Programme Ordinance, POs, PSOs & Course Outcomes (COs)

DEPARTMENT OF ELECTRICAL ENGINEERING
FACULTY OF ENGINEERING & TECHNOLOGY
UNIVERSITY OF LUCKNOW

Programme Ordinance

1. GENERAL INFORMATION:

The degree of Bachelor of Technology (B. Tech.) of University of Lucknow, Lucknow shall be conferred on the candidates who have pursued the prescribed course of study and have passed the examinations as prescribed in the ordinances. The course will be conducted on full time basis.

2. ELIGIBILITY FOR ADMISSION:

2.1 Admission to B. Tech. First year in First Semester (from 2017-18 and onwards) and lateral entry to B. Tech. Second year in Third Semester (from 2018-19 and onwards) will be made through U. P. State Entrance Examination conducted by AKTU, Lucknow, or as decided by Executive Council of the University.

2.2 The minimum academic qualification for appearing in the Entrance Examination will be a pass in the final examination of 10+2 system or its equivalent with Chemistry, Mathematics and Physics or as notified. The candidate should be domiciled of U.P.

2.3 For admission to B. Tech. Second year (lateral entry) in third semester, candidate who have passed 3/4 Year Diploma (with minimum 60% marks) from institutions recognized by the U.P. Board of Technical Education in any branch of Engineering /Technology except Agriculture Engineering are eligible.

2.4 Up to 5% of the seats may be filled by NRI / direct / sponsored admission. These shall be supernumerary seats. They shall be admitted without any entrance examination on the basis of past academic record as notified. The fee structure for such students will be as notified.

2.5 In all cases, the admission of an applicant to the B. Tech, program requires that the applicant has:

a) The minimum academic qualification as notified,
b) Fulfilled the prescribed admission procedure and paid the prescribed fees.

3. ATTENDANCE:

3.1 Students are required to attend 100% classes. Any relaxations in attendance are subject to the satisfaction of concerned HOD/Dean. Normally student shall not be allowed to appear in a semester examination unless he / she has an overall average 75% attendance and 60% attendance in each of the theory / practical subjects in that semester. Attendance for dissertation work shall be verified by the supervisor / guide. However, an additional shortage by an amount not exceeding 15% of the total number of lectures delivered or practical work done in each subject may be condoned for special reasons as given below.

(a) A shortage up-to 5% of the total number of lectures delivered or practical work done in each subject may be condoned by the Head of the Department.

(b) A further shortage upto 10% may be condoned by the Dean of the Faculty on the specific recommendation of the concerned Head of Department.

3.2 No student will be allowed to appear in the end semester examination if he/she does not satisfy the overall average attendance requirements of Clause Nos. 3.1 and such candidate(s) shall be treated as having failed and will be further governed by clause no. 4.2 & 4.3.

3.3 The attendance shall be counted from the date of admission in the Faculty or start of academic session whichever is later.

(Note: For the purpose of the attendance not more than three periods including lecture and tutorial in the same subject shall be counted on any one day).

4. DURATION OF COURSES:

4.1 Total duration of the B. Tech. Course shall be 4 years, each year comprising of two semesters. Each semester shall normally have teaching for the 90 working days or as prescribed by A.I.C.T.E. from time to time.

4.2 A candidate, who has failed twice in first year due to any reason, including due to his/her non-appearance or he/she being not permitted to appear in semester examinations, shall not be allowed to continue his/her studies further subject to clause 8.

Provided further that if a student wishes to continue third time in first year he/she may be allowed on the recommendation of a committee constituted by the Vice Chancellor. However, the maximum time allowed for completing the course shall remain the same as in clause 4.3.

4.3 The maximum time allowed for a candidate admitted in 1st /3rd semester (for lateral entry) for completing the B. Tech. course shall be 7 (seven)/ 6 (Six) years respectively, failing which he/she shall not be allowed to continue for his/her B. Tech. degree.

4.4 The minimum credit requirement for B. Tech. degree is 192. The lower and upper limit for course credit registered in a semester by a full time student are :

Lower limit - 16 credits & Upper limit - 28 credits

5. CHANGE OF BRANCH:

5.1 Change of branch may be allowed against the vacant seats at the following two stages, provided criteria in the following sub clauses are satisfied.

(i) In first year, after the last date of admission to the B. Tech. 1st semester, on the basis of merit of entrance examination on vacant seats subject to clause 5.2

(ii) In the second year, on the basis of merit at the B. Tech. first year examination for those who are passed without any carry over papers subject to clause 5.2

5.2 After change of branch, number of students in branch (s) shall neither increase over the approved intake nor will it decrease below 75% of approved intake.

5.3 Change of branch is not applicable to the candidates admitted in Second Year of B. Tech. courses (lateral entry) as per clause 2.

5.4 The change of branch if allowed will become effective from B. Tech. 3rd semester.

5.5 Further change of branch shall not be permitted.

6. CURRICULUM:

6.1 The 4 year curriculum has been divided into 8 semester and shall include lectures, tutorials, practicals, seminars and projects etc. in addition to industrial training and educational tour etc. as defined in the scheme and executive instructions issued by the Institute from time to time.

6.2 The curriculum shall also include such other curricular, co-curricular and extracurricular activities as may be prescribed by the Faculty from time to time.

7. CURRICULUM STRUCTURE OF THE PROGRAMME :

The Faculty shall follow credit-based semester system. Every programme will have a specific curriculum for all semesters (semester I to semester VIII) with a syllabi consisting of theory, practical, project work, etc. and shall be in accordance with the prescribed syllabus. The courses shall be covered through lectures, tutorials, laboratory classes, seminar, industrial and practical training, project, tours etc.

7.1 Course Coverage

The course coverage for all the B. Tech. Programmes shall have the following categories:

(i) Humanities and Social Sciences (HS)
(ii) Management (M)
(iii) Basic Applied Sciences (BAS)
(iv) Basic Engineering Sciences (BES)
(v) Departmental Core (DC)
(vi) Departmental Electives (DE)
(vii) Open Electives (OE)
(viii) Project Work, Seminar and Industrial Training (PST)
(ix) Mandatory Audit Courses (MAC)
(x) Few audit courses as per demand and requirement of students may be offered.

Each course is assigned a certain number of credits as follows.

(a) 1 credit per lecture hour per week
(b) 1 credit per tutorial hour per week
(c) 1 credit per 2 hours laboratory/practice/project per week.
(d) 2 credits per 3 hours laboratory/practice/project per week.

7.2 Grading System and Assessment Procedure :

An **Absolute Grading System** wherein the marks shall be converted into grades and the result of each semester will be declared with **Semester Grade Point Average** (SGPA) and **Cumulative Grade Point Average** (CGPA). The CGPA will be calculated for every semester, except the first semester. The grading system to be adopted with Letter Grades and Grade Points Scale shall be as given below:

Letter Grade	**Description**	**Grade Point**	**% (Marks Range)**
O	Outstanding	10	Greater than or equal to 90
A^+	Excellent	09	Less than 90 but greater than or equal to 80
A	Very Good	08	Less than 80 but greater than or equal to 70
B^+	Good	07	Less than 70 but greater than or equal to 60
B	Above Average	06	Less than 60 but greater than or equal to 50
C	Average	05	Less than 50 but greater than or equal to 45
P	Poor	04	Less than 45 but greater than or equal to 40
F	Fail	00	Less than 40
U	Short Attendance	-	-
W	Withdrawal	-	-
I	Incomplete	-	-
UFM	Unfair Means	-	-
AP	Audit Pass	-	-
AF	Audit Fail	-	-
S	Satisfactory Completion	-	-
Z	Course Continuation	-	-

Rounding of the numeric value of grades obtained will be done till two places of decimal.

7.3 Tests & Examinations

The theory and practical examinations shall consist of continuous assessment throughout the semester in all subjects. The End Semester Examination (ESE) will be conducted by University at the end of the semester. The assessment of courses will be done on absolute marks basis. However, for the

purpose of reporting the performance of a candidate, letter grades, each carrying certain points, will be awarded as per the range of total marks obtained by the candidate as detailed below.

7.4 Marks Distribution:

S. No.	Exam Category	Evaluation									
		Sessional								ESE	Grand Total
		CT		TA					Total		
		CT 1	CT 2	V	V	W	R	CP			
01	Theory Subject	10	10					10	30	70	100
02	Lab			05	05			10	20	30	50
03	Industrial Training				10	20	20		50		50
04	Seminar				10	20	20		50		50
05	Project 1			20	20	40	20		100		100
06	Project 2			25	25	50	50		150	100	250
07	MAC	10	10						20	30	50

CT: Class Test; TA: Teacher's Assessment; ESE: End Semester Examination; V 1: Viva-Voce 1; V 2: Viva-Voce 2; W: work; R: Report; CP: Class Performance (Tutorial + Attendance)

Notes:

A. The course coverage for Class Test-I, Class Test-II and End Semester Exam (ESE) will be respectively 40%, 80% and 100% of the syllabus.

B. Students who remain absent in either of the class tests on genuine grounds such as medical reasons. Institute representation in academic/extra-curricular activities with prior permission of the concerned Head of Department may be permitted for a special test. Students, who remain absent in both the class tests with prior permission will be allowed one special test covering 80% of the syllabus.

C. Class Performance will be based on assignments/tutorials, quizzes/viva-voce and attendance.

7.5 General Proficiency :

A **qualitative Assessment Remark** for General Proficiency as detailed in the table below will be given in the transcript on the basis of cumulative percentages of marks scored by the student during each semester through various components. Distribution / Weightage for award of marks in each component is prescribed in the subsequent table.

S.N.	Assessment	Weightage of Marks	Marks
1.	Discipline/Behavior of Students Inside/Outside Institute campus by DSW	40%	20
2.	Games/Sports/Cultural/Literary/PFAC/Hobby Events by Chairman, CSA	40%	20
3.	Academic Activities/Special Lecture/ Industrial Visits by HOD	20%	10

S.N.	Marks Secured	Remark
1.	80-100%	Excellent
2.	60-79%	Very Good
3.	40-59%	Good
4.	20-39%	Satisfactory
5.	<20%	Poor

8. CRITERIA FOR PASSING:

The performance of a student in a semester shall be evaluated through continuous class assessment and end semester examination. The continuous assessment shall be based on class tests, assignments/tutorials, quizzes/viva-voce and attendance. The marks for continuous assessment (sessional marks) shall be awarded at the end of the semester. The end semester examination shall comprise of written papers, practical and viva-voce, inspection of certified course work in classes and laboratories, project work, design reports or by means of any combination of these methods.

The distribution of marks for sessional, end semester theory papers, practical and other examinations, seminar, project and industrial training shall be as prescribed in the course structure. The practical, viva-voce, projects and reports shall be examined/evaluated through internal and external examiners as and when required.

The marks obtained in a subject shall consist of marks allotted in end semester theory paper and sessional work.

8.1 A Student who secures Grade O to P shall be considered as passed. If a student secures "F" grade, he /she has to reappear for the concerned subject examination. It is mandatory for a student to earn the required credits as mentioned in each semester.

(a) To pass in a Theory Subject, a student shall have to secure minimum 30% of the maximum marks prescribed for the End Semester Examination (ESE) and 40% of marks in the aggregate of End Semester Examination (ESE) and sessional marks assigned for that particular subject, i.e. **Minimum Passing Grade** shall be **"P".**

(b) For passing a Practical/Internship/Project/Viva-voce examination, a student shall have to secure a minimum of 50% of the prescribed maximum marks in the End Semester Examination of Practical/Internship/Project/Viva-voce and 50% of marks in the aggregate of Practical/Internship/Project/Viva-voce ESE and assigned sessional marks i.e. Minimum Passing Grade shall be "B".

(c) To pass in Seminar, a student shall require to secure a minimum of 50% of the maximum marks prescribed, i.e. Minimum Passing Grade shall be "B".

8.2 The student who do not satisfy the condition 8.1 or the student who remains absent shall be deemed to have failed in that subject and may appear for the University examination in the subsequent examinations the sessional marks awarded to the student/s at previous attempt in the concerned subject will be carried forward. However, if the student has secured less than 40% marks in the sessional, he/she will also be required to complete the sessional work of the concerned subject by way of assignments, quizzes and both class tests. The SGPA of the concerned semester will be calculated on the basis of the new grade secured by the student in the repeat examination of the subject (with new or old sessional marks as the case may be). Number of attempts taken to pass a subject/s shall be recorded in the transcript.

8.3 A student may, at his/her desire, opt to abandon his/her performance of a semester in following manner.

(a) A student may opt to abandon his/her performance only in University Examination of the Semester.

(b) A student may opt to abandon his/her total performance of the Semester which includes performance in University Examination and Sessional Marks.

(c) A student may opt of abandon his/her performance in University Examination of any or both semester of the same academic year only.

(d) A student shall be allowed to abandon the performance maximum twice during the entire course of study.

(e) Performance of a semester, once abandoned, can not be claimed again.

8.4 The student, who opts to abandon the performance of a semester as per clause 8.3, shall abandon performance in all the courses of that semester, irrespective of fact whether the student has passed or failed in any subject of that semester.

8.5 A student, who opt to abandon the total performance of the semester including sessional marks, has to take readmission for the relevant semester. Readmission to the First semester in such cases shall not be considered as fresh admission i.e., the student will continue to have the same University Roll Number, which was allotted earlier.

8.6 The Student, who opted to abandon his/her performance only in the University examination of a semester and does not desire readmission, shall be permitted to re-appear for examinations of all the subjects of the semester in the subsequent examinations as an Ex- Student, However, the sessional marks obtained by the student in the abandoned semester shall be retained as per clause 8.2.

8.7 Such students who opted to abandon the performance at final year are eligible for the award of Class and Distinction at the B. Tech. degree level.

8.8 A student shall be declared to have completed the programme of B. Tech. degree, provided the student has undergone the stipulated course work as per the regulations and has earned atleast 192 Credits.

8.9 A student can avail one chance to improve his/her grade in one subject of just preceding semester in the next corresponding End Semester Examination, provided that he/she has secured P or higher grade in that subject. The grade secured in **"Improvement Attempt"** will be used for calculation of SGPA of the concerned semester and old grade secured in that particular subject will stand nullified.

8.10 For Audit Courses, Grade AP (Audit Pass) or AF (Audit Fail) shall be awarded and this will not be counted for the computation of SGPA/CGPA. Audit Fail students have to pass the course as per clause 8.2.

9. ELIGIBILITY FOR PROMOTION :

9.1 There shall not be any restriction for promotion from an odd semester to the next even semester.

9.2 For promotion from even semester to the next odd semester (i.e. of the next academic year) the student has to secured 24 credits in the immediately preceding two semesters including theory and practical credits.

Minimum Credit Threshold for Promotion

Check Point	Credit Threshold
First Year to Second Year	24 Credits in First Year
Second Year to Third Year	24 Credits in Second year
Third Year to Fourth Year	24 Credits in Third year

9.3 The result of the semester shall be declared pass only on securing P or above grades in all subjects and minimum semester Grade Point Average (SGPA) is 5.0.

9.4 Student himself can decide to abandon the performance of any or both the semesters of same academic year as per clause 8.3 and reappear in abandoned semester examination as per clauses 8.4, 8.5, & 8.6.

10. COMPUTATION OF SGPA AND CGPA :

(i) The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$\boldsymbol{SGPA(S_i)} = \sum(\boldsymbol{C_i} \times \boldsymbol{G_i}) / \sum \boldsymbol{C_i}$$

Where $\boldsymbol{C_i}$ is the number of credits of the ith course and $\boldsymbol{G_i}$ is the grade point scored by the student in the ith course.

(i) The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\boldsymbol{CGPA} = \sum(\boldsymbol{C_i} \times \boldsymbol{S_i}) / \sum \boldsymbol{C_i}$$

Where $\boldsymbol{S_i}$ is the SGPA of the ith semester and $\boldsymbol{C_i}$ is the total number of credits in that semester.

(ii) The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

(iii) Formula for the conversion of CGPA into percent marks is CGPA x 10 = (% Marks)

11. AWARD OF DIVISION & RANK :

Division shall be awarded only after the eighth and final semester examination based on integrated performance of the candidate for all the eight semesters (six semesters for lateral entry) as per following details:

11.1 A candidate who qualifies for the award of the degree securing P or above grades in all subjects pertaining to all semesters in first attempt within eight consecutive semesters (four academic years)/ six consecutive semesters (three academic years) as applicable, and in addition secures a CGPA of 7.5 and above for the semesters I to VIII or IE to VIE shall be declared to have passed the examination in **FIRST DIVISION WITH HONOURS.**

11.2 A candidate who qualifies for the award of the degree by securing P or above grades in all subjects of all the semesters within maximum permissible period and secures CGPA not less than 6.5 shall be declared to have passed the examination in **FIRST DIVISION.**

11.3 All other candidates who qualify for the award of degree by securing P or above grades in all subjects of all semesters and secures CGPA not less than 5.0 shall be declared to have passed the examination in **SECOND DIVISION.**

11.4 For award of ranks in a branch, the first **Three** students will be awarded ranks, provided they have secured Grade P or above in all subjects pertaining to all semesters in first attempt within eight consecutive semesters (four academic years)/ six consecutive semesters (three academic years) as applicable.

12. SCRUTINY AND RE-EVALUATION:

12.1 Scrutiny shall be permitted within two weeks after declaration of result and will only be allowed in theory papers on the request of a student after deposition of prescribed fee for each subject decided by the University.

12.2 Re-evaluation of theory/practical papers is not permitted.

13. UNFAIR MEANS:

Cases of unfair means in the End Semester Examinations and Mid-Term Tests shall be dealt as per the rules of the University of Lucknow.

14. EX-STUDENTSHIP:

14.1 A candidate opting for ex-studentship shall be required to fulfill the conditions 8.3, 8.4, 8.5 & 8.6 and to appear in all the theory & practical subjects in the End Semester Examinations of both semesters of the same Academic Year. However, the marks of Sessional, Industrial Training, Seminar and General Proficiency shall remain the same as those secured by him/her in the previous Academic Year(s) as per clause 8.2.

14.2 A candidate opting for ex-studentship shall be required to apply to the Dean's office by paying only examination fee within 15 days from the start of new session.

15. RE-ADMISSION:

A candidate may be allowed for re-admission provided he/she satisfies one of the following conditions:

15.1 A candidate is declared failed.

15.2 A candidate did not appear in a semester examination/or he/she was not granted permission to appear in the examination.

15.3 A candidate has been detained by the University and subsequently has been permitted to take re-admission.

15.4 A candidate promoted with carry over subjects and he/she opted for readmission.

16. CANCELLATION OF ADMISSION:

The admission of a student at any stage of study shall stand cancelled if:

(i) He/she is not found qualified as per AICTE/State Government norms and guidelines or the eligibility criteria prescribed by the University.

or

(ii) If he/she fails to submit qualifying examination result/mark sheet after getting admission to B. Tech. First Semester/Third Semester (lateral entry) within a prescribed time.

or

(iii) He/she is found unable to complete the course within the stipulated time as prescribed in clause 4.2.

or

(iv) He/she is found involved in creating indiscipline in the University.

17. INTERPRETATION CLAUSE:

In case of any difficulty arising during the course of implementation of these ordinances or in case of any unforeseen circumstance, the interpretation/decision of the Vice-Chancellor shall be final.

18. The Academic Council shall have the power to relax/change any provision provided in the ordinance in any specific matter/situation.

19. Any legal issues arising out of the rules/provisions contained in the ordinances shall fall under the jurisdiction of District Lucknow.

PROGRAMME OUTCOMES (POs)

Electrical Engineering Graduates will be able to:

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

[2] Problem analysis:
Identify, formulate and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

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

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

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

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

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

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

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

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

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

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Electrical Engineering Graduates will be able to:

[1] Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronic circuits, electrical machines and power systems.

[2] Apply appropriate techniques and modern Engineering hardware and software tools in power systems to engage in life- long learning and to successfully adapt in multi-disciplinary environments.

[3] Understand the impact of Professional Engineering solutions in societal and environmental context, commit to professional ethics and communicate effectively.

Course Structure and Evaluation Scheme for B.Tech.

SEMESTER-I

S. No.	Subject Code	Subject Name	L – T - P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	AS 103	Engineering Mathematics-I	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
02.	AS 101	Engineering Physics-I	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
03.	EE 101/ ME 101	Basic Electrical Engineering/ Elements of Mechanical Engineering	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
04.	AS 104 CS 101	Professional Communication/ Computer System & Programming in	**3-0-0**	**20**	**10**	**30**	**70**	**100**	**3**
05.	EC 101/ AS 102	Basic Electronics/Engineering Chemistry	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
	Practical								
06.	AS 151/ AS 152	Engineering Physics Lab/ Engineering Chemistry Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
07.	EE151/ ME 151	Basic Electrical Engineering Lab Elements of Mechanical Engineering Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
08.	AS 154/ CS 151	Professional Communication Lab/ Computer Programming . Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
09.	ME 152/ CE 151	Workshop Practice/Computer Aided Engineering Graphics	**0-0-3**	**-**	**20**	**20**	**30**	**50**	**2**
10.	GP	General Proficiency	**-**	**-**	**-**	**50**	**-**	**50**	**-**
Total								**700**	**24**

SEMESTER-II

S. No.	Subject Code	Subject Name	L - T - P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	AS 203	Engineering Mathematics-II	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
02.	AS 201	Engineering Physics-II	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
03.	ME 201/ EE 201	Elements of Mechanical Engineering/ Basic Electrical Engineering	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
04.	CS 201/ AS 204	Computer System & Programming in C/ Professional Communication	**3-0-0**	**20**	**10**	**30**	**70**	**100**	**3**
05.	AS 202/ EC 201	Engineering Chemistry/ Basic Electronics	**3-1-0**	**20**	**10**	**30**	**70**	**100**	**4**
	Practical								
06.	AS 252/ AS 251	Engineering Chemistry Lab/ Engineering Physics Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
07.	ME 251/ EE 251	Elements of Mechanical Engineering Lab/ Basic Electrical Engineering Lab	**0-0-2**	**—**	**20**	**20**	**30**	**50**	**1**
08.	CS 251/ AS254	Computer Programming. Lab/ Professional Communication Lab	**0-0-2**	**-**	**20**	**20**	**30**	**50**	**1**
09.	CE 251/ ME 252	Computer Aided Engineering Graphics/Workshop Practice	**0-0-3**	**-**	**20**	**20**	**30**	**50**	**2**
10.	GP	**General Proficiency**				**50**		**50**	
Total								**700**	**24**

SEMESTER - III

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
1.	AS – 301	Mathematics – III	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
2.	EE - 301	Network Analysis and Synthesis	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
3.	EE - 302	Electrical Measurement and Measuring Instruments	**3--0--0**	**20**	**10**	**30**	**70**	**100**	3
4.	EE - 303	Electrical Machines –I	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
5.	EC - 304	Analog and Digital Electronics	**3--0--0**	**20**	**10**	**30**	**70**	**100**	3
6.	AS – 302/ AS - 303	Human Values & Ethics / Environment & Ecology	**3—0--0**	**20**	**10**	**30**	**70**	**100**	**3**
	Practical								
7.	EE - 351	Network Analysis and Synthesis Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
8.	EE - 352	Electrical Measurement and Measuring Instruments Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
9.	EE - 353	Electrical Machines Lab – I	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
10.	EC - 354	Analog Integrated Circuits Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
11.	**GP - 301**	**General Proficiency**				**50**		**50**	
Total			**18-2-8**					**800**	**24**

SEMESTER - IV

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
1.	AS – 401	Computer Oriented Numerical Techniques	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
2.	EE - 402	Electrical Machines – II	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
3.	EE - 403	Basic System Analysis	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
4.	EC – 402	Electromagnetic Field Theory	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
5.	EC – 404	Fundamentals of Microprocessors	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
6.	AS – 402/ AS - 403	Human Values & Ethics/ Environment & Ecology	**3—0--0**	**20**	**10**	**30**	**70**	**100**	**3**
	Practical								
7.	EE - 452	Electrical Machines **Lab – II**	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
8.	EC – 454	**Microprocessor Lab**	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
9.	EC - 455	**Digital Electronics Lab**	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
10.	EE – 453	**Numerical Technique Lab**	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
11.	**GP - 401**	**General Proficiency**				**50**		**50**	
Total			**18-2-8**					**800**	**24**

SEMESTER – V

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	EE – 501	Power System - I	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
02.	EE – 502	Control Systems	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
03.	EE – 503	Electrical and Electronics Engineering Materials	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
04.	EE - 504	Advanced Electrical Machines	**3--0--0**	**20**	**10**	**30**	**70**	**100**	**3**
05.	EC– 501	Principles of Communication Engineering	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
	Practical								
06.	EE – 551	Power System Lab - I	**0--0--3**	**-**	**40**	**40**	**60**	**100**	**2**
07.	EE – 552	Control System Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
08.	EE – 553	Electrical Design and Fabrication Lab	**0--0--3**	**-**	**40**	**40**	**60**	**100**	**2**
09.	EC - 555	Principles of Communication Engineering Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
10.	**GP - 501**	**General Proficiency**				**50**		**50**	
Total			**15-3-10**					**800**	**24**

SEMESTER-VI

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	EE – 601	Power system – II	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
02.	EE – 602	Power Electronics	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
03.	EE – 603	Advanced Control Systems	**3--1--0**	**20**	**10**	**30**	**70**	**100**	**4**
04.	EE – 604	Power Station Practice	**3--0--0**	**20**	**10**	**30**	**70**	**100**	3
05.	EE - 605	Any one from the list (DE -1)	**3--0--0**	**20**	**10**	**30**	**70**	**100**	3
	Practical								
06.	EE – 651	Power System Lab - II	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
07.	EE - 652	Power Electronics Lab	**0--0--2**	**-**	**20**	**20**	**30**	**50**	**1**
08.	EE – 653	**Mini Project**	**0--0--3**	**-**	**40**	**40**	**60**	**100**	**2**
09.	EE – 654	Seminar	**0--0--3**	**-**	**40**	**40**	**60**	**100**	**2**
10.	**GP - 601**	**General Proficiency**				**50**		**50**	
Total			**15-3-10**					**800**	**24**

Note: Students have to undergo Industrial Training for a period of six weeks during summer vacation. The report of Industrial Training will be submitted to the Head of the Department in the beginning of seventh semester.

Departmental Elective-1:-

EE – 6051 Computer aided power system analysis
EE – 6052 Electrical Machine Design
EE – 6053 Utilization of Electrical Energy and Traction
EE – 6054 Fundamentals of Digital Signal Processing
EE – 6055 Artificial Neural Networks and Fuzzy system

SEMESTER-VII

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
		Theory							
01.	EE–701	Switchgear and Protection	3–1–0	20	10	30	70	100	4
02.	EE–702	Electric Drives	3–1–0	20	10	30	70	100	4
03.	EE–703	FACTS Devices	3–1–0	20	10	30	70	100	4
04.	EE–704X	Any one from the list (DE-2)	3–1–0	20	10	30	70	100	4
05.	AS–701/ AS–702	Engineering Economics/ Industrial Management	3–0–0	20	10	30	70	100	3
		Practical							
06.	EE–751	Switchgear and Protection Lab	0–0–2	–	20	20	30	50	1
07.	EE–752	Electric Drives Lab	0–0–2	–	20	20	30	50	1
08.	EE–753	Industrial Training	0–0–2	–	–	50	–	50	1
09.	EE–754	Project (Phase–I)	0–0–3	–	–	150	–	150	2
10.	GP–701	General Proficiency				50		50	
Total			**15–4–9**					**800**	**24**

Departmental Elective (DE)–2:

1. EE–7041 Power System Operation and Control
2. EE–7042 Advanced Power Transmission
3. EE–7043 Applications of Modern Power Electronics in Power System
4. EE–7044 SCADA and Energy Management

SEMESTER VIII

S. No.	Subject Code	Subject Name	L-T-P	Evaluation					Credit
				Sessional			ESE	Grand Total	
				CT	TA	Total			
	Theory								
01.	OE–80XX	Any one from the Open Elective List	3–1–0	20	10	30	70	100	4
02.	EE–801X	Any one from the list (DE-3)	3–1–0	20	10	30	70	100	4
03.	EE–802	Instrumentation and Process Control	3–1–0	20	10	30	70	100	4
04.	AS–801/ AS–802	Engineering Economics/ Industrial Management	3–0–0	20	10	30	70	100	3
	Practical								
05.	EE–851	Instrumentation and Process Control Lab	0–0–2	–	20	20	30	50	1
06.	EE–852	Project(Phase–II)	0–0–12	–		100	250	350	8
07.	GP–801	General Proficiency				50		50	
	Total		**12–3–14**					**800**	**24**

Departmental Elective (DE)–3:

1. EE–8011 SMART Grid
2. EE–8012 Power System Planning and Reliability
3. EE–8013 EHV AC and DC Transmission
4. EE–8014 Power Quality

Open Elective: Refer list of Open Electives in APPENDIX.

AS 103

Engineering Mathematics - I

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra, Understand the definitions of Vector Space and its linear Independence, Solve Eigen value problems and apply Cayley Hamilton Theorem.

[2] Study the functions of more than one independent variable and calculate partial derivatives along with their applications

[3] Explore the idea for finding the extreme values of functions and integrate a continuous function of two or three variables over a bounded region.

[4] Understand Curl, divergence and gradient with their applications and have the idea of directional derivatives and derive the equations of tangent planes and normal lines.

[5] Calculate line integral, surface integral and volume integral and correlate them with the application of Stokes, Green and Divergence theorem.

Unit - 1: Matrix Algebra

Types of Matrices, Inverse of a matrix by elementary transformations, Rank of a matrix (Echelon & Normal form). Linear dependence. Consistency of linear system of equations and their solution, Characteristic equation. Eigen values and Eigen vectors, Cayley-Hamilton Theorem, Diagonalization, Complex and Unitary Matrices and its properties

Unit -2: Differential Calculus -I

Successive Differentiation, Leibnitz's theorem, Limit, Continuity and Differentiability of functions of several variables. Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Change of variables, Curve tracing: Cartesian and Polar coordinates.

Unit - 3: Differential Calculus – II

Taylor's and Maclaurin's Theorem, Expansion of function of several variables, Jacobian, Approximation of errors. Extrema of functions of several variables, Lagrange's method of multipliers (Simple applications).

Unit - 4: Vector Calculus

Point function. Gradient, Divergence and Curl of a vector and their physical interpretations. Vector identities. Tangent and Normal, Directional derivatives. Line, Surface and Volume integrals. Applications of Green's, Stake's and Gauss divergence theorems (without proof).

Unit - 5: Multiple Integrals

Double and triple integrals. Change of order of integration. Change of variables. Application of integration to lengths, Surface areas and Volumes - Cartesian and Polar coordinates. Beta and Gamma functions, Diri chiefs integral and its applications.

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, John-Wiley & Sons
2. B. V. Ramana, Higher Engineering Mathematics, Tata Me Graw- Hill Publishing Company Ltd.
3. R.K. Jain & S.R.K. lyenger. Advance Engineering Mathematics, Narosa Publishing House.

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.
3. Thomas & Finley, Calculus, Narosa Publishing House
4. Rukmangadachari, Engineering Mathematics -1, Pearson Education.
5. A.C.Srivastava & P.K.Srivastava, Engineering Mathematics, Vol.l, PHI Learning Pvt. Limited, New Delhi.

AS 101

Engineering Physics - I

L	T	P
3	1	0

Course Outcomes (COs):

After the completion of the course, students are expected to have the ability:

[1] To develop the concept of relativistic mechanics and to explain it in different domains.

[2] To develop the understanding of Modern Physics and their application in various micro and macro systems.

[3] To develop the understanding of Interference and Diffraction with different experimental results.

[4] To illustrate the nature of EM waves and to apply the ideas of production of different types of polarized light and to know about the components and types of laser i.e pulsed and continuous wave.

[5] To develop the understanding of components and types of optical fiber with light propagation mechanism and to illustrate construction and reconstruction of holograms.

Unit -1: Relativistic Mechanics **08 Hrs.**

Inertial & non-inertial frames of reference, Galilean transformations, Michelson-Morley experiment, Einstein's postulates, Lorentz transformation equations. Length contraction & Time dilation. Relativistic addition of velocities; Variation of mass with velocity. Mass energy equivalence. Mass less particle.

Unit-II: Modem Physics **10 Hrs.**

Black body radiation, Weins law and Rayleigh-Jeans law. Quantum theory of radiation, Planck's law. Wave-particle duality, de-Broglie matter waves, Bohr's quantization rule. Phase and Group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications. Wave function and its significance, Time dependent and time independent Schrodinger's wave equations - particle in one dimensional potential box. Eigen values and Eigen function.

Unit - III: Wave Optics **10 Hrs.**

Interference: Coherent sources, condition for sustained Interference in thin films (parallel and wedge shaped film), Newton's rings and its applications.

Diffraction: Types of diffractions, Single, double and N- Slit Diffraction, Diffraction grating. Grating spectra, dispersive power, Rayleigh's criterion and resolving power of grating.

Unit - IV: Polarization and Laser **08 Hrs.**

Polarization: Phenomena of double refraction, Construction and working of Nicol prism. Production and analysis of plane, circular and elliptical polarized light. Retardation Plate, Optical Activity, Fresnel's theory. Specific rotation.

Laser: Spontaneous and stimulated emission of radiation, population inversion, Einstein's Coefficients, Coherence, Concept of 3 and 4 level Laser, Construction and working of Ruby, He-Ne lasers , Laser applications.

Unit - V: Fiber Optics and Holography **06 Hrs.**

Fiber Optics: Fundamental ideas about optical fiber. Propagation mechanism. Acceptance angle and cone. Normalized frequency, Numerical aperture. Single and Multi Mode Fibers, Dispersion and Attenuation.
Holography: Basic Principle of Holography, Construction and reconstruction of Image on hologram and applications of holography.

Reference Books:

1. Concepts of Modem Physics - Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wielly)
3. Optics -Ajoy Ghatak (Tata McGraw Hill Education Private Ltd. New Delhi)

4. Optics - Brijlal & Subramanian (S. Chand)
5. Engineering Physics- C. Mani Naidu(Pearson)
6. Lasers Principles, Types and Applications- K R Nambiar (New Age)
7. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)

AS 102/AS 202

Engineering Chemistry

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Gain knowledge of basic theories of solid materials, nano-materials and liquid crystals.
[2] Demonstrate the knowledge of synthesis of polymeric material, which are required for engineering applications.
[3] Apply basic knowledge of Science and fundamental aspect of cell working, equations in solving electrochemistry problems, functioning of lubricants and the techniques controlling the corrosion.
[4] Analyze the water sample parameters & identify the impurities and its effects. Able to design process for purification of water that is concern with safety of public health & environment.
[5] Apply basic knowledge of fuels and experimental techniques used in identification of structure of organic/inorganic moieties.

Unit-1	Molecular orbital theory and its applications to homo-nuclear diatomic molecules. Band theory of solids. Liquid crystals and its applications. Point defects in Solids. Structure and applications of Graphite and Fullerenes. Concepts of nano-materials and its applications	**8**
Unit-2	Polymers: Basic concepts of polymer- blends and composites. Conducting and biodegradablepolymers. Preparations and applications of some industrially important polymers(Buna N, Buna S, Neoprene, Nylon 6, Nylon 6,6 , Terylene). General methods of synthesis of organometallic compound (Giignard Reagent) and their applications in polymerization.	**8**
Unit-3	Electrochemistry: Galvanic cell, electrode potential. Lead storage battery. Corrosion, causes and its prevention. Setting and hardening of cement, applications of cement. Plaster of paris. Lubricants- Classification, mechanism and applications..	**8**
Unit-4	Hardness of water. Disadvantage of hard water. Boiler troubles. Techniques for water softening; Lime-soda, Zeolite, Ion exchange resin. Reverse osmosis. Phase Rule and its application to water system.	**8**
Unit-5	Fuels; Classification of fuels. Analysis of Coal. Determination of Calorific values (bomb calorimeter & Dulong's method). Biogas. Elementary ideas and simple applications of UV, Visible, IR and H^NMR spectral Techniques.	**8**

Text Book :

1. Chemistry for Engineers, by S. Vairam and Suba Ramesh; Wiley India

Reference Books :

1. Textbook of Engineering Chemistry by Dr. Gopal Krishna Bhatt, Acme Publishers
2. Chemistry (9th ed), by Raymond Chang, Tata McGraw-Hill
3. Chemistry Concepts and Applications by Steven S. Zumdahl; Cengage Learning
4. Engineering Chemistry, Wiley India
5. Engineering Chemistry Author: Abhijit Mallick, Viva Books
6. Text Book of Engineering Chemistry by Harsh Malhotra; Sonali Publications
7. Concise Inorganic Chemistry by J.D. Lee; Wiley India
8. Organic Chemistry (6 ed) by Morrison & Boyd; Pearson Education
9. Physical Chemistry by Gordon M. Barrow; Mc-Graw Hill
10. Organic Chemistry, Volume 1(6 ed)& 2 (5ed) by I. L. Finar; Pearson Education
11. Atkins' Physical Chemistry by Peter Atkins & Julio De Paula; Oxford University Press.

EC 101/EC 201

Basic Electronics Engineering

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Acquire basic knowledge on the working of various semi-conductor devices.

[2] Develop analysis capability in BJT and FET Amplifier Circuits

[3] Identify functions of digital multimeter, voltmeter, Cathode ray oscilloscope and Digital storage oscilloscope in measurement of physical variables

[4] Understand fundamentals of radio communication.

Unit-I

PN junction diode: Introduction of Semiconductor Materials Semiconductor Diode: Depletion layer, V-I characteristics, ideal and practical, diode resistance, capacitance. Diode Equivalent Circuits, Transition and Diffusion Capacitance, Diodes breakdown mechanism (Zener and avalanche) Diode Application: Series , Parallel and Series, Parallel Diode Configuration, Half and Full Wave rectification. Clippers, Clampers, Zener diode as shunt regulator. Voltage-Multiplier Circuits Special Purpose two terminal Devices : Light-Emitting Diodes, Liquid-Crystal Displays. **12 Lectures**

Unit-II

Bipolar Junction Transistor and Field Effect Transistor:

Bipolar Junction Transistor: Transistor Construction, Operation, Amplification action. Common Base, Common Emitter, Common Collector Configuration DC Biasing BJTs: Operating Point, Fixed-Bias, Emitter Bias, Voltage-Divider Bias Configuration. Emitter-Follower Configuration. Bias Stabilization. CE, CB, CC amplifiers and AC analysis of single stage CE amplifier (re Model). Field Effect Transistor: Construction and Characteristic of JFETs. AC analysis of CS amplifier, MOSFET (Depletion and Enhancement)Type, Transfer Characteristic, **10 Lectures**

Unit-III

Operational Amplifiers : Introduction and Block diagram of Op Amp, Ideal & Practical characteristics of Op Amp, Differential amplifier circuits. Practical Op- Amp Circuits (Inverting Amplifier, Non inverting Amplifier, Unity Gain Amplifier, Summing Amplifier, Integrator, Differentiator). OP AMP Parameters: Input offset voltage, Output offset voltage, Input biased current. Input offset current Differential and Common-Mode Operation. **6 Lectures**

Unit-IV

Electronic Instrumentation and Measurements: Digital Voltmeter : Introduction, RAMP Techniques, Analog and Digital Multimeters: Introduction Oscilloscope: Introduction, Basic Principle, Block Diagram of Oscilloscope, Simple CRO, Measurement of voltage, current phase and frequency using CRO, Introduction of Digital Storage Oscilloscope and Comparison of DSO with Analog Oscilloscope.

6 Lectures

Unit-V

Fundamentals of Communication Engineering: Elements of a Communication System, Need of Modulation, Electromagnetic spectrum and typical applications. Basics of Signal Representation and Analysis, Introduction of various analog modulation techniques. Fundamentals of amplitude and frequency modulation. Modulation and Demodulation Techniques of AM. **6 Lectures**

Text Books:

1. Robert L. Boylestand / Louis Nashelsky *"Electronic Devices and Circuit Theory" Latest* Edition, Pearson Education.
2. H S Kalsi, "Electronic Instrumentation", Latest Edition, TMH Publication,.
3. George Kennedy, "Electronic Communication Systems", Latest Edition, TMH,

Reference Books:

1. David A. Bell, *""Electronic Devices and Circuits",* Latest Edition, Oxford University Press.
2. Jacob Millman, C.C. Halkias, Staya brataJit, *""Electronic Devices and Circuits'",* Latest Edition , TMH.
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford University Press India.

ME 101/ME 201

Elements of Mechanical Engineering

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Identify and analyze the problems by applying the fundamental principles of engineering mechanics and to proceed to design and development of the mechanical systems.

[2] Understand the representation of forces and moments.

[3] Understand the concept of static equilibrium of particles and rigid bodies.

[4] Understand the concept of stress and strain.

[5] Understand the basic concepts of Thermodynamics

UNIT-I

Force System: Law of Parallelogram of forces, Lami's theorem. Principle of Transmissibility of forces. Moment of a force. Couple, Varignon's theorem. Resolution of a force into a force and a couple. Resultant and equilibrium of coplanar force system. Determination of reactions. Free body diagrams.
Concept of Centre of Gravity, Centroidand Area Moment of Inertia, Perpendicular axis theorem and Parallel axis theorem

9 Lectures

UNIT-II

Plane Trnss: Perfect Deficient and Redundant Truss. Assumptions and Analysis of Plane Truss by Method of joints and Method of section.
Beams: Types of beams., Shear force and bending moment in Statically Determinate Beams. Shear force and bending moment diagrams. Relationships between load, shear and bending moment.

8 Lectures

UNIT-III

Simple stress and strain: Normal and shear stresses. One Dimensional Loading; members of varying cross section, bars in series. Tensile Test diagram for ductile and brittle materials. Elastic constants. Strain energy.
Bending (Flexural) Stresses: theory of pure bending, neutral surface and neutral axis, stresses in beams .
Engineering Materials: Importance of engineering materials, classification, mechanical properties and applications of Ferrous, Nonferrous and composite materials.

8 Lectures

UNIT-IV

Basic Concepts and Definitions of Thermodynamics: Introduction and definition of thermodynamics. Microscopic and Macroscopic approaches. System, surrounding and universe. Concept of continuum. Thermodynamic equilibrium. Thermodynamic properties, path, process and cycle. Quasi static process. Energy and its forms. Work and heat.
Zeroth law of thermodynamics: Temperature and its' measurement.
First law of thermodynamics: First law of thermodynamics. Internal energy and enthalpy. First law analysis for non-flow processes. Steady flow energy equation; Boilers, Condensers, Turbine, Throttling process. Pumps etc.

8 Lectures

UNIT-V

Second law: Thermal reservoir, Kelvin Planck statement. Heat engines. Efficiency; Clausius' statement Heat pump, Refrigerator. Coefficient of Performance. Carnot cycle, Carnot theorem and it's corollaries.Clausius inequality. Concept of Entropy.

Properties of Pure Substances: P-v, T-s and h-s diagram, dryness fraction and steam tables. Rankine Cycle.

Internal Combustion Engines: Classification of I.C. Engines, working principle and comparison between 2 Stroke and 4 stroke engine , difference between SI and Cl engines. P- V and T-s diagramsof Otto and Diesel cycles, comparison of efficiency.

9Lectures

Reference Books:

1. Engineering Mechanics: Statics by J.L Meriam , Wiley
2. Engineering Mechanics : Statics and Dynamics by R. C. Hibbler, Pearson
3. Strength of Materials by Thimoshenko& Young
4. Mechanics of Solid by R. C. Hibbler, Pearson
5. Introduction to Mechanical Engineering : Thermodynamics, Mechanics & strength of Material, Onkar Singh, New Age International (P) Ltd.
6. Engineering Thermodynamics by P.K.Nag, McGraw Hill
7. Thermodynamics An Engineering Approach by Cengel& Boles, McGraw Hill
8. Internal Combustion Engine by V Ganesan, McGraw Hill Pub .
9. Engineering Mechanics By S. S. Bhavikatti, K. G. Rajashekarappa, New Age International
10. Engineering Mechanics by R K Bansal, Laxmi Publications
11. Elements of Workshop Technology by Hajra Choudhary Media Promoter

EE 101/EE 201

Basic Electrical Engineering

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability:

[1] To understand fundamentals of DC circuits and apply knowledge for

[2] To analyzing network theorems in DC circuits.

[3] To learn the fundamentals and analyze single phase AC circuits.

[4] To learn the fundamentals and analyze three phase AC circuits.

[5] To learn the basic operation and analyze the performance of single phase transformer.

[6] To understand the construction and basic operation of DC motors and generators.

Unit-I: Electrical Circuit Analysis:
Introduction, Circuit Concepts: Concepts of network. Active and passive elements. Voltage and current sources. Concept of linearity and linear network. Unilateral and bilateral elements. Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis. Star-delta transformation,
AC fundamentals: Sinusoidal, square and triangular waveforms - Average and effective values. Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current.

Unit-II: Steady- State Analysis of Single Phase AC Circuits:
Analysis of series and parallel RLCCircuits, Concept of Resonance in series & parallel circuits, bandwidth and quality factor; Apparent, active & reactive powers. Power factor, Concept of power factor improvement and its improvement (Simple numerical problems)
Network theorems (AC & DC with independent sources): Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem (Simple numerical problems)

Unit-III: Three Phase AC Circuits:
Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations. Three-phase power and its measurement (simple numerical problems).
Measuring Instruments: Types of instruments, Construction and working principles of PMMC and moving iron type voltmeters & ammeters, Single phase dynamometer wattmeter, Use of shunts and multipliers (Simple numerical problems on shunts and multipliers), Single phase energy meter.
Power system : basic concept, power line diagram, concept of grid.

Unit-IV: Magnetic Circuits:
Magnetic circuit concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis and eddy current losses, Magnetic circuit calculations (Series & Parallel).
Single Phase Transformer: Principle of operation, Construction, EMF equation, Phaser diagram Equivalent circuit. Power losses, Efficiency (Simple numerical problems), Introduction to auto transformer.

Unit-V: Electrical Machines:
DC machines:Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)
Three Phase Induction Motor:Principle & Construction, Types, Slip-torque characteristics. Applications (Numerical problems related to slip only)

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Text Books:

1 . Basic Electrical Engineering, S N Singh; Prentice Hall International
2. Basic Electrical Engineering, Kuldeep Sahay, New Age International Publishers
3 . Fundamentals of Electrical Engineering, B Dwivedi, A Tripathi; Wiley India
4. Principles of Electrical Engineering, V. Del Toro,; Prentice Hall International
5. Electrical Engineering, J. B. Gupta, Kataria and Sons
6. Basic Electrical Engineering, T.K. Nagsarkar,M.S. Shukhija; Oxford University Press.

Reference Books:

1. Electrical and Electronics Technology, Edward Hughes; Pearson
2. Engineering Circuit Analysis, W.H. Hayt& J.E. Kimerly; Me GrawHill
3. Basic Electrical Engineering, C L Wadhwa; New Age International

CS 101/CS 201

Computer System and Programming in C

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the basics of solving a problem using the computer system.

[2] Solve simple and precise problems using the computer.

[3] Students can develop the attitude to solve the problems in hand in logical manner.

[4] Understand the basic concepts of digital computer, binary arithmetic.

[5] Understand the importance of algorithm and flowcharts in programming.

[6] Understand the basic concepts of writing a program in C language: write, compile, and run programs in C language.

[7] Understand role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language

[8] Write programs that involves decisions and iterations.

[9] Understand how to use functions, arrays, pointers, preprocessor directives along with fare confidence in file handling.

Unit 1: (10 Lectures)

Basics of Computer: Introduction to digital computer, basic operations of computer, functional components of computer. Classification of computers.

Introduction to operating system: [DOS, Windows, Linux and Android] purpose, function, services and types.

Number system: Binary, octal and hexadecimal number systems, their mutual conversions. Binary arithmetic.

Basics of programming: Approaches to Problem Solving, Concept of algorithm and flow charts. Types of computer languages:- Machine Language, Assembly Language and High Level Language, Concept of Assembler, Compiler, Loader and Linker.

Unit 2: (8 Lectures)

Standard I/O in "C", **Fundamental data types-** Character type, integer, short, long, unsigned, single and double floating point. Storage classes- automatic, register, static and external. Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associatively.

Fundamentals of C programming: Structure of C program, writing and executing the first C program. Components of C language. Standard I/O in C.

Units 3: (10 Lectures)

Conditional program execution: Applying if and switch statements, nesting if and else, use of break and

default with switch, program loops and iterations: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

Functions: Introduction, types of functions, functions with array, passing values to functions, recursive functions.

Unit 4: (6 Lectures)

Arrays: Array notation and representation, manipulating array elements, using multi dimensional arrays. Structure, union, enumerated data types

Unit 5: (8 Lectures)

Pointers: Introduction, declaration, applications File handling, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler.

Reference:

1. The C programming by Kemighan Brain W. and Ritchie Dennis M., Pearson Education .
2. Computer Basics and C Programming by V.Rajaraman, PHI Learning Pvt. Limited - 2015.
3. Programming in C by Kochan Stephen G. Pearson Education - 2015.
4. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New Age International Publication.
5. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
6. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication
7. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
8. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
9. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
10. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication
11. Computer Fundamental and C programming by K K Gupta, Acme Learning Publication

AS 104/AS 204

Professional Communication

L	T	P
3	0	0

COURSE OUTCOMES (COs)

Students are able to demonstrate the following:

[1] Understand the communication system for specific purpose

[2] Be able to communicate professionally

[3] Be able to communicate across organizational levels and cultures effectively

[4] Be able to negotiate with the odds and bring in best of the results with specific success

[5] Be able to understand the human needs and adjust accordingly the set goals

Unit-I: Fundamentals of Communications
Technical Communication: features: Distinction between General And Technical Communication; Language as a tool of communications; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of communication: Downward, Upward, Lateral/Horizontal (Peer group)**:** Importance of technical communication; Barriers to Communication

Unit-II: Written Communication
Words and Phrases: Word formation, Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; correct Usage: all Parts of Speech; Modals; Concord; Articles; Infinitives; Transformation of sentences; Requisites f Sentence Construction: Paragraph Development: Techniques and Methods- Inductive, Deductive, Spatial, Linear, Chronological etc.

Unit-III: Business Communication
Principles, Sales & Credit letters; Claim and Adjustment Letters; Job Application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports.Technical Proposal; Parts; Types; Writing of Proposal; Significance; Negotiation skills.

Unit-IV: Presentation Strategies and Soft Skills.
Nuances and Modes of Delivery; Body Language; Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice; Interpersonal communication: Definition; Types; Team work; Attitude; Way to improve Attitude Listening Skills : Types; Methods for improving Listening Skills.

Unit –V: Value- Based Text Readings
Following essays from the prescribed text book with emphasis on Mechanics of writing.

1. Humanistic and Scientific Approaches to Human Activity by Moody E. Prior
2. The Language of Literature and Science by A. Huxley
3. Man and Nature by J. Bronowski
4. Science and Survival by Barry Commoner
5. The Mother of the Sciences by A.J. Bahm.

Text Book:

1. Improve your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New

Delhi.
2. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
3. Functional skills in Language and Literature, by R.P. Singh, Oxford Univ. Press, 2005, New Delhi.

Reference Books:

1. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
2. Business Correspondence and Report Writing by Prof R.C.,Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd. ,2001, New Delhi.
3. **Word Power Made Easy by Norman Lewis, W.R. Goyal Pub. & Distributors, 2009, Delhi.**
4. Developing Communication skills by Krishna Mohan, Mecra Bannerji- Macmillan India Ltd. 1990, Delhi.
5. Manual of Practical Communication by L.U.B. Pandey: A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.
6. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.
7. Spoken English- A manual of Speech and Phonetics by R.K. Bansal & J.B. Harrison Orient Blackswan, 2013, New Delhi.

CE 151/CE 251

Computer Aided Engineering Graphics

L	T	P
0	0	3

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Produce geometric construction, multiview, dimensioning and detail drawings of typical 3-D engineering objects.

[2] Apply the skill for preparing detail drawing of engineering objects.

[3] Understand and visualize the 3-D view of engineering objects.

[4] Understand and apply computer software to prepare engineering drawing.

[5] Visualize better and understand the various engineering problems

Introduction

Drawing Instruments and their uses, BIS conventions. Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.
2 - Sheets

Orthographic Projections Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths. True and apparent inclinations to reference planes.
2 - Sheets

Orthographic Projections of Plane Surfaces (First Angle Projection Only) Introduction, Definitions-projections of plane surfaces-triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only.
1 - Sheet

Projections of Solids (First Angle Projection Only) Introduction, Definitions - Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.
2-Sheets

Sections And Development of Lateral Surfaces of Solids Introduction, Section planes. Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.
1 - Sheet

Isometric Projection (Using Isometric Scale Only)
Introduction, Isometric scale, Isometric projection of simple plane figures. Isometric projection of tetrahedron, hexahedron(cube), right regular prisms , pyramids, cylinders, cones, spheres, cut spheres.
1-Sheet

Text Books:

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, 48thedition, 2005-Charotar Publishing House, Gujarat.

2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K International Publishing House Pvt. Ltd., New Delhi, 3rdrevised edition- 2006.

Reference Books:

1. Engineering Graphics - K.R. Gopalakrishna, 32”** edition, 2005- Subash Publishers Bangalore.
2. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, 2005- Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Engineering Drawing - M.B. Shah, B.C.Rana, 2nd Edition.

AS 203

Engineering Mathematics - II

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand and implement the concept of differential equations and learn various methods to solve ordinary differential equation.

[2] Extend the concept of series solutions to solve differentia equations and learn orthogonality about the functions.

[3] Implement the integral transformation using the concept of Laplace transformation and application to solve differential equations.

[4] Learn Fourier series and Fourier transformations for initial and boundary values problems.

[5] Do Application of Partial differential equation as heat equation, wave equation and Laplace equation.

Unit - 1: Ordinary Differential Equations

Linear differential equations of order with constant coefficients. Complementary function and Particular integral. Simultaneous linear differential equations. Solution of second order differential equations by changing dependent & independent variables. Method of variation of parameters. Applications to engineering problems (without derivation).

Unit - 2: Series Solution and Special Functions

Series solution of second order ordinary differential equations with variable coefficient (Frobenius method), Bessel and Legendre equations and their series solutions. Properties of Bessel function and Legendre polynomials.

Unit - 3: Laplace Transform

Laplace transform. Existence theorem, Laplace transforms of derivatives and integrals. Initial and final value theorems. Unit step function, Dirac- delta function, Laplace transform of periodic function. Inverse Laplace transform. Convolution theorem. Application to solve simple linear and simultaneous differential equations.

Unit - 4: Fourier Series and Partial Differential Equations

Periodic functions, Dirichlet's Conditions, Fourier series of arbitrary periods, Euler's Formulae, Even and odd functions, Half range sine and cosine series, Gibbs Phenomena.

Solution of first order Lagrange's linear partial differential equations. Second order linear partial differential equations with constant coefficients.

Unit - 5: Applications of Partial Differential Equations

Classification of second order partial differential equations, Method of separation of variables for solving partial differential equations, Solution of one and two dimensional wave and heat conduction equations, Laplace equation in two dimension, Equation of transmission lines.

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2. B. V. Ramana, Higher Engineering Mathematics, Tata Me Graw- Hill Publishing Company Ltd.
3. R.K.Jain & S.R.K. lyenger, Advance Engineering Mathematics, Narosa Publishing House.

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.
3. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudranalaya
4. A. C. Srivastava & P. K. Srivastava, Engineering Mathematics, Vol. - II, PHI Learning Pvt. Ltd.
5. Rukmangadachari, Engineering Mathematics - II, Pearson Education.

AS 201

Engineering Physics - II

L	T	P
3	1	0

Course Outcomes (COs):

After the completion of the course, students are expected to have the ability:

[1] To know about the fundamentals of crystal physics and illustrations of Nacl and diamond structures.

[2] To understand the concepts of dielectrics and its polarization and different properties of magnetic materials with their hysteresis curve.

[3] To formulate and solve the engineering problems on electromagnetism with the help of Maxwell's equations.

[4] To understand the basics of band theory of solids and discuss the Fermi energy for semiconductors.

[5] To develop the understanding of superconductors and its types, superconductivity with BCS theory and to understand the various applications of nanotechnology with the help of nano materials.

Unit -1: Crystal Structures and X-ray Diffraction 10Hrs.

Space lattice, basis. Unit cell. Lattice parameter. Seven crystal systems and Fourteen Bravais lattices. Co-ordination number. Atomic radius and Packing factor of different cubic structures. Crystal structure of NaCl and diamond. Lattice planes and Miller Indices, Diffraction of X-rays by crystal, Laue's experiment, Bragg's Law, Bragg's spectrometer. Compton Effect.

Unit - II: Dielectric and Magnetic Properties of Materials 10 Hrs.

Dielectric Properties: Dielectric constant and Polarization of dielectric materials. Relation between E, D and P, Types of Polarization (Polarizability). Equation of internal fields in liquid and solid (One-Dimensional), Claussius-Mossotti equation. Frequency dependence of dielectric constant, Dielectric Losses, Important applications of dielectric material, Ferroelectricity, Piezoelectricity.

Magnetic Properties: Magnetization, Origin of magnetic moment, Dia, para and ferro magnetism, Langevin's theory for diamagnetic material. Phenomena of hysteresis and its applications.

Unit - III: Electromagnetic Theory 06 Hrs.

Equation of continuity, Maxwell's Equations (Integral and Differential Forms) and its derivations, Displacement Current, Poynting vector and Poynting's theorem, EM - Wave equation and its propagation characteristics in free space, non-conducting and conducting media, energy density of electromagnetic wave, Skin depth.

Unit - IV: Band Theory of Solids 06 Hrs.

Free electron Theory, Formation of bands in Solids, Classification of solids on band theory. Density of states, Fermi-Dirac distribution, Concept of effective mass. Charge carrier density (electrons and holes), Conductivity of semiconductors, carrier concentrations Fermi energy. Position of Fermi level in intrinsic and in extrinsic semiconductors. Temperature dependence of conductivity in semiconductors.

Unit - V: Physics of some technologically important Materials 08Hrs.

Superconductors: Temperature dependence of resistivity in superconducting materials. Effect of magnetic field (Meissner effect), Temperature dependence of critical field, London equations, Josephson theory, persistent currents. Type I and Type II superconductors, BCS theory (Qualitative), High temperature superconductors and Applications of Super-conductors. **Nano-Materials:** Basic principle of nanoscience and technology, structure, properties and uses of Fullerene, Carbon nanotubes Single and double walled nanotubes, synthesis of nanotubes. Properties and Applications of nanotubes.

Reference books:

1. Concept of Modem Physics - by Beiser (Tata Mc-Graw Hill)
2. Solid State Physics - by C. Kittel, 7th edition (Wiley Eastern)
3. Materials Science and Engineering - by V. Raghavan (Prentice- Hall India)
4. Solid State Physics - by S.O. Pillai, 5th edition (New Age International).
5. Introduction to Electrodynamics - by David J. Griffith (PH I)
6. Engineering Physics- C. Mani Naidu(Pearson)
7. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New Delhi)

AS - 301
MATHEMATICS- III

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Deal with sequences and various types of series and their convergence,

[2] Determine whether a given complex function is differentiable, and if so find its derivative. Express complex-differentiable functions as power series, find the Singularities, Zeroes and Poles, Residue .

[3] Identify of Integral Transforms Fourier integral, Applications of Fourier transform and Z-transform and its application to solve difference equations.

[4] Analyze of different Statistical Techniques–I Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Correlation, Linear, nonlinear and multiple regression analysis.

[5] Do Analysis of Statistical Techniques – II Binomial, Poisson and Normal distributions, Sampling theory, Tests of significations: Chi- square test, t-test, and Analysis of variance (one way), Application of. Time series and forecasting.

Unit- I: Sequences and Series **08**

Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series, Necessary condition for convergence, Standard infinite series, Geometric series and Harmonic series. Tests for convergence and divergence, Comparison test (only for series with positive terms), Cauchy's integral test, D'alembert's ratio test, Cauchy's nth root test, Raabe's test (higher ratio test), Logarithmic test, Demorgan's and Bertrand's tests, Alternating series Leibnitz's theorem (without proof), Absolute convergence and Conditional convergence, Power series.

Unit- II: Function of Complex variable **08**

Analytic function, C-R equations, Harmonic functions, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions, Taylor's and Laurent's series, Singularities, Zeroes and Poles, Residue theorem, Evaluation of real integrals of the type $\int_0^{2\pi} f(cos\theta, sin\theta)d\theta$ and $\int_{-\infty}^{+\infty} f(x)dx$.

Unit- III: Integral Transforms **08**

Fourier integral, Complex Fourier transform, Inverse transform, Convolution theorem, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations, wave equations and Laplace equations, Z- transform and its application to solve difference equations.

Unit- IV: Statistical Techniques – I **08**

Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non- linear and multiple regression analysis, Probability theory.

Unit- V: Statistical Techniques – II **08**

Binomial, Poisson and Normal distributions, Sampling theory (small and large), Tets of significations: Chi- square test, t-test, Analysis of variance (one way), Application to engineering, medicine, agriculture etc. Time series and forecasting (moving and semi- averages), Statistical quality control methods, Control charts, $\bar{X}$, R, p, np and c charts.

Test Books :-

1. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
2. J.N. Kanpur, Mathematical Statistics, S. Chand & company Ttd., 2000

Reference Books :-

1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House, 2002.
2. Chandika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
3. B. V. Ramana, Higher Engineering Mathematics, Mc Gra Hill Education, 2016.
4. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.
6. S.P. Gupta, Statistical Methods, Sultan and Sons, New Delhi, 2004.
7. Devore, Probability and Statistics, Thomson (Cengage) Learning, 2007.
8. Walpole, Myers, Myers & Ye, Probability and Statistics for Engineers & Scientists, Pearson Education, 2003.

EE - 301
NETWORK ANALYSIS AND SYNTHESIS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Apply different network analysis and simplification theorems to dc and ac circuits and verify the solutions using modern tools for lifelong learning

[2] Solve network equations using classical methods and verify the solutions using modern tools for lifelong learning

[3] Apply Laplace Transformation technique for solution of network equations

[4] Calculate two port parameters and analyze network functions to decide stability of networks

[5] Define basic terms related with filters and design low pass/high pass passive filters

[6] Understand the method to find different type of network function and network function importance

[7] Understand different methods use for network synthesis.

UNIT I **05**

Graph Theory:- Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Nodal methods of analysis.

UNIT II **07**

Network Theorems (Applications to AC networks):-Concept of linearity, and homogeneity Principle, Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman's theorem, compensation theorem, Tellegen's theorem.

UNIT III **07**

Network Functions:-Concept of Complex frequency, Transform Impedances, Network functions of one port and two ports networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot.

UNIT IV **09**

Two Port Networks:-Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks. T & Π Representation, Concepts of multi-port networks and their practical examples.

UNIT V **12**

Network Synthesis:-Positive real function; definition, properties and limitations; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions

using Foster and Cauer first and second forms, similarities and dissimilarities between Foster's and Cauer's forms.

Filters: Image parameters and characteristics impedance, passive and active filter fundamentals, low-pass, high-pass, (constant K type) filters, and introduction to active filters.

Text Books:-

1. A.Chakrabarti, "Circuit Theory" Dhanpat Rai & Co.
2. C.L Wadhwa, "Network Analysis and Synthesis" New Age International Publishers, 2007.
3. N.C. Jagan and C. Lakshminarayana, "Network Analysis" B.S. Publications, 2008.

Reference Books:-

1. D.Roy Choudhary, "Networks and Systems" Wiley Eastern Ltd.
2. M.E. Van Valkenburg, "Network Analysis", Prentice Hall of India
3. Donald E. Scott: "An Introduction to Circuit analysis: A System Approach" McGraw Hill
4. M.E. Van Valkenburg, "An Introduction to Modern Network Synthesis",Wiley Eastern Ltd.

EE - 302
ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Classify resistance; apply measurement techniques for measurement of resistance, inductance using bridges.

[2] Write construction, working principle and use of different type of analog instruments and dynamometer type wattmeter for measurement of power under balance and unbalance condition.

[3] Explain Construction, working principle of 1-phase and 3-phase induction, static energy meter and calibration procedures

[4] Use of CRO for measurement of various electrical parameters, importance of transducers, their classification, selection criterion and various applications

[5] Understand measurement of various physical parameters using transducers

[6] Explain Construction, working principle of current and potential transformer

UNIT I **07**

Philosophy Of Measurement:-Methods of Measurement, Measurement System**,** Classification of instrument system, Characteristics of instruments & measurement system**,** Errors in measurement & its analysis, Standards.

Analog Measurement of Electrical Quantities :-Analog Instruments-Classification, Principle of operation of Permanent Magnet Moving Coil (PMMC) and Moving Iron Instruments, Voltmeters & ammeters, Errors in Voltmeter and Ammeters, Range extension, Advantages and disadvantages, Electrodynamometer Instruments, Power & Energy measurement.

UNIT II **07**

Instrument Transformers- Principle of operation and applications, Current transformer and its error analysis, Potential transformer and its error analysis, Miscellaneous Measurement(speed, Frequency & power factor.

UNIT III **07**

Measurement of Parameters:-Different methods of measuring low, medium and high resistances**,** measurement of inductance & capacitance with the help of AC Bridges, Quality factor (Q) Meter.

UNIT IV **09**

AC Potentiometer:-Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement

Magnetic Measurement:-Ballistic Galvanometer, flux meter, determination of hysteresis loop, measurement of iron losses**.**

UNIT V **10**

Digital Measurement of Electrical Quantities:-Concept of digital measurement, block diagram Study of digital voltmeter, frequency meter Power Analyzer and Harmonics Analyzer; Electronic Multimeter.

Cathode Ray Oscilloscope:-Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its components, application of CRO in measurement, Lissajous Pattern, Dual Trace & Dual Beam Oscilloscopes.

Text Books:

1. A.K. Sawhney, "Electrical& Electronic Measurement & Instrument", Dhanpat Rai & Sons , India
2. J.B. Gupta, "Electrical Measurements and Measuring Instruments", S.K. Kataria & Sons.

Reference Books:

1. W.D. Cooper, "Electronic Instrument and Measurement Technique", Prentice Hall International, India.
2. Forest K. Harries, "Electrical Measurement", Wiley Eastern Pvt. Ltd. India.
3. M.B. Stout, "Basic Electrical Measurement" Prentice hall of India, India.
4. E.W.Golding & F.C.Widdis, " Electrical Measurement & Measuring Instruments",A W Wheeler & Company Pvt. Ltd. India.

EE - 303
ELECTRICAL MACHINES - I

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the construction and working of single phase transformer with its efficiency

[2] Explain connections of three phase transformer and parallel operation of single phase transformer

[3] Understand the construction and working of DC machine (DC Generator and DC Motor) and types of DC generator and DC motor.

[4] Understand commutation process of DC machine and starters required for DC motor

[5] Understand construction, working and performance of three phase induction motor

[6] Understand the necessity of starter for three phase induction motor and types of starter

UNIT I **05**

Principles of Electro-mechanical Energy Conversion - Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems (defining energy & Co-energy), singly Excited Systems; determination of mechanical force, mechanical energy, torque equation, Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque.

UNIT II **09**

D.C. Machines:-Construction of DC Machines, operation, Armature winding, Types according to excitation (with circuit representation and equations), emf and torque equation, Armature Reaction, Commutation process, Interpoles and Compensating Windings, Performance Characteristics of DC generators.

UNIT III **09**

D.C. Machines (Contd.):-Performance Characteristics of D.C. motors, Starting of D. C. motors; 3 point and 4 point starters, Speed control of D.C. motors: Field Control, armature control and Voltage Control (Ward Lenonard method); Efficiency and Testing of D.C. machines (Hopkinson's and Swinburne's Test).

UNIT IV **09**

Single Phase Transformer: Construction, working principle, equivalent circuit, Phasor diagram, efficiency and voltage regulation, Losses in Transformer, Separation of hysteresis and eddy current losses, all day efficiency. Testing of Transformers: O.C. and S.C. tests, Sumpner's test, polarity test.
Auto Transformer: Single phase and three phase auto transformers, volt-amp relation, efficiency, merits & demerits and applications.

UNIT V **06**

Three Phase Transformers: Construction, three phase transformer phasor groups and their connections, open delta connection, three phase to 2 phase, 6 phase or 12 phase connections, and their applications, parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and harmonics in transformers, three winding transformers.

Text Books:-

1. I.J. Nagrath&D.P.Kothari," Electrical Machines", Tata McGraw Hill
2. Husain Ashfaq ," Electrical Machines", Dhanpat Rai & Sons
3. M. G. Say, "The Performance and Design of AC machines", Pit man & Sons.

Reference Books:-

1. A.E. Fitggerald, C.Kingsley Jr and Umans,"Electric Machinery" 6th Edition, McGraw Hill, International Student Edition.
2. Irving L. Kosow, "Electric Machine and Transformers", Prentice Hall of India.
3. P.S.Bhimbhra, Electrical Machinary, Khanna Publications

EC – 304
ANALOG AND DIGITAL ELECTRONICS

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Analyze and find application of special purpose diodes.

[2] Develop analytical capability to analyze feedback in amplifiers

[3] Explain principal of operation of various basic oscillators.

[4] Design and implement Combinational and Sequential logic circuits

[5] Design and testing of OP-AMP based circuits

ANALOG ELECTRONICS

UNIT I **06**

Special Diodes: LED, Varactor diode, Photo diode, Schottky diode, Tunnel diode and their characteristics and applications, Transistors as a switch.

UNIT II **07**

Frequency Response:-Amplifier transfer function, low and high frequency response of common emitter and common source amplifiers.

Feedback: General feedback structure, properties of negative feedback :series-series, series-shunt, shunt-series and shunt-shunt feedback amplifiers.

UNIT III **07**

Basic principle of sinusoidal oscillator, R-C Phase Shift and Wein Bridge oscillators, tuned oscillators-Collpits , Hartley and Crystal oscillators.

DIGITAL ELECTRONICS

UNIT IV **10**

Combinational Logic Circuits: Multiplexers/Demultiplexers, Encoders/Decoders.

Sequential Logic Circuits: latches, flip-flops- S-R, T, D and J-K.

Shift Registers: Basic principle, serial and parallel data transfer, shift left/right registers, universal shift registers.

Counters: Mode N Counters, ripple counters, synchronous counters and ring/Johnson counters.

UNIT V **10**

OP-AMP applications: Astable, Monostable and Bistable multivibrators, Schmitt trigger, IC-555 Timer, A/D and D/A converters.

Voltage Regulators: Series, shunt and switching regulators, op-amp based configurations.

Memories: Introduction to ROM, RAM; Sequential Memory and Memory organization.

Text Books:

1. A. S. Sedra and K.C. Smith, “Microelectronics Circuits”, Oxford University Press (India).
2. Malvino& Leach, “Digital Principles and applications”, Tata Mc. Graw Hill
3. Anand Kumar, “Switching Theory and Logic Design”, Prentice Hall of India, 2008.
4. Aloke. K. Dutta, “Semiconductor Devices and circuits”, Oxford University Press, 2008.

Reference Books:

1. R. A. Gayakwad, “Op amps and Linear Integrated Circuits”, Prentice Hall of India.
2. Balbir Kumar and Shail B. Jain, “Electronic Devices and Circuits”, Prentice Hall of India, 2007.
3. Taub & Schilling “Digital Electronics”, Tata Mc Graw Hill.
4. Anil K. Maini, “Digital Electronics: Principles and Integrated circuits”, Wiley India Ltd, 2008.

AS – 302/402
HUMAN VALUES AND ETHICS

L	T	P
3	0	0

COURSE OUTCOMES (COs)

[1] This course would help to assess ideas about ethics, self-exploration and happiness through reflective enquiry.

[2] It will aid in evaluating the prevailing problems in society due to differentiation and understanding the importance of human values in relationships.

[3] The course would lead to knowledge of the ideas of globalisation and the world as a nation, for a transformative world order.

[4] It will help in analysing ideas of leadership and creativity and using leadership qualities in day-to-day lives.

[5] It will augment an understanding of cross-cultural ethics and help students learn the art of resolving ethical dilemmas in business.

UNIT 1 **08**

Course Introduction

1. Understanding: Why humans are ethical, why they are not;
2. Understanding the need, basic guidelines, content and process for Value Education;
3. Self Exploration–what is it? – It's content and process;
4. 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration;
5. Right understanding of Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority;
6. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario;
7. Method to fulfil the above human aspirations: understanding and living in **harmony** at various levels

UNIT 2 **08**

Understanding of Human Values and Ethics

1. Understanding the needs of Self ('I') and Body ('Me');
2. Understanding values in human-human relationship;
3. Meaning of Co-existence and Mutual Satisfaction;
4. Understanding Respect;
5. Understanding Comprehensive Human Goals;

UNIT 3 **08**

Effects of Holistic Harmony on Professional Ethics

1. World as a Nation;
2. Definitiveness of Ethical Human Conduct;
3. Basis for Humanistic Education and Humanistic Universal Order;
4. Competence in professional ethics:

a) Ability to utilize the professional competence for augmenting universal human order;
b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,;
c) Ability to identify and develop appropriate technologies and management patterns for above production system;

5. Strategy for transition from the present state to Universal Human Order:
   a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers;
   b) At the level of society: as mutually enriching institutions and organizations;

UNIT 4 **08**

Effects of Holistic Personality for Success

1. Negotiation as a tool for success;
2. Leadership as an attribute of a successful Professional;
3. Managing Stress and Time;
4. Team Building--creating a harmonious environment with apathy to each other;
5. Understanding difference between evolution and revolution;

UNIT 5 **08**

Managing Relationship for Success

1. Understanding and valuing Cross-Cultural Ethics;
2. Managing Relationships (Networking), Personal Effectiveness and Self Leadership;
3. Theory of Constraints;
4. A Decision Making Model: Ethics as making decisions and choices;
5. Conflicts and Ethical Dilemmas;
6. Entrepreneurship and Ethics: A sense of business Ethics;
7. Pragmatic Behaviour of Business to its Colleagues/Competitors

Text Books:

1. Kazuo Ishiguro, 1989, *The Remains of the Day*, Faber and Faber
2. B. L. Bajpai, 2004, *Indian Ethos and Modern Management*. New Royal Book Co., Lucknow. Reprinted 2008;
3. Sussan George, 1976, *How the Other Half Dies*. Penguin Press, Reprint 1991;

Reference Books:

1. Amitabh Ghosh, 2008, *Sea of Poppies*. John Murray Publications.
2. R. K. Narayan, 1958, *The Guide*, Viking Press.
3. P. L. Dhar, R. R. Gour, 1990, *Science and Humanism*, Commonwealth Publishers;
4. R. R. Gaur, R. Sangal and G. P. Bagaria, 2010, *A Foundation Course in Human Values and Professional Ethics*, Excel Books.

Relevant movies and documentaries:

1. Story of Stuff (Documentary);
2. The Remains of the Day (Movie);
3. Pursuit of Happyness (Movie);
4. Fences (Movie);
5. Gifted (Movie)

AS – 303/ AS - 403
ENVIRONMENT AND ECOLOGY

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Get the information about environment, ecosystem and also about its functions like Food chain, Ecological pyramids etc.

[2] Get the complete information about EIA- Environmental Impact Assessment in which the student will get the knowledge about the projects and the process involved in getting the projects.

[3] Get the knowledge about the different types of resources like land, water, mineral and energy and also about the effects of environment by the usage of these resources. Also get the knowledge about the analysis of polluted water.

[4] Gain the knowledge about different types of pollution and their treatment techniques like waste water treatment, solid waste management etc.,

[5] Get the complete information about the all legal aspects of environment protection.

Unit I- Fundamentals of Environment & Ecology **08**

Definition, Scope & Importance and Need for public awareness.
Ecosystem- Definition, Energy flow in ecosystem, Ecological succession and Balanced ecosystem.
Effect of human activities on food, Shelter, Economic and social security.
Effect of human activities on environment - Agriculture, Housing, Industry, Mining and Transportation activities.
Basics of Environmental Impact, Assessment and Sustainable development.

Unit II- Natural Resources & Environmental Quality standard **09**

Water resources- Availability and quality aspects. Mineral resources, Material Cycle- Carbon, Nitrogen & Sulphur cycles, DO, BOD and COD.
Modern techniques used in analysis of Pollutants- Determination of disinfectants, Pesticides, Ambient Quality standards, Water quality parameters and standards, Turbidity, pH, Suspended solids and hardness,

Unit III- Environmental Pollution & Current Environmental issues **09**

Environmental Pollution-Definition, Causes, Effects and control measure of:

1. Air Pollution
2. Water Pollution
3. Soil pollution
4. Marine Pollution

Current environmental issues of importance: Population growth, Climate change & Global warming- effects, Urbanization, Cause of global warming, Acid rain. Ozone layer depletion- causes and effects on health, Control measures. Photochemical smog, Solid waste management, Waste water treatment.

Unit IV- Energy-Types , Sources and Uses **08**

Different types of energy, Conventional and nonconventional sources- Hydro-electric, Fossil fuel based, Nuclear, Solar, Biomass, Geothermal energy and Biogas. Hydrogen as alternative future source of energy.

Unit V- Environmental protection **06**

Role of Government, Legal aspects, Environment protection Act, Introduction to ISO 14000, Green building concept.

Text Book-

1. Environmental Studies- Dr. D. L. Manjunath, Pearson Education
2. Text book of Environment Science and Engineering- M. Anji Reddy- B S Publication
3. Elements of Environmental Science and Engineering- Dr. P. Meenakshi- Prentice-Hall of India Pvt Ltd, New Delhi, 2008.
4. Environment and Ecology- P.D. Sharma- Rastogi publication 2009.

Reference Books-

1. Principle of Environmental Science and Engineering- P. Venugopalan Rao, Prentice Hall of India.
2. Environmental studies- R. Rajagopalan- Oxford Publication-2005.

AS - 401
COMPUTER ORIENTED NUMERICAL TECHNIQUES

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Apply numerical methods to obtain the approximate solutions to the linear and non-linear transcendental and polynomial equations and find error.

[2] Identify numerical methods for various mathematical operations and tasks, such as interpolation formulae like forward, backward, and divided difference formulae.

[3] Apply the appropriate techniques for numerical differentiation and integration problems

[4] Design the numerical solution of initial value problems of the ordinary differential equations with implicit and explicit methods as appropriate

[5] Work numerically on the partial differential equations using different methods through of finite difference.

Unit I **08**

Problem solving on computer, Algorithms and flow charts.
Introduction to numerical computing, approximations and errors in numerical computations, truncation and round off errors, propagation of errors.
Root finding: Bisection method, regula-falsi method, iteration method, Newton Raphson method, Secant method, systems of nonlinear equations. Rate of convergence of iterative method.

Unit II **06**

Matrix algebra & solution of simultaneous linear algebraic equations: Gauss elimination, Gauss Jordan method, LU Decomposition, Jacobi method, Gauss Seidel method, SOR method, convergence of iterative methods. Tridiagonal systems and Thomas algorithm, Condition of a system and stability issues.

Unit III **10**

Interpolation and Extrapolation: Finite differences, Newton's forward and backward interpolation formula, Lagrange interpolation formula. Divided differences and Newton's formula.
Numerical differentiation. Numerical integration: Trapezoidal and Simpson's rules. Newton-Cotes integration formulas, Romberg integration, Gaussian quadrature.

Unit IV **08**

Numerical solution of O.D.E.: Taylor series method, Euler's method, Runge Kutta method.
Multistep method: Milne,s method, Adams method, accuracy, convergence criteria, stiffness.

Unit V **08**

Boundary Value problems: Finte difference method, solving eigenvalue problems, polynomial method and power method.

Numerical solution of Partial Differential equations. Elliptic, Parabolic and hyperbolic PDEs.

Text Books :

1. Jain, Iyengar and Jain, Numerical Methods for Scientific and Engineering Computation (2003), New Age International, New Delhi.
2. Grewal B.S., Numerical Methods in Engineering and Science, Khanna Publishers, Delhi.
3. E.Balagurusamy, Numerical Methods, Tata Mc Graw hill.

Reference Books :

1. Sastry, S.S. Introductory Methods of Numerical Analysis, 3rd ed. Prentice Hall of India, New Delhi (2002).
2. Schaum's Outlines: Numerical Analysis, 2nd ed. Tata Mc Graw Hill Publishing Co. Limited (1968).
3. Kandasamy, P. Thialagawathy, K. & Gumawathy, K. Numerical Method, S Chand & Company Ltd., New Delhi (1999)
4. Balaguruswanmy, E. Numerical Methods. Tata Mc Graw Hilll Publishing Co. Limited, New Delhi (2001)

EE – 402
ELECTRICAL MACHINES – II

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Calculate regulation of alternator by direct and indirect methods

[2] Demonstrate operation of synchronous motor at constant load and variable excitation (V curve and inverted V curves) and constant excitation and variable load.

[3] Explain speed control methods of three phase induction motor

[4] Understand the working and importance of single phase induction motors and A.C commutator motor

[5] Calculate the equivalent circuit of single phase induction motor by performing no load and blocked rotor test.

UNIT I **10**

Synchronous Machine-I: Constructional features, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient.

UNIT II **08**

Synchronous Machine-II: Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics Synchronous Motor: Starting methods, Effect of varying field current at different loads, V- Curves, Hunting & damping, synchronous condenser .

UNIT III **10**

Three phase Induction Machine-I: Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator & its applications.

UNIT IV **04**

Three phase Induction Machine-II: Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed Control (with and without emf injection in rotor circuit.)

UNIT V **08**

Single phase Induction Motor: Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, repulsion motors.

AC Commutator Motors: Universal motors, Single phase a.c. series compensated motors, stepper motors.

Text Books:-

1. D.P.Kothari&I.J.Nagrath, "Electric Machines", Tata Mc Graw Hill.
2. Ashfaq Hussain"Electric Machines" Dhanpat Rai & Company.
3. P.S.Bimbhra, "Electrical Machinery", Khanna Publisher

Reference Books

1 Fitzerald,A.E.,Kingsley and S.D.Umans"Electric Machinery", MC Graw Hill.

2 Stephen J Chapman, Electrical Machinery and Power System Fundamentals, McGraw-Hill Higher Education.

3 P.S. Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers.

4 M.G.Say, "Alternating Current Machines",Pitman& Sons

EE – 403
BASIC SYSTEM ANALYSIS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Analyze different basic type of signals and mechanical modeling of electrical system.

[2] Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.

[3] Classify systems based on their properties and determine the response of LSI system using convolution.

[4] Analyze system properties based on impulse response and Fourier analysis.

[5] Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.

[6] Understand the process of sampling and the effects of under sampling.

UNIT I **06**

Introduction to continuous time signals and systems: Basic continuous time signals, unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics. Introduction to various types of systems.

Analogous System: Linear mechanical elements, force-voltage and force-current analogy, modeling of mechanical and electro-mechanical systems: Analysis of first and second order linear systems by classical method.

UNIT II **07**

Fourier Transform Analysis : Exponential form and Trigonometric form of Fourier series, Fourier symmetry, Fourier Integral and Fourier Transform. Transform of common functions and periodic wave forms: Applications of Fourier Transform to network analysis.

UNIT III **10**

Laplace Transform Analysis : Review of Laplace Transform , Laplace Transform of periodic functions, Initial and Final Value Theorems, Inverse Laplace Transform , Convolution Theorem, Superposition Integral , Application of Laplace Transform to analysis of networks, waveform synthesis and Laplace Transform of complex waveforms.

UNIT IV **10**

State – Variable analysis : Introduction, State Space representation of linear systems, Transfer Function and state Variables , State Transition Matrix, Solution of state equations for homogeneous and non-homogeneous systems , Applications of State-Variable technique to the analysis of linear systems.

UNIT V **07**

Z-Transform Analysis : Concept of Z-Transform, Z-Transform of common functions, Inverse Z-Transform, Initial and Final Value theorems , Applications to solution of difference equations, Pulse Transfer Function.

Text Books:-

1. Alan V. Oppenheim & Alan S.Wilsky."Signals and Systems" Pearson
2. B.P. Lathi, "Linear Systems & Signals" Oxford University Press, 2008.

Reference Books:-

1. David K.Cheng; "Analysis of Linear System", Narosa Publishing Co.
2. C.L.Wadhwa, "Network Analysis and Synthesis", New Age International Publishers,2007.
3. ME Van-Valkenberg; " Network Analysis", Prentice Hall of India .
4. Samarajit Ghosh, "Network Theory: Analysis and Synthesis" Prentice Hall of India, 2008 .
5. Choudhary D.Roy, "Network & Systems", Wiley Eastern Ltd.
6. I.J. Nagrath, S.N. Saran, R. Ranjan and S.Kumar, "Signals and Systems, "Tata Mc. Graw Hill, 2001.

EC - 402
ELECTROMAGNETIC FIELD THEORY

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Apply different coordinate systems and their application in electromagnetic field theory, establish a relation between any two systems and also understand the vector calculus.

[2] Understand the concept of static electric field. Understand the concept of current and properties of conductors. Establish boundary conditions and to calculate capacitances of different types of capacitors

[3] Understand the forces due to magnetic field, magnetization, magnetic boundary conditions and inductors.

[4] Understand displacement current, time varying fields, propagation and reflection of EM waves and transmission lines.

Unit I: **08**

Coordinate systems and transformation: Cartesian coordinates, circular cylindrical coordinates, spherical coordinates. Vector calculus: Differential length, area and volume, line surface and volume integrals, del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of vector and Stake's theorem, Laplacian of a scalar.

Unit II: **10**

Electrostatics: Electrostatic fields, Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausse's Law-Maxwell's equation, Electric dipole and flux lines, energy density in electrostatic fields.

Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, dielectric constants, continuity equation and relaxation time, boundary condition. Electrostatic boundary value problems: Poisson's and Laplace's equations, general procedures for solving Poisson's or Laplace's equations, resistance and capacitance, method of images.

Unit III: **08**

Magnetostatics: Magneto-static fields, Biot-Savart's Law, Ampere's circuit law, Maxwell's equation, application of ampere's law, magnetic flux density-Maxwell's equation: Maxwell's equation for static fields, magnetic scalar and vector potential.

Magnetic forces, materials and devices: Forces due to magnetic field, magnetic torque and moment, a magnetic dipole, magnetization in materials, magnetic boundary conditions, inductors and inductances, magnetic energy.

Unit IV: **08**

Waves and applications: Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, displacement current, Maxwell's equation in final form.

Electromagnetic wave propagation: Wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane wave in free spsce, plain waves in good conductors, power and the pointing vector, reflection of a plain wave in a normal incidence.

Unit V: **06**

Transmission lines: Transmission line parameters, Transmission line equations, input impedance, standing wave ratio and power The Smith chart, some applications of transmission lines.

Text Books:

1. M.N.O.Sadiku, "Elements of Electromagnetic" , 4th Ed, Oxford University Press.
2. Hayt, W.H. and Buck, J.A., "Electromagnetic Tata Mc. Graw Hill Publishing.

Reference Books:

1. Jordan E.C. and Balmain K.G., "Electromagnetic Wave and radiating Systems", Prentice Hall International, 2nd Edition.
2. Kraus, F. "Electromagnetic", Tata Mc. Graw Hill 5th Edition.
3. Ramo S, whinnery T.R. and Vanduzer T, "Field and Waves in Communication Electronics", John Wiely and Sons 3rd Edition.

EC - 404

FUNDAMENTALS OF MICROPROCESSOR

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Describe the general architecture of a microcomputer system and architecture & organization of 8085 & 8086 Microprocessor and understand the difference between 8085 and advanced microprocessor.

[2] Understand and realize the Interfacing of memory & various I/O devices with 8085 microprocessor

[3] Understand and classify the instruction set of 8085 microprocessor and distinguish the use of different instructions and apply it in assembly language programming.

[4] Understand the architecture and operation of Programmable Interface devices and realize the programming & interfacing of it with 8085 microprocessor.

Unit-I **08**

Introduction to Microprocessor: Microprocessor evolution and types, microprocessor architecture and its operation, addressing modes, interrupts, data transfer schemes, instruction and data flow, timer and timing diagram, Basic interfacing concepts, Memory interfacing, Interfacing output displays, Interfacing input devices.

Unit-II **09**

Introduction to 8085 microprocessor: Pin diagram and internal architecture of 8085 microprocessor, registers, ALU, Control & status, interrupt and machine cycle. Instruction sets. Instruction formats. Instruction Classification: data transfer, arithmetic, logic, branch operations, looping, counting, indexing, programming techniques, counters and time delays, stacks and subroutines, conditional call and return instructions.

Unit-III **08**

Introduction to 8086 microprocessor: Architecture of 8086 microprocessor, pin diagram, Functional block diagram, register organization, bus interface unit, execution unit, memory addressing, and memory segmentation. Operating modes, Instruction sets, instruction format, Types of instructions. Interrupts: hardware and software interrupts.

Unit-IV **08**

Introduction to Assembly Language: Assembly language programming based on intel 8085/8086. Instructions, data transfer, arithmetic, logic, branch operations, looping, counting, indexing, programming techniques, counters and time delays, stacks and subroutines, conditional call and return instructions.

Unit-V **07**

Peripheral Devices: 8237 DMA Controller, 8255 programmable peripheral interface, 8253/8254 programmable timer/counter, 8259 programmable interrupt controller, 8251 USART and RS232C.

Text Books:

1. Gaonkar, Ramesh S , "Microprocessor Architecture, Programming and Applications with8085", Penram International Publishing.
2. Hall D V ,"Microprocessor Interfacing', TMH
3. Liu Y.C. & Gibson G.A. , " Microcomputer System: The 8086/8088 family'', Pearson Education

Reference Books

1. Ray A. K. Bhurchandi K M, "Advanced Microprocessors and Peripherals", TMH
2. Brey, Barry B, "INTEL Microprocessors", PHI
3. Aditya P Mathur Sigh, "Microprocessor, Interfacing and Applications M Rafiqzzaman, "Microprocessors, Theory and Applications

EE – 501
POWER SYSTEM - I

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the general structure of power system, different supply system, rules and phenomena related to transmission line

[2] Be capable of calculating parameters of overhead transmission line.

[3] Be capable of evaluating the performance of different types overhead transmission lines.

[4] Be capable of analysis of mechanical and electrical design aspects of transmission system

[5] Impart the knowledge of insulated cables and neutral grounding

[6] Impart the knowledge of EHV AC and HVDC transmission

UNIT-I

Power System Components: Single line diagram of power system; Brief description of power system elements: Synchronous machines. Transformers, transmission lines, busbar, circuit breaker and isolator etc.

Supply System: Different kinds of supply system and their comparison, choice of transmission voltage.

Transmission Lines: Conductor materials, types of conductors, resistance of line, Kelvin's law, current distortion effects: skin effect, proximity effect. **08**

UNIT-II

Over Head Transmission Lines: Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines; Interference with communication lines, Reduction methods; Representation and performance of short, medium and long transmission lines, Ferranti effect, surge impedance loading. **10**

UNIT-III

Mechanical Design of Transmission Lines: Catenary curve, calculation of sag & tension, stringing chart, effects of wind and ice loading, sag template, vibration dampers

Overhead Line Insulators: Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency. **08**

UNIT-IV

Corona and Interference: Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona.

Insulated Cables: Type of cables, construction and their applications; dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables. **06**

UNIT-V

Neutral Grounding: Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices.

Electrical Design of Transmission Line: Design consideration of EHV transmission lines, choice of voltage, number of circuits, conductor configuration, insulation design, selection of ground wires.

EHV AC and HVDC Transmission: Introduction to EHV AC and HVDC transmission and their comparison, use of bundle conductors, kinds of DC links and incorporation of HVDC into AC system. **08**

Text Books:

1. W. D. Stevenson, "Elements of Power System Analysis", Tata McGraw Hill Publishing Co.
2. C. L. Wadhwa, "Electrical Power Systems", New Age International Ltd.
3. Ashfaq Hussain, "Electrical Power Systems", CBS Publishers and Distributors.
4. B. R. Gupta, "Power System Analysis and Design", S. Chand & Co.
5. M. V. Deshpande, "Electrical Power Systems Design", Tata McGraw Hill Publishing Co. Ltd.

Reference Books:

1. M. L. Soni, P.V. Gupta and U. S. Bhatnagar, "A Course in Electrical Power", Dhanpat Rai & Sons.
2. S. L. Uppal, "Electrical Power Systems", Khanna Publishers.
3. S. N. Singh, "Electric Power Generation, Transmission & Distribution", PHI Learning Pvt. Ltd.

EE – 502
CONTROL SYSTEMS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Impart the knowledge of open loop and close loop control system, servomechanism

[2] Do modeling of mechanical, electrical and electro-mechanical systems by differential equations.

[3] Learn about representation of the system by transfer function, block diagram reduction technique and signal flow graph.

[4] Analyze the system response and stability in both time-domain and frequency domain

[5] Make students capable of designing of P,PI and PID controllers

[6] Impart the knowledge of Root Locus Technique and State variable Techniques

[7] Learn the features of different types of compensators and to design compensators using time-domain and frequency domain specifications

UNIT-I

The Control System: Open loop & close loop control, servomechanism, physical examples. Modelling of mechanical, electrical and electro-mechanical systems by differential equations, analogy between electrical and mechanical systems.

Transfer functions and its properties, block diagram algebra, signal flow graph, basic characteristics of feedback systems, modes of feedback control, the performance of feedback systems, Mason's gain formula, Reduction of parameter variation and effects of disturbance by using negative feedback**.** **08**

UNIT-II

Time Response Analysis: Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants

Design Specifications of Second Order Systems: Derivative error, derivative output, integral error and PID compensations, design considerations for higher order systems, performance indices. **08**

UNIT-III

Control System Components: Constructional and working concept of ac servomotor, synchros and stepper motor.

Stability and Algebraic Criteria: concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations.

Root Locus Technique: Concepts of root locus, construction of root loci, effect of transportation lag and Root locus of non-minimal phase system and effect of pole-zero cancellation. **08**

UNIT-IV

Frequency Response Analysis: Frequency response analysis from transfer function model, correlation between time and frequency responses, polar and inverse polar plots, Bode plots

Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin; Close loop frequency response: Constant M&N circles **08**

UNIT-V

Introduction to Design: The design problem and preliminary considerations; Realization of basic compensators: lead, lag and lead- lag, design of closed loop systems using compensation techniques in time domain and frequency domain.

Review of State Variable Technique: The concept of state & space, state-space model of physical system, conversion of state variable model to transfer function model and vice-versa, diagonalization, controllability and observability and their testing. **08**

Text Books:

1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Ltd.
2. K. Ogata, "Modern Control Engineering", PHI Learning Pvt. Ltd.
3. B. C. Kuo and F. Golnaraghi, "Automatic Control Systems", Wiley India Ltd.
4. D. Roy Choudhary, "Modern Control Engineering", PHI Learning Pvt. Ltd.

Reference Books:

1. Norman S. Nise, "Control Systems Engineering", John Wiley & Sons Inc.
2. R.T. Stefani, B. Shahian, C. J. Savant and G.H. Hostetter, "Design of Feedback Control Systems", Oxford University Press.

EE – 503
ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Provide students with a thorough understanding of crystal structure of materials

[2] Know about properties and applications of electrical conducting and insulating materials

[3] Understand the mechanism of Conduction in semiconductor materials

[4] Know about magnetic and optical properties of materials

[5] Be capable of selection of materials according to industrial needs

UNIT- I

Crystal Structure of Materials: Bonds in solids, crystal structure, co-ordination number, atomic packing factor, Miller Indices, Bragg's law and x-ray diffraction, structural imperfections, crystal growth. Energy bands in solids, classification of materials using energy band. **08**

UNIT-II

Conductivity of Metals: Electron theory of metals, factors affecting electrical resistance of materials, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, superconductivity and super conducting materials, properties and applications of electrical conducting and insulating materials, mechanical properties of metals. **08**

UNIT-III

Mechanism of Conduction in semiconductor materials: Types of semiconductors, current carriers in semiconductors, Half effect, Drift and Diffusion currents, continuity equation, P-N junction diode, junction transistor, FET & IGFET, properties of semiconducting materials. **08**

UNIT-IV

Magnetic Properties of Material: Origin of permanent magnetic dipoles in matters, Classification: Diamagnetism, Para magnetism, Ferromagnetism, Anti-Ferro-magnetism and Ferrimagnetism, magnetostriction, properties of magnetic materials, soft and hard magnetic materials and permanent magnetic materials. **08**

UNIT-V

Materials Selection and Optical Properties: Material properties and Engineering Design parameters; General effects of processing on parameters; selection of structural design. Light interaction with solids; Absorption, Transmission and Reflection; Luminescence; Photoconductivity. **08**

Text Books:

1. L. H. Van Vlack, "Elements of Materials Science and Engineering", Pearson Education India.
2. V. Raghavan, "Materials Science and Engineering: A First Course", PHI Learning Pvt. Ltd.
3. V. S. R. Murthy, A. K. Jena, K. P. Gupta and G. S. Murty, "Structure and Properties of

Engineering Materials", Tata McGraw Hill Publishing Co. Ltd.
4. J. F. Shackelford, "Introduction to Materials Science for Engineers", Pearson.
5. C. S. Indulkar and S. Thiruvengadam, "An Introduction to Electrical Engg. Materials", S. Chand & Co.

Reference Books:

1. L. Solymar and D. Walsh, "Electrical Properties of Materials", Oxford University Press.
2. I. P. Jones, "Materials Science for Electrical and Electronic Engineers", Oxford University Press.

EE – 504
ADVANCED ELECTRICAL MACHINES

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the construction and performance of double cage and deep bar three phase induction motor

[2] Understand the operating principle and characteristics of induction generator and two phase ac servomotor

[3] Understand the construction and principle of operation of stepper motors and switched reluctance motors

[4] Know about permanent dc motor, PM AC motors, brushless dc motor, PCB motors and single phase synchronous motor

[5] Understand the construction and principle of operation of single phase commutator motor and linear induction motor

UNIT I

Poly-phase AC Machines: Construction and performance of double cage and deep bar three phase induction motors; e.m.f. injection in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power). **08**

UNIT-II

Induction Generator: Self-excited Induction Generator **(**SEIG), Doubly-fed Induction Generator (DFIG): Operating Principle, Equivalent Circuit, Characteristics, Applications.

Two Phase AC Servomotors: Construction, torque-speed characteristics, performance and applications. **06**

UNIT-III

Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications.

Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits. **08**

UNIT-IV

Permanent Magnet Machines: Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet dc motors, sinusoidal PM AC motors, brushless dc motors and their important features and applications, PCB motors. Single phase

synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators and applications. **10**

UNIT-V

Single Phase Commutator Motors: Construction, principle of operation, characteristics of universal and repulsion motors.

Linear Induction Motors: Construction, principle of operation, linear force, and applications. **08**

Text Books:

1. P.S. Bimbhra, "Generalized Theory of Electrical Machines" Khanna Publisher.
2. P.C. Sen, "Principles of Electrical Machines and Power Electronics", John Wiley & Sons.
3. D. P. Kothari and I. J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Co. Ltd.

Reference Books:

1. C. G. Veinott, "Fractional and Sub-fractional Horse Power Electric Motors", Tata McGraw Hill Publishing Co. Ltd.
2. M.G. Say, "Alternating current Machines" Pitman & Sons.
3. I. L. Kosow, "Electric Machinary and Transformers", PHI Learning Pvt. Ltd.

EC - 501
PRINCIPLES OF COMMUNICATION ENGINEERING

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the Basic concept of communication Systems, Amplitude Modulation (AM) and Demodulation Techniques.

[2] Understand the Angle Modulation (FM & PM), Generation and Reception Methods.

[3] Understand the Pulse modulation techniques, their generation and reception.

[4] Understand the Noise analysis in communication systems.

[5] Understand the Different multiplexing techniques.

Unit-I

Introduction: Overview of Communication system, communication channels, need for modulation, base band and pass band signals. Amplitude Modulation : Double side band with carrier (DSB-C), double side band without carrier, single side band modulation, DSB-SC, DSB-C, SSB modulators and demodulators, vestigial side band (VSB), quadrature amplitude modulator. **08**

Unit-II

Angle modulation, modulation index, pre-emphasis & de-emphasis, tone modulated FM signal, arbitrary modulated FM signal, FM modulators, direct method & indirect method and demodulators, PLL, phase discriminator & ratio detector, PM modulator and demodulator, stereophonic FM broadcasting, **08**

Unit-III

Pulse Modulation Digital Transmission of Analog Signals: Sampling theorem and its applications, pulse amplitude modulation (PAM), pulse width modulation, pulse position modulation, their generation and demodulation, digital representation of analog signals. Pulse Code Modulation (PCM) and PCM system. Issues in Digital Transmission: Frequency division multiplexing, time division multiplexing ,line coding and their power spectral density. **08**

Unit-IV

Differential pulse code modulation, delta modulation. adaptive delta modulation, T1 digital system, TDM hierarchy, Noise in Amplitude Modulation: Analysis, signal to noise ratio, figure of merit, noise in frequency modulation **08**

Unit-V

Noise: Types of noise and their sources, noise calculation, noise due to several amplifiers in cascade, noise in reactive circuits, noise figure & noise temperature calculation. **08**

Text Book:

1. H. Taub, D. Schilling, GoutomSaha, "Principles of Communication Systems", 4th Edition, TataMcGraw-Hill Publishing Company Ltd.
2. R.P. Singh, & S.D Sapre, "Communication Systems: Analog & Digital", 3rd Edition McGraw Hill Education.
3. B.P. Lathi, "Modern Digital and Analog communication Systems", 3rd Edition, Oxford University Press,2009.

Reference Books:

1. G. Kennedy, B. Devis, S. R. M. Prasanna, "Electronic Communication Systems" 5th Edition, Tata McGraw-Hill Publishing Company Ltd.
2. Simon Haykin, "Communication Systems",4th Edition, Wiley India.
3. H. Hsu & D. Mitra , "Analog and Digital Communications", 2nd Edition, Tata McGraw-Hill Publishing Company Ltd.

EE – 601
POWER SYSTEM – II

L	T	P
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COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand online diagram, impedance and reactance diagram and per unit system

[2] Analyze symmetrical and unsymmetrical faults

[3] Analyze travelling wave phenomenon on transmission lines

[4] Analyze load flow methods

[5] Determine the stability of a power system

UNIT-I

Representation of Power System Components: Synchronous machines, transformers, transmission lines, one-line diagram, impedance and reactance diagram, per unit system

Symmetrical components: Symmetrical components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks.

Symmetrical fault analysis: Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions. **08**

UNIT-II

Unsymmetrical faults: Analysis of single line-to-ground fault, line-to-line fault and double line-to-ground fault on an unloaded generators and power system network with and without fault impedance, formation of Z-bus using singular transformation. **08**

UNIT-III

Load Flows: Introduction, bus classifications, nodal admittance matrix (Y-bus), development of load flow equations, load flow solution using Gauss-Seidel and Newton-Raphson methods, approximation to N-R method, line flow equations and fast decoupled method. **08**

UNIT-IV

Power System Stability: Stability and Stability limit, Steady state stability study, Swing equation, transient stability studies by equal area criterion and step-by-step method. Factors affecting steady state and transient stability and methods of improvement. **08**

UNIT-V

Traveling Waves: Wave equation for uniform transmission lines, velocity of propagation, surge impedance, reflection and transmission of traveling waves under different line loadings, standing wave ratio, Bewlay's lattice diagram, protection of equipment's and line against traveling waves. **08**

Text Books:

1. W.D. Stevenson, "Elements of Power System Analysis", Tata McGraw Hill Publishing Co. Ltd.
2. C.L. Wadhwa, "Electrical Power Systems", New Age International Ltd.
3. A. Chakrabarti, M. L. Soni, P. V. Gupta and U. S. Bhatnagar, "A Text Book on Power System Engineering", Dhanpat Rai & Co.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", Tata McGraw Hill Publishing Co. Ltd.

Reference Books:

1. Hadi Sadat, “Power Systems Analysis”, Tata McGraw Hill Publishing Co. Ltd.
2. J. D. Glover, M.S. Sharma and T. J. Overbye, “Power System Analysis and Design”, Cengage Learning.
3. P. S. R. Murty, “Power System Analysis”, B. S. Publications.
4. G. W. Stagg and A. H. El-Abiad, “Computer Methods in Power System Analysis”, Tata McGraw Hill Publishing Co. Ltd.

EE – 602
POWER ELECTRONICS

L	T	P
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COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Select switching devices for a given power converters

[2] Understand SCR protection method and commutation techniques

[3] Design a DC-DC converter for a given performance

[4] Evaluate the performance of phase controlled converters

[5] Analyze and evaluate the operation of inverters, ac voltage controllers and cyclo converters

UNIT-I

Power semiconductor Devices: Power semiconductor devices, their symbols and static characteristics; Characteristics and specifications of switches, types of power electronic circuits.
Power Diodes: General purpose diode, Fast recovery diode, Schottky diode and its applications.
Power Bipolar Junction Transistors: Physical structure and device operation, static V-I and switching characteristics, switching limits of power transistor.
Power MOSFETS: Physical structure and device operation, Static V-I characteristics and switching characteristics, safe operating area.
Insulated Gated Bipolar Transistors: Physical structure and device operation, static V-I characteristics, safe operating area.
Thyristor: Physical structure and device operation, static V-I characteristics, two transistor model, methods of turn-on.
GTO (Gate Turn Off) Thyristors: Physical structure and device operation, static V-I and switching characteristics.
TRIAC: Physical structure and device operation, static V-I characteristics and applications.
Special Power Devices: Physical structure, device operation and static V-I characteristics of Reverse Conducting Thyristor (RCT), FET controlled thyristor, Static Induction Thyristors (SITH), MOS Controlled Thyristor (MCT), LASCR. **10**

UNIT-II

Power Semiconductor Devices (Contd): Protection of devices, series and parallel operation of thyristors, commutation techniques of thyristor.
DC-DC Converters: Introduction, Principle of chopper operation, Control strategies, Principles of step-down chopper, step-down chopper with R-L load, Principle of step-up chopper, and operation with R-L load, classification of choppers. **06**

UNIT-III

Phase Controlled Converters: Single-phase half wave controlled rectifier with resistive and inductive loads, effect of freewheeling diode. Single-phase fully controlled and half controlled bridge converters, performance parameters, Three-phase half wave converters, Three-phase fully controlled and half controlled bridge converters, effect of source impedance single-phase and three-phase dual converters. **08**

UNIT-IV

AC Voltage Controllers: Principle of On-Off and phase controls, Single-phase ac voltage controller with resistive and inductive loads, Three-phase ac voltage controllers (various configurations and comparison only) Single-phase transformer taps changer.

Cyclo-converters: Introduction, The basic principle of operation, single-phase to single-phase, three-phase to single-phase and three-phase to three-phase cyclo-converters, output voltage equation. **08**

UNIT-V

Inverters: Introduction, Single-phase series resonant inverter, Single-phase bridge inverters, Three-phase bridge inverters, voltage control of inverters, harmonics reduction techniques, Single-phase and three-phase current source inverters. **08**

Text Books:

1. M. H. Rashid, "Power Electronics: Circuits, Devices & Applications", Pearson Education India.
2. M. D. Singh and K. B. Khanchandani, "Power Electronics", Tata McGraw Hill Publishing Co. Ltd.
3. V. R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications", Oxford University Press.
4. B. Jayant Baliga, "Modern Power Devices", Wiley-Interscience, NewYork.
5. S. N. Singh, "A Textbook of Power Electronics", Dhanpat Rai & Sons.

Reference Books:

1. M. S. J. Asghar, "Power Electronics", PHI Learning Pvt. Ltd.
2. A. Chakrabarti, "Fundamentals of Power Electronics & Drives", Dhanpat Rai & Sons.
3. N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley & Sons Inc.
4. G. K. Dubey et al, "Thyristorised Power Controllers", John Wiley & Sons Inc.
5. J. G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Pearson Education India.

EE – 603
ADVANCED CONTROL SYSTEMS

L	T	P
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COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Do state space analysis of continuous system

[2] Describe the dynamics of a linear, time invariant and causal digital system through difference equations

[3] Determine the stability of discrete control system

[4] Analyze nonlinear system by using phase plane method

[5] Understand the concept of optimal and adaptive control system

UNIT-I

State Space Analysis of Continuous System: Review of state variable representation of continuous system, conversion of state variable models to transfer function and vice-versa, solution of state equations and state transition matrix, controllability and observability, design of state observer and controller. **08**

UNIT-II

Analysis of Discrete System: Discrete system and discrete time signals, state variable model and transfer function model of discrete system, conversion of state variable model to transfer function model and vice-versa, modeling of sample hold circuit, solution of state difference equations, steady state accuracy, stability on the z-plane and Jury stability criterion, bilinear transformation, Routh-Hurwitz criterion on r^{th} planes. **08**

UNIT-III

Stability: Lyapunov's stability theorems for continuous and discrete systems, methods for generating Lyapunov function for continuous and discrete system, Popov's criterion.

Non-linear System: Types of non linearities, phenomena related to non - linear systems. Analysis of non- linear systems-Linearization method, second order non-linear system on the phase plane, types of phase portraits, singular points, system analysis by phase-plane method, describing function and its application to system analysis. **08**

UNIT-IV

Optimal Control: Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization. Pontryagin's Minimum Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation, Riccati equation and its solution. **08**

UNIT-V

Adaptive Control: Introduction, modal reference adaptive control systems, controller structure, self-tuning regulators; Introduction to neural network, Fuzzy logic and genetic algorithms. **08**

Text Books:

1. M. Gopal, “Digital Control and State variable Methods”, Tata McGraw Hill Publishing Co. Ltd.
2. A. K. Mandal, “Introduction to Control Engineering: Modeling, Analysis and Design” New Age International.
3. S. Rajasekaran and G. A. V. Pai, “Neural Networks, Fuzzy Logic and Genetic Alogorithms: Synthesis and Applications” PHI Learning Pvt. Ltd.

Reference Book:

1. Donald E. Kirk, “Optimal Control Theory: An Introduction”, Dover Publications.
2. B.C. Kuo, “Digital Control Systems” Saunders College Publishers.
3. C. H. Houpis and G. B. Lamont, “Digital Control Systems: Theory, Hardware, Software” Tata McGraw Hill Publishing Co. Ltd.

EE – 604
POWER STATION PRACTICE

L	T	P
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COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the awareness of electrical energy demand, growth and electrical energy sources in India

[2] Understand the general layout and operation of thermal and hydro power plant

[3] Understand the operation of nuclear power plant, Gas turbine plant and diesel plant

[4] Draw substation layout

[5] Describe the various terms related to power plant economics and power tariffs

[6] Impart the knowledge of generation of electricity based on non conventional energy sources

UNIT-I

Introduction: Electric energy demand and growth in India, electric energy sources.

Thermal Power Plant: Site selection, general layout and operation of plant, detailed description and use of different parts.

Hydro Electric Plants: Classifications, location and site selection, detailed description of various components, general layout and operation of Plants, brief description of impulse, reaction, Kaplan and Francis turbines, advantages & disadvantages, hydro-potential in India. **08**

UNIT-II

Nuclear Power Plant: Location, site selection, general layout and operation of plant. Brief description of different types of reactors, moderator materials, fissile materials, control of nuclear reactors, disposal of nuclear waste material, shielding.

Gas Turbine Plant: Operational principle of gas turbine plant & its efficiency, fuels, open and closed-cycle plants, regeneration, inter-cooling and reheating, role and applications.

Diesel Plants: Diesel plant layout, components & their functions, its performance, role and applications. **08**

UNIT-III

Sub-stations Layout: Types of substations, bus-bar arrangements, typical layout of substation.

Power Plant Economics and Tariffs: Load curve, load duration curve, different factors related to plants and consumers, Cost of electrical energy, depreciation, generation cost, effect of load factor on unit cost. Fixed and operating cost of different plants, role of load diversity in power system economy; Objectives and forms of Tariff; Causes and effects of low power factor, advantages of power factor improvement, different methods for power factor improvements. **08**

UNIT-IV

Economic Operation of Power Systems: Characteristics of steam and hydro-plants, Constraints in operation, Economic load scheduling of thermal plants neglecting and considering transmission losses, Penalty factor, loss coefficients, incremental transmission loss; Hydrothermal Scheduling. **08**

UNIT-V

Non-Conventional Energy Sources: Power Crisis, future energy demand, role of private sectors in energy management,

MHD Generation: Working principle, open and closed cycles, MHD systems, advantages, parameters governing power output.

Solar Power Plant: Conversion of solar heat to electricity, solar energy collectors, photovoltaic cell, power generation, future prospects of solar energy use.

Wind Energy: Windmills, power output with combined operation of wind turbine generation and isolated generating system, technical choices & economic size.

Geothermal Energy: Earth energy, heat extraction, vapour turbine cycle, difficulties & disadvantages,

Tidal Energy: Tidal phenomenon, tidal barrage, tidal power schemes.

Ocean Thermal Energy: Introduction, energy conversion, problems. **08**

Text Books:

1. B. R. Gupta, "Generation of Electrical Energy", S. Chand Publication.
2. A. Chakrabarti, M. L. Soni, P. V. Gupta and U. S. Bhatnagar, "A textbook on Power System Engineering", Dhanpat Rai & Sons Co.
3. P. S. R. Murthy, "Operation and control of Power System", B S Publications.

Reference Books:

1. W. D. Stevenson, "Elements of Power System Analysis", Tata McGraw Hill Publishing Co. Ltd.
2. S. L. Uppal and S. Rao, "Electrical Power Systems", Khanna Publishers.
3. M. V. Deshpande, "Elements of Electrical Power Station Design", PHI Learning Pvt. Ltd.

EE – 6051
COMPUTER AIDED POWER SYSTEM ANALYSIS

L	T	P
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COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Design mathematical models for power system components

[2] Do short circuit studies using bus impedance matrix, bus admittance matrix and loop impedance matrix.

[3] Generate input data suitable for load flow, fault calculation

[4] Determine voltage stability and small signal stability of power system

UNIT-I

Network Matrices: Evaluation of bus admittance matrix, bus impedance matrix, branch impedance matrix and loop Impedance matrix by singular and non-singular transformations. **08**

UNIT-II

Short Circuit Studies: Formulation of bus impedance matrix for single phase and three phase networks, transformation of network matrices using symmetrical components; Short circuit studies using bus impedance matrix, bus admittance matrix and loop impedance matrix. **06**

UNIT-III

Load Flow Studies: Representation of off-load, on-load tap changing and phase shifting transformers, DC link, Decoupled and fast decoupled methods, sparsity technique; Introduction to load flow of integrated AC/DC system. **08**

UNIT-IV

Stability Studies: Network formulation for stability studies for different types of loads (constant impedance, constant current and constant power loads), digital computer solution of swing equation for single and multi-machine cases using Runge-Kutta and predictor corrector methods, effects of exciter and governor on transient stability. **08**

UNIT-V

Voltage Stability: Transmission system characteristics, generator characteristics, load characteristics, introduction of reactive compensating devices, classification of voltage stability, voltage stability analysis, voltage collapse and its prevention.

Small-Signal Stability: Concept of stability of dynamic system, Eigen-properties of the state matrix, Single-machine infinite bus system, power system stabilizer. **10**

Text Books:

1. G. Kusic, "Computer-Aided Power System Analysis", CRC Press.
2. M. A. Pai and D. Chatterjee, "Computer Techniques in Power System Analysis", Tata McGraw Hill Publishing Co. Ltd.
3. P. Kundur, "Power System Stability and Control", Tata McGraw Hill Publishing Co. Ltd.

Reference Books:

1. G. W. Stagg and A. H. El-Abiad, "Computer Methods in Power System Analysis", Tata McGraw Hill Publishing Co. Ltd.
2. L. P. Singh, "Advanced Power System Analysis and Dynamics", John Wiley Sons & Co.

EE – 6052
ELECTRICAL MACHINE DESIGN

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Acquire knowledge to carry out a detailed design of a transformer and provide the information required for the fabrication of the same along with an estimate of various performance indices

[2] Acquire knowledge to carry out a detailed design of a dc machine

[3] Acquire knowledge to carry out a detailed design of an induction machine and provide the information required for the fabrication of the same along with an estimate of various performance indices.

[4] Perform computer assisted design of transformer, dc machine and induction machine

UNIT-I

Basic design principles and approaches, factors and limitations in design, specification, magnetic and electric loading, output equations and output coefficients, Main dimensions; Ratings, heating cooling and temperature rise, heating cooling curves, heating cooling cycles, estimation of maximum temperature rise, cooling media. **08**

UNIT-II

Transformer: Magnetic circuit, classification of magnetic materials and allowable flux densities, core construction and design, winding types, insulation, loss allocation and estimation, reactance, temperature rise. **08**

UNIT-III

DC Machine: No. of poles and main dimensions, armature windings, single layer, double layer, magnetic circuit and magnetization curve, commutator and brushes. **08**

UNIT-IV

3-phase Induction Machine: Rating specifications, standard frame sizes, main dimensions specific loadings, design of stator windings, rotor design-slots and windings, integral and fractional slot windings, winding factors , calculations of equivalent circuit parameters. **10**

UNIT-V

Computer assisted design of above machines. **06**

Text Books:

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai & Sons.
2. K. G. Upadhyay, "Conventional and Computer Aided Design of Electrical Machines" Galgotia Publications.

Reference Books:

1. M. G. Say, "The Performance and Design of Alternating Current Machines" Pitman & Sons.
2. A. E. Clayton and N.N. Hancock, "The Performance and Design of Direct Current Machines" Pitman & Sons.
3. S. K. Sen, "Principles of Electrical Machine Design with Computer Programs" Oxford and IBM Publications.

EE – 6053
UTILIZATION OF ELECTRICAL ENERGY AND TRACTION

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand basic principles of electric heating and welding

[2] Design of indoor lighting and outdoor lighting systems.

[3] Understand refrigeration and air conditioning

[4] Understand starting and speed control method of electric traction

[5] Evaluate speed time curves for traction

UNIT-I

Electric Heating: Different methods of electric heating: Resistance heating, electric arc heating, principles of high frequency induction and dielectric heating. **08**

UNIT-II

Electric Welding: Electric arc welding, electric resistance welding, welding transformers, electronic welding control.

Electrolyte Process: Principles of electro deposition, laws of electrolysis, applications of electrolysis **08**

UNIT-III

Illumination: Various definitions, laws of illumination, requirements of good lighting, design of indoor lighting and outdoor lighting systems.

Refrigeration and Air Conditioning: Refrigeration systems, domestic refrigerator, water cooler Types of air conditioning, window air conditioner **08**

Unit-IV

Electric Traction-I: Types of electric traction, systems of track electrification, traction mechanics-types of services, speed time curve and its simplification, average and schedule speeds, tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence **08**

UNIT-V

Electric Traction-II: Salient features of traction drives, various methods of starting and speed control of DC and AC drives used in traction, series – parallel control of dc traction drives (bridge transition) and energy saving, power electronic control of dc and ac traction drives, diesel electric traction. **08**

Text Books:

1. H. Partab, "Art and Science of Utilization of Electrical Energy", Dhanpat Rai & Sons.
2. H. Partab, "Modern Electric Traction", Dhanpat Rai & Sons.

Reference Books:

1. G. K. Dubey, "Fundamentals of Electric Drives", Narosa Publishing House.
2. C. L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Pvt. Ltd..

EE – 6054
FUNDAMENTAL OF DIGITAL SIGNAL PROCESSING

L	T	P
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COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Acquire knowledge about the time domain representation and classification of discrete time signals and systems

[2] Acquire knowledge about the time domain analysis of linear time invariant discrete time systems and representation of total response in various formats

[3] Acquire knowledge about the application of discrete time Fourier transform, Discrete Fourier series and z-transform for discrete time signal representation and analysis of linear time invariant systems discrete time systems

[4] Acquire knowledge about the application of discrete Fourier transform in signal representation and system analysis and DFT computation using FFT algorithms

[5] Acquire knowledge about the design methods for IIR and FIR filters and their realization structures.

UNIT-I

Discrete-Time Signals and Systems: Sequences, discrete time systems, LTI systems, frequency domain representation of discrete time signals and systems, discrete time signals and frequency domain representation, Fourier Transform.

Discrete Fourier Transform: Discrete Fourier transforms, properties, linear convolution using DFT, DCT. **08**

UNIT-II

Sampling of Continuous Time Signals: Sampling and reconstruction of signals, frequency domain representation of sampling, discrete time processing of continuous time signals, continuous time processing of discrete time signals, changing the sampling rate using discrete time processing, multi rate signal processing, digital processing of analog signals, over sampling and noise shaping in A/D and D/A conversion. **08**

UNIT-III

Transform Analysis of LTI Systems: Frequency response of LTI systems, system functions, frequency response for rational system functions, magnitude-phase relationship, all pass systems, minimum phase systems, and linear systems with generalized linear phase

Overview of finite precision numerical effects, effects of coefficient quantization, effects of round-off noise in digital filters, zero-input limit cycles in fixed point realizations of IIR digital filters. **08**

UNIT-IV

Filter Design Techniques: Design of D-T IIR filters window method, optimum from continuous – time filters, design of FIR filters by windowing, Kaiser approximations of FIR

filters, FIR equi-ripple approximation

Introduction to Wavelet Transform: Wavelet comparison with Fourier transforms, applications of Wavelet cosine transform, discrete cosine transform (DCT). **08**

UNIT-V

Efficient Computation of the DFT: Goertzel algorithm, decimation in time and decimation in frequency, FFT algorithm, practical considerations, implementation of the DFT using convolution, effects of finite register length.

Fourier Analysis of Signals Using DFT: DFT analysis of sinusoidal signals; Time-dependent Fourier transforms: Block convolution, Fourier analysis of non – stationary and stationary random signals, spectrum analysis of random signals using estimates of the autocorrelation sequence. **08**

Text Books:

1. S. Salivahanan, "Digital Signal Processing", Tata McGraw Hill Publishing Co. Ltd.
2. A. V. Oppenheim, R. W. Schafer, and J. R. Buck, "Discrete Time Signal processing", Pearson Education India.

Reference Books:

1. J. G. Proakis, and D. G. Manolakis," Digital Signal Processing: Principles Algorithms and Applications", Pearson Education India.
2. L. R. Rabiner, and B. Gold, "Theory and applications of DSP", PHI Learning Pvt. Ltd.
3. A. V Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and Systems", PHI Learning Pvt. Ltd.
4. J. R. Johnson, "Introduction to Digital Signal Processing", PHI Learning Pvt. Ltd.
5. D. J. Defatta, J. G. Lucas and W. S. Hodgkiss," Digital Signal Processing: A System Design Approach", John Wiley & Sons.

EE – 6055
ARTIFICIAL NEURAL NETWORKS AND FUZZY SYSTEM

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Provide the student with the basic understanding of neural network fundamentals.
[2] Provide the student with the basic understanding of fuzzy logic fundamentals.
[3] Enable students with Program of Fuzzy logic control in MATLAB
[4] Understand various possible applications of fuzzy systems to electrical engineering field
[5] Cater the knowledge of Fuzzy Logic Control and use of these for controlling real time systems

UNIT-I

Neural Networks-I (Introduction & Architecture): **08**

Neuron, nerve structure and synapse, artificial neuron and its model, activation functions; Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, auto-associative and hetro-associative memory.

UNIT-II **08**

Neural Networks-II (Back propagation networks): Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications.

UNIT-III **08**

Fuzzy Logic-I (Introduction): Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

UNIT-IV **08**

Fuzzy Logic –II (Fuzzy Membership, Rules): Membership functions, interference in Fuzzy logic, Fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

UNIT-V **08**

Fuzzy Neural Networks: L-R Type Fuzzy numbers, Fuzzy neutron, Fuzzy back propagation (BP), architecture, learning in Fuzzy BP, inference by fuzzy BP, applications.

Text Books:

1. Satish Kumar, "Neural Networks- A Classroom Approach", Tata McGraw Hill Publishing Co. Ltd.
2. S. Rajasekaran and G. A. V. Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", PHI Learning Pvt. Ltd.
3. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Neural Networks Using Matlab", Tata McGraw Hill Publishing Co. Ltd.

Reference Books:

1. Siman Haykin, "Neural Networks: A Comprehensive Foundation", PHI Learning Pvt. Ltd.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India.

EE–701
SWITCHGEAR AND PROTECTION

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Summarize the causes and effects of faults in power system and explain the necessity of protection in power system..

[2] Describe the operation of electromagnetic relays and draw their characteristic curves.

[3] Discriminate the characteristics of various relays and list out the various faults that can occur on alternator, transformer, busbar and transmission line

[4] Derive the expression for RRRV, critical resistance value and explain the problems of inductive and capacitive current breaking

[5] Compare the various types of circuit breakers and list out the testing to be carried on circuit breaker manufacturing.

UNIT-I

Introduction to Protection System:

Introduction to protection system and its elements, functions of protective relaying, protective zones, primary and backup protection, desirable qualities of protective relaying, basic terminology; Introduction to numerical relays.

Relays:

Electromagnetic: attraction and induction type relays; thermal relay, gas actuated relay, design considerations of electromagnetic relay. **09**

UNIT-II

Relay Application and Characteristics:

Amplitude and phase comparators, over current relays, directional relays, distance relays, differential relay

Static Relays:

Comparison with electromagnetic relay, classification and their description, over current relays, directional relay, distance relays, differential relay. **06**

UNIT-III

Transmission Line Protection:

Overcurrent, differential, directional-overcurrent and distance relays, back-up protection, carrier relaying; Busbar protection.

Transformer Protection: internal faults such as short circuit and turn-to-turn fault protection using differential and overcurrent relays, protection for other abnormal conditions. **07**

UNIT-IV

GeneratorProtection: short circuit and turn-to-turn fault, stator to ground fault, field to ground fault, loss of excitation, loss of synchronism protection using different types of relays.

Circuit Breaking:

Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, short line interruption, circuit breaker ratings. **08**

UNIT-V

Circuit Breakers:

Operating modes, selection of circuit breakers, constructional features and operation of Bulk Oil, Minimum Oil, Air Blast, SF6, Vacuum and DC circuit breakers,auto-reclosing - definitions & features, Three-Phase versus Single-Phase auto-reclosing

Testing Of Circuit Breakers:

Classification, testing station and equipments, testing procedure, direct and indirect testing. **10**

Text Books:

1. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
2. B. Ravindranath and M. Chander, "Power system Protection and Switchgear",New Age International Publishers.

Reference Books:

1. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Tata Mc Graw Hill.
2. Y. G. Paithankar and S. R.Bhide, "Fundamentals of Power System Protection", Prentice Hall of India.
3. T. S. Madhava Rao,"Power System Protection: Static Relays: with Microprocessor Applications" Tata McGraw Hill.
4. A. R. Van C. Warringtaon, "Protective Relays- Their Theory and Practice, Vol. I & II", Springer.

EE–702
ELECTRIC DRIVES

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Classify the various types of drives and load torque characteristics and Apply the multi quadrant dynamics in hoist load system.

[2] Analyze the operation of steady state analysis of single phase and three phase fully controlled converter and Chopper fed separately excited dc motor drives and discuss the various control strategies of converter.

[3] Explain the operation and characteristics of various methods of solid state speed control of induction motor.

[4] Describe the operation of various modes of V/f control of synchronous motor drives and different types of permanent magnet synchronous motor drives.

[5] Design a current and speed controller and develop the transfer function for DC motor, load and converter, closed loop control with current and speed feedback.

UNIT-I

Introduction to Electric Drive: Electric drives and its parts, advantages of electric drives, classification of electric drives, Components of load torque and load torque classification, Characteristics of different types of mechanical loads, Joint torque –speed characteristics of motor and load, Choice of electrical drives, Speed-torque conventions and multi-quadrant operations. **08**

UNIT-II

Dynamics of Electric Drive: Fundamental torque equations of equivalent motor-load combination; Drive parameters for rotational and translational motion: Equivalent torque and moment of inertia, Steady state stability of Electric Drive; Transient stability of electric Drive, Load equalization.

Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty. **10**

UNIT-III

Electric Braking: Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors.

Dynamics during Starting and Braking: Effect of starting on power supply motor and load, calculation of time and energy loss in transients operations, dynamics during braking, energy relations during starting and braking of dc shunt and three-phase induction motors, methods of reducing energy loss during starting. **08**

UNIT-IV

Power Electronic Control of DC Drives: Single-phase and three-phase controlled converter fed separately excited dc motor drives(continuous conduction only), dual converter fed separately excited dc motor drive, chopper control of separately excited dc motor and dc series motor, supply harmonics, power factor and ripples in motor current. **06**

UNIT-V

Power Electronic Control of AC Drives: Three-Phase Induction Motor Drive: Static Voltage Control scheme, static frequency control scheme (VSI, CSI, and cyclo-converter based), and static rotor resistance control.

Synchronous Motor Drive: Self-controlled synchronous motor drive

Traction Drives: Characteristics of Traction Drives; Drive Power Requirement; DC and AC Traction.

08

Text Books:

1. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa publishing House.
2. S. K. Pillai, "A first course on electric drives", New Age International Publisher.

Reference Books:

1. V.Subrahmanyam, "Electric Drives: Concepts and applications", Tata McGraw-Hill.
2. M.A. El-Sharkawi, "Fundamentals of Electric Drives", Cengage Learning Custom Publishing.
3. N.K. De and P. K. Sen, "Electric Drives", PHI Learning.

EE–703
FACTS DEVICES

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Explain the reactive power control in electrical power transmission lines and the importance of FACTS devices.

[2] Analyze the operation, performance and applications of SVC

[3] Outline the operation, modeling and applications of TCSC.

[4] Analyze the performance of VSC based FACTS devices.

[5] Discuss the FACTS controller interactions and coordination of FACTS controllers.

UNIT-I

FACTS concepts and general system considerations: Reactive power control in electrical power transmission lines - Uncompensated transmission line, description and definition of FACTS, basic types of FACTS controllers, benefits from FACTS technology, brief review of voltage sourced converter and current sourced converter. **08**

UNIT-II

Static voltage and phase angle regulator (TCVR and TCPAR): Objectives of voltage and phase angle regulators, approaches to TCVR and TCPAR, switching converter based voltage and phase angle regulators. **06**

UNIT-III

FACTS Controller for shunt compensation: Objectives of shunt compensation, methods of controllable VAR generation, regulation slope, transfer function, V-I and V-Q characteristics, transient stability enhancement, VAR reserve control, conventional power flow models, shunt variable susceptance model, firing angle model, transient stability model, voltage magnitude control using SVC & STACOM, Application example. **09**

UNIT-IV

FACTS Controller for series compensation: Objectives of series compensation, improvements of voltage and transient stability, power oscillation damping, sub synchronous damping, transmittable power and transmittable angle characteristics, control range, conventional power flow models, variable series impedance model, firing angle model, transient stability model, active power flow control using TCSC & SSSC, Application example. **09**

UNIT-V

Unified power flow controller: Basic operating principles, transmission control, independent real and reactive power flow control, power flow models, transient stability model, control structure, basic control system for P and Q control, dynamic performance, Application example. **08**

Text Books:

1. N.G. Hingorani and L. Gyugyi, "Understanding FACTS", IEEE Press.
2. Y. H. Song and A. T. Johns, "Flexible AC Transmission Systems (FACTS)", IEEE Press.
3. R. M. Mathur and R. K. Varma, "Thyristor-Based FACTS Controllers for Electrical Transmission Systems", Wiley-Blackwell Pub.

Reference Books:

1. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Pvt. Ltd.
2. V. K. Sood, "HVDC and FACTS controllers: Applications of Static Converters in Power Systems", Springer.

EE–7041
POWER SYSTEM OPERATION AND CONTROL

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Analyze the various load characteristics with load curve and load duration curve.

[2] Describe modeling of power-frequency dynamics and design power-frequency controller.

[3] Explain the modeling of reactive power-voltage interaction and the control actions.

[4] Solve economic dispatch problems and unit commitment problems in power systems.

[5] Explain the need of State Estimation.

UNIT-I

Introduction: Structure of power systems, power system control center, level decomposition in power system, Power system security, various operational stages of power system, power system voltage stability, frequency stability, and rotor angle stability. **08**

UNIT-II

Economic Operation: Concept and problems of unit commitment input-output characteristics of thermal and hydro-plants System constraints, optimal operation of thermal units without and with transmission losses, penalty factor, incremental transmission loss, transmission loss formula (without derivation) Hydrothermal scheduling long and short terms, Concept of optimal power flow. **08**

UNIT-III

Load Frequency Control: Concept of load frequency control, load frequency control of single area system: Turbine speed governing system and modeling, block diagram representation of single area system, steady state analysis, dynamic response, control area concept, P-I control, load frequency control and economic dispatch control.

Load frequency control of two area system: Tie line power modeling, block diagram representation of two area system, static and dynamic Response. **10**

UNIT-IV

Automatic Voltage Control: Schematic diagram and block diagram representation, different types of EEE Excitation systems &their controllers and mathematical modeling.

Voltage and Reactive Power control: Concept of voltage control, methods of voltage control, control by tap changing transformer. Shunt Compensation, series compensation, phase angle compensation, concept of bank of capacitors, bank of inductors. **08**

UNIT-V

State Estimation: Detection and identification, Linear and non-linear models.

Application of power system stabilizers: Basic Concepts of PSS, Control Signals, Structure and tuning of PSS, Field Implementation, PSS Design and Applications, Recent Development and Future Trends. **06**

Text Books:

1. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, Tata McGraw Hill.
2. P. S. R. Murty, “Operation and control in Power Systems”, B. S. Publications.
3. N. G. Hingorani and L. Gyugyi, “Understanding FACTs: Concepts and Technology of Flexible AC Transmission Systems”, Wiley india Pvt. Ltd.
4. A. J. Wood and B.F. Wollenburg, “Power Generation, Operation and Control”, John Wiley & Sons.

Reference Books:

5. O. I. Elgerd, “Electric Energy Systems Theory”, Tata McGraw Hill.
6. P. Kundur, “Power System Stability and Control”, Tata McGraw Hill.
7. M.H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Prentice Hall of India.
8. T. K. Nagsarkar& M. S. Sukhija, “Power System Analysis”, Oxford University Press.

EE–7042
ADVANCED POWER TRANSMISSION

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the need of EHV systems.

[2] Understand the need of HVDC systems.

[3] Explain the reactive power control in electrical power transmission lines and the importance of FACTS devices.

[4] Explain the devices used in smart grid (remote terminal unit, phase measurement unit etc.), concept of smart substation and smart storage technologies.

[5] Discuss the various types of power quality problem

UNIT-I

EHV AC Transmission: Need of EHV transmission, standard transmission voltage, electrical and mechanical considerations of EHV lines, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, Features of EHV transmission lines. **08**

UNIT-II

HVDC Transmission: DC links, components and configurations, converter station, operation and controls of converters, characteristics, power control, starting and stopping of dc link. **08**

UNIT-III

Flexible AC Transmission Systems: Fundamentals of ac power transmission, transmission problems and needs, Mechanism of active and reactive power flow control, basic FACTS controllers with application and principles of operation. **08**

UNIT-IV

Introduction to Smart Grid - Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid. **08**

UNIT-V

Power Quality: Overview and definition of power quality, Sources of pollution, power quality disturbances, voltage fluctuations, unbalance waveform distortion, power frequency variations, mitigation and control of power quality issues. **08**

Text Books:

1. R. D.Begmudre, “Extra High Voltage AC Transmission Engineering”, New Age Int. Ltd.
2. K.R. Padiyar, “HVDC Power Transmission System”, New Academic Science Ltd.
3. N. G. Hingorani and L. Gyugyi, “Understanding FACTs: Concepts and Technology of Flexible AC Transmission Systems”, Wiley India Pvt. Ltd.
4. K. S. Manoj, “Smart Grid: Concepts to Design”, Notion Press.

Reference Books;

1. S. Rao, “EHV-AC and HVDC Transmission Engineering & Practice”, Khanna Publishers.
2. E.W. Kimbark, “Direct Current TransmissionVol:1”, Wiley Interscience.
3. Math H. J. Bollen, “Understanding Power Quality Problems:VoltageSags and Interruptions”, Wiley India Pvt. Ltd.
4. Y.-H. Song, A. T. Johns, “Flexible AC Transmission Systems (FACTS)”, IET publication.
5. S. Borlase, “Smart Grids: Infrastructure, Technology, and Solutions”, CRC Press.

EE–7043
APPLICATIONS OF MODERN POWER ELECTRONICS IN POWER SYSTEM

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Summarize the Applications for reactive power compensation.

[2] Understand Static VAR Compensator (SVC) and its Applications.

[3] Explain Thyristor Controlled Series Capacitor (TCSC) and its Applications.

[4] Understand the concept of Voltage Source Converter Based FACTS Controllers.

[5] Discuss the FACTS controller interactions and coordination of FACTS controllers.

UNIT-I

Applications for reactive power compensation: Analysis of uncompensated AC line, passive reactive power compensation, compensation by a series capacitor connected at the mid-point of the line, effect on power transfer capacity, principles of conventional reactive power compensators, synchronous condenser, saturated reactor, Thyristor-Controlled Reactor (TCR), Fixed Capacitor-Thyristor Controlled Reactor (FC-TCR), Thyristor Switched Capacitor (TSC), Thyristor-Switched Capacitor Thyristor Controlled Reactor (TSC-TCR). **10**

UNIT-II

Static VAR Compensator (SVC) and its Applications: Voltage control by SVC, advantages of slope in dynamic characteristics, influence of SVC on system voltage, design of SVC voltage regulator, modeling of SVC for power flow and transient stability, Applications: Enhancement of transient stability, steady-state power transfer, Enhancement of power system damping, prevention of voltage instability. **08**

UNIT-III

Thyristor Controlled Series Capacitor (TCSC) and its Applications: Operation of TCSC, different modes of operation, modeling of TCSC, variable reactance model, modeling for power flow and stability studies, Applications: Improvement of the system stability limit, enhancement of system damping, SSR mitigation. **08**

UNIT-IV

Voltage Source Converter Based FACTS Controllers: Static Synchronous Compensator (STATCOM), Principle of operation, V-I Characteristics, Applications: Steady state power transfer, Enhancement of transient stability, Prevention of voltage instability, SSSC, Operation of SSSC, Control of power flow, Modeling of SSSC in load flow and transient stability studies, Applications: SSR mitigation, UPFC and IPFC. **08**

UNIT-V

Placement & Co-ordination of FACTS Controllers: Controller interactions, SVC, SVC interaction, co-ordination of multiple controllers using linear control techniques, control coordination using AI-techniques. **06**

Text Books:

1. N. G. Hingorani and L. Gyugyi, “Understanding FACTs: Concepts and Technology of Flexible AC Transmission Systems”, Wiley India Pvt. Ltd.
2. Y.-H. Song, A. T. Johns, “Flexible AC Transmission Systems (FACTS)”, IET publication.
3. R. M. Mathur and R.K. Varma, “Thyristor-Based FACTS Controllers for Electrical Transmission Systems”, John Wiley & Sons, Inc.

Reference Books:

1. K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age Int.Pvt. Ltd.
2. V. K. Sood, “HVDC and FACTS controllers: Applications of Static Converters in Power Systems”, Springer.

EE–7044
SCADA AND ENERGY MANAGEMENT

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Define SCADA system and explain its architecture along with various industrial applications.

[2] Define SCADA protocol and explain various protocols used in the industry for communication.

[3] Use the principles and strategy of energy management.

[4] Use various energy measurement and audit instruments.

[5] Carry out preliminary energy audit of various sectors.

[6] Solve simple problems on cost benefit analysis.

UNIT-I

Supervisory Control and Data Acquisition (SCADA): Introduction to supervisory control and data acquisition, general structure, SCADA functional requirements and components, general features, functions and applications, benefits; Configurations of SCADA, RTU (Remote Terminal Units) connections, various communication channels- cables, telephone lines, power line carrier, microwaves, fiber optical channels and satellites. **10**

UNIT-II

Man- Machine Communication: Power Systems SCADA and SCADA in power system automation, SCADA communication requirements. SCADA communication protocols: Past Present and Future. Structure of SCADA communications protocol, operator consoles and VDUs, displays, operator dialogues, alarm and event loggers, mimic diagrams, report and printing facilities. **10**

UNIT-III

Introduction to Energy Management: Need for energy management, principles of energy management, energy management program, energy policy and planning, energy accounting-energy monitoring, targeting and reporting- energy audit process. **06**

UNIT-IV

Energy Cost and Load Management: Important concepts in an economic analysis, economic models-time value of money-utility rate structures, cost of electricity-loss evaluation. load management: demand control techniques, utility monitoring and control system, energy management, economic justification. **08**

UNIT-V

Energy Management for Machines and Electrical Equipment: Introduction, power supply, power meter, electric motors, transformers, reactors and capacitors, motor efficiency management, motor performance management process. **06**

Text Books:

1. George L. Kusic, "Computer Aided Power System Analysis", Prentice Hall of India,
2. Sunil S Rao, "Switchgear Protection & Control System", Khanna Publishers.
3. B. L. Capehart, W. C. Turner, and W. J. Kennedy, "Guide to Energy Management", Fairmont Press.

Reference Books:

1. https://nptel.ac.in/courses/108106022/11
2. M. S. Thomas and J. D. McDonald, "Power Systems SCADA and Smart Grids", CRC Press.
3. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.
4. A. K. Tyagi, "Handbook on Energy Audits and Management", Tata Energy Research Institute, New Delhi.
5. E. Handschinand A. Petroianu, "Energy Management Systems", Springer-Verlag.

AS–701
ENGINEERING ECONOMICS

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand key economic analytical principles for decision-making among alternative courses of action in engineering

[2] Learn about the nature of economics and demand analysis.

[3] Understand about concept of supply, cost analysis and demand forecasting.

[4] Learn about market structure.

[5] Learn about nature and characteristics of Indian economy

[6] Using analytical techniques including benefit-cost ratio and breakeven analysis, solve economic problems involving comparison and selection of alternatives.

Unit-1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of economics, relation between science, engineering, technology and economics; Meaning of demand, determinants of demand, shifts in demand, law of demand, price elasticity of demand &types, income elasticity, cross price elasticity, determinants of elasticity and uses and importance of elasticity. **08**

Unit-2

Concept of Supply: Law of supply, factors affecting supply, and elasticity of supply. Demand forecasting: introduction, meaning and forecasting, methods or techniques of demand forecasting, criteria for good demand forecasting and demand forecasting for a new product. **08**

Unit-3

Cost Analysis: Introduction, types of costs, cost-output relationship: cost function, cost-output relationships in the short run, and cost-output relationships in the long run; Short run and long run, break- even analysis; Production functions: laws of variable proportions, law of returns and economies of scale: internal and external. **08**

Unit-4

Market Structure: Market structure perfect competition, imperfect competition – monopolistic, oligopoly and duopoly sorbent features of price determination and various market conditions. **08**

Unit-5

Nature and characteristics of Indian economy: Concepts of LPG, elementary concepts of national income, inflation and business cycles ,concept of N.I and measurement, meaning of inflation, types and causes and phases of business cycle investment decisions for boosting economy(national income and per capital income). **08**

Text Books:

1. Premvir Kapoor, "Sociology and Economics for Engineers", Khanna Publishing.
2. Salvatore D, “Principles of Microeconomics”, Oxford University Press.
3. Koutsoyiannis A, “Modern Microeconomic”, Macmillan Education Ltd.

Reference Books:

1. Dwivedi DN, “Principles of Microeconomics”, Pearson Education.
2. Cowell, FA, “Microeconomic Principles and Analysis”, Oxford University Press.
3. Riggs J L, “Engineering Economics”, McGraw Hills.

AS–702
INDUSTRIAL MANAGEMENT

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the basic concept of Industrial management and its types and ownership.

[2] Know the functions of management with the help of scientific theory and human resource management.

[3] Know the objective and measurement in work study and use the different model of inventory control.

[4] Design the control chart for variable and attributes in statistical quality control and implementing sampling plan.

[5] Analyze the project management scheme in project network analysis

Unit-1

Introduction: Concept and scope of industrial management. **Productivity:** definition, measurement, productivity index, types of production system and industrial ownership. **08**

Unit-2

Functions of Management: Taylor's scientific management theory, Fayol's principles of management, social responsibilities of management, introduction to human resources management: nature of HRM, functions and importance of HRM. **08**

Unit-3

Work Study: Introduction, definition, objectives, steps in work study; **Method study:** Definition, objectives, steps of method study; **Work measurement:** Purpose, types of study: Stop watch methods steps: Allowances, standard time calculations, work sampling, production planning and control inventory control: inventory, cost, models of inventory control: EOQ, ABC, VED. **08**

Unit-4

Quality Control: Statistical quality control, control charts for variables and attributes, acceptance sampling: single sampling- double sampling plans and introduction to TQM. **08**

Unit-5

Project Management: Project network analysis, CPM, PERT and project crashing and resource leveling. **08**

Text Books:

1. Gideon Halevi, "Industrial Management- Control and Profit: A Technical Approach" Springer.
2. A.P. Verma and N. Mohan "A Textbook of Industrial Management" S.K. Kataria & Sons.
3. S. K. Sharma, Savita Sharma "Industrial Engineering and Organization Management", Kataria and Sons.

Reference Books:

1. S.C. Sharma & T.R. Banga, "Engineering Management" (Industrial Engineering & Management), Khanna Book Publishing Co.
2. P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd.
3. Paneer Selvam, "Production & Operation Management", PHI.

EE–8011
SMART GRID

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Explain the devices used in smart technology (Remote Terminal Unit, Phase Measurement Unit etc.), concept of Smart substation and Smart storage technologies.

[2] Explain the smart meters, advanced metering infrastructure and outage management system.

[3] Understand the concept of Microgrid its application and issues related to interfacing with different devices.

[4] Understand Power Quality Management in smart grid and explain issues of grid connected renewable energy sources.

[5] Understand and explain Communication architecture of Smart Grid various technologies used along with cyber security.

UNIT-I

Introduction to Smart Grid: Evolution of Electric Grid, Need for smart grid, difference between conventional & smart grid, overview of enabling technologies, international experience in smart grid deployment efforts, smart grid road map for INDIA, smart grid architecture. **08**

UNIT-II

Wide Area Monitoring System: Fundamentals of synchro phasor technology, concept and benefits of wide area monitoring system, structure and functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC), Road Map for synchro phasor applications (NAPSI), operational experience and blackout analysis using PMU. **08**

UNIT-III

Smart Meters: Features and functions of smart meters, functional specification, category of smart meters, AMR and AMI drivers and benefits, AMI protocol, Demand Side Integration-Peak load, Outage and Power Quality management **08**

UNIT-IV

Information and Communication Technology: Overview of smart grid communication system, modulation and demodulation techniques, radio communication, mobile communication, power line communication, optical fiber communication, communication protocol for smart grid. **08**

UNIT-V

Smart Grid Applications: Overview and concept of renewable integration, role of protective relaying in smart grid, House Area Network, Advanced Energy Storage Technology - Flow battery– Fuel cell–

SMES–Super capacitors, Plug–in Hybrid electric Vehicles, Cyber Security requirements, Smart grid information model. **08**

Text Books:

1. D.P. Kothari, S. Sen, "Smart Grid Fundamentals and Applications", New Age International.
2. K.S. Manoj, "Smart Grid - Concepts to Design", Notion Press.
3. B. Modi and A. Prakash "Fundamentals of Smart Grid Technology", S.K. Kataria & Sons.

Reference Books:

1. J. Ekanayake, K. Liyanage, J. Wu, A. Yokoyama, N. Jenkins, "Smart Grid Technology and Applications", John Wiley& Sons Publication.
2. "Smart Grid Primer", Power Grid Corporation of India Limited, September 2013.
3. F. P. Sioshansi, "Smart Grid – Integrating Renewable, Distributed and Efficient Energy", Academic Press.

EE–8012
POWER SYSTEM PLANNING AND RELIABILITY

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Discuss the various types planning of generation, transmission and distribution systems.
[2] Understand the Classification and characteristics of loads and various types of load forecasting.
[3] Be familiar with basic probability theory and reliability theory
[4] Have evolved the efficacy to develop reliability models of different electrical systems.
[5] Understand and explain Outage definitions loss of load probability methods.
[6] Explain the Inter-connected Systems Generating Capacity Reliability Evaluation.
[7] Be capable of applying the analytical skills in solving real life problems of engineering and science.

UNIT-I

Introduction: Objectives of planning, long and short term planning, planning of generation, transmission and distribution systems. Least Cost Power Planning, integration of DSM. **06**

UNIT-II

Load Forecasting: Classification and characteristics of loads, approaches to load forecasting, Forecasting methodology: short-run and long run forecasting, energy forecasting, peak demand forecasting, total forecasting, annual and monthly peak demand forecasting, electricity price forecasting. **08**

UNIT-III

Basic Reliability Concepts: General reliability function, exponential distributions, meantime to failure, Markov Chains and processes and their applications, simple series and parallel system models. **06**

UNIT-IV

Static Generating Capacity Reliability Evaluation: Outage definitions, loss of load probability methods, loss of energy probability method, frequency and duration methods, load forecasting uncertainty.

Spinning Generating Capacity Reliability Evaluation: Spinning capacity evaluation, load forecast uncertainty. **10**

UNIT-V

Transmission System Reliability Evaluation: Average interruption rate method, Loss of Load Probability (LOLP) method, the frequency and duration method.

Inter-connected Systems Generating Capacity Reliability Evaluation: Introduction, loss of load approach; Interconnection benefits; Reliability evaluation in two and more than two interconnected systems.

Distribution System Reliability Analysis: Distribution network reliability, reliability performance.**10**

Text Books:

1. Roy Billinton and R. N. Allan, "Reliability Evaluation of Power Systems", Springer India.
2. A.A. Chowdhury and D. O. Koval, "Power Distribution System Reliability: Practical Methods and Applications", Wiley-IEEE Press.

Reference Books:

1. D. Elmakias, "New Computational Methods in Power System Reliability", Springer-Verlag Berlin Heidelberg.
2. J. Endrenyi, "Reliability Modelling in Electric Power System", John Wiley.

EE–8013
EHV AC AND DC TRANSMISSION

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability:

[1] To understand the need of EHV and UHV systems
[2] To know problems encountered with EHV and UHV transmissions
[3] To understand the voltage gradient of conductors.
[4] To describe the impact of such voltage levels on the environment.
[5] To understand the phenomenon corona and its effect.
[6] To know methods of governance on the line conductor design, line height and phase etc.

UNIT-I

Introduction to EHV AC and DC systems: Need of EHV transmission, standard transmission voltage, comparison of EHV AC & DC transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission **08**

UNIT-II

Phenomenon in EHV AC Transmission: Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, Ferro-resonance, reduction of switching surges on EHV system, principle of half wave transmission. **08**

UNIT-III

Testing in Extra High Voltage: Characteristics and generation of impulse voltage, generation of high AC and DC voltages, measurement of high voltage by sphere gaps and potential dividers. Consideration for Design of EHV Lines: Design factors under steady state limits, EHV line insulation design based upon transient over voltages. **08**

UNIT-IV

EHV DC Transmission: Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of DC link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of DC link. **06**

UNIT-V

Analysis of EHV DC Transmission: Converter faults, protection against over currents and over voltages, smoothing reactors, generation of harmonics, AC and DC filters,

Multi Terminal DC systems (MTDC): Types, control, protection and applications. **10**

Text Books:

1. R. D. Begamudre, "Extra High Voltage AC Transmission Engineering" New Age International.
2. K. R. Padiyar, "HVDC Power Transmission Systems: Technology and System Reactions" New Age International.
3. S. Rao, "EHV AC and HVDC Transmission Engineering and Practice" Khanna Publisher.

Reference Books:

1. J. Arrillaga,"High Voltage Direct current Transmission" IET Press.
2. M. H. Rashid, "Power Electronics: Circuits, Devices and Applications" Prentice Hall of India.
3. M. S. Naidu and V. Kamaraju, "High Voltage Engineering" Tata McGraw Hill.

EE–8014
POWER QUALITY

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Discuss the various types of power quality problem.

[2] Analyze the sources, types and mitigation of voltage sag problem.

[3] Analyze the sources, types and mitigation of over voltage issues and model of over voltage problem with computer software tools.

[4] Evaluate the effects of harmonics on power system equipments and analyze the methods of controlling of harmonics.

[5] Explain the principle of operation of various types of power quality monitoring devices.

UNIT-I

Power Quality Terms and Definitions: Introduction, transients; Short Duration Voltage Variations: Interruption, sag, swell; Long Duration Voltage Variations: Under voltage, over voltage and sustained interruptions; Voltage and Phase Imbalance; waveform distortion; voltage fluctuation; power frequency variations, harmonics, frequency deviation monitoring. Power Quality Problems: Poor load power factor, load containing harmonics, notching in load voltage, DC offset in loads, unbalanced loads, and disturbance in supply voltage. **08**

UNIT-II

Voltage Sag: Sources of voltage sag: motor starting, arc furnace, fault clearing etc; estimating voltage sag performance and principle of its protection; solutions at end user Level- Isolation Transformer, Voltage Regulator, Static UPS, Rotary UPS, Active Series Compensator. **08**

UNIT-III

Electrical Transients: Sources of Transient Over Voltages-Atmospheric and switching transients-motor starting transients, power factor correction capacitor switching transients, ups switching transients, neutral voltage swing etc; devices for over voltage protection. **06**

UNIT-IV

Harmonics: Causes of harmonics; current and voltage harmonics: measurement of harmonics; effects of harmonics on-Transformers, AC motors, capacitor banks, cables, and protection devices, energy metering, communication lines etc., harmonic mitigation techniques. **08**

UNIT-V

Monitoring Power Quality: Power quality related standards, standard test waveforms, and detailed power quality monitoring; Power quality measurement devices: Harmonic analyzer, Transient Disturbance Analyzer, wiring and grounding tester, flicker meter, oscilloscope, multimeter etc.

Custom Power Devices: Utility customer interface, network reconfiguration devices; Load compensation and voltage regulation using D-STATCOM; protecting sensitive loads using Dynamic Voltage Restorer (DVR); Unified Power Quality Conditioner (UPQC). **10**

Text Books:

1. R. C. Dugan, M.F. McGranaghan, S. Santoso & H.W. Beaty, "Electrical Power System Quality", Tata McGraw Hill.

2. A. Ghosh & G.Ledwich, “Power Quality Enhancement Using Custom Power Devices”, Springer US.
3. C. Sankaran, “Power Quality”, CRC Press.

Reference Books:

1. G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications.
2. G. J. Porter and J. A. V. Sciver, “Power Quality Salutations: Case Study for Troubleshooters”, Fairmont Press.

EE–802
INSTRUMENTATION AND PROCESS CONTROL

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the need of electrical transducers and their advantages and applications.

[2] Understand principle of working of various transducers used to measure Temperature, comparative study of various transducers.

[3] Explain the principle of Telemetry and Data Acquisition System.

[4] Explain the terminologies of electrochemical sensors and their applications in industry.

[5] Handle any kind of process by framing it in block diagram, mathematical model and different process variables.

UNIT-I

Transducer-I: Definition, advantages of electrical transducers, classification, characteristics, factors affecting the choice of transducers, potentiometers, strain gauges, resistance thermometer, thermistors, thermocouples, LVDT, RVDT.

08

UNIT-II

Transducer-II: Capacitive, Piezoelectric Hall Effect and opto electronic transducers; Measurement of motion, Force pressure, temperature, flow and liquid level. **06**

UNIT-III

Telemetry: General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter. Data Acquisition System: Analog data acquisition system, digital data acquisition system, modern digital data acquisition system.

09

UNIT-IV

Display Devices and Recorders: Display devices, storage oscilloscope, spectrum analyzer, strip chart & x-y recorders, magnetic tape &digital tape recorders. Recent Developments: Computer aided measurements, fiber-optic transducers, micro-sensors, smart sensors, and smart transmitters.

07

UNIT-V

Process Control: Principle, elements of process control system, process characteristics, proportional (P), integral (I), Derivative (D), PI, PD and PID control modes; Electronic, Pneumatic & digital controllers.

09

Text Books:

1. A. K. Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai & Sons.
2. B. C. Nakra and K. K. Chaudhry, "Instrumentation, Measurement and Analysis", Tata McGraw Hill.
3. C. D. Johnson, "Process Control Instrumentation Technology", Pearson.

Reference Books:

1. E.O. Doebelin, "Measurement Systems – Application and design", McGraw Hill.
2. W. D. Cooper and A. D. Helfrick, "Electronics Instrumentation and Measurement Techniques", Prentice Hall International.

AS–801
ENGINEERING ECONOMICS

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand key economic analytical principles for decision-making among alternative courses of action in engineering

[2] Learn about the nature of economics and demand analysis.

[3] Understand about concept of supply, cost analysis and demand forecasting.

[4] Learn about market structure.

[5] Learn about nature and characteristics of Indian economy

[6] Using analytical techniques including benefit-cost ratio and breakeven analysis, solve economic problems involving comparison and selection of alternatives.

Unit-1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of economics, relation between science, engineering, technology and economics; Meaning of demand, determinants of demand, shifts in demand, law of demand, price elasticity of demand &types, income elasticity, cross price elasticity, determinants of elasticity and uses and importance of elasticity.

08

Unit-2

Concept of Supply: Law of supply, factors affecting supply, and elasticity of supply. Demand forecasting: introduction, meaning and forecasting, methods or techniques of demand forecasting, criteria for good demand forecasting and demand forecasting for a new product.

08

Unit-3

Cost Analysis: Introduction, types of costs, cost-output relationship: cost function, cost-output relationships in the short run, and cost-output relationships in the long run; Short run and long run, break- even analysis; Production functions: laws of variable proportions, law of returns and economies of scale: internal and external. **08**

Unit-4

Market Structure: Market structure perfect competition, imperfect competition – monopolistic, oligopoly and duopoly sorbent features of price determination and various market conditions.

08

Unit-5

Nature and characteristics of Indian economy: Concepts of LPG, elementary concepts of national income, inflation and business cycles ,concept of N.I and measurement, meaning of inflation, types and causes and phases of business cycle investment decisions for boosting economy(national income and per capital income).

08

Text Books:

1. Premvir Kapoor, "Sociology and Economics for Engineers", Khanna Publishing.
2. Salvatore D, “Principles of Microeconomics”, Oxford University Press.
3. Koutsoyiannis A, “Modern Microeconomic”, Macmillan Education Ltd.

Reference Books:

1. Dwivedi DN, “Principles of Microeconomics”, Pearson Education.
2. Cowell, FA, “Microeconomic Principles and Analysis”, Oxford University Press.
3. Riggs J L, “Engineering Economics”, McGraw Hills.

AS–802
INDUSTRIAL MANAGEMENT

L	T	P
3	0	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the basic concept of Industrial management and its types and ownership.

[2] Know the functions of management with the help of scientific theory and human resource management.

[3] Know the objective and measurement in work study and use the different model of inventory control.

[4] Design the control chart for variable and attributes in statistical quality control and implementing sampling plan.

[5] Analyze the project management scheme in project network analysis

Unit-1

Introduction: Concept and scope of industrial management. **Productivity:** definition, measurement, productivity index, types of production system and industrial ownership.

08

Unit-2

Functions of Management: Taylor's scientific management theory, Fayol's principles of management, social responsibilities of management, introduction to human resources management: nature of HRM, functions and importance of HRM.

08

Unit-3

Work Study: Introduction, definition, objectives, steps in work study; **Method study:** Definition, objectives, steps of method study; **Work measurement:** Purpose, types of study: Stop watch methods steps: Allowances, standard time calculations, work sampling, production planning and control inventory control: inventory, cost, models of inventory control: EOQ, ABC, VED.

08

Unit-4

Quality Control: Statistical quality control, control charts for variables and attributes, acceptance sampling: single sampling- double sampling plans and introduction to TQM.

08

Unit-5

Project Management: Project network analysis, CPM, PERT and project crashing and resource leveling. **08**

Text Books:

1. Gideon Halevi, "Industrial Management- Control and Profit: A Technical Approach" Springer.
2. A.P. Verma and N. Mohan "A Textbook of Industrial Management" S.K. Kataria & Sons.
3. S. K. Sharma, Savita Sharma "Industrial Engineering and Organization Management", Kataria and Sons.

References Books:

1. S.C. Sharma & T.R. Banga, "Engineering Management" (Industrial Engineering & Management), Khanna Book Publishing Co.
2. P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd.
3. Paneer Selvam, "Production & Operation Management", PHI.

APPENDIX

List of Open Electives

Note: Students may opt any one subject from the following list of open electives with restriction in some subjects as mentioned-

S.No.	Subject Code	Subject Name	Subject Offered by Department of	Remark
1.	OE-8011	Fuzzy logic and Neural Network	Computer Science & Engg.	--
2.	OE -8012	Mobile Application development	Computer Science & Engg.	--
3.	OE -8013	Automation & Robotics	Computer Science & Engg.	--
4.	OE -8014	Mobile Computing	Computer Science & Engg.	--
5.	OE -8015	Internet-of-Things	Computer Science & Engg.	--
6.	OE -8016	Cyber Law and Ethics	Computer Science & Engg.	--
7.	OE -8017	Data Analytics	Electrical Engg.	--
8.	OE -8018	4241	Electrical Engg.	--
9.	OE -8019	Applied Operations Research	Mechanical Engg.	Not to be opted by students of Mechanical Engg.
10.	OE -8020	Six Sigma Methods & Application	Mechanical Engg.	--
11.	OE -8021	Mechatronics	Mechanical Engg.	--
12.	OE -8022	Biomedical Electronics	Electronics & Comm. Engg.	Not to be opted by students of Electronics & Comm. Engg.
13.	OE -8023	Embedded System	Electronics & Comm. Engg.	Not to be opted by students of Electronics & Comm. Engg.
14.	OE -8024	Advances in Polymer Science Technology	Applied Science & Humanities	--
15.	OE -8025	Mathematical Modeling and Simulation	Applied Science & Humanities	--
16.	OE -8026	Nanoscience and Quantum Computing	Applied Science & Humanities	--
17.	OE -8027	Entrepreneurship Development	Applied Science & Humanities	--

18.	OE -8028	Critical And Logical Thinking	Applied Science & Humanities	--
19.	OE -8029	Town Planning	Civil Engg.	--
20.	OE -8030	Disaster Management	Civil Engg.	--
21.	OE -8031	Environmental Pollution & Management	Civil Engg.	--

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OE -8011
FUZZY LOGIC AND NEURAL NETWORK

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand basic knowledge of fuzzy sets and fuzzy logic.

[2] Apply basic fuzzy inference and approximate reasoning.

[3] Understand principles of neural networks.

[4] Apply basic fuzzy system modelling methods.

Unit-1 **08**

Introduction to Neural Networks: Introduction, humans and computers, organization of the brain, biological neuron, biological and artificial neuron models, Hodgkin-Huxley neuron model, integrate-and-fire neuron model, spiking neuron model, characteristics of ANN, Mcculloch-Pitts model, historical developments, and potential applications of ANN.

Unit-2 **08**

Essentials of Artificial Neural Networks: Artificial neuron model, operations of artificial neuron, types of neuron activation function, ANN architectures, classification taxonomy of ANN –connectivity, neural dynamics (activation and synaptic), learning strategy (supervised, unsupervised, reinforcement), learning rules, and types of application.

Unit-3 **08**

Single Layer Feed Forward Neural Networks: Introduction, **Perceptron models:** discrete, continuous and multi-category; **Training algorithms:** discrete and continuous perceptron networks, perceptron convergence theorem, limitations of the perceptron model, and applications.

Unit-4 **08**

Classical & Fuzzy Sets: Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, and membership functions.

Unit-5 **08**

Fuzzy Logic System Components: Fuzzification, membership value assignment, development of rule base and decision making system, defuzzification to crisp sets, and defuzzification methods.

Text Books:

1. Rajasekharan and Rai., "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", PHI Publication.
2. Bart Kosko, "Neural Networks and Fuzzy Logic System", PHI Publications.

3. S.N.Sivanandam, S.Sumathi, S.N.Deepa, ”Introduction to Neural Networks using MATLAB 6.0”, TMH.

Reference Books:

1. James A Freeman and Davis Skapura, “Neural Networks”, Pearson Education.
2. Simon Hakins, “Neural Networks”, Pearson Education.
3. C.Eliasmith and CH.Anderson, ”Neural Engineering”, PHI.

OE -8012
Mobile Application Development

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have:

[1] Ability to apply general programming knowledge in the field of developing mobile applications.

[2] Understanding of the specific requirements, possibilities and challenges when developing for a mobile context.

[3] Understanding of the interactions between user interface and underlying application infrastructure

Unit-1 **08**

Introduction: What is android, android versions and its feature to set the various android devices on the market, the android market application store, android development environment - system requirements, android SDK, installing java, and ADT bundle - eclipse integrated development environment (IDE), creating android virtual devices (AVDs), android architecture overview and creating an example. **Android Application:** The android software stack, the linux kernel and android runtime - Dalvik virtual machine

Unit-2 **08**

Android Software Development Platform: Understanding java SE and the Dalvik virtual machine, the directory structure of an android project, common default resources folders, the values folder, leveraging android XML, screen sizes. **Launching your application:** The android manifest.xml file, creating your first android application, android framework overview and android application components.

Unit-3 **10**

Understanding Android Views: View groups and layouts, designing for different android devices, views and view groups, android layout managers, the view hierarchy, designing an android user interface using the graphical layout tool. Graphical user interface screen with views, displaying text with text view, retrieving data from users, using buttons, check boxes and audio groups. Getting dates and times from users, using indicators to display data to users, adjusting progress with seek bar and working with menus using views.

Unit-4 **07**

Displaying Pictures: Gallery, image switcher, grid view, and image view, views to display images, creating animation files, content providers, and databases, saving and loading files, SQLite databases and android database design.

Unit-5 **07**

Intents and Intent Filters: Intent overview, implicit intents, creating the implicit intent example project, explicit intents, creating the explicit intent example application, intents with

activities and intents with broadcast receivers. A basic overview of android threads and thread handlers.

Text Books:

1. S. Sydhani Begum, “Mobile App Development”, Notion press.
2. Pradeep Kothari, “Android Application Development”, Dream Tech press.
3. Bill Phillips, Chris Stewart and Kristin Marsicano, ”Android Programming”, Big Nerd Ranch.

Reference Books:

1. Jonathan McCallister, “Mobile Apps”, Create Space Independent Publishing platform.
2. Dan Hermes , “Xamarin Mobile Application Development”, Apress.
3. Dawn Griffiths, ”Head First Android Development”, O’Reilly.

OE -8013
AUTOMATION AND ROBOTICS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Explain the fundamentals of robotics and its components

[2] Illustrate the Dynamics of robotics

[3] Explain sensors and instrumentation in robotics.

Unit-1 **08**

Introduction to Robotics: Types and components of a robot, classification of robots, closed-loop and open-loop control systems. Kinematics systems: Definition of mechanisms and manipulators, social issues and safety.

Unit-2 **09**

Robot Kinematics and Dynamics: Kinematic Modelling: Translation and rotation representation, co-ordinate transformation, DH parameters, Jacobian, singularity and statics, dynamic modelling, Equations of motion: Euler-Lagrange formulation.

Unit-3 **09**

Sensors and Vision System: Sensor: Contact and proximity, position, velocity, force and tactile etc., Introduction to Cameras: Camera calibration, geometry of image formation, Euclidean/similarity/affine/projective transformations and vision applications in robotics.

Unit-4 **08**

Robot Control: Basics of control: Transfer functions, control laws: P, PD, PID, non-linear and advanced controls, robot actuation systems: actuators: electric, hydraulic and pneumatic. Transmission: Gears, timing belts and bearings and parameters for selection of actuators.

Unit-5 **06**

Control Hardware and Interfacing: Embedded systems: Architecture and integration with sensors, actuators, components and programming for robot applications

Text Books:

1. Mittal R.K., NagrathI.J., "Robotics and Control", Tata McGraw Hill.
2. Mukherjee S., "Robotics and Automation", Khanna Publishing House, Delhi.
3. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson, New Delhi,

Reference Books:

1. Saha, S.K., "Introduction to Robotics", McGraw-Hill Higher Education", New Delhi.
2. Ghosal, A., "Robotics", Oxford, New Delhi.
3. Niku Saeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI, New Delhi.

OE - 8014
MOBILE COMPUTING

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Explain the principles and theories of mobile computing technologies.

[2] Describe infrastructures and technologies of mobile computing technologies.

[3] List applications in different domains that mobile computing offers to the public, employees, and businesses.

Unit -1: **08**

Introduction: Challenges in mobile computing, coping with uncertainties, resource poorness and bandwidth, etc. cellular architecture, co-channel interference, frequency reuse and capacity increase by cell splitting. **Evolution of mobile system**: CDMA, FDMA, TDMA, and GSM.

Unit -2: **08**

Mobility Management: Cellular architecture, co-channel interference. **Mobility:** handoff, types of handoffs, location management, HLR-VLR scheme, hierarchical scheme, predictive location management schemes, Mobile IP and cellular IP.

Unit -3: **09**

Publishing & Accessing Data in Air: Pull and push based data delivery models, data dissemination by broadcast, broadcast disks, directory service in air and energy efficient indexing scheme for push based data delivery. **File System Support for Mobility**: Distributed file sharing for mobility support, CODA and other storage manager for mobility support.

Unit -4: **08**

Ad-hoc Network Routing Protocols: Ad-hoc network routing protocols, destination sequenced distance vector algorithm, cluster based gateway switch routing, global state routing, fish-eye state routing, dynamic source routing, ad-hoc on-demand routing, location aided routing and zonal routing algorithm.

Unit -5: **07**

Mobile Transaction and Commerce: Models for mobile transaction, Kangaroo and Joey transactions and team transaction, recovery model for mobile transactions, electronic payment and protocols for mobile commerce.

Text Books:

1. J. schiller , “Mobile Communication”, Addison Wesley.
2. Charlsperkins, “Ad-hoc Networks”, Addison Wesley.
3. Charlsperkins, “Mobile IP”, Addison Wesley.

Reference Books:

1. Willam Stallings, “Wireless Communications and Networking “, Pearson Education.
2. Sandeep Ks Gupta, “Fundamentals of Mobile & Pervasive Computing”, Frank Adelstein.
3. A. Mehrotra, “GSM System Engineering” Artech House.

OE - 8015
INTERNET OF THINGS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the application areas of IOT

[2] Understand building blocks of Internet of Things and characteristics.

Unit-1 **08**

Introduction: Internet of thing, history of IoT, about IoT, overview and motivations, examples of applications, internet of things definitions and frameworks: IoT definitions, IoT architecture, general observations, ITU-T views, working definition, IoT frameworks and basic nodal capabilities.

Unit-2 **08**

Fundamentals of IoT Mechanisms and Key Technologies: Identification of IoT objects and services, structural aspects of the IoT, environment characteristics, traffic characteristics, scalability, interoperability, security and privacy, open architecture, key IoT technologies, device intelligence, communication capabilities, mobility support, device power, sensor technology, RFID technology and satellite technology.

Unit-3 **08**

Radio Frequency Identification Technology: RFID introduction, principle of RFID, components of an RFID system, Issues EPC global architecture framework- EPCIS & ONS, design issues, technological challenges, security challenges, IP for IoT, and web of things. **Wireless Sensor Networks:** History and context, WSN architecture, the node, connecting nodes, networking nodes, securing communication WSN specific IoT applications, challenges- security, QoS, configuration, various integration approaches, data link layer protocols, routing protocols and infrastructure establishment.

Unit-4 **08**

Resource Management in the Internet of Things: Clustering, software agents, clustering principles in an internet of things, architecture, design guidelines, and software agents for object representation, data synchronization, identity portrayal, identity management, various identity management models- local, network, federated and global web identity, user-centric identity management, device centric identity management and hybrid-identity management, identity and trust.

Unit-5 **08**

Internet of Things Privacy, Security and Governance: Vulnerabilities of IoT, security requirements, threat analysis, use cases and misuse cases, IoT security tomography and layered attacker model, identity establishment, access control, message integrity, non-repudiation, availability and security model for IoT.

Text Books:

1. A. Bahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach”, Universities Press.
2. Matt Richardson, S. Wallace, “Getting Started with Raspberry Pi”, O'Reilly (SPD).
3. Olivier Hersent, D. Boswarthick, O.Elloumi, “The Internet of Things: Key Applications and Protocols”, 2nd Edition, Willy Publications.

Reference Books:

1. D. Uckelmann, M. Harrison, Michahelles, Florian , “Architecting the Internet of Things”, Springer.
2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press.
3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier.

OE -8016
CYBER LAW AND ETHICS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Identify and analyse statutory, regulatory, constitutional, and organizational laws that affect the information technology professional.

[2] Locate and apply case law and common law to current legal dilemmas in the technology field.

Unit-1 **08**

Fundamentals of Cyber Law: Jurisprudence of cyber law, object and scope of the IT Act 2000, introduction to Indian cyber law, uncitral model law, ISP guideline. Intellectual property issues and cyber space, Indian perspective, overview of intellectual property related legislation in India, patent, copy right, trademark law, law related to semiconductor layout and design.

Unit-2 **08**

E-commerce Security: Security threats to e-commerce, virtual organization, business transactions on web, e-governance and EDI, concepts in electronic payment systems, e-cash, credit/debit cards, e-agreement, legal recognition of electronic and digital records, e-commerce issues of privacy, wireless computing-security challenges in mobile devices. **Digital Signatures** -Technical issues, legal issues, electronic records, digital contracts, and requirements of digital signature system.

Unit-3 **08**

Security Policies: Development of policies, www policies, email security policies, policy review process-corporate policies-sample security policies, publishing and notification requirement of the policies, **Evolving technology security:** mobile, cloud, outsourcing and SCM.

Unit-4 **09**

Internet Security Threats: Information systems and its importance, role of security in internet and web services, classification of threats and attacks, security challenges, security implication for organizations, security services-authentication, confidentiality, integrity, availability and other terms in information security, Introduction to cryptography, firewalls, basic concepts of network security, perimeters of network protection & network attack, need of intrusion monitoring and detection, hacking, cracking, sneaking, viruses, trojan horse, malicious code & logic bombs, Introduction to biometric security, its challenges, and finger prints.

Unit-5 **07**

Investigation and Ethics: Cyber-crime, cyber jurisdiction, cyber-crime and evidence act, treatment of different countries of cyber-crime, ethical issues in data and software privacy, plagiarism, pornography, tampering computer documents, data privacy and protection, domain name system, software piracy, issues in ethical hacking. **Cyber-crime forensic:** Case study in cyber-crime.

Text Books:

1. Charles P. Pfleeger, Shari Lawerance Pfleeger, "Analyzing Computer Security", Pearson Education India.
2. Harish Chander, "Cyber Law and IT Protection", PHI Publication, New Delhi.
3. Sarika Gupta & Gaurav Gupta, Information Security and Cyber Laws, Khanna Publishing House.

Reference Books:

1. Schou, Shoemaker, "Information Assurance for the Enterprise", Tata McGraw Hill.
2. Anshul Kaushik, "Cyber Security", Khanna Publishing House.
3. V.K. Jain, "Cryptography and Network Security", Khanna Publishing House, Delhi.

OE -8017
DATA ANALYTICS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Identify appropriate data mining algorithms to solve real world problems

[2] Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining

[3] Describe complex data types with respect to spatial and web mining.

UNIT-I **10**

Introduction: Sources, modes of availability, inaccuracies and uses of data; Data Objects and Attributes; Descriptive Statistics: Visualization, Data Similarity and Dissimilarity, Pre-processing of Data: Cleaning for Missing and Noisy Data; Data Reduction: Discrete Wavelet Transform, Principal Component Analysis, Partial Least Square Method, Attribute Subset Selection, Data Transformation and Discretization.

UNIT-II **08**

Inferential Statistics: Probability density functions; Inferential statistics through hypothesis tests. **Business Analytics:** Predictive Analysis (Regression and Correlation, Logistic Regression, In-Sample and Out-of-Sample Predictions), Prescriptive Analytics (Optimization and Simulation with Multiple Objectives);

UNIT-III **08**

Mining Frequent Patterns: Concepts of support and confidence; Frequent Item sets Mining Methods; Pattern Evaluation. Classification: Decision Trees – Attribute Selection Measures and Tree Pruning; Bayesian and Rule-based Classification; Model Evaluation and Selection; Cross-Validation; Classification Accuracy; Bayesian Belief Networks; Classification by Back-propagation and Support Vector Machine.

UNIT-IV **06**

Clustering: Partitioning Methods – k-means Hierarchical Methods and Hierarchical Clustering using Feature Trees; Probabilistic Hierarchical Clustering; Introduction to Density, Grid and Fuzzy and Probabilistic Model-based Clustering Methods; and Evaluation of Clustering Methods.

UNIT-V **08**

Machine Learning: Introduction and Concepts: Ridge Regression; Lasso Regression; and *k*-Nearest Neighbours, Regression and Classification;

Supervised Learning with Regression and Classification Techniques: Bias-Variance Dichotomy, Linear and Quadratic Discriminant Analysis, Classification and Regression Trees; Ensemble Methods: Random Forest, Neural Networks, Deep Learning.

Text Books:

1. G. Shmueli, N. R. Patel, and P. C. Bruce, "Data Mining for Business Intelligence", John Wiley & Sons, New York.
2. V. Kumar, and P.N. T. M. Steinbach, "Introduction to Data Mining", Pearson.

Reference Books:

1. J. Han, M. Kamber and J. Pei, "Data Mining: Concepts and Techniques, Morgan Kaufmann.
2. G. James, D. Witten, T. Hastie, and R. Tibshirani, "An Introduction to Statistical learning with Applications in R", Springer, New York.
3. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer.

OE -8018
NON-CONVENTIONAL ENERGY RESOURCES

L T P
3 1 0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Identify renewable energy sources and their utilization.

[2] Understand basic concepts of solar radiation and analyze solar thermal systems for its utilization.

[3] Understand working of solar cells and its modern manufacturing technologies.

[4] Understand concepts of Fuel cells and their applications

[5] Compare energy utilization from wind energy, geothermal energy, biomass, biogas and hydrogen

UNIT-I **09**

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits; Solar Energy: Solar Radiation and its measurement, modes of utilization of solar energy; Solar Photovoltaic Technology: Theory of solar cells. Solar cell materials, voltage developed by solar cell, Solar cell performance, solar PV power plant.

UNIT-II **06**

Solar Thermal Energy: Flat plate collectors: materials used, applications and performance; Focusing type collectors: materials used, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling systems, limitations.

UNIT-III **10**

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations; Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations; Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IV **07**

Thermo-electric and Thermionic conversions: Principle of working, performance and limitations; Wind Energy: Wind power, site selection criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics, performance and limitations of energy conversion systems.

UNIT-V **08**

Bio-mass: Availability of bio-mass and its conversion theory; Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and

limitations; Wave energy and Tidal energy: Working principle, performance, limitations; waste recycling plants; Grid integration of RES.

Text Books:

1. M. V. R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional", BS Publications.
2. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
3. C.S. Solanki, "Renewable Energy Technologies: A Practical Guide for Beginners" PHI Learning.
4. G.D. Rai, "Non-Conventional Energy Sources", Khanna Publishers.
5. R. D. Begamudre, "Energy Conversion Systems", New Age International Publishers.

Reference Books:

1. Peter Auer, "Advances in Energy Systems and Technology", Vol. 1 & II Edited by Academic Press.
2. Godfrey Boyle, "Renewable Energy Power for A Sustainable Future", Oxford University Press.

OE-8019
APPLIED OPERATIONS RESEARCH

L T P
3 1 0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability :

[1] Understand the application of OR and frame a LP Problem with solution–graphical and through solver add in excel (software).

[2] Build and solve Transportation and Assignment problems using appropriate method.

[3] Design and solve simple models of CPM and queuing to improve decision making and develop critical thinking and objective analysis of decision problems.

[4] Solve simple problems of replacement and implement practical cases of decision making under different business environments.

[5] Take best course of action out of several alternative courses for the purpose of achieving objectives by applying game theory and sequencing models.

UNIT-I **10**

Introduction: Definition and scope of OR, Techniques and tools, model formulation, general methods for solution, Classification of Optimization problems, Optimization techniques.

Linear Optimization Models: Complex and revised Simplex algorithms, Degeneracy and duality, Post-optimum and Sensitivity analysis, Assignment, transportation and transhipment models, Travelling salesman problem, Integer and parametric programming.

UNIT-II **08**

Game Problems: Minimax criterion and optimal strategy, two persons zero sum game, Games by Simplex dominance rules.

UNIT-III **07**

Waiting Line Problems: Classification of queuing problems, M/M/1 & M/M/1/N queuing systems, Steady state analysis of M/M/m queues, Discrete and continuous time Markov models, Chapman-Kolmogorov equation, Birth & death processes in manufacturing, Open and Closed queuing networks.

UNIT-IV **07**

Inventory Management: ABC analysis, deterministic and Probabilistic models.

UNIT-V **08**

Dynamic Programming: Characteristics of dynamic programming problems, Bellman's principle of optimality, Problems with finite number of stages.

Stochastic Programming: Basic concepts of Probability theory, Stochastic linear programming.

Text Books:

1. L.Saaty, Elements of Queuing Theory,Dover Pubns, New Ed edition
2. HadleyAddison&Wesley, Nonlinear and Dynamic Programming, Pearson Education(US)
3. Ackoff & Sasieni, Fundamentals of Operations Research,Wiley & Sons Inc.

References Books:

1. Wagner, Principles of OR with Applications to ManagerialDecisions, Prentice Hall
2. Taha, OperationsResearch, Pearson Education India
3. R PanneerselvamPrentice, OperationsResearch, Hall of India
4. A P VermaS.K, OperationsResearch, Kataria & Sons
5. Hillier and Lieberman, Introduction to Operations Research, Prentice Hall

OE-8020
SIX SIGMA METHODS & APPLICATION

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the concepts, implementation and objectives of six sigma.

[2] Use a structural approach to process improvement.

[3] Develop a skill to predict, prevent and control defects in a process.

[4] Achieve quality improvement through process improvement.

[5] Understand the tools of process discovery.

UNIT I **08**

Quality Perception; Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories. Statistical foundation and methods of quality improvement. Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis. Probability Distribution: Normal, Binomial, Poisson Distribution.

UNIT II **08**

Basics of Six Sigma: Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S,Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score,Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.

UNIT III **08**

Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects.

UNIT IV **08**

Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.

UNIT V **08**

Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to software for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.

Text Books :

1. Hillier and Lieberman, Six Sigma: SPC and TQM in manufacturing and service, Geoff Tennant, Gower Publishing Co.
2. Greg Brue, Six Sigma for managers, McGraw-Hill

3. Pete Pande, What is Six Sigma, McGraw-Hill

References Books:

1. Peter S. Pande, The Six Sigma Way, McGraw-Hill education
2. Peter S. Pande, The Six Sigma way, McGraw-Hill
3. Adam Vardy, Lean Six Sigma, Create space Independent Publishing Platform
4. Thomas Pyzdek and Paul Keller, Six Sigma, McGraw-Hill

OE-8021
MECHATRONICS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Identify key elements of mechatronics and its representation by block diagram.

[2] Understand the concept of sensors and use of interfacing systems.

[3] Understand the concept and applications of different actuators.

[4] Illustrate various applications of mechatronic systems.

[5] Develop PLC ladder programming and implementation in real life problem.

UNIT-I **08**

Introduction: Introduction to mechatronics, systems, measurement systems, control systems, microprocessor based controllers, The mechatronics approach, Problems.

Review of Transducers: Sensors and transducers, performance terminology, Displacement position and proximity, velocity& motion, Force, Fluid pressure, Liquid flow, liquid level, Temperature, Light sensors, Selection of sensors, Inputting data by switches.

UNIT-II **09**

Signal Conditioning: Signal conditioning, The operational amplifier, Protection, Filtering, Wheatstone bridge, Digital signals, Multiplexers, Data acquisition, Digital signal processing, Pulse - modulation, Problems.

Data Presentation Systems: Displays, Data presentation elements, Magnetic recording, Displays, Data acquisition systems, Measurement systems, Measurement systems, Testing and calibration.

UNIT-III **09**

Pneumatic and Hydraulic Systems: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure-control valves, Cylinders, Process control valves, rotary actuators, Problems.

Mechanical Actuation Systems: Mechanical systems, Types of motion, Kinematics chains, Cams, Gear trains, Ratchet and pawl, Belt and chain drives, Bearings, Mechanical aspects of motor selection problems.

UNIT-IV **07**

Electrical Actuation Systems: Electrical systems, Mechanical Switches, Solid-state switches, Solenoids, DC motors, AC motors, Stepper motors.

UNIT-V **07**

Basic System Models: Mathematical models, mechanical system building blocks, Electrical system building blocks, Thermal system building blocks.

Text Books :

1. W. Bolton, Mechatronics,. Addison Wesley Longman, Pub, 1999 (Delhi)

2. K.P Ramachandra, Mechatronics, Wiley Publication.
3. Dr. Rajesh Purohit, Industrial Engineering robotics and Mechatronics, Made Easy Publication

References Books:

1. William Bolton, Mechatronics, Pearson Education.
2. M.D.Singh and J.G Joshi, Mehatronics, PHI Publication
3. Richard A. Kolk, Mechatronics System design. Cengage Learning, Inc
4. AppuKuttan K.K, Introduction To Mechatronics, Oxford University Press

OE-8022
BIOMEDICAL ELECTRONICS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected:

[1] To have a basic understanding of medical terminology, relevant for biomedical instrumentation

[2] To understand and describe the physical and medical principles used as a basis for biomedical instrumentation

[3] To understand the elements of risk for different instrumentation methods and basic electrical safety

[4] To understand the position of biomedical instrumentation in modern hospital care.

Unit I **08**

Introduction: The age of Biomedical Engineering, Development of Biomedical Instrumentation, Man–Instrumentation system, Components, Physiological system of the body, Problem encountered in measuring a living system.
Transducers: The Transducers & Transduction principles, Active transducers, Passive Transducers, Transducer for Biomedical Applications.

Unit II **08**

Sources of Bioelectric potentials: Resting & Action potentials, propagation of active potential, The Bioelectric potentials-ECG, EEG, EMG, and Invoked responses.
Electrodes: Electrode theory, Biopotential Electrodes–Microelectrodes Body surface electrodes, Needle Electrodes, Biochemical Transducers, Reference electrodes, PH electrodes, Blood Gas electrodes.

Unit III **08**

Cardiovascular Measurements: Electrocardiography – ECG amplifiers, Electrodes & leads, ECG recorders - Three channel, Vector Cardiographs, ECG system for stress testing, Continuous ECG recording (Holter recording), Blood pressure measurement, Blood flow measurement, Heart sound measurements.
Patient Care & Monitoring - Elements of Intensive Care monitoring, patient monitoring displays, Diagnosis, Calibration & Repairability of patient monitoring equipment, pacemakers & Defibrillators.

Unit IV **08**

Measurements in Respiratory system: Physiology of respiratory system Measurement of breathing mechanics - Spiro meter, Respiratory Therapy equipments: Inhalators ventilators & Respirators, Humidifiers, Nebulizers & Aspirators.
Diagnostic Techniques: Ultrasonic Diagnosis Echocardiography, Echo Encephalography, Ophthalmic scans, X-Ray & Radio-isotope Instrumentation, Computerized Axial Tomography Scanners.

Unit V **08**

Introduction to Bio-Medical Signals:
Classification, Acquisition and Difficulties during Acquisition, Electroencephalography, Electromyography, & electro-retinography, Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field.

Bio Telemetry: The components of Biotelemetry system Implantable units, Telemetry for ECG measurements during exercise, for Emergency patient monitoring. Physiological Effects of Electric Current Safety of Medical Electronic Equipments, Shock hazards from Electrical equipment and prevention against them.

Text Books:

1. Leslie Cromwell, Fred J. Welbell and Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall (India).

Reference Books:

1. R. S. Khandpur, "Biomedical Instrumentation", Tata McGraw-Hill.
2. Willis J. Tompkins, "Biomedical DSP: C Language Examples and Laboratory Experiments
   for the IBM PC", Prentice Hall (India).
3. D. C. Reddy, "Biomedical Signal Processing", McGraw-Hill

OE-8023
EMBEDDED SYSTEMS

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Gain knowledge of embedded systems.

[2] Understand the concept, classification, characteristics, quality attributes and applications of Embedded Systems.

[3] Understand the architecture of embedded system and basics of real-time operating system.

[4] Write simple programs based on 8051 μC.

[5] Design simple applications using 8051 μC kit.

Unit I **08**

Introduction to Embedded system, Embedded System Project Management, ESD and Codesign issues in System development Process, Design cycle in the development phase for an embedded system, Use of target system or its emulator and In-circuit emulator, Use of software tools for development of an ES.

Unit II **08**

8051 Microcontroller: Microprocessor V/s Micro-controller, 8051 Microcontroller: General architecture; Memory organization; I/O pins, ports & circuits; Counters and Timers; Serial data input/output; Interrupts. 8051 Instructions: Addressing Modes, Instruction set: Data Move Operations, Logical Operations, Arithmetic Operations, Jump and Call Subroutine, Advanced Instructions. 8051 Interfacing and Applications: Interfacing External Memory, Keyboard and Display Devices: LED, 7-segment LED display, LCD.

Unit III **08**

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit IV **08**

Brief general architecture of AVR, PIC and ARM microcontrollers, JTAG: Concept and Boundary Scan Architecture. Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

Unit V **08**

Advanced Processor: (only architectures) 80386, 80486 and ARM (References)

RTOS: Tasks, states, Data, Semaphores and shared data, Operating system, services, Message queues, Mailboxes.

Communication basics: Microprocessor Interfacing, I/O Addressing, Direct memory access, Arbitration, multilevel bus architecture, Serial protocols, Parallel Protocols and wireless protocols.

Real world Interfacing: LCD, Stepping Motor, ADC, DAC, LED, Push Buttons, Keyboard, Latch Interconnection, PPI.

Text Books:

1. K. V. Shibu, "Introduction to Embedded Systems", McGraw Hill.
2. E. Mazadi, "The 8051 Microcontroller And Embedded Systems Using Assembly And C", Pearson Education India, 2007

Reference Books:

1. Kenneth Hintz and Daniel Tabak, "Microcontrollers (Architecture, Implementation and Programming)", TMH 2005.
2. Raj Kamal, "Embedded Systems", TMH, 2006.
3. K. Ayala, "The 8051 Microcontroller", 3rd Ed., Thomson Delmar Learning, 2007.
4. Frank Vahid and Tony Givargis, "Embedded System Design", John Wiley.

OE-8024
ADVANCES IN POLYMER SCIENCE TECHNOLOGY

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Get knowledge of calculation of molecular weight of polymers.

[2] Get know about rate of different polymerization reactions

[3] Get know about morphology and deformation causes in polymers.

[4] Get know the use of composites and conducting in technology

[5] Get knowledge about various processing techniques of polymers like plastic, fibres and elastomers.

UNIT 1: **08**

Characteristics and Analysis of Polymers

Basic concept of Polymer Science, Measurement of molecular weight and size, Polymer degradation, Analysis and testing of polymers.

UNIT 2: **0**8

Mechanism and Kinetics of Polymerisation

Free radical, Cationic, Anionic, Coordination polymerization and their kinetics. Step Growth polymerization and their kinetics, Ring opening polymerization.

UNIT 3: **08**

Structure and Properties of Polymers

Morphology in crystalline polymers, Calculation of crystallinity, Polymer structure and physical properties, Deformation, flow and melt characteristics, Rheology and mechanical properties of polymers.

UNIT 4: **0**8

Composites, Conducting Polymers

Definition, types of composites, preparation methods, testing of composites, Applications of composites in technology. Conducting polymers- Definition, Synthesis and application in technology.

UNIT 5: **0**8

Processing of Polymers- Plastics, Fibers and Elastomers

Plastics-extrusion, injection molding, blow molding, compression and transfer molding; Spinning of fibers. Elastomers: Utility of Vulcanization and Reinforcement in Engineering.

Text Books:

- F.W. Billmeyer, "Text Book of Polymer Science", 3rd Edn., Wiley Inter Science.
- V. R. Gowarikar, N. V. Viswanathan, Jayadev Sreedhar, “Polymer Science” 3rd Edition, New Age International Publishers.

Reference Books:

- F. Rodriguez, "Principles of polymer systems",4th Edn., Taylor and Francis, Washington.
- Fried, J.R., “Polymer Science and Technology”, Prentice Hall, Inc.

OE-8025
Mathematical Modeling and Simulation

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After completion of the course student will be able to:

[1] Define, describe and apply basic concepts related to modeling and simulation.

[2] Know the importance of simulation, how to simulate real world problems.

[3] Analyze simulation of real world problems like water reservoir, autopilot, and servo system.

[4] Develop mathematical model for real world problems.

[5] Create Model and simulate mechanical and electrical systems using the computer tools simulink.

UNIT I **08**

Introduction to Modeling and Simulation: System definition and components, stochastic activities, continuous and discrete systems, system modeling, types of models, static and dynamic physical models, static and dynamic mathematical models, full corporate model, types of system study. Introduction to Simulation, appropriate and not appropriate, advantages and disadvantage, application areas, history of simulation software, MATLAB as a Simulation tool.

UNIT II **08**

System simulation, why& when to simulate, nature and techniques of simulation, comparison of simulation and analytical methods, types of system simulation, real time simulation, hybrid simulation, simulation of pure-pursuit problem, single-server queuing system and an inventory problem, Monte-Carlo simulation, Distributed Lag models, Cobweb model.

UNIT III **08**

Simulation of continuous systems, analog vs. digital Simulation, Simulation of water reservoir system, Simulation of a servo system, simulation of an autopilot, Discrete system simulation, fixed time-step vs. even to even model, generation of random numbers, test for randomness, Monte-Carlo computation vs. stochastic simulation.

Unit IV **08**

System dynamics,exponential growth models, exponential decay models, modified exponential growth models, logistic curves, generalization of growth models, system dynamic diagrams.

Introduction to SIMSCRIPT: Program, system concepts, origination, and statements, defining the telephone system model.

UNIT V **08**

Simulation of PERT Networks, critical path computation, uncertainties in activity duration, resource allocation and consideration. Simulation languages and software, continuous and discrete simulation languages, expression based languages, object oriented simulation, general purpose vs. application - oriented simulation packages, CSMP-III, MODSIM-III.

Text Books:

1. Geoftrey Gordon, " System Simulation", PHI
2. Narsingh Deo, "System Simulation with digital computer"PHI

Reference Books

1 .Jerry Banks, John S. C Barry L. Nelson David M. Nicol, "Discrete Event System Simulation", Pearson Education

2. V P Singh, "System Modeling and simulation", New Age International.

3. Averill M. Law, W. David Kelton, "System Modeling and simulation and Analysis", TMH

OE-8026
Nanoscience and Quantum Computing

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Apply engineering and physics concepts to the nano-scale and non-continuum domain. Identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the research literature. Design processing conditions to engineer functional nanomaterials.

[2] Explain the fundamental science and quantum mechanics behind nanoelectronics. Explain the concepts of a quantum well, quantum transport and tunnelling effects. Differentiate between microelectronics and nanoelectronics and to understand basic and advanced concepts of nanoelectronic devices, sensors

[3] Understand the general concepts of photon trapping and plasmons in nanooptics, nano-photonics etc and to explain the basic functions, properties and different methods of Nanoholes and photons, solar energy, solar cells, optically used nanomaterials, Photonic crystals.

[4] Impart knowledge on *Nanomaterials* for *biomedical* applications such as Proteins and applications, Drug delivery systems and to explain fabrication of nanoporous and nanofluidic devices and its applications.

[5] Provide a brief idea about quantum information and quantum Computing, Superposition, Measurement and working principle of quantum computers.

UNIT - I: Nanomaterials and Nano-structures **08**

Brief review of nanomaterials: Fullerenes, Nanotubes, Nanowires, Quantum Dots, Dendrites, Synthesis- Top Down, Bottom Up, Plasma arcing, Chemical vapour Deposition, sol-gel methods, Characterization using Electron Microscopy Techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy, Scanning Probe Microscopy, X ray methods, Fluorescence, Properties of nanomaterials.

UNIT – II: Nanoelectronics **08**

Introduction – micro, and nano fabrication: Optical lithography, Electron beam lithography, Atomic lithography, Molecular beam epitaxy, Quantum electronic devices: High electron mobility transistors, Quantum interference Transistor, Single electron Transistor, MEMS, NEMS

UNIT - III: Nanotechnology in Optics **08**

Properties of light – interaction of light and nanomaterials: Photon trapping and Plasmons, Dielectric Constant and Polarisation, Refractive index, Nanoholes and photons, solar energy, solar cells, optically used nanomaterials, Photonic crystals

UNIT – IV: Nanotechnology in Biomedicine **08**

Self assembled monolayers, Bio molecular motors: Function of Motor Proteins and applications, Drug delivery systems, Nanofluidics: Fluids at micro and Nanometer scale, fabrication of nanoporous and nanofluidic devices and its applications.

UNIT – V: Quantum Computers **08**

Brief idea about quantum information and quantum Computing: Superposition, Measurement, Unitary evolution, qubits-single and multiple qubits, quantum memory, Elementary gates-quantum teleportation, working principle of quantum computers.

TextBooks:

1. Nanotechnology- Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannangara Geoff Smith, Michelle Simmons and Burkhard Raguse, I Edition – Overseas Press, 2005
2. Introduction to Nanoscale Science & Technology, Ed. By Massimilano Di Ventra – I Edition, Kluwer Academic - 2004
3. Nanotechnology, Gregory Timp – I Edition, Springer International – 2005

Reference Books:

1. Nanotechnology, Michael Kohler – I Edition, Wiley VCH – 2004
2. Nano-Engineering in Science & Technology, Michael Rieth – I Edition, World Scientific – 2004
3. Nano, The Nwext Revoliution, Mohan Sundara Rajan – I Edition, National Book Trust – 2004
4. Nanotechnology, Gregory Timp-I Edition, Springer International - 2005

OE-8027
ENTREPRENEURSHIP DEVELOPMENT

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Define, describe and apply basic concepts related to entrepreneurship.

[2] Understand the systematic process to analyze and evaluate project, prepare project report.

[3] Prepare balance sheet, financial report.

[4] Interpret their own business plan.

[5] Consider the legal and financial conditions for starting a business venture.

UNIT-I **08**

Entrepreneurship- definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.

UNIT-II **08**

Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

UNIT-III **08**

Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.

UNIT-IV **08**

Project Planning and control: The financial functions cost of capital approach inproject planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.

UNIT-V **08**

Laws concerning entrepreneur viz, partnership laws, business ownership, salesand income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

Text Books:

1. Khana.S.S., "Entrepreneurial Development" S. Chand &Co.Ltd., Ram Nagar, New Delhi,2013.
2. Donald F Kuratko, "Entrepreneurship-Theory, Process and Practice",9th Edition, Cengage Learning 2014.

Reference Books:

1. Forbat, John, "Entrepreneurship" New Age International.
2. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International
3. Joseph, L. Massod, "Essential of Management", Prentice Hall of India

OE-8028
CRITICAL AND LOGICAL THINKING

L	T	P
3	1	0

COURSE OUTCOMES (COs)

Students shall demonstrate the following outcomes post-learning of the course:

[1] Analyzing, reasoning, evaluating, decision-making and problem-solving attributes to play a vital role in organizational growth.

[2] Understand and comprehend the complexity of the professional domain and implement Interpersonal Skills.

[3] Negotiate with the odds and provide best opinions to the higher officials.

[4] Logical leadership with critical bent to produce positive results in unfavourable situations.

Unit I: Fundamentals of Critical Thinking **08**

Introduction to Critical Thinking, Recognizing Arguments, Key Concepts – Thinking Reflection and Creativity; Rhetorical Language; Principles of Interpretations; Process of Elimination; The Parts of an Argument – Claims and Propositions, Evidence, Reasoning; Argument and Critical thought; Communicating Arguments; Co-orientational, Cultural and Ethical View of Arguments

Unit II: Critical Thinking and Logical Communication **07**

Language and Critical Thinking; Citing and listing references – How to refer appropriately to the work of others; Putting your thinking into words; Writing about reflection - How to structure and report your thoughts; Editing and presenting your assignment – How to review your own work and follow academic conventions; Preparing for employment – How to transfer your thinking skills to a career.

Unit III: Logical Concepts and Philosophy of Science **08**

Truth and Validity; Hypothesis; Methods of Experimental Enquiry; Logic: Inductive and Deductive; Syllogism and Fallacies; Aristotle's conception of Virtue and Well-being; Kant's conception of Good Will, Duty and Categorical Imperative; Joseph Butler's Theory of Conscience and Self Love; J. S. Mill's Utiliterianism, Freedom and Responsibility, Chankya's Arthsashtra

Unit IV: Select School of Thought and Criticism 08

Structuralism (Ferdinand de Saussure), Post Structuralism, Deconstruction (Jacques Derrida), Reader Response Theory (Roland Barthes), Gender Studies, Cultural Studies (Raymond Williams).

Unit V: Select School of Thought and Criticism 08

1) ***Hind Swaraj*** by Mahatma Gandhi
2) ***Tradition and Individual Talent*** by T.S. Eliot
3) ***"Phenomenal Woman"*** by *Maya* Angelou
4) ***Heart of Darkness*** by Joseph Conrad

Note: (*) denotes texts for detailed study.

Text Books:

1 Rangarajan, L.N. *Kautilya The Arthashashtra*. Penguin Classics, New Delhi, 2000.
2 Gandhi, M. K. *Hindi Swaraj.* Delhi Open Books, New Delhi, 2019.
3 Eliot, T. S. *Tradition and the Individual Talent*, The Sacred Wood, New York, 1921.
4 Conrad, Joseph. *Heart of Darkness*. Signet Classic Publishers, New York, 1997.
5 Angelou, Maya. *Phenomenal Woman: Four Poems Celebrating Women*. New York: Random House, 1994.
6 *Critical Thinking: A Student's Introduction* by Gregory Bassham and William Irwin and Henry Nardone and James Wallace, McGraw-Hill, Noida, 2019.
7 *How to Improve your Critical Thinking & Reflective Skills* by Jonathan Weyers, Pearson Education, New York, 2011.

Reference Books:

1 *Critical Thinking* by Brooke Noel Moore and Richard Parker, McGraw-Hill, Noida, 2019.
2 *Critical Thinking and Communication* by Edward S Inch, Pearson Education, New York, 2011.
3 *A glossary of literary terms* by M H Abrams & Geoffrey Galt Harpham, Cengage Learning, San Francisco, 1957.
4 *English Literary Criticism and Theory* by M.S. Nagarajan, Orient BlackSwan, Hyderabad, 2006.
5 *The Penguin Dictionary of Philosophy* by Thomas Mautner, Penguin Reference, New Delhi, 1997.
6 *Western Philosophy: An Anthology* by John Cottingham, Wiley-Blackwell, New Jersey, 1996.

CE-8029
TOWN PLANNING

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the concept of balanced town by ensuring that new and existing facilities are complimentary to each other.

[2] Provide sustainable buildings by considering the environmental, social and economic conditions.

[3] Provide diversity of accommodation.

[4] Provide leisure and cultural facilities for the town.

[5] Create awareness about the traffic management within the town.

UNIT-1 **08**

Introduction to Town Planning: Definitions of town planning, form of planning, Elements and planning principal of city plan, Shapes of plan in accordance to road networks.

UNIT-2 **08**

Planning Concepts and Evolution: Planning concepts related to City beautiful movement (Chicago, Chandigarh), Urban Utopia (Broadacre), Garden city (Letchworth), Radburn Theory (Radburn) and Neighbourhood planning.

UNIT-3 **08**

Planning Process & Standards: Understanding of planning process, Relevance of standards in planning as per URDPFI guidelines prepared by TCPO.

UNIT-4
08

Roads and traffic studies: Awareness of concepts related to various traffic problems in India, Understanding of PCU, Traffic volume, Road capacities, Road types; their sections and intersections, Traffic calming as per IRC guidelines.

UNIT-5 **08**

Modern Transportation systems: New concepts in mass and rapid transportation systems e.g. BRT, LRT and Metro rail. **Modern approach in Planning:** Introduction, Benefits and Planning components of Green City (e.g. Vancouver), Compact City (e.g. Sky city, China) and Smart City (e.g. Malta)

Text Books:

1 John Ratcliffe, "An Introduction to Town and Country Planning", Hutchinson 1981.
2 Arthur B. Gallion and Simon Eisner, "The Urban Pattern – City planning and Design", Van Nostrand Reinhold company.
3 Rangwala, "Town Planning", Charotar publishing house.

4 G.K.Hiraskar, “Town Planning”.

Reference Books:

1 Rame Gowda, “ Urban and Regional planning”.
2 S.K. Khanna, C.E.G. Jhusto, “Highway Engineering”, Nemchand & Bros. Roorkee 1997.
3 N.V.Modak, V.N. Ambedkar, “Town and country planning and Housing”, orient longman, 1971.
4 URDPFI Guidelines for Planning by TCPO.
5 IRC Guidelines.

CE-8030

DISASTER MANAGEMENT

L	T	P
3	1	0

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the:

[1] Capacity to integrate knowledge and to analyse, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.

[2] Capacity to describe, analyse and evaluate the environmental, social, cultural, economic, legal and organisational aspects influencing vulnerabilities and capacities to face disasters.

[3] Capacity to work theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery) and relate their interconnections, particularly in the field of the Public Health aspects of the disasters.

[4] Capacity to manage the Public Health aspects of the disasters.

[5] Capacity to obtain, analyse, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios with the ability to clearly present and discuss their conclusions and the knowledge and arguments behind them.

[6] Capacity to design and perform research on the different aspects of the emergencies and disaster events while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.

[7] Capacity to analyse and evaluate research work on the field of emergencies and disaster while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.

UNIT-1 **08**

Introduction: Reasons, classifications-natural, based on violence, deterioration of environment and health and failures of industrial society; disaster risk, elements of risk Goals of disaster management, Assessment of disasters magnitude**.**

UNIT-2 **08**

Natural disasters: Earthquake, floods, cyclone, landslide, volcano, Tsunami, drought.

UNIT-3 **08**

Man-made disasters: Reasons, types, assessment methodologies, mitigation; community-based participation; government intervention.

UNIT-4 **08**

Phases / Elements of disaster management: Mitigation, Preparedness, response, recovery, Structural and non-structural measures for flood disasters, earthquake, cyclone, landslides

UNIT-5 **08**

Community based disaster preparedness, new paradigm for risk reduction, Government of India‘s initiatives, International bodies, Case studies of recent major disasters in India and Abroad.

Text Books:

1 R.B. Singh (Ed.), “Disaster management”, Rawat publications, New Delhi.

2 “National Disaster Response Plan”, A Document prepared by Department of Agriculture and Cooperation.

Reference Books:

1. Concept of Trigger Mechanism, Govt. Of India, Ministry of Home Affairs, February 2001, Publication.
2. Water and Climate related Disasters, Govt. of India, Ministry of Home affairs, Publication.

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ENVIRONMENTAL POLLUTION AND MANAGEMENT

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COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

[1] Understand the relation, impact and dependency of human being on environment.

[2] Identify the sources of different types of pollutants, methods of reduction of these pollutants.

[3] Identify the sources and effects of air, water and land pollution.

[4] Demonstrate the use of different uses and effectiveness of government policies related to reduction of pollution.

UNIT-1 **08**

Impact of man on environment, Consequence of population growth, Energy problem, Pollution of air, water & land, Global environmental issues

UNIT-2 **08**

Water pollution: Sources and classification of water pollutants, wastewater treatment, control strategies, Eutrophication of lakes, self purification capacity of streams,
Thermal pollution: Sources, effects and control measures.

UNIT-3 **08**

Air pollution: Sources and effects, meteorological aspects, control methods and equipments, Land pollution: Types of land pollution, solid waste management-generation, storage, collection, transport, processing and disposal
Noise pollution: Sources, effects, preventive and control measures.

UNIT-4 **08**

EIA: Planning and management of environmental impact studies;
Impact evaluation methodologies: baseline studies, screening, scooping, checklist, overlays, Environmental Impact Assessment of water resources and environmental projects, Case study of power plant.
EA: Meaning, audit items, audit procedure, safety audit.

UNIT-5 **08**

Contemporary issues: Emission trading, discharge permits, international resource sharing issues, climate change, international environmental treaties and protocol, Environmental legislation: Introduction to various legislations related to water, air, biodiversity, ozone depletion etc at National and International level; Institutions for governance.

Text Books:

1 C. Manoharachary and P. Jayarama Reddy, "Principles of environmental studies (Ecology, economics, management and law)", B.S. Publications.
2 P.V. Rao, "Text of Environmental Engineering", Prentice Hall Pvt ltd., Delhi.

Reference Books:

1 Y. Ananayulu and C.A. Sastry, "Environmental impact assessment methodologies", B.S. Publications, Hyderabad.