sons, 2012.
4. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
5. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

WEBSITES

1. <https://nptel.ac.in/courses/108101039/>
2. <https://electrical-engineering-portal.com/selectivity-between-circuit-breakers>

21BEEE7E04**Semester – VII
HVDC Transmission Systems****3H-3C****Instruction Hours / week: L:3 T: 0 P: 0****Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objectives**

- To Understand the high voltage DC

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

1. Justify the advantages of dc transmission over ac transmission.
2. Reproduce the operation of Line Commutated Converters and Voltage Source Converters.
3. Evaluate the control strategies used in HVdc transmission system.
4. Identify and propose the improvement of power system stability using an HVdc system.

UNIT I DC Transmission Technology**(9)**

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVdc Systems. Components of a HVdc system. Line Commutated Converter and Voltage Source Converter based systems.

UNIT II Analysis of Line Commutated and Voltage Source Converters**(9)**

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links. Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

UNIT III Control of HVDC Converters**(9)**

Principles of Link Control in a LCC HVdc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

UNIT IV Components of HVDC systems

(9)

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Monopolar Operation. Ground Electrodes.

UNIT V Stability Enhancement using HVDC Control

(9)

Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

SUGGESTED READING

1. K. R. Padiyar, “HVDC Power Transmission Systems”, New Age International Publishers, 2011.
2. J. Arrillaga, “High Voltage Direct Current Transmission”, 2nd Edition, Peter Peregrinus Ltd., 2008.
3. E. W. Kimbark, “Direct Current Transmission”, Reprint, Wiley-Interscience, 2000.

WEB REFERENCES

1. <https://nptel.ac.in/courses/108/104/108104013/>
2. <https://www.smartworld.com/notes/high-voltage-direct-current-transmission-pdf-notes-hvdc-pdf-notes/>

21BEEE7E05**Semester – VII
Communication Engineering****3H-3C****Instruction Hours / week: L:3 T: 0 P: 0****Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objectives**

- To introduce the fundamental techniques of analog, digital and data communication.
- To explain satellite and fibre optic communication and Networking systems.
- To understand basic signals, analog modulation, demodulation and radio receivers.
- To explain the characteristics and model of transmission medium.

Course Outcomes (COs)

At the end of the course the student will be

- 1.Ability to understand and analyse analog circuits.
- 2.Gain Knowledge on digital modulation techniques.
- 3.Understand coding techniques

UNIT I MODULATION SYSTEMS (9)

Time and frequency domain representation of signals, amplitude modulation and demodulation, frequency modulation and demodulation, super heterodyne radio receiver. Frequency division multiplexing. Pulse width modulation.

UNIT II TRANSMISSION MEDIUM (9)

Transmission lines – Types, equivalent circuit, losses, standing waves, impedance matching, bandwidth; radio propagation – Ground wave and space wave propagation, critical frequency, maximum usable frequency, path loss, white Gaussian noise.

UNIT III DIGITAL COMMUNICATION (9)

Pulse code modulation, time division multiplexing, digital T-carrier system. Digital radio system. Digital modulation: Frequency and phase shift keying – Modulator and demodulator, bit error rate calculation.

UNIT IV DATA COMMUNICATION AND NETWORK PROTOCOL (9)

Data Communication codes, error control. Serial and parallel interface, telephone network, data modem, ISDN, LAN, ISO–OSI seven layer architecture for WAN.

UNIT V SATELLITE AND OPTICAL FIBRE COMMUNICATION (9)

Orbital satellites, geostationary satellites, look angles, satellite system link models, satellite system link equations. Advantages of optical fibre communication – Light propagation through fibre, fibre loss, light sources and detectors.

SUGGESTED READING

1. Wayne Tomasi Electronic Communication Systems Pearson Education New Delhi 2002.
2. Roy Blake Electronic Communication Systems Thomson Delmar , New Delhi 2002.
3. William Schweber Electronic Communication Systems Prentice Hall of India, New Delhi.2002
4. Kennedy, G. Electronic Communication Systems Prentice Hall of India, New Delhi.2002
5. Miller, M. Modern Electronic Communication Prentice Hall of India, New Delhi.2003.
6. John G Proakis and Masoud Salehi Communication Systems Engineering Prentice Hall of India, New Delhi.2001

WEBSITES

1. www.complextoreal.com/tutorial.htm
2. www.discogs.com/artist/Nephlim+Modulation+Systems

21BEEE8E01

Semester – VIII
ADVANCED ELECTRIC DRIVES

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

- To study and understand the operation of electric drives controlled from a power electronic converter and to introduce the design concepts of controllers.
- To understand the stable steady-state operation and transient dynamics of a motor-load system.
- To study and analyze the operation of the converter/chopper fed dc drive and to solve simple problems.

Course Outcomes(COs)

At the end of this course, students will demonstrate the ability to

- 1.Reproduce the operation of power electronic converters and their control strategies.
- 2.Easily access the vector control strategies for ac motor drives
- 3.Analyze and evaluate the implementation of the control strategies using digital signal processors.
- 4.Discriminate the usage of devices in any kind of applications

UNIT I Power Converters for AC drives (9)

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

UNIT II Induction motor drives (9)

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).

UNIT III Synchronous motor drives (9)

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

UNIT IV Permanent magnet motor drives (9)

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

UNIT V Switched reluctance motor drives

(9)

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.

SUGGESTED READINGS

1. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons, 2013.
3. H. A. Taliyat and S. G. Campbell, “DSP based Electromechanical Motion Control”, CRC press, 2003.
4. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press, 2009.

WEB REFERENCES

1. <https://nptel.ac.in/courses/108/104/108104011/>
2. <http://www.faadooengineers.com/threads/9449-ELECTRIC-DRIVES-full-notes-pdf-ebooks>

21BEEE8E02

POWER GENERATION SYSTEMS

3H-3C

Instruction Hours / week: L:3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To learn the economics connected with power generation.
- To understand the measurements of various parameter in power plant and their control.

Course Outcomes(COs)

At the end of the course the student will gain knowledge about

1. Economics of power generation, layout and working of thermal, nuclear and hydropower plants.
2. Distributed generation, boiler turbine monitoring system.
3. Assess the instrumentation available in the plant
4. Demonstrate the monitorin control in the plant
5. Analyse the various cost arrivals for various TARIFF consumers

UNIT I ECONOMICS OF GENERATION**(9)**

Load and load duration curve–Load, demand and diversity factors–Plant capacity and plant use factors–choice of type of generation–choice of size and number of unit–cost of energy generated – Tariffs.

UNIT II THERMAL, NUCLEARAND HYDROPOWER PLANTS**(9)**

Location, Layout and working of steam, diesel and gas power plants-Principles of nuclear power generation, Types of nuclear power plants and their comparison, Layout and working of nuclear power plants, Advantages and disadvantages of nuclear energy-Layout and working, Types of hydroelectric power plants, Advantages of hydro generation, Environmental issues.

UNIT III POWERPLANT INSTRUMENTATION**(9)**

Importanceofinstrumentationinpowerplants,UP&Idiagramofboiler-Measurements ofnon Electrical parameters, flow of feed water, air, steam, radiation detector, smoke density measurement-analyzers, flue gas oxygen analyzer, chromatography, PH meter, pollution monitoring instruments.

UNIT IV BOILER, TURBINE-MONITORINGAND CONTROL**(9)**

Combustion control - furnace draft control-drum level control- de-aerator control- boiler interlocks-speed, vibration, temperature monitoring control of turbine lubrication and cooling system of turbine.

UNITV DISTRIBUTED GENERATION AND NON CONVENTIONAL PLANTS (9)

Introduction to the concept of distributed generation –basics on distributed generation Technologies-Effect on system operation. Basic concepts, Principle of working and layout of

MHD, Solar, Wind, Tidal, Biomass and Geothermal Power Generation Systems.

SUGGESTED READINGS

1. Nagpal.G.R Power plant engineering Khanna Publishers, New Delhi 2001
2. Wadhwa, C.L Generation,Distribution and Utilization of Electric Energy New Age International Ltd 2011.
3. Gupta B.R Generation of Electrical Energy Eurasia Publishing House (p) Ltd, New Delhi

WEB REFERENCES

1. <https://nptel.ac.in/courses/108/102/108102047/>
2. <http://www.ilocis.org/documents/chpt76e.htm>

21BEEE8E03

POWER SYSTEM OPERATION AND CONTROL

3H-3C

Instruction Hours / week: L:3 T: 0 P: 0

Marks: Internal: 40

External: 60 Total: 100

End Semester Exam: 3 Hours

Course Objectives

- To become familiar with the preparatory work necessary for meeting the next day's operation and the various control actions to be implemented on the Power system to meet the minute-to-minute variation of system load.
- To get an overview of system operation and control.
- To understand and model power-frequency dynamics and to design power-frequency controller.
- To understand and model reactive power-voltage interaction and different methods of control for maintaining voltage profile against varying system load.

Course Outcomes(COs)

At the end of this course, students will demonstrate the ability to

- 1.Understand the day-to-day operation of electric power system.
- 2.Analyze the control actions to be implemented on the system to meet the minute-to-minute variation of system demand.
- 3.understand the significance of power system operation and control.
- 4.acquire knowledge on real power-frequency interaction.
- 5.understand the reactive power-voltage interaction.
- 6.design SCADA and its application for real time operation.

UNIT I INTRODUCTION**(9)**

System load variation: System load characteristics, load curves - daily, weekly and annual, load-duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation: Load forecasting, unit commitment, load dispatching. Overview of system control: Governor Control, LFC, EDC, AVR, system voltage control, security control.

UNIT II REAL POWER - FREQUENCY CONTROL**(9)**

Fundamentals of speed governing mechanism and modeling: Speed-load characteristics – Load sharing between two synchronous machines in parallel; concept of control area, LFC control of a single-area system: Static and dynamic analysis of uncontrolled and controlled cases, Economic Dispatch Control. Multi-area systems: Two-area system modeling; static analysis, uncontrolled case; tie line with frequency bias control of two-area system derivation.

UNIT III REACTIVE POWER-VOLTAGE CONTROL**(9)**

Typical excitation system, modeling, static and dynamic analysis, stability compensation; generation and absorption of reactive power: Relation between voltage, power and reactive power

at a node; methods of voltage control: Injection of reactive power. Tap-changing transformer, numerical problems - System level control using generator voltage magnitude setting, tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH (9)

Statement of Unit Commitment (UC) problem; constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints; UC solution methods: Priority-list methods, forward dynamic programming approach, numerical problems only in priority-list method using full-load average production cost. Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ -iteration method. (No derivation of loss coefficients) Base point and participation factors. Economic dispatch controller added to LFC control.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS (9)

Energy control centre: Functions – Monitoring, data acquisition and control. System hardware configuration – SCADA and EMS functions: Network topology determination, state estimation security analysis and control. Various operating states: Normal, alert, emergency, inextremis and restorative. State transition diagram showing various state transitions and control strategies.

SUGGESTED READINGS

- 1.Olle.I.Elgerd, ‘Electric Energy Systems theory - An introduction’, McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
- 2.Allen. J. Wood and Bruce F. Wollen berg, ‘Power Generation, Operation and Control’, John Wiley & Sons, Inc., 2016.
- 3.Abhijit Chakrabarti and Sunita Halder, ‘Power System Analysis Operation and Control’, PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.
- 4.Kothari D.P. and Nagrath I.J., ‘Power System Engineering’, Tata McGraw-Hill Education, Second Edition, 2008.
- 5.Hadi Saadat, ‘Power System Analysis’, McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
- 6.Kundur P., ‘Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

21BEEE8E04**Power Quality and FACTS****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**

- To understand the concept of power and power factor in single phase and three phase systems supplying non linear loads
- To understand the conventional compensation techniques used for power factor correction and load voltage regulation.
- To understand the active compensation techniques used for power factor correction.
- To understand the active compensation techniques used for load voltage regulation.

Course Outcomes (COs)

At the end of this course, students will demonstrate the ability to

- 1.Evaluate the characteristics of ac transmission
- 2.Reproduce the effect of shunt and series reactive compensation.
- 3.Justify the working principles of FACTS devices and their operating characteristics.
- 4.Reproduce the basic concepts of power quality.
- 5.Rewrite the concept of Harmonics
- 6.Reproduce and justify the working principles of devices to improve power quality.

UNIT I TRANSMISSION LINES AND SERIES/SHUNT REACTIVE POWER COMPENSATION (9)

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

UNIT II THYRISTOR-BASED FLEXIBLE AC TRANSMISSION CONTROLLERS (FACTS) (9)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

UNIT III : VOLTAGE SOURCE CONVERTER BASED (FACTS) CONTROLLERS (9)

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

UNIT- IV APPLICATION OF FACTS AND POWER QUALITY PROBLEMS IN DISTRIBUTION SYSTEMS (9)

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

UNIT V DSTATCOM (9)

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

SUGGESTED READINGS

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 2011.
2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
3. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 2010.
4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.
5. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 2005

WEB REFERENCES

1. <https://nptel.ac.in/courses/108/106/108106025/>
2. <https://nptel.ac.in/courses/108/107/108107114/>

OPEN ELECTIVES

B.E. Electrical and Electronics Engineering

2021-2022

21BEBMEOE01

ROBOTICS IN MEDICINE

3H-3C

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for students

- To Discuss the basics of Robotics, Kinematics.
- To perceive the basics of Inverse Kinematics.
- To Explore various kinematic motion planning solutions for various Robotic configurations.
- To Explore various applications of Robots in Medicine

COURSE OUTCOMES

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

- Demonstrate kinds robotics techniques, vision, planning and applications.
- Design various robotics applications
- Simulate planar motion, Source, Goal scenes and Task Planner

UNIT I INTRODUCTION (9)

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot

UNIT II KINEMATICS (9)

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three-Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, workspace fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT III ROBOT VISION (9)

Robot Vision Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNIT IV PLANNING

(9)

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

UNIT V APPLICATIONS

(9)

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynecology, Orthopedics, Neurosurgery.

SUGGESTED READINGS:

1. Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall, 2003.
2. J.J.Craig, Introduction to Robotics, Pearson Education, 2005.
3. Staugaard, Andrew C, Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning, Prentice Hall Of India, 1987.
4. Grover, Wiess, Nagel, Oderey, Industrial Robotics: Technology, Programming and Applications, McGraw Hill, 1986.
5. Wolfram Stadler, Analytical Robotics and Mechatronics, McGraw Hill, 1995.
6. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, Prentice Hall, 2001
7. K. S. Fu, R. C. Gonzales and C. S. G. Lee, Robotics, McGraw Hill, 2008

WEBSITES:

1. www.mit.edu
2. www.nptel.com

COURSE OBJECTIVES:

The goal of this course is for students:

- To discuss the overview of artificial organs & transplants
- To extend the principles of implant design with a case study
- To explain the implant design parameters and solution in use
- To simplify about various blood interfacing implants

COURSE OUTCOMES:

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

1. Explain the implant design parameters and solution in use
2. Analyze about various blood interfacing implants
3. Perceive knowledge about artificial organs & transplants
4. Demonstrate different types of soft tissue replacement and hard tissue replacement

UNIT I ARTIFICIAL ORGANS**(9)**

Artificial blood, Artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyser membrane), Dental Implants

UNIT II IMPLANT DESIGN & MATERIALS**(9)**

Principles of implant design, Clinical problems requiring implants for solution. Metallic implant materials, stainless steels, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION**(9)**

Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV BLOOD INTERFACING IMPLANTS**(9)**

Neural and neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS**(9)**

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

SUGGESTED READINGS

1. Kopff W.J, Kopff W.J, John Wiley and sons, New York, 1st edition, 1976.
2. Park J.B., Biomaterials Science and Engineering, Plenum Press, 1984.
3. Plenum Press, Biomedical Engineering handbook Volume II, CRC Press / IEEE Press, 2000.
4. R S Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003.
5. Joon B Park, Biomaterials – An Introduction, Plenum press, New York, 1992.
6. Yannas, I. V, Tissue and Organ Regeneration in Adults, New York, NY: Springer, 2001.
7. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition, 2010.
8. Myer Kutz, Standard Handbook of Biomedical Engineering & Design, McGraw- Hill, 2003.

WEBSITE:

1. www.mit.edu
2. www.nptel.com

21BTCEO01**ENERGY MANAGEMENT IN CHEMICAL INDUSTRIES****3H-3C**

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

The goal of this course is for students to

- Familiarize basic concepts and fundamental aspects of industrial and domestic thermal systems design.
- Plan to optimize energy using systems and procedures to meet energy demand.
- Examine the relationship between energy systems and society.
- Audit and evaluate energy management in energy intensive industries.

Course Outcomes:

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

- Plan for energy needs for process industries.
- Use optimization techniques for conservation of energy in chemical industries
- Evaluate the production rate and analyze the cost from economic balance for energy consumption.
- Enumerate the societal values of energy resources and the need for the conservation strategies.

UNIT I - PLANNING FOR ENERGY NEEDS (9)

Forecasting techniques; energy demand; magnitude and pattern; input and output analysis; energy modeling and optimal mix of energy sources.

UNIT II - ENERGY AND ENVIRONMENT (9)

Energy; various forms; energy storage; structural properties of environment; bio-geo-chemical cycles; society, environment population and technology.

UNIT III - ENERGY AND SOCIETY (9)

Energy and evolution; growth and change; patterns of consumption in developing and advanced countries; commercial generation of power requirements and benefit.

UNIT IV - MANAGEMENT OF ENERGY CONSERVATION IN CHEMICAL INDUSTRIES (9)

Chemical industries; classification; conservation in unit operations such as separation; cooling tower; drying; conservation applied to refineries, petrochemical, fertilizers, cement, pulp and paper, food and chlor-alkali industries; conservation using optimization techniques.

UNIT V-ECONOMIC BALANCE IN ENERGY CONSUMPTION (9)

Cost analysis; capacity; production rate; system rate; system cost analysis; corporate models; production analysis and production using fuel inventories; input-output analysis; economics; tariffs

Total: 45 Hours

SUGGESTED READINGS:

1. W.F. Kenney, Energy Conservation in the Process Industries. Academic Press Inc., 1984.
2. Vladimir S. Stepanov, Analysis of Energy Efficiency of Industrial Processes. 1st Edition, Springer-Verlag, 1993.
3. Jakob de Swaan Arons, Hedzer van der Kooi, Krishnan Sankaranarayanan, Efficiency and Sustainability in the Energy and Chemical Industries, 1st Edition, Marcel Dekker, Inc., 2004.
4. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, Guide to energy management, The Fairmont Press (2008).
5. Nagabhushan Raju, K., Industrial Energy Conservation Techniques: Concepts, Applications and Case Studies, Atlantic Publishers & Distributors (2007).
6. Jerrold H Kertz, Energy Conservation and Utilization, Allyn and BacurInc, 2016.
7. Gemand M Gramlay, Energy, Macmillan publishing Co, Newyork, 2005
8. Krentz J. H., Energy Conservation and Utilization, Allyn and Bacur Inc., 2006.
9. NPTEL course: Energy Management Systems: nptel.ac.in/courses/108/106/108106022/

21BTCEO02**INDUSTRIAL WASTEWATER TREATMENT****3H-3C****Instruction Hours/week: L:3 T:0 P:0****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours**

Course Objectives

The goal of this course is for students to

- Introduce the principles of wastewater and solid waste treatment and management.
- Know about the fundamental concepts in water and wastewater treatment technologies.
- Learn the hazardous solid waste disposal and management issues related to sludge treatment and disposal.
- Examine the constituents of waste water and its effects.

Course Outcomes

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

- Identify and separate the contaminants from the effluent for treatability.
- Determine the biomass yield and substrate utilization rate for biological treatment process and design of activated sludge process.
- Develop a flow sheet for the waste water treatment from dairy, sugar, pulp and paper, textile and pharmaceutical industries.
- Design process flow diagram for water reuse and sludge disposal.

UNIT I - INTRODUCTION TO WASTE WATER ENGINEERING (9)

Waste Water Engineering - Overview, inorganic non-metallic constituents and metallic constituents, physical and biological Characteristics.

UNIT II - OPERATIONS AND UNIT PROCESS (9)

Screening, Flow Equalization, Mixing, Flocculation, Grit removal, Sedimentation, Coagulation, Precipitation, Oxidation and Neutralization

UNIT III - FUNDAMENTALS OF BIOLOGICAL TREATMENT (9)

Introduction, Microbial growth kinetics, types of biological process for wastewater treatment - aerobic and anaerobic oxidation, Biological Nitrification and De-nitrification, biological phosphorous removal, activated sludge process (with design Considerations), trickling filters and lagoons.

UNIT IV - WASTE WATER TREATMENT IN SPECIFIC INDUSTRIES (9)

Dairy, Sugar, Pulp and Paper, Textile and Pharmaceutical Industries

UNIT V - WATER REUSE

(9)

Wastewater reclamation technologies and reuse, Solid processing flow diagrams, sludge and scum pumping, grinding, screening, degritting, blending, anaerobic digestion, composting, conditioning, dewatering and incineration.

Total: 45 Hours

SUGGESTED READINGS:

1. Metcalf Eddy, Wastewater Engineering -Treatment and Reuse, Fourth Edition, Tata McGraw Hill, New Delhi, 2002.
2. Mark J. Hammer, Water and Wastewater Technology, Seventh Edition, Prentice Hall of India Pvt Limited, New Delhi, 2012.
3. James M. Montgomery, Water Treatment Principles and Design, First Edition, A Wiley Interscience publication, New York, 1985
4. NPTEL course: Waste water treatment <https://nptel.ac.in/courses/105/105/105105178/>

21BECEO01**HOUSING, PLAN AND MANAGEMENT****3H-3C****Instruction Hours/week: L:3 T:0 P:0****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****COURSE OBJECTIVES**

- 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

COURSE OUTCOME

The students will be able to

1. Know the Importance of basic housing policies and building bye laws
2. Use Housing Programmes and Schemes
3. Plan and Design of Housing projects
4. Examine Innovative construction methods and Materials
5. Know Housing finance and loan approval procedures
6. Understand Construction as well as managing techniques

UNIT I INTRODUCTION TO HOUSING (9)

Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II HOUSING PROGRAMMES (9)

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 (9)

Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS (9)

New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNIT V HOUSING FINANCE AND PROJECT APPRAISAL (9)

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, 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.

End Semester Exam:3 Hours**COURSE OBJECTIVES**

- Defining and identifying of engineering services systems in buildings.
- The role of engineering services systems in providing comfort and facilitating life of users of the building.
- The basic principles of asset management in a building & facilities maintenance environment
- Importance of Fire safety and its installation techniques

COURSE OUTCOME

The students will be able to

1. Machineries involved in building construction
2. Understand Electrical system and its selection criteria
3. Use the Principles of illumination & design
4. Know the principle of Refrigeration and application
5. Importance of Fire safety and its installation techniques
6. Know the principle behind the installation of building services and to ensure safety in buildings

UNIT I: MACHINERIES**(9)**

Hot Water Boilers – Lifts and Escalators – Special features required for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

UNIT II: ELECTRICAL SYSTEMS IN BUILDINGS**(9)**

Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and

their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations

UNIT III: PRINCIPLES OF ILLUMINATION & DESIGN (9)

Visual tasks – Factors affecting visual tasks – Modern theory of light and colour – Synthesis of light – Additive and subtractive synthesis of colour – Luminous flux – Candela – Solid angle illumination – Utilization factor – Depreciation factor – MSCP – MHCP – Classification of lighting – Artificial light sources – Spectral energy distribution – Luminous efficiency – Colour temperature – Colour rendering. Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.

UNIT IV: REFRIGERATION PRINCIPLES & APPLICATIONS (9)

Thermodynamics – Heat – Temperature, measurement transfer – Change of state – Sensible heat – Latent heat of fusion, evaporation, sublimation – saturation temperature – Super heated vapour – Sub cooled liquid – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Compressors – Evaporators – Refrigerant control devices – Electric motors – Starters – Air handling units – Cooling towers – Window type and packaged air-conditioners – Chilled water plant – Fan coil systems – Water piping – Cooling load – Air conditioning systems for different types of buildings – Protection against fire to be caused by A.C. Systems

UNIT V: FIRE SAFETY INSTALLATION (9)

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems. Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder – Fire lighting pump and water storage – Dry and wet risers – Automatic sprinklers

TEXT BOOKS

- 1.E.R.Ambrose, “Heat Pumps and Electric Heating”, John and Wiley and Sons, Inc., New York, 2002.
2. Handbook for Building Engineers in Metric systems, NBC, New Delhi, 2005.

REFERENCES

1. Philips Lighting in Architectural Design, McGraw-Hill, New York, 2000.
2. A.F.C. Sherratt, “Air-conditioning and Energy Conservation”, The Architectural Press, London, 2005.
3. National Building Code.

21BEC50E01

INTERNET PROGRAMMING

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:

- To study concepts of Internet, IP addresses and protocols
- To introduce the Java programming language and explore its current strengths and Weaknesses
- To Elaborate on the principles of web page development
- To write working Java code to demonstrate the use of applets for client side programming
- To study Internet telephony and various multimedia applications

COURSE OUTCOMES:

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

- Learn the advanced concepts& techniques of Internet and Java.
- analyze the requirements for and create and implement the principles of web page development
- Understand the concepts of object-oriented and scripting
- Implement client side programming using java applets
- Generate applications based upon advanced java concepts

UNIT I Introduction**(9)**

Introduction - Network of Networks, Intranet, Extranet and Internet. World Wide Web- Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. TCP/IP- Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing- Classful and Classless Addressing, Subnetting

UNIT II HTML**(9)**

Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue. Image Maps- map, area, attributes of image area- Extensible Markup Language (XML)- Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief. CGI Scripts- Introduction- Environment Variable, GET and POST Methods.

UNIT III PERL**(9)**

Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling- JavaScript- Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation. Cookies- Definition of cookies, Create and Store a cookie with example. Java Applets-

UNIT IV Client-Server programming (9)

UNIT V Internet Telephony (9)

Total Hours: 45

REFERENCES:

- WEBSITES:**

1. <https://nptel.ac.in/courses/106/105/106105084/>
2. <https://supportline.microfocus.com/Documentation/books/sx22sp1/piover.htm>
3. <https://www.geeksforgeeks.org/internet-and-web-programming/>

21BEC SOE02**MACHINE LEARNING****3H-3C****Instruction Hours/week: L:3 T:0 P:0****Marks: Internal:40 External:60 Total:100****End Semester Exam:3 Hours****COURSE OBJECTIVES**

The goal of this course is for the students

- To introduce the basic concepts and techniques of Machine Learning.
- To have a complete understanding of the Supervised and Unsupervised learning techniques
- To study the various probability based learning techniques
- To learn Dimensionality Reduction Techniques.
- To understand Evolutionary Models and Graphical models of machine learning algorithms
- To design appropriate machine learning algorithms for problem solving

COURSE OUTCOMES

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

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification accuracy / efficiency
- Analyse and suggest appropriate machine learning approaches for various types of problems

UNIT I Introduction**(9)**

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II Neural Networks And Genetic Algorithms**(9)**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT III Bayesian And Computational Learning**(9)**

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV Instant Based Learning**(9)**

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

UNIT V Advanced Learning

(9)

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

TEXT BOOKS:

1. Michael Bowles, “Machine Learning in Python-Essential Techniques for Predictive Analysis”, Wiley Publication, 2015.
2. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. Jason Bell, “Machine learning – Hands on for Developers and Technical Professionals”, First Edition, Wiley, 2014.

REFERENCES:

1. Ethem Alpaydin, “Introduction to Machine Learning”, 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014
2. Tom M. Mitchell, “Machine Learning”, First Edition, McGrawHill Education, 2013.
3. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.

WEBSITES:

1. <https://nptel.ac.in/courses/106106139/>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-867-machine-learning-fall-2006/>
3. <https://www.dataquest.io/blog/machine-learning-python/>

Course Objectives

- To introduce the basic concepts of neural networks and its applications in various domain
- To educate about supervised and unsupervised learning process
- To have a solid understanding of various neural network model
- To learn the concepts of Self-organizing map (SOM) algorithm

Course Outcomes

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

- Understand the basic concepts of neural networks and its applications in various domains
- Gain knowledge about learning process in Neural Networks
- Design using Adaptive Resonance Theory (ART) technique
- Gain knowledge on SOM concepts

UNIT I INTRODUCTION TO NEURAL NETWORKS (9)

Introduction-biological neurons and their artificial models-learning, adaptation and neural network's learning rules-types of neural networks-single layer, multiple layer-feed forward, feedback networks

UNIT II LEARNING PROCESS (9)

Error– correction learning– memory based learning- hebbian learning-competitive learning- Boltzmann learning-supervised and unsupervised learning-adaptation-statistical learning theory.

UNIT III PERCEPTION (9)

Single layer Perception-Adaptive filtering-unconstrained Optimization-Least-mean square algorithm- Leaning Curve-Annealing Technique-perception convergence Theorem-Relationship between perception and Baye's Classifier-Back propagation algorithm

UNIT IV ATTRACTOR NEURAL NETWORK AND ART (9)

Hopfield model-BAM model -BAM Stability-Adaptive BAM -Lyapunov function-effect of gain-Hopfield Design-Application to TSP problem-ART-layer 1-layer 2-orienting subsystem- ART algorithm-ARTMAP.

UNIT-V SELF ORGANIZATION (9)

Self-organizing map-SOM Algorithm-properties of the feature map-LVQ-Hierarchical Vector Quantization. Applications of self-organizing maps: The Neural Phonetic Type Writer Learning Ballistic Arm Movements.

Suggested Readings

1. SimonHaykin Neural Networks and Learning Machines 3rd Edition Pearson/Prentice Hall 2009
2. SatishKumar Neural Networks: A Classroom Approach TMH 2008
3. Rajasekaran.S, Vijayalakshmi Pai.G.A Neural Networks, Fuzzy Logic and Genetic Algorithms, Synthesis and Applications PHI, New Delhi 2003.
4. LaureneFausett Fundamentals of Neural Networks: Architectures, Algorithms, and Applications Pearson/Prentice Hall 1994
5. Wasserman P.D Neural Computing Theory & Practice Van Nortrand Reinhold 1989.
6. Freeman J.A, S kapura D.M Neural networks, algorithms, applications, and programming techniques Addition Wesley 2005.

Web links

1. <https://nptel.ac.in/courses/117105084/>
2. <https://www.geeksforgeeks.org/adaptive-resonance-theory-art/>

Course Objectives

The goal of this course for students is :

- To provide clear knowledge on evolution of communication systems
- To make aware of mobile communication generations
- To deliver knowledge on wireless communication standards
- To make students to have a better understanding on satellite and radar communication

Course Outcomes

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

- Understand past, present and future trends in mobile communication.
- Understand various standards in use for wireless communication
- Demonstrate some basic application of GPS.
- Gain knowledge about RADAR working and its applications

UNIT I THE EVOLUTION OF ELECTRONIC COMMUNICATION (9)

From smoke signals to smart phones - History of communications: Theoretical Foundations, Development & Applications - Frequencies for communication - Frequency regulations - Overview of communication transmitter and receiver.

UNIT II MOBILE CELLULAR COMMUNICATIONS (9)

Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G, 4G - Cellular network components - Components of a mobile phone - setting up a call process - Making a call process - Receiving a call process - Spectrum allocation: Policies and strategies, Role of TRAI.

UNIT III WIRELESS COMMUNICATION (9)

Introduction - Bluetooth - Infrared communication - IEEE Wireless LANs (Wi-Fi) - IEEE 802.16 (WiMaX) - Future mobile and wireless networks: Introduction to 5G- device to device communication- IoT.

UNIT IV SATELLITE COMMUNICATION (9)

History of Satellite communication, Basics of Satellites, Types of Satellites, Capacity Allocation - Launch Vehicles and Orbits: Introduction to launching vehicles, Important Orbits, working of rocket, Three Pioneers of Rocketry - Basics of Global Positioning System (GPS) - Applications of GPS.

UNIT V RADAR & NAVIGATION (9)

Introduction, Radar Block diagram and Operation, Radar Frequencies, Applications of Radar. Navigation Systems: Introduction & methods of navigation, Instrument Landing System, Microwave landing system- Modern Navigation systems.

Suggested Readings

1. S.Haykin, —Communication Systems, 4/e, John Wiley 2007
2. B.P.Lathi, —Modern Digital and Analog Communication Systems, 3/e, Oxford University Press,2007
3. Rappaport Theodore S - Wireless Communications: Principles and Practice, 2/E, Pearson Education India, 2010
4. Vijay. K. Garg, —Wireless Communication and Networking, Morgan Kaufmann Publishers, 2007.
5. T.Pratt, C. Bostian and J.Allnutt; —Satellite Communications, John Wiley and Sons, Second Edition., 2003
6. M. I .Skolnik —Introduction to Radar Systems, Tata McGraw Hill 2006.
7. Myron Kyton and W.R.Fried —Avionics Navigation Systems, John Wiley & Sons 1997.

COURSE OBJECTIVE

1. To provide an overview of how computers are being used in mechanical component design
2. To study about the various computer graphics concepts
3. To get basic knowledge on geometric modeling
4. To study about the basics of parametric design and object representation
5. To get basic knowledge in product design and development.

COURSE OUTCOMES:

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

1. Give the overview of the cad systems and its importance
2. Explain the ideas and principles behind the computer graphics
3. Explain the process involved in graphic transformations
4. Understand the operations involved in the geometric modeling.
5. Describe the concepts of parametric design
6. Understand the basics of the product design and development.

UNIT I OVERVIEW OF CAD SYSTEMS

Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD- CAD hardware and software, analytical and graphics packages, CAD work stations. Networking of CAD systems.

UNIT II INTERACTIVE COMPUTER GRAPHICS AND GRAPHICS TRANSFORMATIONS

Generative, cognitive and image processing graphics. Static and dynamic data graphics. Transport of graphics data. Graphic standards. Generation of graphic primitives-display transformation in Two- and Three – Dimensional graphics concepts, Graphical input technique, Geometric transformations, Visual Realism, Computer animation, customizing graphics software.

UNIT III GEOMETRIC MODELING

Wireframe, surface, NURBS and solid modeling-applications and advantages. Creating primitive solids, sweeping solids, Boolean operations. Extracting entities from a solid. Filletting of edges of solids. Boundary representation (B-rep) Constructive Solid Geometry (CSG) and Analytical Solid Modeling (ASM).

UNITIV PARAMETRIC DESIGN AND OBJECT REPRESENTATION

Types of co-ordinate systems. Parametric design - definition and advantages. Parametric representation of analytic and synthetic curves. Parametric representation of surfaces and solids- manipulations.

UNITV PRODUCT DESIGN AND DEVELOPMENT

Automated 2D drafting-basics, mating conditions—Types of translators (IGES, STEP, ACIS and DXF). Mass property calculations.

SUGGESTED READINGS

1. Vera B Anand, Computer Graphics and Geometric Modeling for Engineers, 1st edition, John Wiley & Sons, New York, 2000
2. Radhakrishnan Pand Subramanyan S, CAD/CAM/CIM, 2nd edition, New Age International Pvt. Ltd, 2008
3. Ibrahim Zeid, CAD/CAM Theory and Practice, 2nd edition, McGraw Hill Inc., New York, 2009
4. Barry Hawhes, The CAD/CAM Process, 1st edition, Pitman Publishing, London, 2007 (digital)
5. William M Newman and Robert Sproul, Principles of Interactive Computer Graphics, 1st edition, McGraw Hill Inc., New York, 2001
6. Rao SS, Optimization Techniques, 1st edition, Wiley Eastern, New Delhi, 2006

COURSE OBJECTIVE

To provide in-depth knowledge on various techniques of non-destructive testing

COURSE OUTCOME

At the end of the course, student will be able to

1. Understand the need and awareness of the safety concepts
2. Understand the various safety techniques involved in industrial sector.
3. Record and investigate the accident zone and prepare reports related to it.
4. Conduct basic safety inspections using strategies that they have developed
5. Identify and demonstrate working of safety monitoring
6. Train about the education and training based on safety

UNIT I CONCEPTS

Evolution of modern safety concept-Safety policy-Safety Organization-line and staff functions for safety-Safety Committee-budgeting for safety.

UNIT II TECHNIQUES

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING

Concept of an accident, reportable and non reportable accidents, unsafe act and condition–

principles of accident prevention, Supervisory role-Role of safety committee–Accident causation models–

Cost of accident. Overall accident investigation process-Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

UNIT IV SAFETY PERFORMANCE MONITORING

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

Importance of training-identification of training needs-training methods–programme, seminars, conferences, competitions–method of promoting safe practice-motivation–communication- role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign– Domestic Safety and Training.

SUGGESTED READINGS

1. Accident Prevention Manual for Industrial Operations, 3rd edition, N.S.C. Chicago, 2010 (digital).
2. Heinrich H.W. "Industrial Accident Prevention", 2nd edition, Tata McGraw-Hill Company, New York, 1941.
3. Krishnan N.V, Safety Management in Industry, 1st edition, Jaico Publishing House, Bombay, 1997.
4. John R Ridley, Safety at Work, 3rd edition, Elsevier, 2014
5. Roland P. Blake, Industrial Safety, 2nd edition, Prentice Hall, Inc., New Jersey, 1973
6. LM Deshmukh, Industrial safety management, 1st edition, TATA McGraw Hill, 2005

COURSES OFFERED TO OTHER DEPARTMENT
ELECTRICAL AND ELECTRONICS ENGINEERING

B.E Electrical and Electronics Engineering **2021-2022**

21BEEEOE01	ELECTRIC HYBRID VEHICLE	3H-3C
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Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

Course Objectives

- Summarize To understand the basic concepts of electric hybrid vehicle.
- To gain the knowledge about electric propulsion unit.
- To gain the concept of Hybrid Electric Drive-Trains.
- To gain the different Energy Management Strategies.
- To study about the efficiency manipulation in drives
- To understand and gain the knowledge about various energy storage devices

Course Outcomes:

- the basic concepts in bioprocess Engineering.
- Explain the concept of Hybrid Electric Vehicles.
- Understand the concept of Hybrid Electric Drive-Trains.
- Identify the different Energy Management Strategies.
- Understand the concept of different Energy Storage devices.
- Analyze the different motor drives used in Hybrid Electric Vehicles.

UNIT I INTRODUCTION **(9)**

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 **(9)**

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 **(9)**

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 **(9)**

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 **(9)**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Suggested Readings

1. Iqbal Hussein Electric and Hybrid Vehicles: Design Fundamentals CRC Press – 2nd edition 2010.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design Standardsmedia – 2nd edition 2009.
3. James Larminie, John Lowry Electric Vehicle Technology Wiley – 2nd edition 2012.
4. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
5. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
6. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and FuelCell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
7. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.
8. <https://www.energy.gov/eere/electricvehicles/electric-vehicle-basics>
9. https://swayam.gov.in/nd1_noc20_ee18/preview
10. <https://nptel.ac.in/courses/108103009/>

Course Objectives

- To gain the knowledge about environmental aspects of energy utilization.
- To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
- To study about solar energy collectors and its storages
- To study about the inter connected system in wind power
- To understand the basic principles fuel cell, Geo thermal power plants.
- To gain the knowledge about hydro energy.

Course Outcomes

At the end of this course, students will demonstrate the ability to

- Analyze the Energy Scenario in India.
- Understand the concept of Solar Energy.
- Understand the concept of Wind Energy.
- Understand the concept of Hydro Energy.
- Analyze the different energy sources.
- Students gathered the real time inter connected system modelling in wind power.

UNIT I INTRODUCTION**(9)**

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization - Energy Conservation and Energy Efficiency - Needs and Advantages, Energy Conservation Act 2001.

UNIT II SOLAR ENERGY**(9)**

Introduction to solar energy: solar radiation, availability, measurement and estimation– Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storage.

UNIT III WIND ENERGY**(9)**

Introduction – Basic principles of wind energy conversion- components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

UNIT IV HYDRO ENERGY**(9)**

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

UNIT V OTHER SOURCES

(9)

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

Suggested Readings

1. Rai.G.D Non-conventional sources of energy Khanna publishers 2011
 2. Khan.B.H Non-Conventional Energy Resources The McGraw Hills, Second edition 2009
 3. Rao.S. & Parulekar Energy Technology Khanna publishers, Eleventh Reprint 2013
 4. Godfrey Boyl Renewable Energy: Power sustainable future Oxford University Press, Third edition 2012.
 5. John W Twidell and Anthony D Weir Renewable Energy Resources Taylor and Francis – 3rd edition 2015.
 6. <https://nptel.ac.in/courses/103/107/103107157/>
 7. <https://nptel.ac.in/courses/121/106/121106014/>
 8. <https://nptel.ac.in/courses/108/108/108108078/>
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