B.E

Electrical and Electronics Engineering Degree Programmes

(Regular & Sandwich)

Regulations & Syllabi (under CBCS)

2019

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Government Aided Autonomous College Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' Grade
ISO 9001:2015 Certified

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PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

(Autonomous college affiliated to Anna University, Chennai)

2019 REGULATIONS FOR FOUR YEAR BE / BTech DEGREE PROGRAMMES*

(for the batches of students admitted in 2019 - 2020 and subsequently, under Choice Based Credit System)*

NOTE: The regulations hereunder are subject to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already undergoing the programme) as may be decided by the Academic Council.

1. (a) PRELIMINARY DEFINITIONS AND NOMENCLATURE

In the following Regulations, unless the context otherwise requires

i) **"Programme"** means Degree Programme, that is **BE / BTech Degree Programme.**

ii) **"Branch"** means specialization or discipline of BE / BTech Degree Programme, like Civil Engineering, Textile Technology, etc.

iii) **"Course"** means a theory or practical course that is normally studied in a semester, like Mathematics, Physics, etc.

iv) **"University"** means **Anna University.**

(b) CONDITIONS FOR ADMISSION

Students for admission to the BE / BTech degree programme will be required to satisfy the conditions of admission thereto prescribed by the University and Government of Tamil Nadu.

2. DURATION OF THE PROGRAMME

i) **Minimum Duration:** The programme will extend over a period of four years* leading to the Degree of Bachelor of Engineering (BE) / Bachelor of Technology (BTech) of the Anna University. The four academic years will be divided into eight semesters with two semesters per academic year. Each semester shall normally consist of 90 working days including examination days.

ii) **Maximum Duration:** The student shall complete all the passing requirements of the BE / BTech degree programme within a maximum period of 7 years (6 years for lateral entry); these periods reckoned from the commencement of the semester to which the student was first admitted to the programme.

3. BE / BTech PROGRAMMES OFFERED

The following are the branches of study under BE / BTech degree programme.

BE	Automobile Engineering
	Biomedical Engineering
	Civil Engineering
	Computer Science and Engineering
	Electrical and Electronics Engineering
	Electronics and Communication Engineering
	Instrumentation and Control Engineering

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* Provision is made for lateral entry of students in the third semester of the programme in all branches of study(except part time progarmme) and they will be required to satisfy the conditions of admissions thereto prescribed by the University and Government of Tamil Nadu.

Mechanical Engineering
Metallurgical Engineering
Production Engineering
Robotics and Automation

BTech Biotechnology
Fashion Technology
Information Technology
Textile Technology

4. STRUCTURE OF PROGRAMMES

(i) The course work of the odd semesters will normally be conducted in odd semesters and that of the even semesters in even semesters.

(ii) **Curriculum:** The curriculum will comprise courses of study as given in section 13 infra in accordance with the prescribed syllabi. The hours / week listed in section 13 infra for each of the course refer to periods/week. The curriculum consists of (a) Basic Sciences, (b) Humanities and Social sciences (c) Engineering Sciences (d) Professional cores (e) Professional electives (f) Open electives (g) Employability Enhancement courses (h) Mandatory courses (i) Induction programme and (j) Activity point programme as per AICTE guidelines.

(iii) **Electives:** Every student shall opt for electives from the list of electives of the respective degree programme as given in section 13 in consultation with the Tutor, Programme Co-ordinator and the HoD. A student shall undergo two open elective courses and six professional elective courses. Professional electives will be offered from 5^{th} semester to 8^{th} semester. **Minimum number of credits to be earned for open elective courses is 6. Minimum number of credits to be earned for professional elective courses is 18.** Open electives are the elective courses offered by a department for students of other branches and professional electives are courses offered by a department to the students of their own branches only.

(iv) **Project Work:** Every student shall be required to undertake a suitable project in industry / research organization / department in consultation with the Head of the Department and the faculty guide and submit the project report thereon at the end of the semesters in which the student registered, on dates announced by the College/Department. A student shall register for the Project Work I in the 7^{th} semester and for Project Work II in the 8^{th} semester.

(v) **Online Courses:** Students can register and earn credits for online courses approved by department committee consisting of HoD, Programme Coordinator, Tutor and Subject Expert. Students who complete relevant online courses (having 3 credits only) successfully to a maximum of 9 credits may obtain exemption from studying three Professional Electives. Similarly, students who complete relevant online courses (having 3 credits only) successfully to a maximum of 6 credits may obtain exemption from studying two Open Electives. The list of online courses is to be approved by Chairman Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the subsequent Academic Council meeting. The Committee will monitor the progress of the student and recommend the grade or evaluate the candidate in 100% Continuous Assessment (CA) pattern, if necessary. Candidates may do online courses from fifth to seventh semester for getting exemption from professional electives and from third to seventh semesters for getting exemption from open electives. Any online course undergone by a student during break of study period shall not be considered for exempting a professional elective/open elective course.

(vi) **Self Study Courses:** A student without current reappearance courses and /or redo courses can opt for one course as a Self Study course, which may be either an Open Elective or a Professional Elective by getting prior approval from the HoD who will nominate a faculty for the periodic monitoring and evaluation of the course.

(vii) (a) **Induction Programme:** All students shall undergo induction program in the first semester for a duration of three weeks as per the guidelines of All India Council for Technical Education (AICTE). A student completing the induction programme will be awarded **completed** grade and only the students who complete the induction programme shall be considered as eligible for award of degree subject to satisfying other conditions. A student who does not complete the induction program in the first semester shall Redo the same in the subsequent semester.

(b) **Internship**

Every student has to earn minimum 14 credits (Recommended credit range 14-20) of Internship/ Entrepreneurial activities / Project work/ Seminar and Inter/ Intra Institutional Training as a part of his BE/BTech degree programme. It should be noted that for these activities, one credit is equivalent to minimum 40 hours of work. Various activities as per AICTE guidelines under internship is provided in the scheme under the category of Employability Enhancement Courses.

(c) **ACTIVITY POINT PROGRAMME (ADDITIONAL REQUIREMENT FOR EARNING BE/BTech Degree**

Every student shall have to earn prescribed number of activity points detailed below relating to entrepreneurial capabilities and societal commitment from 2nd semester to 6th semester.

Level of entry in degree course	**Total years for points**	**Minimum points**
1st Year	1st to 4th Year	100
2nd Year (3rd Sem.) through lateral entry or transfer from other University	2nd to 4th Year	80

A student shall earn 20 points in each semester from 2nd semester (3rd semester for later entry) to 6th semester the activities shall consists of participation of the student in NSS/NCC/Sports/Sansad Adarsh Gram Yojna (SAGY). These activities will be coordinated by the student department and 3 hours of participation in activity will be taken as 1 activity point these points will not be accounted for CGPA calculation.

A student completing the minimum number of activity points in a semester will be awarded **completed** grade and only the student who secure **completed** grade in all specified semesters shall be considered as eligible for award of degree subject to satisfying other conditions. A student who fails to secure the specified number of activity points in a semester shall Redo the same in the subsequent semester

The Details of implementation (semester wise) is provided. One activity point is considered equivalent to 3 hours of activity.

Semesters	Responsibility	Supporting agency / Activity	points
2	Respective department	NSS/NCC/TRAINING & PLACEMENT/TECHNICAL ASSOCIATIONS/SPORTS/ ENTREPRENEURSHIP/APPROVED EXTRA CURRICULAR ACTIVITIES	20
3			20
4			20
5			20
6			20

These activities will be coordinated by the respective department with the support of NSS / NCC / Sports / Sansad Adarsh Gram Yojna (SAGY) Coordinator or Training and Placement Officer (TPO) of the Institute. The student will be provided with a certificate from the

concerned coordinator and Institutional Head. These points will not be accounted for CGPA calculation. The student may choose any relevant (techno-economic-societal) activity as per their liking in order to earn the Activity points.

(viii) **One-Credit Courses**: Students can also opt for one credit industry oriented courses of 15 hours duration which will be offered by experts from industry / other institution on specialized topics related to their branches of study. Students can complete such one credit courses during the semesters 3 to 7 as and when these courses are offered by different departments. A student will also be permitted to register for the one credit courses offered by other departments provided the student has fulfilled the necessary pre-requisites of the course subject to approval by both the Heads of Departments. There is no limit on the number of one credit courses a student can register and successfully complete during the above period. If a student wishes to avail exemption of professional electives, he/she can do so by exercising his/her option in writing to the respective Head of the Department during the beginning of the prefinal / final semester (i.e., semester 7/8) by following the equivalence norm that one professional elective is equivalent to three one credit courses completed by the student. The grades of the students completing the one credit courses will be finalized based on absolute grading system listed in 8(iii)(b) infra. The grades earned by the students for the one-credit courses which are not opted for conversion into an elective, will not be included in the computation of CGPA.

However number of professional electives for which the student seeks exemption in having studied online courses and/or one credit courses shall not exceed three under any circumstance.

(ix) **Course Enrollment and Registration**

a) Each student, on admission shall be assigned to a Tutor who shall advise and counsel the student about the details of the academic programme and the choice of courses considering the student"s academic background and career objectives.

b) Each student on admission shall register for all the courses prescribed in the curriculum in the student"s first and second semester of study. In the case of lateral entry students, they shall register for all the courses prescribed in the curriculum in the third semester of study.

c) From third semester onwards, (fourth semester in the case of lateral entry students) a student has the option to drop a maximum of two theory courses except Professional Core Courses in a semester. A student has the option to study two additional theory courses in a semester from third semester onwards. These courses can be open electives in third and fourth semesters and/ or professional electives from fifth semester onwards. The maximum number of credits the student can register in a particular semester cannot exceed 30 credits including courses for which the student has registered for redoing (section 5, iii (a)).

d) In case of a student dropping a course of study (other than professional core courses) in one semester, he/she shall register for that course in the next given opportunity and earn necessary attendance in that course exclusively to become eligible to appear for the semester examination in that course.

e) The courses to be offered in a semester for candidates who need to reappear (as per 5 (iii) infra) or having attendance shortage etc., will be decided by HoD.

f) After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the semester end examinations.

The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II.

The enrollment for the courses of the Semesters III to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the Tutor. If the student wishes, the student may drop or add courses subject to eligibility within five working days after the commencement of the concerned semester and complete the registration process duly authorized by the Tutor.

(x) **Credit assignment:** Each course is assigned certain number of credits based on the following:

Contact Period per week	Credits
One Lecture Period	1
One Tutorial Period	1
Two Practical Periods (Laboratory / Project Work/ etc.)	1

The Contact Periods per week for Practicals shall be in multiples of 2. The exact number of credits assigned to the different courses is shown in section 13.

(xi) **Minimum credits:** The minimum number of credits to be earned through successful completion of the courses of study in the respective branch listed in section 13 infra, by a student to qualify for the award of degree is provided below.

Branch of Study	Minimum number of credits to be earned through successful completion of the courses of study of the respective branch listed in section 13 infra, for the award of degree	
	for entry at first semester	**for *lateral entry* at third semester**
BE Programmes		
Automobile Engineering	165	122
Biomedical Engineering	165	124
Civil Engineering	165	124
Computer Science Engineering	165	120
Electronics and Communication Engineering	165	122
Electrical and Electronics Engineering	165	121
Instrumentation and Control Engineering	165	123
Mechanical Engineering	165	122
Metallurgical Engineering	165	121
Production Engineering	165	122
Robotics and Automation	165	119
BTech Programmes		
Biotechnology	165	122
Fashion Technology	165	121
Information Technology	165	120
Textile Technology	165	122

(xii) **Medium of instruction:** English is the medium of instruction for examinations, project report etc. other than elective language courses.

5. REQUIREMENTS OF ATTENDANCE AND PROGRESS

i. A student will be qualified to appear for semester end examinations in a particular course of a semester only if

a) he / she has satisfied the attendance requirements as per the norms given below:

- Shall secure not less than 75% attendance in that course
- If a student secures attendance 65% or more but less than 75% in any course in the current semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level Sports events with prior permission from the Chairman, Sports Board and Head of the Department concerned, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examinations of that course.

b) his / her progress has been satisfactory and
c) his / her conduct has been satisfactory.

ii. A student shall normally be permitted to appear for Semester end examinations of the course if the student has satisfied the attendance requirements (vide Clause 5(i) supra) and has registered for examination in those courses of that semester by paying the prescribed fee.

iii. a) Students who do not satisfy clause 5(i) supra will not be permitted to appear for the Semester End Examinations / Evaluation of that course. The student has to register and redo that course in a subsequent semester when it is offered next, earn necessary attendance and CA mark and appear for semester end examinations.

b) If the total number of "Redo" courses at the end of any EVEN semester is more than SIX, the student will not be eligible to register for next immediate odd and further semester courses.

Such students will be permitted to register for those courses only when offered next, subject to fulfillment of the above condition.

c) If a student with more than SIX "Redo" courses is in the last batch of his/her current regulation, then

i) the courses which he/she has to redo in the next regulation instead of the redo courses in the current regulation,
ii) the passed courses in the current regulation which could be / could not be found equivalent to courses in next regulation for the purpose of calculation of CGPA and
iii) the courses in next regulation which he/she has to study on own without attendance requirement

shall be identified and the student be permitted to redo the courses under new regulation accordingly.

iv. A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

v. In respect of students who complete a part of the academic programme either one or two semesters under the student exchange scheme in approved foreign Universities, the transfer of credits of equivalent courses completed by them in the foreign university will be approved; and in the case of the remaining courses of the respective semester(s) which they have not studied in the respective regulation, they shall register for those courses within the next two or subsequent semesters on a self-study basis. Such an appearance of the student in those courses will be treated as first appearance for the purpose of classification. (Vide sections infra 10 (A,B,C &D))

6. DISCIPLINE

i) Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the college. The Head of the Institution shall constitute a disciplinary committee to enquire into acts of indiscipline and notify the punishment

ii) If a student indulges in malpractice in any of the examinations, he / she shall be liable for punitive action as decided by the Board of Examiners.

7. PROCEDURE FOR REJOINING THE PROGRAMME

A student who desires to rejoin the programme after a period of discontinuance or who upon his/her own request is permitted by the authorities to repeat the study of any semester, may join the semester which he/she is eligible or permitted to join, only at the time of its normal commencement for a regular batch of students and after obtaining the approval from the Commissioner of Technical Education and the University. No student will however be enrolled in more than one semester at any time.

8. ASSESSMENT AND PASSING REQUIREMENTS

i) **Assessment:** The assessment will comprise of Final Examination (FE) and /or Continuous Assessment (CA), carrying marks as specified in the scheme in section 13 infra. The CA marks will be awarded on assessing the student continuously during the semester as per guidelines 8(vii) infra. The assessment for theory courses carrying CA and FE components will be done on relative grading system. Other courses (Laboratory Course, Summer term Course, Industry Visit and Lecture, Industry Visit, Inplant Training, Industrial Training, Mini Project, One Credit courses, Project Work I and II, etc) will be assessed by absolute grading system. However, for the purpose of reporting the performance of a student, letter grades and grade points will be awarded as per section 8(iii)

ii) **Semester End Examinations:** Semester end examinations will normally be conducted during October / November and during March / April of each year. Reappearance examinations may be conducted at such times as may be decided by the college.

A student will be permitted to appear for the final semester examination in a course only if he/she has completed the study of that course.

iii) **Grade and Grade Point:** Each student, based on his / her performance, will be awarded a final grade and grade point as given below for each course at the end of each semester by following relative grading system and absolute grading system.

a. Relative Grading System

In this system, the grades are awarded to the students based on their performance relative to others in Theory courses having Continuous Assessment (CA) and Final Examination (FE) components.

For each theory course, the total mark M [ie., the sum of Continuous Assessment marks (CA) and Final examination marks (FE)] is computed for every candidate.

The students who secure a mark as detailed below are declared as fail (RA) in a theory course.

Marks scored in FE is less than 45% (or) M less than 50% of total marks	Grade : RA

Note:

- "RA" denotes reappearance in a course

After omitting the marks (M) of all failed candidates, the statistical parameters Mean (μ) and Standard Deviation (σ) of the distribution of marks are computed as given below for the remaining candidates (passed).

$$\mu = \frac{1}{n}\sum_{j=1}^{n} M_j \qquad \sigma = \sqrt{\frac{\sum_{j=1}^{n}(M_j - \mu)^2}{n}}$$

where, M_j – Total mark of the „jth student passed in the course
n – Number of students who passed in that particular course.

Then letter grade and grade point to each student are awarded based on the μ and σ as detailed below.

Total Mark, M secured by the student (CA +FE)	Grade	Relative Grade Point, g
M ≥ [(μ+1.5σ)]	O	10
μ+0.52σ ≤ M < μ+1.5σ	A+	9
μ − 0.25σ ≤ M < μ+0.52σ	A	8
μ –1.08σ ≤ M < μ−0.25σ	B+	7
M < μ – 1.08σ	B	6
Withdrawal from examination	W	0
Reappearance	RA	0
Shortage of Attendance	SA	0

Note:

- If the total number of candidates passed is less than 10, the grades shall be awarded as per Absolute Grading System otherwise Relative Grading System may be followed.
- No „O" grade shall be awarded if scored mark is less than 75.
- If the maximum marks awarded in a course is greater than or equal to 95% and if the number of candidates getting „O" Grade is less than 7% of the total number of candidates, then some candidates with A+ grade may be awarded „O" grade. In such a case some candidates having „A" grade may be awarded „A+" grade, some candidates having „B+" grade may be awarded „A" grade and some candidates having „B" grade may be awarded „B+" in order to ensure that a minimum of 7% of the candidates are awarded „O" grade, 23% of the candidates are awarded „A+" grade, 30% of the candidates are awarded „A" grade and 26% are awarded „B+" grade.

b. Absolute Grading System

In absolute grading system, the letter grade and grade points are awarded to each student based on the percentage of marks secured by him/her in all courses like Laboratory Course, Summer term Course, Industry Visit and Lecture, Industry Visit, Inplant Training, Industrial Training, Mini Project, One Credit courses, Project Work I and II, etc. except theory courses having CA and FE components, as detailed below.

Range of percentage of total marks	Letter grade	Grade Point g
90 to 100	O	10
80 to 89	A+	9
70 to 79	A	8
60 to 69	B+	7
50 to 59	B	6
0 to 49 or less than 45% in final examination	RA	0
Withdrawal from examination	W	0
Shortage of Attendance	SA	0

- "RA" denotes Reappearance in a course.

The grades RA and SA will not figure in the grade sheet.

c. For online courses the following grading pattern is applicable in case of credit transfer and CGPA calculations.

Range of percentage of total marks	Letter grade	Grade Point g
90 to 100	O	10
76 to 89	A+	9
60 to 75	A	8
50 to 59	B+	7
40 to 49	B	6

iv) **Cumulative Grade Point Average:**

After the completion of the programme, the Cumulative Grade Point Average (CGPA) from the semester in which the student has joined first (first semester for regular & third semester for lateral entry students) to the final semester is calculated using the relationship:

$$CGPA = \frac{\sum g_i * C_i}{\sum C_i}$$

where, g_i is Grade point secured for i^{th} course.
C_i is Credit allotted for the i^{th} course.

v) **Passing a course:**

a. A student shall be deemed to have passed a theory course with CA and FE components. if

i) he/she secures at least 45% of the total marks in the final examination and
ii) he/she secures not less than 50% of total marks [CA and FE put together] prescribed for the course shall be declared to have passed the course and acquired the relevant number of credits.

A student is deemed to have passed in any other course like Laboratory Course, Summer term Course, Industry Visit, Inplant Training, Mini Project and Project Work I & II etc. with CA and FE components (except theory course with CA and FE components) or in any course carrying only Continuous Assessment marks if the total mark secured by him/her is at least 50% of total marks.

b. A student who is absent or has failed in the semester end examinations in any theory course has to register for the examination in that theory course when it is offered next time either by retaining or by not retaining the CA marks already earned.

I. A student after choosing the option as not retaining CA in second attempt shall have to continue to register for further appearances in that options only till he/she obtains a pass
II. A student after choosing the option as retaining CA in second attempt may continue to appear for further appearances in that option or at any time can switch over to the option **not retaining to CA** which shall be final till he/she obtains a pass

c. A student who after having earned necessary attendance, is absent for semester end examination or has failed in any other course like Laboratory Course, Summer term Course, Industry Visit, Inplant Training, Mini Project and Project Work I etc. with CA and FE components (except theory course with CA and FE components) or in any course carrying only Continuous Assessment marks will register for the examinations when it is

conducted next time and will be solely assessed in the final examinations carrying the entire marks of that course.

d. A student who has earned necessary attendance in the course Project work II but does not submit the report on Project Work II on or before the date specified by the college / department, he/she shall be deemed to have failed in the Project work II and awarded grade RA and will have to register for the same at the beginning of the subsequent semester, redo and submit the project report at the end of that semester and appear for the final examination, the CA mark earned afresh.

e. A student who has earned necessary attendance in the course Project work II but whose project report is not accepted for reasons of incompleteness or other serious deficiencies will be treated as „absent" and will have to register for the same at the beginning of the subsequent semester, redo and submit the project report at the end of that semester and appear for the final examination, the CA mark earned afresh.

f. A student who has submitted the report on Project Work II, but could not appear for the semester end examination on the scheduled date, shall be deemed to have failed in the Project work II and awarded grade RA and will have to register for the same at the beginning of the subsequent semester, Redo and submit the project report at the end of that semester and appear for the final examinations, the CA mark earned afresh. The same shall be applicable also to candidates who fail in the Project work.

g. If a student is absent or has failed in an elective course, he/she may register for the same course as detailed in v (b) above or for any other elective in the subsequent semester by registering afresh.

h. A student who is not eligible to write the semester end examination in any course due to lack of attendance, will be awarded grade SA and the student has to register for that course again, when offered next, attend the classes and fulfill the attendance requirements as per section 5 supra. If the course, in which the student has lack of attendance, is a Professional Elective or an Open Elective, the student may register for the same or any other Professional Elective or Open Elective course respectively in the subsequent semesters.

i. A student after registering for a course may withdraw his / her registration between first & second CA Test on valid reasons.

j. Out of the required six Professional Electives to be studied, a student has to study a minimum of three Professional Electives from the list of Professional electives prescribed in their scheme of courses of study / those courses approved by the department committee with the Head of the Department as the Chairman (in case of credit transfer while undergoing programme in other Universities/Institutions as approved by the head of the Institution). The remaining three Professional electives can be studied either from the list of electives prescribed in the scheme of study of the department of the student/other departments or as online courses / special courses (vide clause 4.(v) supra) by obtaining equivalence or by studying required number of One / Two Credit Courses etc.

   If a student has studied more than six professional electives totally, three Professional Electives with highest grade among all Professional Electives prescribed in the scheme and the three courses with next highest grade among all remaining courses will be considered for calculation of CGPA; however the grades obtained in all other remaining courses will also appear in the grade sheet.

k. If a student has studied more than two open elective courses, then two open elective courses with higher grades alone will be considered for CGPA calculation. The grades obtained in other elective courses will also appear in the grade sheet.

l. If a student does not clear an one credit course it will be treated as a course „withdrawn" by a student; One credit courses will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for continuous assessment; out of which 75 marks will be for final test to be scheduled by the course instructor / department faculty concerned.

m. A student who is absent in the semester end examination of a course after registering for the same will be considered to have appeared and failed in that examination and awarded grade RA.

vi) Reappearance Examinations:

For Reappearance Examinations/ Examinations in any course under REDO category, absolute grading will be followed irrespective of whether the grading was originally under Relative Grading System or Absolute Grading System

vii) **Scheme of Evaluation**

a. <u>Theory Courses with Tutorial Component (CA: 50% + FE: 50%)</u>

Total: 100 Marks

CA Distribution:

(i) Assignment Presentation	10 Marks
(ii) Assessment Tutorial I	05 Marks
(iii) Assessment Tutorial II	05 Marks
(iv) Internal Tests (Best 2 out of 3):	30 Marks
• Test I (conducted for 50 marks)	30 Marks
• Test II (conducted for 50 marks)	30 Marks
• Test III (conducted for 35 marks)	30 Marks
Final Examination (FE)	50 Marks

Note:

1. **a)** Theory courses with tutorial component- Separate tutorial note books/files are to be maintained by the students for regular class room tutorials and **two assessment tutorials** have to be conducted and marks entered in e-assessment.

   b) Assessment Tutorial I is of **open book type**, to be conducted as per schedule in the allotted halls.

   c) Assessment Tutorial II is of surprise type. The 5 marks allotted must be the best out of a minimum of two surprise Tutorials to be conducted by the faculty concerned.

   d) During tutorial sessions, if requested the students may be **guided** by faculty to solve problems.

2. Assignment Presentation for the first **and final year students** shall be conducted by the **faculty concerned** as per his/her own schedule. For **others** it shall be conducted by the faculty concerned as per the **schedule prescribed in academic calendar**.

b. <u>Theory Courses with no Tutorial Component (CA: 50% + FE: 50%)</u>

Total: 100 Marks

CA Distribution:

(i) Assignment Presentation	10 Marks
(ii) Objective Tests I (Surprise type)	05 Marks

(iii) Objective Tests II (Surprise type) 05 Marks

(iv) Internal Tests (Best 2 out of 3): 30 Marks

- Test I (conducted for 50 marks) 30 Marks
- Test II (conducted for 50 marks) 30 Marks
- Test III (conducted for 35 marks) 30 Marks

Final Examination (FE) 50 Marks

Note:

1. Theory courses with no tutorial component- Objective Type Tests I and II- The 5 marks allotted for Objective Type Test I must be the best out of a minimum of two surprise tests to be conducted by the faculty concerned. A similar procedure is to be adopted for the award of the 5 marks allotted for the objective Type Test II.
2. Assignment Presentation for the first **and final year students** shall be conducted by the **faculty concerned** as per his/her own schedule. For **others** it shall be conducted by the faculty concerned as per the **schedule prescribed in academic calendar**.

c. <u>Summer Term Courses (CA: 50% + FE: 50%)</u> **Total : 100 Marks**

- **CA Distribution**
  - (i) Presentation - I (At the middle of II week) 25 Marks
  - (ii) Presentation - II (At the end of III week) 25 Marks
- **Final Examination**
  - a) Report 30 Marks
  - b) Viva voce 20 Marks

d. <u>Laboratory Courses (CA: 50% + FE: 50%)</u> **Total : 100 Marks**

- **CA Distribution:**
  - (i) I Cycle
    - Pre-laboratory Reports & Observations 10 Marks
    - Individual Report 15 Marks
  - (ii) II Cycle
    - Pre-laboratory Reports & Observations 10 Marks
    - Individual Report 15 Marks
- **Final Examination**
  - a) Lab examination 30 Marks
  - b) Viva Voce* 20 Marks

e. <u>Industry Visit and Lecture / Industry Visit (CA : 100%)</u> **Total: 100 Marks**

- **CA Distribution:**
  - (i) Presentation / Report 80 Marks
    - Presentation I /Report I 25 Marks
    - Viva Voce I 15 Marks
    - Presentation II /Report II 25 Marks

Viva Voce II 15 Marks

(ii) Viva Voce* 20 Marks

- Minimum of 2 Industry Visits, at least one shall be associated with PSG II / PSG Foundry Division
- Minimum of 2 Lectures by External Experts

f. <u>Inplant Training (CA: 50% + FE: 50%)</u> **Total: 100 Marks**

- **CA Distribution:**

(i) Record / Report 50 Marks
(ii) Final Examination / Presentation 30 Marks
(iii) Viva Voce* 20 Marks

g. <u>Industrial Training (CA: 50% + FE: 50%)</u> **Total: 100 Marks**

- **CA Distribution:**
  (i) Test / Viva Voce 50 Marks
  - Test I 10 Marks
  - Viva Voce I (based on daily observation) 15 Marks
  - Test II 10 Marks
  - Viva Voce II (based on daily observation) 15 Marks
- **Final Examination** 50 Marks
  - Final Examination / Mini Project 25 Marks
  - Viva Voce# 25 Marks

h. <u>Mini Project (CA: 50% + FE: 50%)</u> **Total: 100 Marks**

- **CA Distribution:**
  (i) Presentation - I 20 Marks
  - Guide
  - Committee

  (ii) Presentation – II 30 Marks
  - Guide
  - Committee
- **Final Examination** 50 Marks
  Project Report Evaluation & Viva Voce
  - Guide 25 Marks
  - Committee 25 Marks

i. <u>Project Work I (CA: 50% + FE: 50%)</u> **Total : 100 Marks**

- **CA Distribution:**
  (i) Review - I 20 Marks
  - Guide 10 Marks
  - Committee[$] 10 Marks

  (ii) Review – II 30 Marks
  - Guide 15 Marks
  - Committee[$] 15 Marks

  (iii) **Final Examination**
  Project Report Evaluation & Viva Voce 50 Marks
  - Guide 25 Marks
  - Committee[$] 25 Marks

j. <u>Project Work II (CA : 50% + FE : 50%)</u> **Total : 100 Marks**

- **CA Distribution:**

(i)	Review - I		20 Marks
	▪ Guide	10 Marks	
	▪ Committee$	10 Marks	
(ii)	Review - II		30 Marks
	▪ Guide	15 Marks	
	▪ Committee$	15 Marks	

- **Final Examination (FE)** 50 Marks
  - ▪ External 25 Marks
    - ▪ Thesis Evaluation 10 Marks
    - ▪ Presentation & Viva Voce 15 Marks
  - ▪ Internal 25 Marks
    - ▪ Thesis Evaluation 10 Marks
    - ▪ Presentation & Viva Voce 15 Marks

k. <u>Mandatory Course/AICTE Activity Point Programme (CA: 100%)</u> Total: 100 Marks

(i)	Assessment - I	50 Marks
(ii)	Assessment – II	50 Marks

l. <u>Soft Skills Development/Business and Managerial Communications/ Quantitative and Reasoning Skills (CA: 100%)</u> Total: 100 Marks

(i)	Basic Test	50 Marks
(ii)	Advanced Test	50 Marks

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* - by external examiner

\# - by internal & external examiner

$ - In respect of Project Work I & II carried out and reviewed in the departments, the review committee shall comprise of at least three senior faculty nominated by the HoD.

However, in respect of Project Work II carried out in industry, the committee nominated for the second review at industry includes one faculty deputed by the department and one mentor from respective industry.

9. QUALIFYING FOR THE AWARD OF DEGREE

A student shall be declared to have qualified for the award of the BE / BTech Degree provided

i) the student has successfully completed the course requirements and has passed all the prescribed courses of study of the respective programme listed in section 13 within the duration specified in section 2 and

ii) no disciplinary action is pending against the student.

10. CLASSIFICATION OF DEGREE

Classification of a student while awarding the degree will not be affected if the student has to REDO courses which are Mandatory in nature (i.e. having no credit but whose completion is compulsory for the award of degree)

A) <u>FIRST CLASS WITH DISTINCTION:</u>

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction.

* Should have passed the semester end examination in all the courses of all the eight semesters in his/her First appearance within 5 years, which includes authorized break of study of one year. Withdrawal from examination (vide clause 11) will not be considered as an appearance.

* Should have secured a CGPA of not less than 8.50.
* Should not have been prevented from writing semester end examination due to lack of attendance in any of the courses.

B) FIRST CLASS:

A student who satisfies the following condition shall be declared to have passed the examination in First Class.

* Should have passed the semester end examination in all the courses of all eight semesters within 5 years, which includes one year of authorized break of study (if availed) or prevention from writing the semester end examination due to lack of attendance (if applicable)
* Should have secured a CGPA of not less than 7.

C) SECOND CLASS :

All other students (not covered in clauses A and B) who qualify for the award of the degree shall be declared to have passed the examination in Second class.

D) RANK :

A student shall be eligible for award of ranking only if he/she has passed the examination in first class with distinction or first class in having passed all the courses in first attempt. Those who have availed the provision of break of study / withdrawal will not be eligible for rank.

11. WITHDRAWAL FROM EXAMINATION

i) A student may, for valid reasons, be granted permission to withdraw from appearing for the examination in any course or courses of only one semester if he/she does not have any history of reappearance courses at the time of request for withdrawal. Prior permission for withdrawal from semester examinations is to be obtained from Principal. Also, only one application for withdrawal is permitted for that semester examination in which withdrawal is sought. Withdrawal may be granted only once during one semester examination throughout the period of study what so ever the reasons may be.

ii) Withdrawal application shall be valid only if the student is otherwise eligible to write the examination and if it is made prior to the commencement of the examination in that course or courses and also recommended by the Head of the Department.

12. TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

i) A student is not normally permitted to temporarily break the study. However, if a student intends to temporarily discontinue the programme in the middle for valid reasons (such as accident or hospitalization due to prolonged ill health) and to rejoin the programme in a later respective semester, he/she shall apply to the Principal through the Head of the Department and stating the reasons therefore.

ii) A student is permitted to rejoin the programme at the respective semester as and when it is offered after the break subject to the approval of Commissioner of Technical Education and Anna University, Chennai, and shall be governed by rules and regulations in force at the time of rejoining.

iii) The duration specified for passing all the courses for the purpose of classification (vide sections 10 supra) shall be increased by the period of such break of study permitted.

iv) The total period for completion of the programme reckoned from the commencement of the semester to which the student was first admitted shall not exceed the maximum period specified in section 2 (ii) supra irrespective of the period of break of study in order that he/she may be qualified for the award of the degree.

v) If any student is detained for want of requisite attendance, progress and conduct, the period spent in that semester shall not be considered as permitted 'Break of Study' and section 12 (iii) supra is not applicable for such cases.

13. Courses of Study and Scheme of Assessment

BE ELECTRICAL AND ELECTRTONICS ENGINEERING (2019 Regulations)
(Minimum credits to be earned: 165)

Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 1									
19E101	Calculus and its Applications	3	1	0	4	50	50	100	BS
19E102	Physics	3	0	0	3	50	50	100	BS
19E103	Chemistry of Electronic Materials	3	0	0	3	50	50	100	BS
19E104	Problem Solving and C Programming	2	0	0	2	50	50	100	ES
19G105	English Language Proficiency	2	1	0	3	50	50	100	HS
19E110	Basic Sciences Laboratory	0	0	4	2	50	50	100	BS
19E111	Electrical Engineering Drawing	0	0	4	2	50	50	100	ES
19E112	Problem Solving and C Programming Laboratory	0	0	2	1	50	50	100	ES
19IP15	Induction Programme **	0	0	0	0	-	-	-	MC
	Total 25 periods	**13**	**2**	**10**	**20**	**400**	**400**	**800**	
SEMESTER 2									
19E201	Complex Variables and Transforms	3	1	0	4	50	50	100	BS
19E202	Semiconductor Devices	3	0	0	3	50	50	100	BS
19E203	Applied Electrochemistry	3	0	0	3	50	50	100	BS
19E204	Electric Circuits	3	1	0	4	50	50	100	ES
19E205	Basics of Mechanical Engineering	3	0	0	3	50	50	100	ES
19E210	Engineering Practices	0	0	2	1	50	50	100	ES
19E211	Circuits and Devices Laboratory	0	0	4	2	50	50	100	ES
19G	Language Electives	0	0	4	2	50	50	100	HS
19E215	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
Semester 2- Summer Term									
19E213	Internship €	0	0	0	2 €	100	0	100	EEC
	Total 27 periods	**15**	**2**	**10**	**22**	**500**	**400**	**900**	

** As per norms
* - As per AICTE Norms; Total 60 Hrs; Grade: Completed/Not Completed; Not counted for CGPA
CA Continuous Assessment
FE Final Examination
€ This course will be conducted prior to the commencement of the third semester for a period of 3 weeks
£ For internship, one credit is equivalent to minimum 40 hours of work as per norms

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BE ELECTRICAL AND ELECTRTONICS ENGINEERING (2019 Regulations)

Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 3									
19E301	Linear Algebra and Numerical Analysis	3	1	0	4	50	50	100	BS
19E302	Network Theory	2	2	0	4	50	50	100	ES
19E303	Electromagnetic Theory	3	0	0	3	50	50	100	ES
19E304	Electronic Circuits	3	0	0	3	50	50	100	ES
19E305	DC Machines and Transformers	3	0	0	3	50	50	100	PC
19O306	Economics for Engineers	3	0	0	3	50	50	100	HS
19E310	Electronic Circuits Lab	0	0	2	1	50	50	100	ES
19E311	DC Machines and Transformers Laboratory	0	0	2	1	50	50	100	PC
19K312	Environmental Science **	2	0	0	0	-	-	-	MC
19E315	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
	Total 26 periods	**19**	**3**	**4**	**22**	**400**	**400**	**800**	
SEMESTER 4									
19E401	Probability and Statistics	2	1	0	3	50	50	100	BS
19E402	Measurements and Instrumentation	3	0	0	3	50	50	100	PC
19E403	Digital Electronics	2	2	0	4	50	50	100	PC
19E404	Induction and Synchronous Machines	3	0	0	3	50	50	100	PC
19E405	Control Systems	3	0	0	3	50	50	100	PC
19E406	Electrical Power Generation Systems	3	0	0	3	50	50	100	PC
19E410	Instrumentation and Control Laboratory	0	0	2	1	50	50	100	PC
19E411	Digital Electronics Laboratory	0	0	2	1	50	50	100	PC
19O412	Indian Constitution **	2	0	0	0	-	-	-	MC
19Q413	Soft Skills Development	0	0	2	1	100	0	100	EEC
19E415	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
	Total 27 periods	**18**	**3**	**6**	**22**	**500**	**400**	**900**	

** As per norms

* - As per AICTE Norms; Total 60 Hrs; Grade: Completed/Not Completed; Not counted for CGPA

CA Continuous Assessment

FE Final Examination

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BE ELECTRICAL AND ELECTRTONICS ENGINEERING (2019 Regulations)

Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 5									
19E501	Linear Integrated Circuits	3	0	0	3	50	50	100	PC
19E502	Embedded Controllers	3	0	0	3	50	50	100	PC
19E503	Computer Architecture	3	0	0	3	50	50	100	PC
19E504	Electrical Machine Design	2	2	0	4	50	50	100	PC
19E505	Power Electronics and Applications	3	1	0	4	50	50	100	PC
19E___	Professional Elective - 1	3	0	0	3	50	50	100	PE
19E510	Power Electronics and Embedded Controllers Laboratory	0	0	2	1	50	50	100	PC
19E511	Induction and Synchronous Machines Laboratory	0	0	4	2	50	50	100	PC
19Q513	Business and Managerial Communications	0	0	2	1	100	0	100	EEC
19E515	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
	Total 28 periods	**17**	**3**	**8**	**24**	**500**	**400**	**900**	
SEMESTER 6									
19E601	Electric Drives and Control	3	0	0	3	50	50	100	PC
19E602	Digital Signal Processing	3	0	0	3	50	50	100	PC
19E603	Transmission and Distribution	3	1	0	4	50	50	100	PC
19E604	Data Structures using C++	2	2	0	4	50	50	100	PC
19E___	Professional Elective II	3	0	0	3	50	50	100	PE
19____	Open Elective I	3	0	0	3	50	50	100	OE
19E610	Digital Signal Processing and Linear Integrated Circuits Laboratory	0	0	2	1	50	50	100	PC
19E611	Electric Drives and Control Laboratory	0	0	2	1	50	50	100	PC
19Q613	Quantitative and Reasoning Skills	0	0	2	1	100	0	100	EEC
19E620	Innovation Practices	0	0	2	1	100	0	100	EEC
19E615	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
	Total 28 periods	**17**	**3**	**8**	**24**	**600**	**400**	**1000**	

At the end of 6th semester, the students are required to earn the minimum number of activity points from the AICTE mandated ACTIVITY POINT PROGRAMME to qualify for the award of BE/BTech degree (Refer Section 4 (vii) (c) of 2019 Regulations)

* - As per AICTE Norms; Total 60 Hrs; Grade: Completed/Not Completed; Not counted for CGPA
CA Continuous Assessment
FE Final Examination

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BE ELECTRICAL AND ELECTRTONICS ENGINEERING (2019 Regulations)

Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 7									
19E701	Power System Protection and Switchgear	3	0	0	3	50	50	100	PC
19E702	Power System Analysis	2	2	0	4	50	50	100	PC
19E___	Professional Elective III	3	0	0	3	50	50	100	PE
19E___	Professional Elective IV	3	0	0	3	50	50	100	PE
19____	Open Elective II	3	0	0	3	50	50	100	OE
19E710	Power System Laboratory	0	0	2	1	50	50	100	PC
19E720	Project Work I	0	0	4	2	100	0	100	EEC
	Total 22 periods	**14**	**2**	**6**	**19**	**400**	**300**	**700**	
SEMESTER 8									
19E___	Professional Elective V	3	0	0	3	50	50	100	PE
19E___	Professional Elective VI	3	0	0	3	50	50	100	PE
19E820	Project Work II	0	0	8	4	50	50	100	EEC
	Total 14 periods	**6**	**0**	**8**	**10**	**150**	**150**	**300**	

CA Continuous Assessment
FE Final Examination

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PROFESSIONAL ELECTIVES

Group A: Electrical/Power

19E001 Flexible AC Transmission Systems
19E002 Special Machines and Controllers
19E003 Utilization and Conservation of Electrical Energy
19E004 Advanced Control Systems
19E005 Smart Grid
19E006 Industrial Automation
19E007 HVDC Transmission
19E008 Power Quality Management
19E009 Power System Operations and Control
19E010 Hybrid Electric Vehicles
19E011 High Voltage Engineering

Group B: Electronics / Embedded

19E012 Embedded Systems and Internet of Things
19E013 System Design using FPGA
19E014 VLSI Design
19E015 Mixed Signal VLSI Design
19E016 Virtual Instrumentation
19E017 Communication Systems
19E018 Automotive Electrical and Electronics Systems
19E019 Wearable Electronics
19E020 Electronic Product Design
19E021 Digital Image Processing

Group C : Computer

19E022 Advanced Data Structures
19E023 Computer Networks
19E024 Software Project Management and Quality Assurance
19E025 Advanced Computer Architecture
19E026 Internetworking and Applications
19E027 Java Programming
19E028 Relational Database Management Systems
19E029 Operating systems
19E030 Neural Networks and Fuzzy Systems
19E031 Linux Architecture
19E032 Total Quality Management

ONE-CREDIT COURSES

19EF01 LV Switchgears
19EF02 Energy Auditing and Conservation Techniques
19EF03 Electrical Safety Standards and Practices
19EF04 Automotive Electrical Systems
19EF05 CAD Tools for VLSI Design Automation
19EF06 Digital Design with Verilog HDL
19EF07 Graphical Programming
19EF08 Advanced Graphical Programming
19EF09 Low Power Microcontrollers and Applications
19EF10 Controller Design and Simulation Using Dspace
19EF11 Solar PV Systems Design Simulation Monitoring and Control
19EF12 Power Electronics in More-Electric Aircraft
19EF13 Field Programmable Analog Array for Analog System Design
19EF14 Systems Engineering for Automotive Applications
19EF15 Electrical Vehicles
19EF16 Phasor Measurement Units and Applications
19EF17 Industrial Drives for Automation
19EF18 Data Science and Analytics for Electrical Engineers
19EF19 Electrical Power on-board War Vessels and Aircraft
19EF20 Aerospace Avionics
19EF21 1-D Model Based System Design for Control System Applications
19EF22 Printed Circuit Board Design and its Fabrication
19EF23 Digital System Design and Verification Using System Verilog
19EF24 Metrology for Electrical Engineers
19EF25 Embedded Linux
19EF26 Internet of Things using CC3200

LANGUAGE ELECTIVES

19G001 Communication Skills for Engineers
19G002 German- Level A1.1
19G003 French Language Level 1
19G004 Basic Japanese

ENGLISH
19GF01 Interpersonal and Organizational Communication
19GF02 Human Values Through Literature

HUMANITIES
19OFA1 Export – Import Practices
19OFA2 Insurance - Concepts and Practices
19OFA3 Public Finance
19OFA4 Security Analysis and Portfolio Management

Summary of Credit Distribution

BE ELECTRICAL AND ELECTRONICS ENGINEERING										
S. No	**Course Category**	**Credits Per Semester**								**Total Credits**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
1	HS	3	2	3	0	0	0	0	0	8
2	BS	12	10	4	3	0	0	0	0	29
3	ES	5	10	11	0	0	0	0	0	26
4	PC	0	0	4	18	20	16	8	0	66
5	PE	0	0	0	0	3	3	6	6	18
6	OE	0	0	0	0	0	3	3	0	6
7	EEC	0	0+2	0	1	1	2	2	4	12
8	MC	-	-	-	-	-	-	-	-	-
	TOTAL	**20**	**22+2**	**22**	**22**	**24**	**24**	**19**	**10**	**165**

CAT - Category; BS - Basic Science; HS - Humanities and Social Sciences; ES - Engineering Sciences; PC - Professional Core; PE - Professional Elective; OE - Open Elective; EEC - Employability Enhancement Course; MC – Mandatory Course.

BE ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER - 1

19E101 CALCULUS AND ITS APPLICATIONS

3 1 0 4

DIFFERENTIAL CALCULUS : Functions of two variables, limit, continuity, partial derivatives, differentiability, total differential, extreme values and saddle points, constrained maxima and minima, Lagrange multipliers with single constraint, Taylor"s formula for two variables. (9 + 3)

MULTIPLE INTEGRALS I : Basic concepts, double integrals over rectangles, double integrals as volumes, Fubini"s theorem, double integrals over general regions, area by double integration, reversing the order of integration. (9 + 3)

MULTIPLE INTEGRALS II : Double integrals in polar form, triple integrals in rectangular coordinates, spherical and cylindrical coordinates. (9 + 3)

SECOND ORDER LINEAR ORDINARY DIFFERENTIAL EQUATIONS : Homogeneous linear ODEs of second order, linearity principle, general solution, homogeneous linear ODEs with constant coefficients, Euler–Cauchy equations, solution by variation of parameters, modeling of electric circuits. (9 + 3)

VECTOR CALCULUS : Gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field. Integration in vector field — line integrals, Green"s, Gauss divergence and Stokes"s theorems. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:
1. Joel Hass, Christopher Heil, Maurice D.Weir "Thomas" Calculus", Pearson Education., New Delhi, 2018
2. Erwin Kreyszig "Advanced Engineering Mathematics", Wiley India Pvt Ltd., New Delhi, 2015

REFERENCES:
1. J.E.Marsden, A.J.Tromba, A. Weinstein "Basic Multivariable Calculus", Springer Verlag., New York, 2019
2. Howard Anton, Irl Bivens, Stephen Davis "Calculus", , John Wiley & Sons, INC., USA, 2016
3. Wylie C R and Barrett L C "Advanced Engineering Mathematics", Tata McGraw-Hill., New Delhi, 2019
4. James Stewart "Multivariable Calculus", Brooks Cole., USA, 2012

19E102 PHYSICS

3 0 0 3

MECHANICS : Motion in a straight line — motion in two and three dimensions — force and motion — Applications of Newton"s laws. Work, power and energy — conservation of energy — Gravity. Rigid bodies: center of mass, momentum, collisions. Rotational motion. Rotational vectors: velocity, acceleration, torque, momentum, moment of inertia. Static equilibrium. (8)

ELECTRIC CHARGE, FORCE & FIELD : Electric charge, Coulomb"s laws, Electric field, Fields of charge distributors, Matters in Electric field: Point charge, dipoles, Conductors, Insulators & dielectrics. Gauss law: Electric field lines, Electric flux and field, Gauss law, Fields of Arbitrary charge distribution, Field at a conductor surface. Applications: Microwave cooking, Liquid Crystals, Shielding and Lightning Safety. (9)

ELECTRIC POTENTIAL : Electric potential difference, curved paths and non uniform fields. Calculating potential difference: potential of a point charge, zero potential, finding potential differences using superposition. Potential difference and Electric field, charged conductors. Electrostatic Energy, Capacitors, Energy in the Electric field. Applications: Corona discharge, pollution control and xerography. (9)

ELECTRIC CURRENT, CIRCUITS AND MAGNETISM : Electric current, conduction mechanisms, Resistance & ohm"s law, Electric power, Safety. Series and parallel resistors, Kirchhoff"s law, Electrical measurements. Magnetism: Magnetic force and field, Charged particles in magnetic fields, Magnetic force on a current, Magnetic dipoles, Ampere"s law. Induced currents, Faraday"s law, Induction and Energy, Lenz"s law, Magnetic energy, Induced electric fields. (10)

MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVES: : Ampere"s law - modification. Maxwell"s equations, electromagnetic waves, Properties of electromagnetic waves, Electromagnetic spectrum, Electromagnetic waves propagation through isotropic media. (9)

Total L: 45

TEXT BOOKS:
1. Richard Wolfson "Essential University Physics", Pearson, 2009
2. Gaur R K, Gupta S L "Engineering Physics", Dhanpat Rai publications., 2013

REFERENCES:
1. David J Griffiths "Introduction to Electrodynamics", Pearson, 2013

2. D.Halliday and R. Resnick "Fundamentals of Physics", John Wiley and Sons, 2015
3. Richard P Fenynman and Robert B Leighton "The Feynman Lectures on Physics", Addison-Wesley, 2005
4. Raymond A. Serway, John W. Jewett "Physics for Scientists and Engineers", Cengage Learning, 2010

19E103 CHEMISTRY OF ELECTRONIC MATERIALS

3 0 0 3

CONDUCTING PROPERTIES OF MATERIALS : Molecular orbital treatment of bonding in metals, insulators, semiconductors — direct band and indirect band, elemental, p-doped, n-doped, stoichiometric compound semiconductors and chalcogen semiconductors. Crystal defects and their influence on properties of materials — intrinsic defects - schottky and frenkel, non-stoichiometeric compounds, extrinsic defects - oxide ion conductors - applications. Nanoscale materials – Quantum dots-band gap – size dependant optical properties. (9)

POLYMERIC MATERIALS : Classification, degree of polymerization, average molecular weights, polydispersity. Polymerization reactions — chain and condensation. Thermal properties -glass transition temperature(Tg) — factors affecting Tg - determination by DSC. Mechanical properties — significance in fabrication of electronics. Electrical insulating properties - dielectric breakdown - aging of polymer insulations - discharges in voids, electrical treeing.Thermal and photochemical degradations. Additives - plasticisers, stabilisers, functional additives. (9)

FLEXIBLE ELECTRONIC MATERIALS : Conjugated polymers — electronic energy bands - mechanism of charge transport — intrachain and interchain - solitons, polarons and bipolarons. Factors influencing charge transport — structural features - defects, molecular weight, crystalline/amorphous nature, doping- oxidative and reductive. Synthesis, properties and applications of polyaniline, polythiophene and polypyrrole. Molecular electronics - graphene, fullerenes, carbon nanotubes – structure, synthesis, properties and applications. (9)

OPTOELECTRONIC MATERIALS : Electroluminescence- exciton, OLED materials– emitters- charge transfer complexes, metal chelates, polycyclic aromatic oligomers, conjugated polymers — polyphenylenes, polyfluorenes. Liquid crystalline polymers- classification of liquid crystals, chemical constitution, stability and applications. Organic and dye sensitized photovoltaics — working principle, materials, advantages and disadvantages. Preparation of ultrathin polymer films - Langmuir-Blodgett Films –self assembled monolayers. (9)

MATERIALS FOR ELECTRONICS PROCESSING : Semiconductor wafer fabrication -Overview and challenges –high purity chemicals, air filters for clean rooms, electronic grade water- quality parameters, water treatment stages for ultrapure water production — membranes and ion-exchange resins, electrodialysis. Photoresists for wafer fabrication — microlithography, resist requirements, material chemistry. Electronic packaging materials-adhesives, connectors, eutectic alloys, phase change materials-phase diagrams, applications. (9)

Total L: 45

TEXT BOOKS:

1. Lesley E.Smart, Elaine A.Moore "Solid State Chemistry - an Introduction", 4th edition, CRC Press., London, 2005.
2. Cowie J.M.G, Valeria Arrighi "Polymers: Chemistry and Physics of modern materials", 3rd edition CRC Press., London, 2007.

REFERENCES:

1. Bansi D. Malhotra "Handbook of Polymers in Electronics", 1st edition, Rapra Technology Ltd., UK, 2002.
2. Stergios Logothetidis "Handbook of Flexible Organic Electronics Materials - Manufacturing and Applications", 1st Edition, WoodHead publishing, London, 2015.
3. Peter Van Zant "Microchip Fabrication: A Practical Guide to Semiconductor Processing", 6th edition, MC Graw Hill, 2014.
4. Shashi Chawla "A Textbook of Engineering Chemistry", 1st edition, Dhanpat Rai and Co, New Delhi, 2005.

19E104 PROBLEM SOLVING AND C PROGRAMMING

2 0 0 2

INTRODUCTION TO PROBLEM SOLVING : Analyzing and Defining the Problem - Algorithm - Flow Chart — Program development steps -Types of programming language. C: The C character set - Identifiers and keywords – Data types — Constants - Variables - Declarations -input and output functions-preprocessor directives. (3)

OPERATORS AND EXPRESSIONS : Arithmetic operators - Unary operators - Relational operators - logical operators - Assignment operators - Conditional operators - comma operator - sizeof operator -precedence and associativity- Library functions. CONTROL STATEMENTS: simple if, if..else, nested if .. else ,elseifladder , switch case - while -do while - for - Nested loops - break — continue — go to statements. (9)

ARRAYS : Defining an array - Processing an array - Multi dimensional arrays -strings. (6)

FUNCTIONS : Function prototype - Defining a function — function call - Passing arguments to a function –nested function — recursive function- Storage classes - auto - static - extern and register variables (4)

STRUCTURES : Definitions - Processing a structure — Array and structures — Nested structures - Structures and functions.POINTERS: Definition - Pointer Arithmetic — types of pointer - const pointer, pointer to a constant, void pointer, null pointer (8)

Total L: 30

TEXT BOOKS:
1. Deitel H. M. and Deitel P. J "C: How To Program", Prentice Hall of India., New Delhi, 2015.
2. Ajay Mittal "Programming in C - A Practical approach", Pearson, New Delhi, 2010.

REFERENCES:
1. Gottfried B "Programming with C", McGraw Hill Education, New Delhi, 2018.
2. Herbert Schildt "C: The Complete Reference", McGraw Hill, New Delhi, 2017.
3. Kernighan B. W. and Ritchie D. M "Programming Language (ANSI C)", Prentice Hall of India, New Delhi, 2013.

19G105 ENGLISH LANGUAGE PROFICIENCY

2 1 0 3

LEARNING LANGUAGE THROUGH STANDARD LITERARY AND GENERAL TEXTS : Integrated tasks focusing on language skills ; Training based on Text based vocabulary, tone, register and Syntax features (12 + 0)

GRAMMAR IN CONTEXT : Word Order ; Subject Verb Concord ; Style features - Tenses, Conditionals, Prepositions, Active and Passive Voice, Modals, Cloze and Spotting Error exercises (10 + 0)

GUIDELINES FOR WRITTEN COMMUNICATION : Principles of clear writing, Paragraph writing, Essay writing, Emphasis Techniques, Summarizing and Paraphrasing, Analytical writing (8 + 0)

FOCUS ON SPOKEN ENGLISH : Task — based activities: Graded levels of difficulty and with focus on language functions - Level 1: Self — expression — Greetings in Conversation, Hobbies, Special interests, Daily routine - Level 2: General Awareness — Expression of Concepts, Opinions, Social Issues, Description of a process / picture/chart, news presentation / review - Level 3: Advanced Skills — Making Short Speeches and Participating in Role Plays (0 + 10)

LISTENING ACTIVITY : Task based activities using Language Laboratory (0 + 5)

Total L: 30 +T: 15 = 45

TEXT BOOKS:
1. Faculty Incharge "Course Material on "English Language Proficiency", PSG College of Technology, Coimbatore, 2019

REFERENCES:
1. Jill Singleton "Writers at Work: The Paragraph", Cambridge University Press., New York, 2012
2. Simon Haines, Mark Nettle and Martin Hewings "Advanced Grammar In Use", Cambridge University Press, New Delhi, 2008
3. Anne Laws "Writing Skills", Orient Black Swan, Hyderabad, 2011
4. Sinha DK "Specimens of English Prose", Orient Black Swan, Hyderabad, 2012

19E110 BASIC SCIENCES LABORATORY

0 0 4 2

PHYSICS LIST OF EXPERIMENTS(ANY EIGHT) :
1. Determination of Young"s Modulus of a wooden bar — Cantilever method
2. Determination of Hysteresis loss of a ferromagnetic material
3. Determination of resistivity of metal and alloy using Carey Foster bridge
4. Determination of Temperature Coefficient of Resistance of metallic wire using post office box
5. Determination of capacitance using LCR bridge
6. Study of reverse bias characteristics of Germanium diode and determination of its band gap
7. Thermistor: Measurement of temperature and band gap
8. Hall effect set up - Determination of Hall Coefficient
9. Study of characteristics of Photo Diode
10. Phototransistor — Characteristics (30)

CHEMISTRY (ANY EIGHT EXPERIMENTS) :
1. Determination of hardness, TDS, pH and conductivity of a water sample.
2. Determination of molecular weight of polymers by Ostwald / Ubbelohde Viscometer.
3. Construction of phase diagram for eutectic system – for application in electronic cooling system.
4. Study of a galvanic cell.
5. Conductometric estimation of acid strength of a pickling bath.
6. Potentiometric estimation of ferrous ion in an effluent.
7. Anodizing of aluminium and determination of thickness of anodised film.
8. Preparation of chloride ion sensor by anodizing silver and calibration.
9. Electroplating of nickel & copper and determination of cathode efficiency.
10. Examination of different forms of corrosion using Ferroxyl indicator and determination of corrosion rate by current measurement. (30)

Total P: 60

REFERENCES:
1. Department of Chemistry "Chemistry Laboratory Manual", 2019
2. Department of Physics "Physics Practicals", 2019
3. Wilson J. D. and Hernandez C. A. "Physics Laboratory Experiments", 7th edition, Houghton Miffin Company, New York, 2009

19E111 ELECTRICAL ENGINEERING DRAWING

0 0 4 2

INTRODUCTION : Introduction to Engineering Drawing- Lettering practice, drawing instrument practice, Bureau of Indian Standards (BIS), geometric constructions, principles of dimensioning (12)

ORTHOGRAPHIC PROJECTION : Types of Projections- Principles of orthographic projection-projection of points, straight lines, planes and solids. Orthographic projection of simple engineering components (12)

DRAWING OF ELECTRICAL INSTRUMENTS : Symbols for Electrical and Electronics Components — Drawing of Common Electrical Instruments — Connection Diagrams of Electrical Instruments - Domestic & Industrial Wiring Diagram (12)

SUBSTATION LAYOUT DIAGRAMS : Domestic and Industrial Wiring Diagram — Single Line Diagram of Power Systems - Layout Diagrams of Distribution Substations. Earthing System — Circuit Breakers — Lightning Arrestors — Air Break Switches — HRC Fuses. (12)

COMPUTER AIDED DRAWING : Exercises using AUTOCAD- Introduction and simple exercise using Eplan (12)

Total P: 24

TEXT BOOKS:
1. Venugopal K. and Prabhu Raja V "Engineering Graphics", New Age Publishers, 2007
2. Dr.S. S.K.Bhattacharya "Electrical Engineering Drawing", New Age International, 2005

REFERENCES:
1. Bureau of Indian Standards "Engineering Drawing Practices for Schools and Colleges", 2004 , SP 46-2003, BIS
2. Yogesh M, Nagaraja B.S, Nandan N "Computer Aided Electrical Drawing", Prentice Hall of India, 2014

19E112 PROBLEM SOLVING AND C PROGRAMMING LABORATORY

0 0 2 1

LIST OF EXPERIMENTS :
1) Working with RAPTOR Tool — Flowchart Interpreter
2) Operators
3) Decision making Statements
4) Loops : while , do..while, for
5) One dimensional array
6) Two dimensional array
7) Strings
8) Functions
9) Recursive functions
10) Structures
11) Structures and arrays
12) Nested Structures
13) Pointers

Total P: 30

REFERENCES:
1. Deitel H. M. and Deitel P "C: How To Program", Prentice Hall of India, New Delhi, 2015
2. Ajay Mittal "Programming in C - A Practical approach", Pearson, New Delhi, 2010
3. Gottfried B "Programming with C", McGraw Hill Education, New Delhi, 2018
4. Herbert Schildt "C: The Complete Reference", McGraw Hill, New Delhi, 2017

19IP15 INDUCTION PROGRAMME

0 0 0 0

As per AICTE guidelines

SEMESTER - 2

19E201 COMPLEX VARIABLES AND TRANSFORMS

3 1 0 4

COMPLEX DIFFERENTIATION : Complex differentiation - analytic function, Cauchy-Riemann equations, harmonic functions, linear fractional transformations. (9 + 3)

COMPLEX INTEGRATION : Cauchy"s integral theorem, Cauchy"s integral formula, Laurent series, singularities and zeros, residue integration method (Residue integration of complex integrals only). (9 + 3)

LAPLACE TRANSFORMS : Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t - shifting, Dirac"s delta function, periodic functions, method of solving differential equations by using Laplace transform technique. (9 + 3)

FOURIER SERIES : Fourier series- convergence and sum of Fourier series, functions of any period 2L, even and odd functions, half range expansions. (9 + 3)

FOURIER TRANSFORMS : Fourier transform, Fourier cosine and sine transforms, Discrete Fourier transform, Fast Fouriertransform—DITalgorithm. (9+3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:
1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 2015
2. Wylie C. R. and Barrett L. C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019

REFERENCES:
1. Mathews J. H. and Howell R. W, "Complex Analysis for Mathematics and Engineering", Narosa Publishing House, New Delhi, 2012
2. Peter V.O Neil, "Advanced Engineering Mathematics", Cengage, New Delhi, 2016
3. Dennis G Zill, "Advanced Engineering Mathematics", Jones & Bartlett India Pvt Ltd., New Delhi, 2017
4. Dean G Duffy, "Advanced Engineering Mathematics with MATLAB", CRC., USA, 2017

19E202 SEMICONDUCTOR DEVICES

3 0 0 3

P-N JUNCTION DIODE : V-I characteristics - static and dynamic resistance, Temperature dependence of characteristics, diffusion and transition capacitances, Diode as a circuit element, small signal and large signal models. Elementary applications - Clippers and clampers, Diode switching times, p - n junction diode ratings. Breakdown phenomena in diodes - zener diodes. The metal - semiconductor junction - Tunnel diode- Schottky barrier diode (8)

BIPOLAR JUNCTION TRANSISTOR : Physical behaviour of a BJT — Ebers - Moll model, large signal current gains. Modes of transistor operation - Common base, common emitter and common collector configurations, Input and output characteristics, Early effect, regions of operation. AC and DC load lines - Need for stability of Q-Point. Bias stability - fixed bias, collector to base bias, self bias. Transistor switching times - Transistor as a switch and an amplifier, small signal ac model, high frequency effects, hybrid — π model - BJT ratings. Opto-electronic devices: Light Emitting Diodes (LED) : Seven Segment Displays — Liquid Crystal Cells — Photo conductive cells — Photodiodes and SolarCells—Phototransistors. (10)

JUNCTION FIELD EFFECT TRANSISTOR : JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET biasing. Small signal JFET model, JFET as a switch, voltage variable resistor and an amplifier. (9)

MOSFET : Constructional details - Operation of enhancement and depletion type MOSFETs , V-I characteristics, transfer characteristics, analytic expression for drain current. Comparison of PMOS and NMOS devices - MOSFET biasing, MOSFET as a switch, resistor and amplifier, small signal ac model. Introduction to CMOS, BiCMOS devices. (9)

INTEGRATED CIRCUIT FABRICATION : Monolithic I C technology - Planar processes, Epitaxial growth, Oxidation, Photolithography, Diffusion, Ion implantation, metallization. BJT fabrication - need for buried layer, Junction and dielectric isolation, Fabrication of p-n-p, multiple emitter transistors. Monolithic diodes. Monolithic IC Resistors: sheet resistance - diffused, ion implanted, epitaxial, pinch, MOS and thin film resistors. Monolithic IC capacitors - junction, MOS and thin film capacitors. IC packaging. (9)

Total L: 45

TEXT BOOKS:
1. Millman J, Grabel A "Microelectronics", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2017
2. Boylestead L R, Nashelsky L "Electronic Devices and Circuit theory", Pearson Prentice Hall, New Delhi, 2013

REFERENCES:
1. Abel S Sedra, Kenneth C Smith "Microelectronic Circuits", Oxford University Press, New York, 2017
2. Thomas L Floyd "Electronic Devices", Pearson Education, New Delhi, 2017
3. David A Bell "Electronic Devices and Circuits", Oxford University Press, UK, 2013
4. Muhammad H Rashid "Introduction to PSpice using OrCAD for Circuits and Electronics", PHI Learning, New Delhi, 2012

19E203 APPLIED ELECTROCHEMISTRY

3 0 0 3

ELECTROCHEMISTRY : Conductance of strong and weak electrolytes, mobility of ions - transport number. Theories of electrolytic conductance, applications of conductance measurement. Electrode potential — standard and reference electrodes, Nernst equation, emf series — applications. Galvanic and concentration cells. Applications of emf

measurements — glass electrode - pH measurement, potentiometric redox titrations. (9)

CORROSION : Mechanisms - Galvanic and differential aeration corrosion. Corrosion rate — factors influencing corrosion - Galvanic series. Corrosion control - corrosion inhibitors, cathodic protection - sacrificial anode, current impression, conversion coatings — chromating, anodizing — determination of thickness of anodized film. Nature inspired coatings-superhydrophobic coatings, self healing coatings. Corrosion in electronic components — control by vapour phase inhibitors, dehumidifiers. (9)

METAL FINISHING IN ELECTRONIC INDUSTRY : Electroplating — plating parameters- polarization and overvoltage, current and energy efficiency. Electroplating of Cu, Ni, and Cr. Electroless deposition of Ni and Cu. Production of plated through hole PCBs, electroforming - fabrication of CD stampers. Electrochemical etching- Cu from PCBs, semiconductors, electrophoretic painting, electropolishing, electrochemical machining. (9)

ELECTROCHEMICAL POWER SOURCES : Batteries- types, battery characteristics. Fabrication and working of dry cell, primary lithium cell, lead- acid battery, Ni — Cd, Ni-metal hydride and lithium ion batteries. Advanced batteries and supercapacitors. Fuel cells - classification, working principle, components and applications of proton exchange membrane, direct methanol, solid oxide and molten carbonate fuel cells. Hydrogen as a fuel-production and storage. (9)

SENSORS : Components of electrochemical sensors, electrochemical transducers-potentiometric, amperometric and conductometric methods – ion-selective electrodes – solid-state electrode, liquid ion-exchange membrane electrodes. Gas sensors — CO2, O2 and NH3 sensing. Sensors for health care — glucose and urea. Smart polymers – pH, temperature, photosensitive, electroactive polymers-applications. (9)

Total L: 45

TEXT BOOKS:

1. Derek Pletcher and Frank C. Walsh "Industrial Electrochemistry", 2nd edition, Chapman and Hall, London, 1993.
2. John O"M.Bockris and Amulya K. N. Reddy "Modern Electrochemistry 2B", 2nd edition, Kluwer Academic/Plenum Publishers, New York, 1998.

REFERENCES:

1. Dell R. M., Rand D. A. J "Understanding Batteries", 1st edition, Royal Society of Chemistry, UK, 2001.
2. Brian Eggins "Chemical Sensors and Biosensors", 1st edition, John Willey & Sons, US, 2002.
3. Zaki Ahmad, Digby Macdonald "Principles of Corrosion Engineering and Corrosion Control", 2nd edition, Butterworth-Heinemann, London, 2013.
4. María Rosa Aguilar, Julio San Román "Smart Polymers and their Applications", 1st edition, Woodhead Publishing Ltd., UK, 2014.

19E204 ELECTRIC CIRCUITS

3 1 0 4

BASIC CONCEPTS : : System of Units - Fundamentals of Circuit Elements - Independent and Dependent Sources- Ohm"s law - Kirchhoff"s Laws — Series Circuits, Parallel Circuits and Series-Parallel Circuits - Network Reduction Techniques - Star to Delta and Delta to Star Transformations — Analysis of Circuits with independent and dependent Sources . (9)

AC STEADY STATE ANALYSIS : RMS and Average values, Steady State Analysis of R, L and C (in Series, Parallel and Series Parallel Combinations) with Sinusoidal Excitation, Phasor Relationships for Circuit Elements — Impedance and Admittance — Phasor Diagrams — Complex power, Apparent power, Active power and Reactive power, Power factor - Analysis of circuits using Kirchhoff"s Laws. Resonance : Series Resonance — Parallel Resonance – Bandwidth – Quality Factor – Selectivity. (11)

MESH ANALYSIS : Mesh Analysis — Circuits with Independent and Dependent Voltage Sources — Circuits with Independent and Dependent Sources. (8)

NODAL ANALYSIS : Nodal Analysis — Circuits with Independent and Dependent Current Sources — Circuits with Independent and Dependent Sources. (8)

NETWORK THEOREMS : Superposition Theorem — Thevenin"s and Norton"s Theorems — Maximum Power Transfer Theorem. (9)

Total L: 45

TEXT BOOKS:

1. Charles K Alexander, Mathew N O Sadiku "Fundamentals of Electric Circuits", 6th edition, Tata McGraw Hill Publishing Company, 2019
2. J David Irwin, Robert M Nelms "Basic Engineering Circuit Analysis", 11th edition, Wiley., 2015

REFERENCES:

1. Mahmood Nahvi, Joseph A Edminister "Electric Circuits", 7th edition, Tata McGraw Hill Publishing Company., 2018
2. William H Hayt Jr, Jack E Kemmerly, Steven M Durbin "Engineering Circuit Analysis", 8th edition, Tata McGraw Hill Publishing Company, 2015
3. James A. Svoboda, Richard C. Dorf "Introduction to Electric Circuits", 9th edition, Wiley India, 2015
4. A Sudhakar, Shyammohan S Pali "Circuits and Networks: Analysis and Synthesis", 5th edition, Tata McGraw Hill Publishing Company, 2015

19E205 BASICS OF MECHANICAL ENGINEERING

3 0 0 3

BASIC MANUFACTURING PROCESSES : Carpentry, Fitting, Welding, Smithy, Foundry and Sheet Metal-Basic tools, merits and applications; Overview of manufacturing processes-Introduction to metal casting process, bulk deformation processes, powder metallurgy and plastic processing (10)

POWER TRANSMISSION : Types of drives, construction and operation of belt drives, flat and V belts, rope drive, chain drive; Gear drives - spur, helical, bevel, worm and worm wheel, rack and pinion; Gear trains - simple and compound gear trains (7)

INTERNAL COMBUSTION ENGINES AND AIR COMPRESSORS : Engines: Classification of IC engines, construction and working principle of petrol and diesel engines, four stroke and two stroke cycles, comparison of four stroke and two stroke engines, petrol and diesel engines; Air compressors: Classification, constructional details and working principle-axial flow, reciprocating and centrifugal compressors. (10)

PUMPS, TURBINES, REFRIGERATION AND AIR-CONDITIONING : Pumps: Basic concepts of centrifugal and reciprocating pumps - constructional details and working principle; Turbines: Principle and working of Pelton wheel, Francis and Kaplan turbine; Refrigeration and air conditioning: Principle and working of vapour compression and absorption systems, layout of typical domestic refrigerator, window and split type room air conditioners. (10)

BASIC CONCEPTS OF FLUID MECHANICS AND THERMODYNAMICS : Fluid mechanics: Properties of fluids, measurement of pressure using manometers, flow measurement using orifice, venturimeter, nozzle meters and pitot tubes; Thermodynamics: System, property, state and equilibrium, process and cycle, work, heat and other forms of energy, Zeroth law and application, first law of thermodynamics-application to closed and open systems, second law of thermodynamics-Clausius and Kelvin-Planck statements. (8)

Total L: 45

TEXT BOOKS:
1. Kalpakjian. S "Manufacturing Engineering and Technology", Pearson Education India Edition., 2013
2. Venugopal K, Prabhu Raja V and Sree Kanjana G "Basic Mechanical Engineering", Anuradha Publications., Chennai, 2014

REFERENCES:
1. Jayagopal L S and Rudramoorthy R "Elements of Civil & Mechanical Engineering", Vikas Publishing House Pvt. Ltd., 2003
2. Kumar D S "Fluid Mechanics and Fluid Power Engineering", Kataria S K and Sons, New Delhi, 2010
3. Ganesan .V "Internal Combustion Engines", Tata McGraw Hill, 2007

19E210 ENGINEERING PRACTICES

0 0 2 1

1. Welding - Metal arc welding tools and equipment, exercises on arc welding and MIG welding processes
2. Fitting - Tools, operations, exercises on “T”-Joint and “L” Joint, types of joints
3. Plumbing-Exercises on external thread cutting and joining
4. Sheet metal work and soldering - Tools, operations, exercise on rectangular tray using Galvanized Iron sheet.
5. Lathe: Constructional details and demonstration on various machining operations using lathe

Total P: 30

REFERENCES:
1. Department of Mechanical Engineering "Engineering Practices Laboratory Manual", PSG College of Technology, Coimbatore, 2019
2. Chapman W.A.J "Workshop Technology", Edward Arnold, 2001

19E211 CIRCUITS & DEVICES LABORATORY

0 0 4 2

LIST OF EXPERIMENTS :
1) Verification of Ohm"s and Kirchhoff"s Laws
2) Verification of Superposition Theorem
3) Verification of Thevenin"s, and Maximum Power Transfer Theorems
4) Series and Parallel Resonance Circuits
5) Steady State Analysis of DC And AC Circuits using Pspice
6) Characteristics of PN Junction Diode, Design and Implementation of Clipping and Clamping Circuits
7) Characteristics of Zener Diode, Design and Implementation of Zener Diode Voltage Regulator
8) Characteristics of BJT and Photo Transistor
9) Characteristics of MOSFET and Application of MOSFET as a Switch
10) Experiments on BJT Biasing Circuits

Total P: 60

19E213 INTERNSHIP

0 0 0 2

WIRING
Staircase / Godown wiring
Fire Alarm with exit/emergency light wiring
Two Lamps operated by One Two way Switch
Fluorescent lamp wiring
Selection of wires and wiring for Home Appliances
Measurement of Electrical parameters using Analog meters and DSO MATLAB

MATLAB
MATLAB basics – the MATLAB environment - Basic computer programming – Variables and constants, operators and simple calculations -Formulas and functions –Exercises. Matrices and vectors -Matrix and linear algebra review -Vectors and matrices in MATLAB -Matrix operations and functions in MATLAB Exercises. Computer programming -Algorithms and structures - MATLAB scripts and functions (m -files) -Simple sequential algorithms - Control structures (if...then, loops) Exercises

PSPICE
Introduction to PSpice software, file types, netlist commands. Basic analysis: DC, AC -KVL, KCL, Mesh & Nodal Analysis Resonance, Filters, RL, RC, RLC Circuits (Series & Parallel), voltage/current/ frequency dependent sources.

TEXT BOOKS:
1. Surjit Singh "Electric Estimating and Costing", Dhanpat Rai and Co Pvt Limited, 2016

SEMESTER - 3

19E301 LINEAR ALGEBRA AND NUMERICAL ANALYSIS

3 1 0 4

VECTOR SPACE: General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension. (9 + 3)

SYSTEM OF LINEAR EQUATIONS, EIGENVALUES AND EIGEN VECTORS : Errors - approximations and round-off errors – truncation errors, system of linear equations - Naive Gauss elimination method, Crout"s method, Gauss– Seidel method, eigenvalues and eigenvectors using power method. (9 + 3)

INTERPOLATION, DIFFERENTIATION AND INTEGRATION : Newton„s divided-difference interpolating polynomials, Lagrange interpolating polynomials, equally spaced data - Newton„s forward and backward interpolating polynomials, numerical differentiation - evenly spaced data, numerical integration - Newton-cotes formulae, trapezoidal rule, Simpson„s 1/3 rule.(9 + 3)

NUMERICAL SOLUTION TO ORDINARY DIFFERENTIAL EQUATIONS : Numerical methods for initial value problem, Taylor-series, Euler"s method, modified Euler"s method, Runge-Kutta method of 4th order, multi step methods - Milne method. (9 + 3)

NUMERICAL SOLUTION TO PARTIAL DIFFERENTIAL EQUATIONS : Finite difference: elliptic equations - the Laplace equation, Poisson equation – Liebmann method, parabolic equations – heat conduction equation – Crank Nicolson„s method, hyperbolic equations – vibrating string. (9 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:
1. Howard Anton and Chris Rorres , "Elementary Linear Algebra", Wiley India, New Delhi, 2018.
2. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 2017.

REFERENCES:
1. David C Lay, "Linear Algebra and its Applications", Pearson, New Delhi, 2016.
2. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson, New Delhi, 2017.
3. Richard L Burden and Douglas J Faires, "Numerical Analysis", Thomas Learning, New York, 2017.
4. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning, USA, 2018.

19E302 NETWORK THEORY

2 2 0 4

THREE PHASE CIRCUITS : Phase sequence – Star and Delta connection – Phase and line quantities - Phasor diagram - Balanced and unbalanced loads – Analysis – 3-phase power measurement – Two wattmeter method - Power factor calculation - Reactive power measurement (6 + 6)

MAGNETICALLY COUPLED CIRCUITS : Self and Mutual inductance – Co-efficient of coupling - Dot convention - Analysis of coupled circuits – Ideal transformer and auto transformer (6 + 6)

NETWORK TRANSIENTS : Transient concepts – Complex frequency - Transient response of simple RL, RC, and RLC series and parallel circuits for impulse, step and sinusoidal signals (6 + 6)

TWO PORT NETWORK : Two port network parameters – Interconnection of two port networks: series , parallel, and cascade – T-Equivalent and π-Equivalent networks – Network functions - Driving point and transfer impedance /admittance - Poles and zeros of network function (6 + 6)

FILTERS AND ATTENUATORS : Low pass and High pass filters –Constant K-Type – Attenuators – T and π Type (2 + 2)

NETWORK SYNTHESIS : Realizability concept – Hurwitz property - Positive real function - Properties - Synthesis of RL, RC and LC driving point impedance and admittance functions using Foster and Cauer forms (4 + 4)

Total L: 30 +T: 30 = 60

TEXT BOOKS:
1. Charles K Alexander, Mathew N O Sadiku , "Fundamentals of Electric Circuits", Tata McGraw-Hill, New Delhi, 2016.
2. Sudhakar A, Shyammohan S Palli , "Circuits and Networks", Tata McGraw Hill, New Delhi, 2015.

REFERENCES:
1. William H Hayt, Jack E Kemmerly, Steven M Durbin, "Engineering Circuit Analysis", McGraw-Hill, New Delhi, 2013.
2. Navhi M, Edminister J A, "Theory and Problems of Electric Circuits", Tata McGraw-Hill, New Delhi, 2011.
3. Samarajit Ghosh, "Network Theory - Analysis and Synthesis", Prentice Hall of India, New Delhi, 2013.
4. J David Irwin, Robert M Nelms, "Basic Engineering Circuit Analysis", 11th Edition, Wiley, USA, 2015.

19E303 ELECTROMAGNETIC THEORY

3 0 0 3

VECTOR CALCULUS : Review of 3D Co-ordinate Systems - Gradient, Divergence and Curl Operations – Divergence theorem - Stokes' theorem - Line, Surface and Volume integrals (8)

ELECTROSTATIC FIELDS : Coulomb's law - Electric field intensity - Electric flux density - Gauss's law and its Applications - Absolute potential - Potential difference - Potential Gradient - Determination of electric field and potential due to point, line, surface and volume charge distributions - Electric Dipole - Energy density in electrostatic field (10)

ELECTRIC FIELDS IN MATERIAL SPACE AND BOUNDARY-VALUE PROBLEMS : Properties of conductors and dielectrics - convection and conduction currents -polarization in dielectrics - dielectric constant and strength - continuity equation and relaxation time- Capacitance determination - Method of images - Boundary conditions involving conductors, dielectric, and free space - Poisson's and Laplace's equations- Uniqueness theorem - Solution of Laplace's equation of single variable only (8)

MAGNETOSTATIC FIELDS : Biot Savart's law - Ampere's circuital law and its applications - Magnetic flux density - Scalar and Vector magnetic potentials - Maxwell's equations for static EM fields - Forces due to magnetic fields - Force and Torque on a closed circuit - Magnetic Materials - Boundary conditions at the interface of two different magnetic materials (10)

INDUCTANCE : Inductance of Solenoid, Toroid, Coaxial cable and Transmission line - Energy density in magnetic field - Lifting force of a magnet (4)

TIME VARYING FIELD : Faraday's Law - Transformer and Motional emfs - Displacement Current- Maxwell's Equations in final form - Poynting theorem. (5)

Total L: 45

TEXT BOOKS:
1. Mathew N O Sadiku, S.V. Kulkarni, "Principles of Electromagnetics", 6th Edition, Oxford University Press, New Delhi, 2015.
2. William H Hayt Jr., John A Buck, "Engineering Electromagnetics", 9th Edition, Tata McGraw-Hill, New Delhi, 2019.

REFERENCES:
1. Joseph A Edminister, "Electromagnetics Schaum"s Outline Series", REPRINT, Tata McGraw-Hill, New Delhi, 2014.
2. Gangadhar K A, "Field Theory", Khanna Publishers, New Delhi, 2009.
3. Nannapaneni Narayana Rao, "Elements of Engineering Electromagnetics", 6th Edition, Prentice Hall, New Delhi, 2011.
4. Nathan Ida, "Engineering Electromagnetics", 3th Edition, Springer, Switzerland, 2015.

19E304 ELECTRONIC CIRCUITS

3 0 0 3

POWER SUPPLIES : Rectifiers – Half-wave and Full-wave rectifiers, Average and RMS value, Ripple factor, Regulation, Rectification efficiency, Transformer Utility Factor. Filters – Capacitor, Inductor, L-type and π -type, Ripple Factor, Regulation - Need for voltage regulators – Series and Shunt regulators, Comparison, Current limiting and protection circuits. (9)

SMALL SIGNAL AMPLIFIERS : Single stage BJT and FET amplifiers – RC coupled amplifier, Analysis at low, medium and

high frequencies – BJT and MOS Differential amplifier, Differential and Common mode gain with resistive load and active load, CMRR - Cascode and Darlington Amplifiers. (9)

LARGE SIGNAL AMPLIFIERS : Power amplifiers– Classification, Single ended and Push-pull Configuration, Power issipation, Output power and Conversion efficiency, Complementary symmetry power amplifiers, Class AB operation, Class C and Class D amplifiers, thermal considerations. (9)

FEEDBACK AMPLIFIERS : Basic concepts of feedback amplifiers – Effect of negative feedback on input and output resistances, gain, gain stability, distortion and bandwidth.Voltage and current feedback circuits. Application of negative feedback in dc-dc converters. (9)

OSCILLATORS AND PULSE CIRCUITS : Oscillators – Barkhausen criteria, RC and LC oscillators using BJT – RC phase shift, Wien bridge oscillators, Hartley and Colpitt"s oscillators. Frequency stability of oscillators. Crystal oscillators. Pulse circuits – RC integrator and Differentiator. Non-sinusoidal oscillators – Multivibrators – Bistable, Monostable, Astable multivibrators and Schmitt Trigger using BJT. (9)

Total L: 45

TEXT BOOKS:
1. Millman J, Halkias C, SatyaBrata JIT, "Electronic Devices & Circuits", Tata McGraw-Hill, New Delhi, 2010.
2. Boylestead L R, Nashelsky L, "Electronic Devices and Circuit Theory", Pearson Education, New Delhi, 2009.

REFERENCES:
1. David A Bell, "Electronic Devices and Circuits", Oxford University Press, New Delhi, 2009.
2. Adel Sedra, Kenneth.C Smith, "Microelectronics Circuits", Oxford University Press, New Delhi, 2010.
3. Thomas L Floyd, "Electronic Devices", Prentice Hall of India, New Delhi, 2011.
4. Millman J, Taub H, Mothiki S Prakash Rao, "Pulse, Digital and Switching Waveforms", Tata McGraw-Hill, New Delhi, 2011.

19E305 DC MACHINES AND TRANSFORMERS

3 0 0 3

PRINCIPLES OF ELECTROMECHANICAL ENERGY CONVERSION : Energy and Co-energy in Magnetic System – Field Energy and Mechanical Force-Singly and Doubly Excited Field Systems –Forces/Torques in Systems with Permanent Magnets. (8)

DC MACHINES : Constructional Details - Principle of Operation of DC Generators - Armature Windings - EMF Equation – Methods of Excitation – Armature Reaction – Compensating Winding – Commutation - No Load Characteristics of DC Generators - Principle of Operation of DC Motors - Torque Equation –Characteristics of DC Motors - Starters – Speed Control of DC Motors – Electrical Braking. (12)

TRANSFORMERS : Single Phase Transformer : Principle of Operation – Construction - EMF Equation - Transformer on No Load and Load - Phasor Diagram - Equivalent Circuit – Voltage Regulation through equivalent circuit - Losses - Efficiency - All Day Efficiency - Parallel Operation - Three Phase Transformers – Three-Winding Transformers – Transformer connections – Choice of Transformer connections - Tap Changing Transformers - Voltage and Current Transformers. (12)

TESTING : DC Machines: Losses & Efficiency – Swinburne"s Test – Separation of Losses. TRANSFORMERS: Polarity and Voltage Ratio Tests – Open Circuit and Short Circuit Test – Sumpner"s Test - Separation of Losses. (6)

SINGLE PHASE AUTOTRANSFORMER : Principle of Operation – Equivalent Circuit – Phasor Diagram - Saving of Copper – Conversion of a Two Winding Transformer to an Auto-Transformer- Introduction to High frequency transformers. (7)

Total L: 45

TEXT BOOKS:
1.K Murugesh Kumar , "Electrical Machines Vol. 1", Vikas Publishing House, New Delhi, 2010.
2.Prithwiraj Purkait and Indrayud Bandyapadhray, "Electrical Machines", Oxford University Press, New Delhi, 2017.

REFERENCES:
1.Bimbhra P S , "Electrical Machinery", Khanna Publishers, New Delhi, 2011.
2.A E Fitzgerald, Charles Kingsley Jr., and Stephen D. Umans , "Electric Machinery", Tata McGraw-Hill, New Delhi, 2011.
3.Ashfaq Husain , "Electric Machines", Dhanpat Rai & Co., New Delhi, 2011.
4.D P Kothari, I J Nagrath , "Electric Machines", McGraw Hill Education (India) Private Limited, New Delhi, 2013.

19O306 ECONOMICS FOR ENGINEERS

3 0 0 3

INTRODUCTION : Definition – Nature and Scope – Central Problems of an Economy – Positive and Normative Economics– Micro Economics and Macro Economics, Significance of Economics, Economic Assumptions. (9)

THEORY OF CONSUMER BEHAVIOR : Utility – Indifference Curve Analysis - Properties, Consumer"s Budget Line – Demand Analysis: Demand Function and Law of Demand, Elasticity of Demand. Demand forecasting using Econometric Techniques.

Supply – Factors Affecting Supply, Market Equilibrium Price, Consumer Surplus. (9)

PRODUCTION, COST AND REVENUE : Production Function, Total Product, Average Product and Marginal Product, Returns to Scale. Costs, Nature of Costs, Short-run and Long-run Cost Curves, Revenue concepts. (9)

MARKET STRUCTURE : Types of Markets - Perfect Competition – Characteristics – Imperfect Competition: Monopoly – Monopolistic Competition – Oligopoly and Duopoly - Price Discrimination and Product Differentiation under Different Markets – Price and Output Determination in Short run and Long run and profit maximization. (9)

PERFORMANCE OF AN ECONOMY (MACRO ECONOMICS) : Demand and Supply of Money – Quantity Theory of Money, Banking – Functions of Commercial Banks and Central Bank – Inflation – Causes – Control Measures – National Income – Concepts – Methods of Calculating National Income – Problems in Calculating National Income. (9)

Total L: 45

TEXT BOOKS:

1. Varian H.R., "Intermediate Microeconomics", East– West Press, New Delhi, 2014.
2. Dewett.K.K, Navalur. M.H, "Modern Economic Theory", S. Chand, New Delhi, 2015.

REFERENCES:

1. William A, McEachern, Simrit Kaur , "Micro ECON", Cengage Learning, Noida, 2013.
2. William A, McEachern, Indira A, "Macro ECON", Cengage Learning, Noida, 2014.
3. Deepashree , "Principles of Economics", Ane Books Pvt Ltd, New Delhi, 2010.
4. Dwivedi , "Essentials of Business Economics", Vikas Publishing House Pvt. Ltd., New Delhi, 2010.

19E310 ELECTRONIC CIRCUITS LAB

0 0 2 1

LIST OF EXPERIMENTS :
1) Design and Implementation of Half-Wave and Full-Wave Rectifier with and without Capacitor Filter
2) Design and Implementation of Series Voltage Regulator
3) Frequency analysis of Common Emitter Amplifier
4) Measurement of input / output impedance of Common Collector amplifier
5) Transfer characteristics of Differential amplifier
6) Frequency response of Voltage series Negative Feedback Amplifier
7) Design and verification of RC Oscillators
8) Design and Verification of Class B Power Amplifiers
9) Wave shaping using RC Filters
10) Design and implementation of Astable Multivibrator

(30)

Total P: 30

REFERENCES:

1. Department of EEE , "Electronic Circuits Laboratory Manual", 1st Edition, PSG College of Technology, Coimbatore, 2019.

19E311 DC MACHINES AND TRANSFORMERS LABORATORY

0 0 2 1

LIST OF EXPERIMENTS :
1) Load Characteristics of DC Shunt and DC Compound Motor.
2) Load Test on DC series motor.
3) Electrical Braking of DC Shunt motor.
4) Load Test on 1-Phase Transformer.
5) Open circuit and Short circuit Tests on 1- Phase Transformer
6) Sumpner„s Test on a 1- Phase Transformer.
7) Separation of Losses in a 1- Phase Transformer.
8) Phase relation and polarity test of transformers.
9) Study of starters and development of LAP/WAVE winding diagram for DC machines.
10) Three phase transformer connections.

(30)

Total P: 30

REFERENCES:

1. Dept. of EEE , "DC Machines and Transformers Laboratory Manual", PSG College of Technology, Coimbatore, 2019.

19K312 ENVIRONMENTAL SCIENCE

2 0 0 0

INTRODUCTION TO ENVIRONMENT : Environment - Definition, scope and importance. Types and composition of atmosphere – particles, ions and radicals. Ozone layer- significance, formation and depletion. Ecosystems- Structure and functions, components, energy flow, food chains, food web, Biodiversity-levels, values and threats – India as a mega-diversity nation – hotspots of biodiversity – endangered and endemic species of India – conservation of biodiversity. (6)

ENERGY RESOURCES : Introduction – National and International status- exploitation - sustainable strategies- Fossil fuels-classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas; solar energy - introduction, harnessing strategies. Wind energy - availability, wind power plants, wind energy conversion systems, site characteristics, and types of wind turbines. Supporting renewable energy resources - tidal –geothermal -hydroelectric. (6)

ENVIRONMENTAL POLLUTION : Definition – Sources, causes, impacts and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards (h) RF hazards - Role of an individual in prevention of pollution. DISASTER MANAGEMENT: Floods, earthquake, cyclone and landslides – Case studies, consequences and rescue measures (6)

WASTE MANAGEMENT : Wastewater - Characteristics of domestic and industrial wastewater - COD and BOD – Various stages of treatment – primary, secondary, tertiary treatment- Biological and advanced oxidation processes. Solid waste management – Characteristics of municipal solid waste(MSW), biomedical, automobile and e-wastes and their management – landfills, incineration, pyrolysis, gasification and composting. (6)

SOCIAL ISSUES AND THE ENVIRONMENT : Environmentally Sustainable work practices- Rain water harvesting – Role of non-governmental organizations. Human ethics and rights- impact on environment and human health – role of information technology on environment and human kind. Green IT policies, Process of EIA - ISO 14000. Legislation- Environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act. (6)

Total L: 30

TEXT BOOKS:
1. Gilbert M.Masters , "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi, 2004.
2. De A K , "Environmental Chemistry", New Age International P Ltd, New Delhi, 2006.

REFERENCES:
1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. KoteswaraRao MVR, "Energy Resources: Conventional & Non-Conventional", BSP Publications, New Delhi, 2006.
3. Deswal S and Deswal A, "A Basic Course in Environmental Studies", Dhanpat Rai and Co, New Delhi, 2004.

SEMESTER - 4

19E401 PROBABILITY AND STATISTICS

2 1 0 3

PROBABILITY AND DISCRETE RANDOM VARIABLES : Probability, axiomatic approach to probability, Baye's theorem, probability distributions and probability mass functions, cumulative distribution functions, mean and variance, binomial, Poisson and geometric distributions. (6 + 3)

CONTINUOUS RANDOM VARIABLES : Probability distributions and probability density functions, cumulative distribution functions, mean and variance, exponential, normal and Weibull distributions. (6 + 3)

JOINT PROBABILITY DISTRIBUTIONS : Two dimensional discrete and continuous random variables, marginal probability functions, independence, covariance, correlation and linear regression. (6 + 3)

STATISTICAL INFERENCE : Point estimation - interval estimation – testing of hypothesis for means – large, small samples and matched pairs tests – testing of hypothesis for proportions, chi square test for goodness of fit and independence of attributes. (6 + 3)

VARIANCE TESTS AND ANALYSIS OF VARIANCE : Hypothesis concerning one variance, two variances, analysis of variance - completely randomized design, randomized block design. (6 + 3)

Total L: 30 +T: 15 = 45

TEXT BOOKS:
1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Wiley India, New Delhi, 2018.
2. Richard A. Johnson, "Miller & Freund"s, Probability and Statistics for Engineers", Prentice Hall, New Delhi, 2017.

REFERENCES:
1. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Brooks/Cole, USA, 2015.

2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probability & Statistics for Engineers & Scientists", Pearson, New Delhi, 2016.
3. Robert V. Hogg, Elliot Tanis and Dale Zimmerman, "Probability and Statistical Inference", Pearson Education, USA, 2014.
4. J. Susan Milton and Jesse Arnold, "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 2017.

19E402 MEASUREMENTS AND INSTRUMENTATION

3 0 0 3

MEASUREMENT SYSTEMS : Methods – Classification of units – standards and calibration - modes of operation – functions – Application of measurement systems – Input / Output Configuration of Measurement and Instrumentation – medhos of correction – Errors in measurement – types of errors – statistical treatment of data – Histogram – Arithmetic mean – dispersion from mean – Average deviation – statndard deviation – variance – Normal or Gaussian Curve of errors. (9)

ANALOG INDICATING INSTRUMENTS : Types of ammeters and voltmeters – PMMC Instruments – Moving Iron Instruments – Dynamometer type Instruments - measurement of power and energy- Dynamometer type wattmeter – single phase Induction type energy meter, Calibration of meters- Instrument Transformer (9)

MEASUREMENT OF R-L-C : Resistance measurement – Kelvin double bridge, Wheatstone bridge, substitution method, Loss of charge method, Guard Wire method. Measurement of inductance and capacitance – Maxwell, Anderson, Wein, Hay"s and Schering bridge. Measurement of Earth resistance - megger. (9)

INSTRUMENTATION SYSTEMS : Elements of Instrumentation systems - Transducers – Classifications, Principle of operation of Resistance potentiometer, Strain Gauge, Inductive and capacitive transducers, LVDT, Piezo-electric transducers. Encoders. Hall effect sensors, and photo sensors and its applications. Measurement of Pressure – High Pressure and low pressure measurement. Measurement of Temperature - Resistance thermometers, thermistors and thermocouples. (9)

TEST AND MEASURING INSTRUMENTS : Electronic voltmeter – Digital voltmeter of ramp and integrating types. Digital Multimeter-Spectrum Analyser-Harmonic Distortion Analyser- Function Generator- Dual channelOscilloscope-Digital storage Oscilloscope- PC based measurements. (9)

Total L: 45

TEXT BOOKS:
1. Sawhney A K, "A Course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai & Sons, New Delhi, 2011.
2. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press, New Delhi, 2012.

REFERENCES:
1. Doeblin E O, Dhanesh N Manik, "Measurement Systems", McGraw-Hill, New Delhi, 2012.
2. Rangan C S, Sharma G R, Mani V S, "Instrumentation Devices and Systems", Tata McGraw-Hill, New Delhi, 2004.
3. Kalsi H S, "Electronic Instrumentation", Tata McGraw-Hill, New Delhi, 2013.
4. Albert D, Helfrick, William D Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Pearson Education, New Delhi, 2016.

19E403 DIGITAL ELECTRONICS

2 2 0 4

NUMBER SYSTEMS AND BOOLEAN ALGEBRA : Review of Number Systems –Number representation: Signed – Unsigned- Fixed point- Floating point- Computer codes-BCD- Gray code- Excess 3 code- Error detection and correction codes- Parity- Hamming codes- Boolean algebra-Basic Postulates and theorems- Switching functions- Canonical forms- Logic gates- Incompletely specified functions- Simplification of logic functions through K-maps and Quine – McClusky method (6 + 6)

DIGITAL LOGIC FAMILIES : Characteristics of digital ICs – Voltage and current ratings-Noise margin-Propagation delay- Power dissipation. TTL logic family-Inverter-Totem pole- Open collector and tri-state outputs- wired output operations- CMOS logic Inverter- High speed CMOS and ECL logic families- Comparison of performance of various logic families- Interfacing TTL and CMOS devices. (5 + 3)

COMBINATIONAL LOGIC DESIGN : Decoders, Encoders-Multiplexers and Demutiplexers- Implementation of Combinational circuits using Multiplexers and Demultiplexers-Hazards- Arithmetic circuits: Binary /BCD adders and subtractors- Magnitude comparator. (5 + 6)

SEQUENTIAL CIRCUITS : General model of sequential circuits- Latch- Flip-Flops – setup and hold times - Level triggering- Edge triggering- Master-slave configuration-Binary counters-Shift register- Ring Counter- Johnson counter- Timing diagram- Mealy /Moore Models – Concept of state -State diagram-State table – Minimal flip-flop/ one hot realization -Design of synchronous sequential circuits – Up-down/Modulus counters- Sequence detector- Introduction to Asynchronous Sequential circuits. (7 + 7)

MEMORY AND PROGRAMMABLE LOGIC DEVICES : Memories – Read Write Operators – Timing Diagrams- ROM- PROM- EPROM- EEPROM-Static, Dynamic RAM- Semicustom design – Introduction to PLDs – ROM, PAL, PLA.Architecture of PLDs – PAL16L8,PAL16R4, 22V10 - Implementation of digital functions. (3 + 3)

INTRODUCTION TO VERILOG HDL : Digital design process flow using HDL - Modules and ports - compiler directives - data types and operators - gate level modeling - data flow modeling - behavioral modeling – structural modeling -simple Verilog codes. (4 + 5)

Total L: 30 +T: 30 = 60

TEXT BOOKS:
1. Tocci R J, Widmer N, Moss G, "Digital Systems: Principles and Applications", Pearson, New Delhi, 2016.
2. Leach D, Malvino A, GoutamSaha, "Digital Principles and Applications", Tata McGraw-Hill, New Delhi, 2016.

REFERENCES:
1. Donald Givone, "Digital Principles and Design", Tata McGraw-Hill, New Delhi, 2016.
2. Anand Kumar A, "Fundamentals of Digital Circuits", Prentice Hall of India, New Delhi, 2016.
3. Nelson V P, Nagle H T, Carroll B D, Irwin J D, "Digital Logic Circuit Analysis and Design", Prentice Hall International, New Jersey, 1996.
4. Bhasker J, "A Verilog HDL Primer", BS Publications, New Delhi, 2007.

19E404 INDUCTION AND SYNCHRONOUS MACHINES

3 0 0 3

THREE PHASE INDUCTION MOTOR : Types - Construction - MMF in Distributed AC Windings - Rotating Magnetic Field - Principle of Operation - Torque equation - Slip-Torque Characteristics - Equivalent Circuit - Phasor Diagram Losses and efficiency. (9)

PERFORMANCE AND CONTROL OF 3-PHASE INDUCTION MOTOR : No-Load and Blocked Rotor Tests - Performance prediction by Circle Diagram - Starters - Cogging and Crawling - Speed Control - Braking - Principle of Induction Generators. (9)

SINGLE PHASE INDUCTION MOTOR : Construction - Principle of Operation - Double Revolving Field Theory - Equivalent Circuit - Methods of Starting - Types: Split phase, Capacitor type, Shaded pole and Universal Motor. (9)

SYNCHRONOUS GENERATOR : Construction - types - Winding Factors - EMF Equation - Armature Reaction - Voltage Regulation; EMF, MMF, and ZPF Methods - Parallel Operation - Synchronization - Synchronizing power - Two reaction theory - Slip test - Phasor Diagrams - Voltage Regulation. (9)

SYNCHRONOUS MOTOR : Principle of Operation - Methods of Starting - Phasor Diagrams - Power Flow Equations - Effect of Varying load angle and excitation - V and Inverted V Curves - Synchronous Condenser - Hunting and Suppression Techniques. (9)

Total L: 45

TEXT BOOKS:
1. D P Kothari, I J Nagrath, "Electric Machines", McGraw Hill Education (India) Private Limited, New Delhi, 2017.
2. K Murugesh Kumar, "Electrical Machines - II", Vikas Publishing House, New Delhi, 2010.

REFERENCES:
1. Bimbhra P S, "Electrical Machinery", Khanna Publishers, New Delhi, 2011.
2. A E Fitzgerald, Charles Kingsley Jr, Stephen D. Umans, "Electric Machinery", Tata McGraw-Hill, New Delhi, 2011.
3. Ashfaq Husain, "Electric Machines", Dhanpat Rai & Co., New Delhi, 2011.
4. Bhattacharya S K, "Electrical Machines", Tata McGraw-Hill, New Delhi, 2011.

19E405 CONTROL SYSTEMS

3 0 0 3

INTRODUCTION AND TRANSFER FUNCTION MODELLING : Open loop and closed loop systems – Examples, Control system components. Transfer function of physical systems: Mechanical systems - Translational and Rotational systems, Electrical network, Thermal and hydraulic systems. Transfer function of DC servomotor, AC servomotor, Transfer function of overall systems. Block diagram-reduction techniques. Signal flow graphs – Mason"s gain formula. (10)

TIME RESPONSE ANALYSIS : Standard Test signals –Time response of zero, first and second order system, Performance criteria, Type of systems. Steady state error constants – position, velocity and acceleration error constants. Generalized error series – Feedback characteristics of control systems. (8)

FREQUENCY RESPONSE ANALYSIS : Frequency domain specifications – peak resonance, resonant frequency, bandwidth and cut-off rate, correlation between time and frequency responses for second order systems. Polar plot, Bode plot – Gain Margin and Phase Margin. (10)

STABILITY OF SYSTEMS : Characteristic equation – Location of roots of characteristic equation – Absolute stability and Relative stability. Routh Hurwitz criterion of stability – Necessary and sufficient conditions - Nyquist Stability - Principle of argument – Nyquist path – Nyquist stability criterion and determination of stability – Assessment of relative stability - Stability analysis using Bode Plot. Root locus concept, Rules for construction of Root Locus. (10)

COMPENSATORS AND CONTROLLERS : Introduction to Compensators - Lag, Lead and Lag-Lead Compensators- Transfer function and Characteristics – Controllers - P, PI and PID control modes. (7)

Total L: 45

TEXT BOOKS:
1. Gopal M, "Control Systems – Principles and Design", Tata McGraw-Hill, New Delhi, 2013.
2. Norman S Nise, "Control System Engineering ", John Wiley & Sons, New Delhi, 2013.

REFERENCES:
1. Benjamin Kuo, "Automatic Control Systems", Prentice Hall of India, New Delhi, 2010.
2. Dazzo J J, Houpis C H, "Linear Control System Analysis and Design with MATLAB", 5th Edition, McGraw-Hill, New York, USA, 2003.
3. Ogatta K, "Modern Control Engineering", Prentice Hall of India, New Delhi, 2013.
4. Richard C. Dorf, Robert H. Bishop, "Modern Control Systems", 12th Edition, Prentice Hall, USA, 2011.

19E406 ELECTRICAL POWER GENERATION SYSTEMS

3 0 0 3

INTRODUCTION TO POWER SYSTEMS : Structure of electric power system - load curve. Conventional power generation Systems: Coal, Oil, Natural Gas, Nuclear Power and Hydro power generating systems - principle of operation, working. Energy Scenario in India, Sector-wise Energy Consumption in India - potential for renewable energy - Need for Renewable Energy Sources. (9)

SOLAR ENERGY SYSTEMS : Introduction to solar radiation- Solar Thermal Systems: Principle and operation – Low, medium and high temperature systems. Solar Photovoltaic Systems: Solar cells and their characteristics - Influence of insolation and temperature - PV arrays – Maximum Power Point Tracking Algorithms – Grid Connected PV System - Concentrated Solar PV systems - Stand alone PV system. (9)

WIND ENERGY SYSTEMS : Nature and Power in the wind - Wind Energy Conversion System (WECS) - Components and Classification of a WECS - Wind Turbines - Types - Horizontal and vertical axis wind turbines - Yaw and Pitch Control - Betz model - Generators for WECS - Types - Selection of Generators - Operation and Control of Grid-connected and Self-excited Induction Generator - Permanent Magnet Synchronous Generators - Schemes for Fixed and Variable Speed Wind Turbines. (9)

ENERGY STORAGE SYSTEMS : Fuel Cells - Principle and operation, Types - Alkaline, Direct Methanol, Molten Carbonate, SOFC, PEMFC - Efficiency - Effect of Polarization on Efficiency - Hydrogen Production and Storage: Reforming types - Solid state, Gas phase, Cryogenic Liquid phase hydrogen storage - Batteries for Renewable energy applications - Types - Lead acid and Lithium ion batteries - Sizing of Batteries. (9)

MISCELLANEOUS ENERGY SOURCES : Energy from Ocean – Tidal Energy, Wave Energy, Ocean Thermal Energy Conversion Systems - Geo-thermal Energy Systems - Magneto Hydro Dynamic Systems. (9)

Total L: 45

TEXT BOOKS:
1. Mehta V K, Rohit Mehta, "Principles of Power System", S. Chand & Company Pvt. Ltd, New Delhi, 2014.
2. Khan B H, "Non-Conventional Energy Resources", Tata McGraw-Hill, New Delhi, 2010.

REFERENCES:
1. P. V. Gupta, M.L. Soni, U.S. Bhatnagar, A. Chakrabarti, "A Textbook on Power System Engineering", Dhanpat Rai & Co, New Delhi, 2010.
2. G. D. Rai, "Non Conventional Energy Sources", 6th Reprint, Khanna Publishers, New Delhi, 2018.
3. D.P. Kothari, K. C. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2011.
4. Mukund R. Patel, "Wind and Solar Power Systems", CRC Press, New York, 2005.

19E410 INSTRUMENTATION AND CONTROL LABORATORY

0 0 2 1

LIST OF EXPERIMENTS :
1) Calibration of Temperature sensors (RTD / Thermocouple / Thermistor)
2) Measurement of Linear displacement using LVDT and Measurement of strain using Strain gauge
3) Burden Current Characteristics of Current Transformer
4) Measurement of a Physical variable using PC
5) Measurement of Pressure using Load cell
6) Transfer function of DC Motor a) Armature Control Mode b) Field Control Mode
7) Transfer function of AC Servomotor
8) Time & Frequency Response of the Systems using MATLAB

9) Study of response of First and Second order system using Linear System Simulator
10) Design of PID Controller using tuning methods in MATLAB

Total P: 30

REFERENCES:
1. Department of EEE, "Instrumentation and Control Laboratory Manual", 1st Edition, PSG College of Technology, Coimbatore, 2019.

19E411 DIGITAL ELECTRONICS LABORATORY

0 0 2 1

LIST OF EXPERIMENTS :
1) Realization and characterization of Digital Logic Gates using BJT/MOSFET.
2) Study of basic digital IC"s and implementation of adder and subtractor circuits.
3) Design and implementation of code converters.
4) Study of multiplexer and de-multiplexer, and design of combinational circuits using multiplexer and de- multiplexer.
5) Design and implementation of counters and shift registers.
6) Design and implementation of synchronous sequential circuits.
7) Implementing 4-bit ALU operations using IC 74181.
8) Design and Simulation of Simple Combinational circuits using Verilog.
9) Design and Simulation of Simple Sequential circuits using Verilog.
10) Implementation of Simple Logic Circuits using PLDs / FPGA.

Total P: 30

REFERENCES:
1. Department of EEE, "Digital Electronics Laboratory Manual", 1st Edition, PSG College of Technology, Coimbatore, 2019.

19O412 INDIAN CONSTITUTION

2 0 0 0

INTRODUCTION : Evolution of Indian Constitution; Significance of Constitution; Composition; Preamble and its Philosophy. (4)

RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES: Fundamental Rights- Writs and Duties, Directive Principles of State Policy.(6)

COMPOSITION OF PARLIAMENT AND FEDERALISM : Union Government, President and Vice President, Houses of the Parliament and their functions; Composition of State Legislature; Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers; The Indian Federal System, Administrative Relationship between Union and States. (8)

BILLS AND CONSTITUTION AMENDMENT PROCEDURE : Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India. (6)

JUDICIARY : Supreme Court and High Court; Functions and powers, Judicial Review. (6)

Total L: 30

TEXT BOOKS:
1. Subash C. Kashyap, "Our Constitution", 5th Edition, NBT, India, New Delhi, 2015.
2. Basu D D, "Introduction to the Constitution of India", 20th Edition, Prentice Hall of India, New Delhi, 2011.

REFERENCES:
1. Briji Kishore Sharma, "Introduction to the Constitution of India", 8th Edition, Prentice Hall of India, New Delhi, 2017.
2. Hoshiar Singh, "Indian Administration", 1st Edition, Pearson Education, New Delhi, 2011.
3. Jain M C, "The Constitution of India", 5th Edition, State Mutual Book & Periodical Service, Limited, New Delhi, 1988.
4. Shukla V N, "Constitution of India", 13th Edition, Eastern Book Company Limited, New Delhi, 2017.

19Q413 SOFT SKILLS DEVELOPMENT

0 0 2 1

SOFT SKILLS DEVELOPMENT :
1) Body Language and Professionalism
2) Interpersonal skills
3) Goal setting
4) Impression Management
5) Team Building
6) Time Management
7) Stress Management
8) Convincing Skills
9) Motivation
10) Change Management

11) Communication Confidence
12) Group discussion basics
13) Personal Interview basics
14) Resume writing

Total P: 30

REFERENCES:

1. Jeff Butterfield, "Soft Skills for Everyone", 6th Edition, Cengage Learning, Delhi, 2015.
2. Rao M S, "Soft Skills - Enhancing Employability", LK International Publishing House, New Delhi, 2011.

SEMESTER - 5

19E501 LINEAR INTEGRATED CIRCUITS

3 0 0 3

OPERATIONAL AMPLIFIER CHARACTERISTICS : Functional Block Diagram – Symbol, Characteristics of an ideal operational amplifier, transfer characteristics, Circuit schematic of μA 741, Open loop gain, CMRR-input bias and offset currents, input and output offset voltages, offset compensation techniques. Frequency response, characteristics – stability, limitations, frequency compensation, slew rate. Transfer characteristics. (9)

LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS : Inverting and Non-inverting amplifiers – Voltage follower, Summing amplifier, Differential amplifier, Instrumentation amplifier. Integrator and Differentiator – Practical considerations. Voltage to Current and Current to Voltage converters, Phase changers. Sinusoidal oscillators. Active filters – Design of low pass, high pass, wide band pass and Band stop Butterworth filters, Narrow band pass and notch filters. (9)

NON-LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS AND SINGLE POWER SUPPLY OPERATIONAL AMPLIFIERS : Comparator – Regenerative comparator, Zero crossing detector, Window detector, Sample and hold circuit, Precision diode, Half and Full wave rectifiers, Active peak detector, Clipper and Clamper, Logarithmic, Exponential amplifiers and Multiplier, Square, and Triangular waveform generators. : Need for single power supply operational amplifiers – LM324, AC Inverting and Non-Inverting amplifiers, Applications - Introduction to FPAA (Field Programmable analog array). (9)

IC VOLTAGE REGULATORS : Block diagram of 723 general purpose voltage regulator – Circuit configurations, Current limiting schemes, Output current boosting, Fixed and adjustable three terminal regulators- LM78XX, LM79XX, LM317, Switching regulators. (6)

A-D AND D-A CONVERTERS : DAC/ADC performance characteristics – Digital to Analog Converters: Binary weighted and R-2R Ladder types – Analog to digital converters: Continuous, Counter ramp, Successive approximation, Single slope, Dual slope and Flash Type. (3)

SPECIAL FUNCTION ICS : 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, 566 Voltage Controlled Oscillator, Analog Multiplier, Comparator ICs. PLL Functional Block diagram – Principle of operation, Building blocks of PLL, Characteristics, Derivations of expressions for Lock and Capture ranges, Applications: Frequency synthesis, AM and FM detection, FSK demodulator, Motor speed control. (9)

Total L: 45

TEXT BOOKS:

1. Adel Sedra, Kenneth.C Smith, "Microelectronic Circuits", 7th Edition, Oxford University Press, New Delhi, 2014.
2. Roy Choudhury Shail Jain, "Linear Integrated Circuits", 5th Edition, New Age International, New Delhi, 2018.

REFERENCES:

1. Gayakwad A R, "OP-Amps and Linear Integrated circuits", 4th Edition, Prentice Hall India, New Delhi, 2015.
2. Coughlin F R, and Driscoll F F, "Operational Amplifiers and Linear Integrated Circuits", 6th Edition, Prentice Hall of India, New Delhi, 2010.
3. Michael Jacob J, "Applications and Design with Analog Integrated Circuits", 2nd Edition, Prentice Hall of India, New Delhi, 2010.
4. K. Lal kishore, "Operational Amplifiers and Linear Integrated Circuit", 1st Edition, Pearson, New Delhi, 2013.

19E502 EMBEDDED CONTROLLERS

3 0 0 3

BASICS OF EMBEDDED C : Introduction to Embedded Systems - Embedded Software Programming Languages – Embedded C: Data Types – Storage Classes – Scope of Variables – Bitwise Operations – Cross-Platform Development – Integrated Development Environment - Super-loop based Design Approach (7)

ARCHITECTURE OF 8051 MICROCONTROLLER : Functional Block Diagram and Programmer's Model of 8051– Power Supply, Clock and Reset Circuit –Program and Data memory - Memory Organization – Pipelining – Special Function Registers -Addressing modes – Instruction set - Assembly Language Programming (9)

ON-CHIP PERIPHERALS OF 8051 MICROCONTROLLER : General Purpose Input / Output Ports – Timers / Counters - Serial Communication– External and Internal Interrupts – Power Saving Modes (9)

ARCHITECTURE OF ARM : RISC vs CISC - ARM7 Processor Fundamentals- Registers – Pipelining - ARM Instruction set and Thumb Instruction set— Exception and Interrupt handling –Memory System – On-chip Peripherals of LPC2148: GPIO, Timers, RTC, ADC, PWM, Serial Ports – Introduction to ARM Cortex Mx – Processors core overview- Programmers Model (11)

OFF-CHIP PERIPHERAL INTERFACING : LED, Switch, Seven Segment Display, Matrix Keypad, LCD Interfacing, ADC, DAC and Sensor Interfacing– Interfacing of Relays, DC Motor, Stepper Motor and Servo Motor – SPI Protocol – I2C Protocol (9)

Total L: 45

TEXT BOOKS:
1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D Mckinlay, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education India, New Delhi, 2011.
2. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer"s Guide", 1st Edition, Elsevier, USA, 2005.

REFERENCES:
1. Subrata Ghoshal, "8051 Microcontroller: Internals, Instructions, Programming and Interfacing", 1st Edition, Pearson Education, India, 2010.
2. Kenneth Ayala, "The 8051 Microcontroller", 3rd Edition, CENGAGE Delmar Learning, India, 2007.
3. Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Pearson Education, England, 2009.
4. Joseph Yiu, "The Definitive Guide to ARM Cortex M3", 2nd Edition, Newnes, United Kingdom, 2010.

19E503 COMPUTER ARCHITECTURE

3 0 0 3

REGISTER TRANSFER LANGUAGE AND MICRO-OPERATIONS : Register transfer language – Register, bus and memory transfers – Arithmetic, logic and shift micro-operations – control functions. (3)

BASIC COMPUTER ORGANISATION : Instruction codes – Instructions – Timing and Control – Instruction Cycle : Fetch and Decode , Execution – Typical register and memory reference instructions – Input / Output operations and Interrupt – Design stages. (7)

CENTRAL PROCESSOR ORGANISATION : General register organization – Stack organisation – Instruction formats– Addressing modes – Data transfer and manipulation – Program control – Hard-wired and Micro-programmed Control Implementation – Data path structures – Design Examples - CISC characteristics, RISC Characteristics – RISC pipeline. (10)

ARITHMETIC PROCESSING : Introduction – Binary operations: Addition, Subtraction, Multiplication and Division algorithms – Algorithms for Floating point Arithmetic operations – Algorithms for BCD Arithmetic operations. (8)

MEMORY AND INPUT/OUTPUT ORGANISATION : Basic concepts – Memory Hierarchy – Main memory – Auxiliary memory – Associative memory - Cache Memory – Basic cache structure – Direct, fully associative and set associative mapping – Replacement policies - Virtual memory – paging- Input /Output interface – Modes of data transfer: Programmed I/O and Interrupt driven data transfer – Direct Memory Access – Asynchronous Data transfer
– I/O processor. (9)

INTRODUCTION TO PARALLEL PROCESSING : Parallelism in uniprocessor systems – Flynn"s classification: SISD, SIMD, MISD, MIMD schemes – Principles of Pipelining – Pipeline hazards – Array Processing – Introduction to multiprocessors - Typical Applications. (8)

Total L: 45

TEXT BOOKS:
1. Morris Mano M, Rajib Mall , "Computer System Architecture,", 3rd Edition, Pearson Education, New Delhi, 2019.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky , "Computer Organization,", 5th Edition, McGraw Hill Education (I) P, New Delhi, 2018.

REFERENCES:
1. William Stallings, "Computer Organization and Architecture: Designing for Performance", 9th Edition, Pearson Education, New Delhi, 2018.
2. Hwang K, and Briggs F A, "Computer Architecture and Parallel Processing", 1st Edition, McGraw Hill Education (I) P Ltd, New Delhi, 2017.
3. John Hennessy, David Patterson, "Computer Architecture: A quantitative Approach", 5th Edition, Elsevier, India, 2017.
4. David Money Harris, Sarah L. Harris, "Digital Design and Computer Architecture", 2nd Edition, Elsevier, USA, 2013.

19E504 ELECTRICAL MACHINE DESIGN

2 2 0 4

GENERAL ASPECTS & MAGNETIC CIRCUIT CALCULATIONS : Design factors and limitations – Materials for electrical machines – properties - Modes of heat transfer – Temperature rise-time relation - heating and cooling curves – Types of rating.

B-H curves - electromagnet – design of magnet coils – magnetic force calculation - MMF for air and iron - MMF for teeth – Real and Apparent flux densities – leakage flux - permanent magnet – design procedure (8 + 8)

DC MACHINES: : Output equation - choice of specific electric and magnetic loadings -Choice of number of poles – length of air gap – Armature and Field design – Design of commutator and brushes. (5 + 5)

TRANSFORMERS: : Output equation – Design of core and winding – Window and Yoke dimensions – Overall dimensions – No load current calculation -Temperature rise of Transformers- Design of tanks and cooling tubes (5 + 5)

INDUCTION MOTORS : output equation - choice of specific electric and magnetic loadings- Length of air-gap – Stator design – Design of cage and wound rotor – No-load current calculation – Stator and rotor resistance – leakage reactance calculation(7 + 7)

SYNCHRONOUS MACHINES: : Output equation - choice of specific electric and magnetic loadings - Pole construction – Runaway speed – Armature design – Short circuit ratio – Air-gap length – Design of rotor and field winding. (5 + 5)

Total L: 30 +T: 30 = 60

TEXT BOOKS:

1. Sawhney A K, Chakrabarti A, "A Course in Electrical Machine Design", 6th Edition, Dhanpat Rai & Company, New Delhi, 2014.
2. Mittle V N, Mittle A, "Design of Electrical Machines"", 5th Edition, Standard Publications and Distributors, New Delhi, 2013.

REFERENCES:

1. R.K. Agarwal, "Principles of Electrical Machine Design", 5th Edition, S. K. Kataria & Sons, New Delhi, 2014.
2. K.G.Upadhyay, "Design of Electrical Machines", New Age International Publishers, New Delhi, 2013..
3. M.V.Deshpande, "Design and Testing of Electrical Machines", Prentice Hall of India, New Delhi, 2010.
4. V.Rajini, V.S.Nagarajan, "Electrical Machine Design with Motorsolve & Matlab", 1st Edition, Pearson Publications, 2018.

19E505 POWER ELECTRONICS AND APPLICATIONS

3 1 0 4

POWER SEMICONDUCTOR DEVICES : Introduction - Power Diodes - Power Transistors - Power MOSFETs – IGBTs - Thyristor family: SCR, TRIAC, GTO, IGCT - Static and Dynamic characteristics –Introduction to intelligent power module- Protection circuits - Series and parallel connections – Interpretation of power device data sheet (8 + 2)

AC TO DC CONVERTERS : Uncontrolled Bridge Rectifiers: Single Phase and Three Phase Uncontrolled Rectifier with R, RL and RLE load - Continuous and discontinuous mode of operation - Average, RMS load voltage and load current, input power factor. Controlled Bridge Rectifiers – Single Phase and Three Phase (no analysis) Half and Fully Controlled Bridge Rectifier with R, RL and RLE load - Effect of free-wheeling diode - Continuous and Discontinuous Mode of operation - Average, RMS load voltage and load current, input power factor – Dual converters – HVDC Transmission. Introduction to Utility Interface- Need for utility interface- Principle of operation of PWM rectifier. (10 + 5)

AC TO AC CONVERTERS : Single phase full wave controller with R and RL load - Estimation of RMS load voltage, RMS load current and input power factor - Three phase AC voltage controllers (No analysis)- Single phase transformer connection changers- Introduction to cycloconverters- Introduction to AC voltage controller with PWM control. (6 + 3)

DC TO DC CONVERTERS : Introduction - Time ratio control - Principle of step-up and step-down operation - Two quadrant and four quadrant DC choppers with R, RL and RLE load - Estimation of average load voltage and load current for continuous current operation –Switched mode power Converter – Ideal buck and Boost converter (steady state analysis) – Fly-Back Type Switched Mode Power Supply (no analysis) - SMPS (Half and full bridge) (8 + 3)

DC TO AC CONVERTERS : Types - Voltage source and current source inverters - Single phase bridge inverters - Three phase bridge inverters -PWM Techniques - Control of AC output voltage - Harmonic reduction- UPS. (7 + 2)

CONTROL CIRCUITS : Functional requirements of switching control circuits - Generation of control signals for single phase AC to DC converters - Cosine wave crossing control, ramp comparator approach. Generation of timing pulses for DC choppers - Power converter control using microcontrollers. (6 + 0)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Rashid M H, "Power Electronics – Circuits, Devices and Applications", 4th Edition, Prentice Hall of India, New Delhi, 2014.
2. P.S.Bimbhra, "Power Electronics", 4th Edition, Khanna Publishers, New Delhi, 2006.

REFERENCES:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters, Applications, and Design", 3rd Edition, John Wiley and Sons, Inc., New York, 2003.
2. VedamSubramanyam, "Power Electronics", New Age International, New Delhi, 1996.
3. Joseph Vithayathil, "Power Electronics", Tata McGraw-Hill, New Delhi, 2010.
4. M.D.Singh and K.B.Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hills Publishing Company Limited, New Delhi, 2006.

19E510 POWER ELECTRONICS AND EMBEDDED CONTROLLERS LABORATORY

0 0 2 1

LIST OF EXPERIMENTS :

1) Characteristics of MOSFET, IGBT, SCR and TRIAC
2) Single Phase and Three Phase Diode Bridge Rectifier with R and RL load
3) Single Phase Fully Controlled Thyristor Converter with R and RL load
4) DC Chopper with R and RL load
5) Single phase AC Voltage controller with R and RL load
6) Assembly Language Programming in 8051 Microcontroller
7) On-chip Peripheral Programming in 8051 Microcontroller: GPIO, Timer/ Counter, Serial Port, Interrupt System
8) Interfacing Actuators with 8051 Microcontroller: Relay, DC Motor, Stepper Motor
9) On-chip Peripheral Programming in ARM7 based Microcontroller: GPIO, ADC, PWM
10) Interfacing Memory IC with ARM7 based Microcontroller using I2C Protocol

Total P: 30

REFERENCES:

1. EEE Department, "Power Electronics and Embedded Controllers Lab Manual", PSG College of Technology, Coimbatore, 2019.

19E511 INDUCTION AND SYNCHRONOUS MACHINES LABORATORY

0 0 4 2

LIST OF EXPERIMENTS :

1) Load Test on 1- Phase and 3-Phase Induction Motors
2) No load Test and Blocked Rotor Test on 3-Phase Induction Motor (circle diagram)
3) Electrical Braking of 3-Phase Induction Motor
4) Load Test on 3-phase Alternator and determination of Voltage regulation
5) Predetermination of voltage regulation of Alternator by EMF and MMF Methods
6) Predetermination of voltage regulation of Alternator by ZPF Method
7) Predetermination of voltage regulation of Alternator by Bus bar Loading
8) Determination of V and Inverted V Curves of Synchronous Motor
9) Load test on 3-Phase Induction Generator
10) Predetermination of voltage regulation of Salient Pole Alternator by Blondel"s Method

Total P: 60

REFERENCES:

1. EEE Department, "Induction and Synchronous Machines Laboratory Manual", 1st Edition, PSG College of Technology, 2019

19Q513 BUSINESS AND MANAGERIAL COMMUNICATIONS

0 0 2 1

BUSINESS AND MANAGERIAL COMMUNICATIONS :

1) Advanced Group discussion
2) Advanced Resume writing
3) Mock Group discussion
4) Advanced Personal Interview
5) Mock Personal Interview
6) Cracking special Interviews
7) Essential Grammar for Placements
8) Vocabulary for Placements
9) Email writing
10) Paragraph writing
11) Essay writing

Total P: 30

REFERENCES:

1. Priyadarshi Patnaik, "Group Discussion and Interview Skills", Cambridge, New Delhi, 2011.
2. Hari Mohan Prasad, Rajnish Mohan, "How to Prepare for Group Discussion and Interview", 2nd Edition, Tata McGrawhill, New Delhi, 2009.

SEMESTER - 6

19E601 ELECTRIC DRIVES AND CONTROL

3 0 0 3

INTRODUCTION TO ELECTRIC DRIVES : History and development of electric drives, Characteristics of Electrical & mechanical loads, Classification of electric drives, Basic elements & advantages of variable speed drives. Modes of operation, closed loop control of drives - Selection of power rating for drive motors with regard to thermal overloading and load variation. (8)

DC DRIVES : Speed control of DC motors - Chopper fed DC drives - Single, two and four quadrant operations. (4)

INDUCTION MOTOR DRIVES : Speed control of 3 phase Induction Motors - Stator control: PWM &V/f control, rotor control: Rotor resistance control - Static control of rotor resistance using DC chopper - Static Krammer and Scherbius drives – Introduction to Vector Controlled Induction Motor Drives (8)

SYNCHRONOUS MOTOR AND BLDC MOTOR DRIVES : Speed control of 3 phase Synchronous Motors - True synchronous and self-controlled modes of operation - PMSM: principle-flux density distribution-Types. BLDC motor : Principle-drive scheme - converter topologies. (7)

RELUCTANCE MOTOR DRIVES : DC servo drives -principle of operation - AC servo drives- principle of operation - Stepper motor –principle of operation –SRM drives - principle of operation - drives. Introduction to synRM drives. (8)

DIGITAL CONTROL AND DRIVE APPLICATIONS : Digital techniques in speed control - Advantages and limitations - Microprocessor/Microcontroller and PLC based control of drives, networking of drives - Selection of drives and control schemes for Steel rolling mills, Paper mills, Cement mills, Machine tools, Lifts and Cranes. Solar and battery powered drives. (10)

Total L: 45

TEXT BOOKS:

1. Dubey G K, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2012.
2. Bose B K, "Modern Power Electronics and AC Drives", Pearson Education, New Delhi, 2009.

REFERENCES:

1. Ion Boldea and Nasar S A, "Electric Drives", CRC Press LLC, New York, 2005.
2. Krishnan R, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall of India, New Delhi, 2010.
3. Vedam Subramanyam, "Electric Drives: Concepts and Applications", Tata McGraw-Hill, New Delhi, 2011.
4. T.J.E. Miller, "Brushless Permanent-Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.

19E602 DIGITAL SIGNAL PROCESSING

3 0 0 3

DISCRETE-TIME SIGNALS AND SYSTEMS : Need and benefits of Digital Signal Processing - Sampling and Quantization of analog signals - Signal classification and basic operations - LTI system –Impulse response - Convolution sum and Correlation - I/O relationship - Determination of Impulse response and Step response using Z transformation - A Typical DSP system (10)

DISCRETE TRANSFORMS : Fourier Series and Fourier Transform - Discrete Fourier Transform (DFT) - Properties- DFT frequency axis - DIT - FFT and DIF - FFT radix2 algorithms- linear filtering via circular convolution-inverse FFT. (8)

DESIGN OF IIR DIGITAL FILTERS : Characteristics and applications of IIR filters - Design techniques for analog filters - Frequency transformation - Digital IIR filter design: impulse invariant and bilinear transform methods - Canonical forms of Realization: direct, cascade, and parallel forms (10)

DESIGN OF FIR FILTERS : Characteristics and applications of FIR filters - FIR filter design using Window functions - Canonical forms of Realization (8)

GENERAL-PURPOSE DIGITAL SIGNAL PROCESSORS : Computer architectures for signal processing - pipelining - hardware multiplier – accumulator - special instructions - Extended parallelism: SIMD, VLIW, and super scalar processing - Finite word length effects in IIR filters and FFT algorithms (9)

Total L: 45

TEXT BOOKS:

1. Lonnie C. Ludeman , "Fundamental of Digital Signal Processing", 1st Edition, Wiley India, New Delhi, 2014.
2. Emmanuel Ifeachor, Barrie W. Jervis , "Digital Signal Processing, A practical approach", 2nd Edition, Pearson Education, New Delhi, 2015.

REFERENCES:

1. John G Proakis, Dimitris G. Manolakis, "Digital Signal Processing : Principles , Algorithms, and Applications", 4th Edition, Pearson Education, New Delhi, 2018.
2. Sanjit K Mitra, "Digital Signal Processing, A Computer based Approach", 4th Edition, McGraw-Hill, New Delhi, 2013.
3. Monson H. Hayes, "Schaums Outline of Digital Signal Processing", 2nd Edition, McGraw-Hill Education, USA, 2011.
4. Dimitris G. Manolakis, Vinay K. Ingle, "Applied Digital Signal Processing: Theory and Practice", 1st Edition, Cambridge University Press, UK, 2011.

19E603 TRANSMISSION AND DISTRIBUTION

3 1 0 4

TRANSMISSION SYSTEMS AND LINE PARAMETERS : Overview of power system layout – Various systems of transmission – Advantages of high transmission voltages - Introduction to HVDC Transmission – Comparison of conductor materials required for various overhead systems - Electrical constants – Resistance, Inductance and capacitance of Single and 3 Phase lines - Bundled conductor lines – Double circuit three phase lines - Effects of earth on line capacitance – Skin effect – Proximity effect – Transposition (10 + 5)

MODELLING AND PERFORMANCE OF TRANSMISSION LINES : Short and medium transmission lines – Phasor diagrams – Nominal T and Pi methods - Line regulation – Efficiency. Rigorous solution for long line – ABCD constants – Ferranti effect - Tuned power lines – Surge impedance and surge impedance loading - Corona – Factors affecting corona (8 + 2)

MECHANICAL DESIGN OF OVERHEAD LINES AND LINE INSULATORS : Insulators – Types – Potential distribution over a string of suspension insulators - Methods of increasing string efficiency – Testing of insulators - Typical Configuration of Line Supports and Conductor Types - Stress and Sag in overhead lines – causes - Sag tension calculation - Vibration and dampers (12 + 3)

UNDERGROUND CABLES : Underground cables types – Capacitance and insulation resistance - Sheath effects – Grading – Heating – Current rating - Comparison between overhead lines and underground cables (8 + 2)

DISTRIBUTION SYSTEMS : Substations and its Types – Typical Key Diagram of a 11kV / 400V Substation, Feeders, distributors and service mains - Radial and ring main systems – Calculation of voltage in distributors with concentrated and distributed loads - AC single phase and three phase systems - Introduction to Substation automation protocols (7 + 3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Mehta V K, Rohit Mehta, "Principles of Power Systems", S.Chand & Co., New Delhi, 2011.
2. Wadhwa C L, "Electrical Power Systems", New Age International, New Delhi, 2012.

REFERENCES:

1. Soni M L, Gupta P V, Bhatnagar U S and Chakrabarthi A, "A Text Book on Power System Engineering", Dhanpat Rai & Co, New Delhi, 2013.
2. Uppal S L, "Electrical Power Systems", Khanna Publishers, New Delhi, 2009.
3. Duncan Glover J, Mulukutla S. Sarma, Thomas Jeffrey Overbye, Thomas J. Overbye, "Power System Analysis and Design", Thomson Learning, New Delhi, 2015.
4. Kothari D P and Nagrath J, "Power System Engineering", Tata McGraw-Hill, New Delhi, 2008.

19E604 DATA STRUCTURES USING C++

2 2 0 4

INTRODUCTION TO DATASTRUCTURES : Data types - Primitive data structures - Linear and non-linear data structures - Data structure operations. INTRODUCTION TO ALGORITHMS: Algorithms - Analysis of Algorithms – best case, average case, and worst case complexities – Big O notation – Pseudo code for algorithms – Simple algorithms and their analysis (3 + 2)

INTRODUCTION TO OBJECT-ORIENTATION & C++ : Characteristics of Object–oriented Programming – Encapsulation – Inheritance – Polymorphism – Aggregation – Implementation using C++ (4 + 8)

ARRAY, STACK, & QUEUES : Arrays – storage structure for 1-D and 2-D arrays. Sparse matrix -Stacks - Array implementation of stacks - stack operations - Applications - Conversion of infix expressions to polish notation - Parenthesis checking - Array implementation of strings - Operation on strings. Array implementation - Queue operations -Types - Dequeues - Priority queues (5 + 4)

LINKED LIST & TREES : Operation of linear list - Linked list – Linked Implementation of stacks and queues - Circular list – Doubly-linked list - List with header node. Definitions - Binary trees - Operations on binary trees - Storage representation – Threaded binary tree - Application of trees - Manipulation of arithmetic expression - Huffman's algorithm (8 + 6)

SORTING & SEARCHING : Exchange Sorting: Bubble sort, quick sort –Selection sorting: Straight selection sort, Binary tree sort, Heap sort - Insertion sorting: Simple insertion sort, Shell sort, Address calculation sort – Merge sort – Radix sort. Linear search - Binary search – Tree searching: Binary search tree, Insertion & Deletion of an element, Efficiency – Hashing - Introduction to Multiway search trees (10 + 10)

Total L: 30 +T: 30 = 60

TEXT BOOKS:
1. Yedidayah Langsam, Moshe J. Augenstein, Aaron M.Tanenbaum, "Data Structures using C and C++", Pearson Education, Chennai, 2019.
2. Vijayalakshmi Pai G A, "Data Structures and Algorithms: Concepts, Techniques and Applications", McGraw Hill Education (I) P. Ltd, New Delhi, 2017.

REFERENCES:
1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, "Introduction to Algorithms", PHI Learning Pvt Ltd, New Delhi, 2018.
2. Jean Paul Tremblay, Paul G Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill Education (I) P Ltd, New Delhi, 2016.
3. Lipschutz S., Pai GA, "Data Structures", Tata McGraw-Hill, New Delhi, 2013.
4. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles(C/C++)", 5th Edition, CareerMonk Publications, Hyderabad, 2016.

19E610 DIGITAL SIGNAL PROCESSING AND LINEAR INTEGRATED CIRCUITS LABORATORY

0 0 2 1

LIST OF EXPERIMENTS :
1) Computation of Convolution sum
2) Computation of Impulse response and frequency response of the LTI system
3) Computation of DFT
4) Design of IIR filters by BLT method and Impulse Invariant method
5) Design of FIR filters using Windows
6) Characteristics and applications of Op-Amp: Slew rate, Adder, Subtractor, zero crossing detector, Differentiator and integrator
7) Waveform Generation using Analog system Lab kit.
8) Performance characteristics of Voltage regulator ICs
9) Design and implementation of 555 timer applications and VCO.
10) Design and implementation of Active filters.

Total P: 30

REFERENCES:
1. EEE Department, "Digital Signal Processing and Linear Integrated Circuits Laboratory Manual", PSG College of Technology, Coimbatore, 2019.

19E611 ELECTRIC DRIVES AND CONTROL LABORATORY

0 0 2 1

LIST OF EXPERIMENTS :
1) Sinusoidal Pulse Width Modulation Inverter with voltage control and v/f control mode
2) Performance analysis of Three phase AC voltage controller with R and RL load
3) Performance analysis of Three phase fully controlled Thyristor converter with R and RL load
4) Design and testing of pulse generation circuits for AC to DC and DC to DC converters
5) Simulation of single phase and three phase power converter topologies.
6) Performance analysis of Voltage/Frequency control of an Induction motor
7) Performance Analysis of vector control of Induction Motor drive
8) Performance Analysis of PMSM drive
9) Performance Analysis of SynRM drive
10) Simulation of DC motor drive

Total P: 30

REFERENCES:
1. EEE Department, "Electric Drives and Control Laboratory Manual", EEE Department, PSG College of Technology, 2019.

19Q613 QUANTITATIVE AND REASONING SKILLS

0 0 2 1

QUANTITATIVE AND REASONING SKILLS :
1) Number System, Time and Work
2) Percentages , Simple and Compound Interests
3) Time, Speed and Distance
4) Permutation, Combination and Probability
5) Ratio and Proportion
6) Profit, Loss and Partnership
7) Logarithms, Progressions, Geometry and Quadratic Equations

8) Coding and Decoding
9) Series, Analogy and Odd Man Out
10) Visual Reasoning
11) Data Arrangements
12) Blood Relations
13) Clocks, Calendars and Direction Sense
14) Cubes, Logical Connectives and Syllogisms
15) Venn Diagrams, Interpretations and solving

Total P: 30

REFERENCES:
1. Aggarwal R S, "Quantitative Aptitude for Competitive Examinations", 3rd Edition, S Chand Publishing, New Delhi, 2017.
2. ETHNUS, "Aptimithra", 1st Edition, McGraw-Hill Education Pvt Ltd, 2013.
3. FACE, "Aptipedia Aptitude Encyclopedia", 1st Edition, Wiley Publications, Delhi, 2016.

19E620 INNOVATION PRACTICES

0 0 2 1

Students will
- Learn about current practices in product / process development
- Identify key issues, priorities, and tasks
- Perform literature survey, including Patents
- Perform feasibility analysis
- Develop prototypes and test or Re-use recent innovations systematically and submit a report.

Total P:30

SEMESTER – 7

19E701 POWER SYSTEM PROTECTION AND SWITCHGEAR

3 0 0 3

PROTECTIVE RELAYS : Switchgears: essential features and equipments – types of fault - short circuit MVA: definition -Static relay – Advantages over Electromechanical relay- Universal relay torque equation - IDMT characteristics -Non-directional and directional over current relays – Principle of Earth fault and phase fault relays - Distance and Differential protection scheme - Negative sequence relays - Pilot (Translay) relay – Carrier current protection scheme. (9)

APPARATUS AND LINE PROTECTION : Alternator, transformer and Busbar protection schemes – Feeder Protection: radial and ring main system – 3 stage distance protection scheme – Current limiting Reactor : location and design - Microprocessor based protective schemes. (9)

CIRCUIT BREAKERS : Arc phenomenon – principles and methods of arc extinction - Recovery and restriking voltage - classification of circuit breakers – Problems and solution of circuit interruption – circuit breaker ratings – selection of circuit breakers - Fuses: types-selection-discrimination – concept of HVDC breakers. (9)

SURGE AND SURGE PROTECTION : Causes of overvoltages - Lightning phenomena – Traveling waves on transmission lines – specifications - Protections against lightning - Lightning arresters – Types – Surge absorbers. (9)

NEUTRAL GROUNDING AND INSULATION CO-ORDINATION : Problems in ungrounded neutral system – methods of neutral gounding – design of Arc suppression coil - Earthing transformers – Insulation co-ordination: BIL- Definition – Design of insulation co-ordination for sub-station equipments - Indian Electricity rules. (9)

Total L: 45

TEXT BOOKS:
1. Badri Ram, Vishwakarma D N, "Power System Protection and Switchgear", Tata McGraw-Hill, New Delhi, 2011.
2. Ravindranath B, Chander M, "Power System Protection and Switchgear", New Age International, New Delhi, 2011.

REFERENCES:
1. Soni M L, Gupta P V, Bhatnagar U S, Chakrabarti A, "A Text Book on Power Systems Engineering", Dhanpat Rai & Co., New Delhi, 2013.
2. Sunil S Rao, "Switchgear Protection and Power Systems", Khanna Publishers, New Delhi, 2012.
3. Y.G. Paithankar, S.R. Bhide, "Fundamentals of Power System Protection", PHI Learning Private Limited, New Delhi, 2010.
4. Ravindra P.Singh, "Switchgear and Power System Protection", PHI Learning Private Ltd, New Delhi, 2009.

19E702 POWER SYSTEM ANALYSIS

2 2 0 4

MODELING & NETWORK FORMULATION : Formation of Y Bus – pi-equivalent circuit of transformer with off-nominal tap ratio - Z bus formation by using building algorithm Modeling of power system components - single linediagram- Per unit representation – advantages –Per unit reactance diagram- Primitive network. (7 + 7)

SHORT CIRCUIT STUDIES : Types of faults – Symmetrical components - Algorithms for fault calculations –– positive, negative and zero sequence networks and impedance matrices – Analysis of Symmetrical and unsymmetrical fault using Zbus. (6 + 6)

LOAD FLOW STUDIES : Formulation of load flow problem - bus classification – Load flow solution by Gauss - Seidal, Newton - Raphson and Fast decoupled methods - Comparison -. Computation of slack bus power, transmission loss and line flow.(5 + 5)

UNIT COMMITMENT AND ECONOMIC DISPATCH : Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve – coordination equations without and with loss (No derivation of loss coefficients) – solution by direct method and λ-iteration method – statement of unit commitment problem – Dynamic programming method (6 + 6)

STABILITY STUDIES : Steady state and transient stability - Swing equation and its solution by Runge-Kutta method – Equal area criterion and its Application -methods of improving transient stability-Power quality problems-issues and causes (6 + 6)

Total L: 30 +T: 30 = 60

TEXT BOOKS:
1. Haadi Saadat, "Power System Analysis", 1st edition, Tata McGraw-Hill, New Delhi, 2011.
2. D.P.Kothari, J.Nagrath, "Modern Power System Analysis", Tata McGraw-Hill, New Delhi, 2013.

REFERENCES:
1. Gupta B R , "Power System Analysis and Design", S.Chand & Company Ltd., New Delhi, 2016.
2. Abhijit Chakrabarti, Sunita Halder, “Power System Analysis, Operation and Control”, Prentice Hall, India, New Delhi, 2012.
3. M.A.PAI, “Computer Techniques in Power System Analysis”, Tata McGraw-Hill, New Delhi, 2006.
4. Roger C.Dugan, "Electrical power systems quality", Tata McGraw-Hill, New Delhi, 2012.

19E710 POWER SYSTEM LABORATORY

0 0 2 1

LIST OF EXPERIMENTS: :
1) Study of Transmission line hardware model
2) Formation of a bus admittance matrix (YBus)
3) Formation of a bus impedance matrix (ZBus)
4) Determination of String efficiency of suspensions insulator
5) Determination of sequence impedances of 3-phase Alternator
6) Symmetrical and Unsymmetrical short - circuit fault analysis
7) Solution of power-flow problem using Newton-Raphson method.
8) Differential protection of 1-phase Transformer.
9) Characteristics of static under-voltage/over- voltage relay
10) Characteristics of solar PV cell

Total P: 30

REFERENCES:
1. Hadi Saadat, "Power System Analysis", Tata McGraw-Hill,, New Delhi, 2011.
2. Department of EEE, "Power Systems Engineering Laboratory Manual", PSGCT, Coimbatore, 2019.

19E720 PROJECT WORK I

0 0 4 2

Students will do the following:
* Identification of project
* Define the objectives of the project
* Literature Survey
* Finilisation of System Requirements and Specifications
* Development of software / Hardware Model
* Testing/Validating and obtaining Results
* Future Trends/Extension of the project
* Consolidated Report Preparation

Total P:60

SEMESTER - 8

19E820 PROJECT WORK II

0 0 8 4

Students will do the following:

* Identification of project
* Define the objectives of the project
* Literature Survey
* Finalisation of System Requirements and Specifications
* Development of software / Hardware Model
* Testing/Validating and obtaining Results
* Future Trends/Extension of the project
* Consolidated Report Preparation

Total P:120

PROFESSIONAL ELECTIVES

19E001 FLEXIBLE AC TRANSMISSION SYSTEMS

3 0 0 3

INTRODUCTION : Fundamentals of AC power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers (5)

SHUNT COMPENSATORS : COMPENSATORS Need for shunt controllers - Principle and operation of SVC- transient stability improvement-power oscillation damping. Methods of controllable VAR generation- types - Variable Impedance type & switching converter type – Static Synchronous Compensator (STATCOM) - configuration, characteristics and control-applications (10)

SERIES COMPENSATOR : Principles of operation- types - static series compensation using GCSC, TCSC and TSSC, Static Synchronous Series Compensator (SSSC) – characteristics and control-applications. (10)

VOLTAGE REGULATORS AND PHASE SHIFTERS : Principles of operation-types -Steady state model and Characteristics of a static voltage regulators and phase shifters- power circuit configurations-applications. (10)

UNIFIED POWER FLOW CONTROLLER : Principles of operation – characteristics - independent active and reactive power flow control - applications. Comparison of UPFC with the controlled series compensators and phase shifters. (10)

Total L: 45

TEXT BOOKS:

1. Hingorani, L.Gyugyi, "Understanding FACTS - Concepts and Technology of flexible ac transmission system", IEEE Press, New York, 2000.
2. K.R.Padiyar, "FACTS controllers for transmission and Distribution systems", New Age international Publishers, New Delhi, 2007.

REFERENCES:

1. R .Mohan Mathur and Rajiv K.Varma, "Thyristor - based FACTS controllers for Electrical transmission systems", ISBN no. 0-471-20643-1, IEEE press, Wiley Inter science, New York, 2002.
2. P. Kundur, "Power system stability and control", McGraw-Hill, New York, 1994.
3. Enrique Acha, Claudio R. Fuerte-Esquivel, Hugo Ambriz-Pérez, César Angeles-Camacho , "FACTS: Modelling and Simulation in Power Networks", John Wiley & Sons, London, 2004.
4. Hirofumi Akagi, Edson Hirokazu Watanabe, Mauricio Aredes, "Instantaneous Power Theory and Applications to Power Conditioning", John Wiley & Sons, New Jersey, 2017.

19E002 SPECIAL MACHINES AND CONTROLLERS

3 0 0 3

STEPPER MOTORS : Types - Constructional features - principle of operation - variable reluctance motor - Single and Multi-stack configurations - Permanent Magnet Stepper motor - Hybrid stepper motor - Different modes of Excitation - theory of torque predictions - Speed-Torque Characteristics - Drive systems and circuit for open-loop and closed-loop control of stepper motor - NEMA Frame size - Selection of Stepper motor (9)

SWITCHED RELUCTANCE MOTORS : Constructional features and configurations - principle of operation - Inductance Profile - Torque Equation - Power Converters for SR Motor - Rotor Sensing Mechanism – Sensorless Control of SR motor - Applications (8)

PERMANENT MAGNET MOTORS : Types - PMDC - BLDC - PMSIM - Construction - Principle of operation - EMF and torque equations - Torque speed characteristics - Magnetic circuit analysis - BH curve - Magnet - Lamination - Power controllers - Applications (13)

SYNCHRONOUS RELUCTANCE MOTORS (SYNRM) : Construction - Principle of operation - Rotor Configurations - Phasor diagram and torque equation - Control system for SynRM Drive - Applications of SynRM (7)

LINEAR MOTORS : Linear Induction Motor (LIM) classification - construction - Principle of operation - DC Linear Motor (DCLM) types - control applications - Linear Synchronous Motor (LSM) - Types and Applications (4)

SERVOMOTORS : Servomotor - Types - Constructional features, principle of operation - Servo Drives (4)

Total L: 45

TEXT BOOKS:

1. Kenjo T, "Stepping Motors and their Microprocessor Controls", Clarendon Press, London, 2003.
2. K. Venkataratnam, "Special Electrical Machines", University Press, India, 2009.

REFERENCES:

1. Berker Biglin, James Weisheng Jiang, Ali Emadi, "Switched reluctance Motor drives: Fundamentals to Applications", CRC Press, New York, 2019.
2. Ion Boldea, Lucian Tutelea, "Reluctance Electric machines: design and control", CRC Press, New York, 2019.
3. J. R. Hendershot, TJE Miller, "Design of Brushless Permanent-magnet Machines", Motor Design Books, 2010.
4. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, New Delhi, 1989.

19E003 UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY

3 0 0 3

ELECTRIC TRACTION : Requirements of traction system - Systems of traction - Systems of track electrification - Speed-Time curves - Tractive effort - Power of traction motor - Specific energy consumption – Block Diagram of Modern Locomotive – Main and Auxiliary Power supply circuits – Current Collection Systems -Motors for traction - Starting and speed control - Electric braking – Case Study Metro Rail System. (12)

ELECTRIC HEATING AND WELDING : Advantages of electric heating – Types of Heating - Resistance heating - Temperature control, Induction heating – induction furnace - Dielectric heating - Choice of voltage and frequencies for Dielectric heating. Equipments for Welding - Resistance welding - Arc welding - Laser welding – Ultrasonic Welding (8)

ILLUMINATION : Nature of light - Luminous intensity - Illumination - Brightness - Lamp efficiency - Luminous efficiency - Laws of illumination - Electrical sources of light - Fluorescent lamp, Sodium Vapour lamp, Mercury Vapour lamp – CFL – LED Lighting systems - Polar curves - Calculation of illumination - Indoor and outdoor Lighting schemes (8)

REFRIGERATION AND AIR CONDITIONING : Refrigeration Systems – Refrigerants – Types of Refrigeration Systems – Electrical Circuit of a Domestic Refrigerator – Trouble shooting of Refrigerator. Air Conditioning Systems – Types Electrical circuit of window and Central Air Conditioning Systems. (7)

ECONOMIC ASPECTS OF UTILISATION : PF and its improvement - Load curves - Load factors - Its improvement – Depreciation – Types. Introduction to Availability based Tariff - Demand side Management –Peak clipping – Peak shifting – valley filling - Use of off peak energy - Trends in Conservation : Green Buildings. Introduction to Energy conservation and Energy auditing - Case studies on Energy efficiency in thermal & electrical utilities. (10)

Total L: 45

TEXT BOOKS:

1. Garg G C, "Utilisation of Electric Power and Electric Traction", Khanna Publishers, New Delhi, 2004.
2. Openshaw Taylor E, "Utilisation of Electric Energy in SI Units", Universities Press, Hyderabad, 2011.

REFERENCES:

1. Wadhwa C L, "Generation, Distribution and Utilisation of Electrical Energy", New Age International Publishers, New Delhi, 2012.
2. Tripathy S.C, "Electric Energy Utilisation and Conservation", Tata Mc Graw-Hill, New Delhi, 1993.
3. Suryanarayanan N.V, "Utilisation of Electric Power Including Electric Drives and Electric Traction", New Age International Publishers, New Delhi, 2010.
4. Abbi Y P, Shashank Jain, "Handbook on Energy Audit and Environment Management", Teri Press, New Delhi, 2006.

19E004 ADVANCED CONTROL SYSTEMS

3 0 0 3

DESIGN OF COMPENSATOR AND CONTROLLERS : Compensator Design-Lead, Lag, Lag-Lead compensation - Realisation of compensator using Electrical Networks - Frequency Response of Compensator- Design using Bode Plot. Controller Design: P, PI, PID Controllers - Transfer function – Design – Tuning of PID Controller: Ziegler-Nichols tuning, Cohen Coon tuning Method. (9)

STATE SPACE ANALYSIS : Concept of State, State Variables and State Model - State Space representation using Physical, Phase and Canonical variables - State Transition Matrix – Solution of State equation – Controllability and Observability - Controller design using state feedback – Observer design using Ackermann`s formula (9)

PHASE PLANE ANALYSIS : Features Non-Linear systems - Common physical Non-Linearities – Methods of linearizing Non-Linear systems - Concept of Phase Portraits – Singular points – Construction of Phase Plane– Isocline method – Existence of Limit cycles. (9)

DESCRIBING FUNCTION : Describing Function Fundamentals -Describing functions of common Non-Linearities – Describing function analysis of Non-Linear systems:- Limit Cycles - Dual input describing function for typical Non- Linearities: Relay, Hysteresis and Polynomial type Non-Linearity. (9)

STABILITY ANALYSIS : Introduction – Concept of Stability – Equilibrium points- Lyapunov"s Stability theorems - Lyapunov"s direct method for LTI systems – Lyapunov"s method for Non-Linear systems - Krasovski"s theorem on Lyapunov function (9)

Total L: 45

TEXT BOOKS:
1. Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Prentice Hall of India Learning Private Ltd, New Delhi, 2013.
2. Zoran Vukic, Ljubomir Kuljaca, Dali Donlagic, Sejid Tesnjak, "Nonlinear Control Systems", 1st Edition, Taylor & Francis Inc, United Kingdom, 2003.

REFERENCES:
1. Gopal M, "Digital Control and State Variable Methods", 4th Edition, Tata McGraw- Hill Ltd, New Delhi, 2003.
2. Benjamin Kuo, "Automatic Control Systems", 3rd Edition, Prentice Hall of India, New Delhi, 2010.
3. Horacio J Marquez, "Nonlinear Control Systems: Analysis and Design", 1st Edition, John Wiley & Sons Inc, United States, 2003.
4. Bandyopadhyay, M.N, "Control Engineering: Theory and Practice", 2nd Edition, Prentice-Hall of India Private Limited, New Delhi, 2003.

19E005 SMART GRID

3 0 0 3

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 (9)

WIDE AREA MONITORING SYSTEM : Fundamentals of Synchrophasor 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 Synchrophasor applications (NAPSI) – Operational experience and Blackout analysis using PMU - Case study on PMU. (9)

SMART METERS : Features and functions of Smart Meters – Functional specification – category of Smart Meters – Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) drivers and benefits – AMI protocol – Demand Side Integration: Peak load, Outage and Power Quality management. (9)

INFORMATION AND COMMUNICATION TECHNOLOGY : Overview of Smart Grid Communication system – Modulation and Demodulation Techniques: Radio Communication – Mobile Communication – Power Line Communication – Optical Fibre Communication – Communication Protocol for Smart Grid. (9)

SMART GRID APPLICATIONS AND CYBER SECURITY : Applications : Overview and concept of Renewable Integration – Introduction to distributed generation - 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: Security issues in DG, Distribution Automation, AMI, Electric Vehicle Management Systems – Approach to assessment of smart grid cyber security risks – Methodologies. Cyber Security requirements – Smart Grid Information Model. (9)

Total L: 45

TEXT BOOKS:
1. James Momoh, "SMART GRID : Fundamentals of Design and Analysis", John Wiley and Sons, New York, 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & Sons, New Jersey, 2012.

REFERENCES:
1. Power Grid Corporation of India Limited, "Smart Grid Primer", 1st Edition, Power Grid Corporation of India Limited, Bangalore, India, 2013.
2. Fereidoon.P.Sioshansi, "Smart Grid – Integrating Renewable, Distributed and Efficient Energy", 1st Edition, Academic Press, USA, 2011.
3. Stuart Borlase, "Smart Grids: Infrastructure, Technology and Solutions", 1st Edition, CRC Press Publication, England, 2013.
4. Phadke A G, Thorp J S, "Synchronized Phasor Measurements and Their Applications", 1st Edition, Springer, Newyork, 2012.

19E006 INDUSTRIAL AUTOMATION

3 0 0 3

INTRODUCTION TO FACTORY & PROCESS AUTOMATION: : Industrial Versions - Introduction to Architecture of Totally Integrated Automation (TIA) - Components of TIA and its Functions - Industrial Automation Control Elements IEC/ ISA symbols and Utilization category of Control Elements - Relay Ladder logic using control elements (6)

PROGRAMMABLE LOGIC CONTROLLERS : Architecture of PLC - Types of PLC - PLC Configuration - PLC modules - Selection criteria for PLC - PLC Wiring - Installation of PLC and its modules (5)

PROGRAMMING OF PLC : Types of Programming - Bit Instructions - Timers and counters - PLC arithmetic functions PTO / PWM generation - High Speed Counter - Analog Scaling - Encoder Interfacing - Servo drive control - Stepper Motor Control (12)

HMI SYSTEMS : Need for HMI in Industrial Automation, - Types of HMI - Configuration of HMI, Screen development and navigation - Configuration of HMI elements / objects and Interfacing with PLC (6)

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA): : Architecture - Tools - Tags - Graphics – Alarm logging - Tag logging - Trends - History - Report generation, Global Scripts for SCADA application (10)

INDUSTRIAL NETWORKING : Types and comparison of Industrial Buses - Proprietary and open Protocols - OLE/OPC - Networking standards & IEEE Standard - Introduction to EtherCAT - Applications of Various industrial Buses (6)

Total L: 45

TEXT BOOKS:

1. W. Bolton, "Programmable logic controllers", Elsevier Ltd, 2015.
2. Gordon Clarke, Deon Reyneders, Edwin Wright, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related systems", Newnes Publishing, 2004.

REFERENCES:

1. John R Hackworth and Fredrick D Hackworth Jr, "Programmable Logic Controllers: Programming Methods and Applications", Pearson Education, India, 2006.
2. SIEMENS, "SIMATIC Programming with STEP 7", SIEMENS Manual, 2014.
3. SIEMENS, "SIMATIC STEP 7 in the Totally Integrated Automation Portal", SIEMENS AG, 2012.
4. William T Shaw, "Cybersecurity for SCADA systems", PennWell, USA, 2006.

19E007 HVDC TRANSMISSION

3 0 0 3

GENERAL ASPECTS : Historical development of HVAC and HVDC system. HVDC system configuration and components comparison – Economic technical performance – Reliability – Limitations (6)

CONVERTER CIRCUITS AND ANALYSIS : Introduction to single phase and three phase converters. Converters for HVDC system – 6 pulse converter and 12 pulse converter (both LCC and VSC types). Analysis of 6 pulse converter with and without source impedance. – With overlap less than 60 degrees - With overlap greater than 60 degrees - Complete characteristics of HVDC converter – Rectifier mode and Inverter mode of operation- Equivalent circuits. (10)

CONTROL : Bas ic means of control – Power reversal – Constant current versus constant voltage control characteristics- Desired features of control. Ideal and actual steady state characteristics and combined rectifier and inverter characteristics. – Constant minimum delay angle control, constant current control, constant extinction angle control and tap changer control. (9)

MISOPERATION OF CONVERTERS AND HARMONICS : Introduction to converter disturbance- Causes and effects– By pass action in bridges -Commutation failure. Characteristic and un – characteristic harmonics – Troubles due to harmonics – Means of reducing harmonics. Need for reactive power – Sources of VAr (7)

POWER FLOW ANALYSIS IN AC/DC SYSTEMS : Modelling of DC links – DC network – DC converter – Controller equations – Solutions of DC load flow . Solution of AC-DC power flow (7)

PROTECTION : Basics of protection – DC reactors – Voltage and current oscillations – Clearing line faults and re- energising – Circuit breakers – Over voltage protection – Control of di/dt and dv/dt.-Introduction to multi terminal HVDC system. (6)

Total L: 45

TEXT BOOKS:

1. Kimbark E W, "Direct Current Transmission", Wiley Interscience, New York, 1971.
2. Arrillaga J, "High voltage Direct Current Transmission", 2nd Edition, IEEE Publications, London, UK, 2012.

REFERENCES:

1. S. Kamakshaiah, V. Kamaraju, "HVDC Transmission", Tata McGraw-Hill, New Delhi, 2011.
2. Adamson C, Hingorani N G, "High Voltage Direct Current Power Transmission", Garaway Ltd, 1968.
3. Padiyar K R, "HVDC Transmission Systems", New Age International Publishers Ltd, New Delhi, 2002.
4. Chan-Ki Kim, Vijay K. Sood, Gil-Soo Jang, Seong-Joo Lim, Seok-Jin Lee, "HVDC Transmission: Power Conversion Applications in Power Systems", John Wiley and Sons, Singapore, 2009.

19E008 POWER QUALITY MANAGEMENT

3 0 0 3

INTRODUCTION : Definition of power quality – Power quality- Voltage quality. Terms and definitions: General Classes of Power Quality Problems- Concepts of transients – Short duration voltage variations - Long duration voltage variation. Voltage imbalance - Waveform distortion- Voltage fluctuation-Power frequency variation- Power quality terms - International standards of power quality- IEEE-IEC and Computer Business Equipment Manufacturers Associations (CBEMA) curve (8)

VOLTAGE SAGS AND INTERRUPTIONS : Sources of sags and interruptions - Estimating voltage sag performance. Thevenin"s equivalent source - Analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Estimation of the sag severity - Mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches (8)

OVER VOLTAGES : Sources of over voltages - Capacitor switching – Lightning - Ferro resonance. Mitigation of voltage swells - Surge arresters - Low pass filters - Power conditioners. Lightning protection – Shielding – Line arresters - Protection of transformers and cables. An introduction to computer analysis tools for transients (8)

REACTIVE POWER COMPENSATION AND HARMONICS : Effect of load pattern on reactive power and power factor correction-Harmonic distortion- Voltage and current distortion- Harmonics versus Transients. Power System Quantities under Non-sinusoidal Conditions.Harmonic indices. Harmonic sources from commercial and industrial loads. Locating harmonic sources.Power system response characteristics. Effect of harmonics. Inter- harmonics – Resonance. Harmonic distortion evaluation - Devices for controlling harmonic distortion – Passive and active filters (12)

DISTRIBUTED GENERATION AND POWER QUALITY : Introduction to distributed generation - Interface to the Utility System - Power Quality Issues - Operating Conflicts. Interconnection Standards- Industry standards efforts,Interconnection requirements, simple interconnection and complex interconnection (6)

POWER QUALITY MONITORING : Monitoring considerations. Power quality measurement equipment - Harmonic / spectrum analyzer - Flicker meters – Disturbance analyzer. Applications of expert systems for power quality monitoring (3)

Total L: 45

TEXT BOOKS:

1. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, "Electrical Power Systems Quality", McGraw Hill, 2012.
2. Sankaran.C, "Power Quality", CRC Press, Washington, D.C., 2002.

REFERENCES:

1. Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", IEEE Press, New York, 2000.
2. Arrillaga.J, Watson.N.R, Chen.S, "Power System Quality Assessment", John Wiley & Sons, England, 2000.
3. Barry W.Kennedy, "Power Quality Primer", McGraw-Hill, New York, 2000.
4. Math H. Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", 1st Edition, Wiley- IEEE Press, 2000.

19E009 POWER SYSTEM OPERATIONS AND CONTROL

3 0 0 3

INTRODUCTION : An overview of power system operation and control – Basic control loops - Operating states – System load variation – Load characteristics - Load curves and load-duration curve – Load factor – Diversity factor - Plant level and system level controls (9)

ACTIVE POWER – FREQUENCY CONTROL : Basics of speed governing mechanism and modelling – Speed-load characteristics - Control area concept – LFC control of a single-area system - Static and dynamic analysis of uncontrolled and controlled cases – Two-area system – Modelling - Static analysis of uncontrolled case – Tie line with frequency bias control – State variable model (9)

REACTIVE POWER–VOLTAGE CONTROL : Generation and absorption of reactive power – System voltage and Reactive power - Excitation control – AVR and its modelling - Static and dynamic performance analysis – Methods of voltage control: tap-changing transformer, SVC (TCR + TSC) and STATCOM - Secondary voltage control (9)

COMPUTER CONTROL OF POWER SYSTEMS : Concept of energy control centre – Functions – System monitoring – Data acquisition and control - System hardware configuration – SCADA and EMS functions - Network topology – State estimation – WLSE – Contingency Analysis - State transition diagram showing various state transitions and control strategies (9)

INTRODUCTION TO POWER SYSTEM DEREGULATION AND RESTRUCTURING : Motivation for Restructuring of power system – Electricity market entities and model – Benefits of Deregulation - Basic terminologies – Deregulation – International scenario – Milestones of deregulation in the world - Indian power sector – Past and present status – Growth of power sector in India (9)

Total L: 45

TEXT BOOKS:
1. Allen. J. Wood, Bruce F. Wollenberg and Gerald B.Sheble, "Power Generation, Operation and Control", 3rd Edition, John Wiley & Sons, Inc., Singapore, 2013.
2. S.K.Gupta, "Power System Operation Control & Restructuring", I K International Publishing House Pvt. Ltd, Delhi, 2015.

REFERENCES:
1. P S R Murthy, "Operation and control in Power Systems", 2nd Edition, CRC press, Delhi, 2011.
2. Sunita Halder, Abhijit Chakrabarti, "Power System Analysis Operation and Control", Third Edition, PHI learning Pvt. Ltd., New Delhi, 2010.
3. Kundur P, "Power System Stability and Control", 10th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
4. K. Uma Rao, "Power System: Operation & Control", 1st Edition, Wiley India Pvt. Ltd, New Delhi, 2012.

19E010 HYBRID ELECTRIC VEHICLES

3 0 0 3

VEHICLE FUNDAMENTALS : Vehicle movement - Vehicle resistance - Dynamic equation - Power train tractive effort and vehicle speed - Vehicle power plant and transmission characteristics - Vehicle performance - Operating fuel economy - Braking performance. (9)

ELECTRIC AND HYBRID ELECTRIC VEHICLES : History - Environmental impact - Configurations of electric vehicles - Performance of electric vehicles - Tractive effort in normal driving - Energy consumption - Concept and architecture of hybrid electric drive trains (9)

ELECTRIC PROPULSION SYSTEMS : Principle of operation and performance of DC motor drives - Induction motor drives - Permanent Magnetic Brushless DC Motor Drives - Switched Reluctance Motor Drives - Electric drive train design - Case study(9)

ENERGY STORAGE SYSTEMS : Electrochemical batteries - Ultra capacitors - Ultrahigh-speed flywheels – Hybrid sources - Storage system design aspects (9)

FUEL CELL VEHICLES : Operating principle and characteristics - Fuel Cell Technologies - Fuel Supply - Fuel Cell Hybrid Electric Drive Train Design (9)

Total L: 45

TEXT BOOKS:
1. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, New York, 2009.
2. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, New York, 2011.

REFERENCES:
1. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, Taylor & Francis Corp, New York, 2015.
2. Seref Soylu, "Electric Vehicles - The Benefits and Barriers", InTech Publishers, Croatia, 2011.
3. Aulice Scibioh M. and Viswanathan B, "Fuel Cells – Principles and Applications", University Press, India, 2006.
4. Barbir F, "PEM Fuel Cells: Theory and Practice", Elsevier, London, 2005.

19E011 HIGH VOLTAGE ENGINEERING

3 0 0 3

DIELECTRIC BREAKDOWN : : Breakdown Mechanisms- breakdown of gaseous dielectrics: Streamer theory - Paschen"s law – Corona discharges – Vacuum breakdown – Breakdown of Liquid dielectrics : Suspended Particle Mechanism - Cavitation and Bubble Mechanism - Stressed Oil Volume Mechanism - Maintenance of oil Quality – Breakdown in solid and composite dielectrics : intrinsic breakdown - electromechanical breakdown -failure due to treeing and tracking - thermal breakdown (10)

GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS : Generation of high DC voltage - Voltage Multiplier Circuits - Van de Graaff Generators - Generation of Power Frequency high voltage: Cascade Transformers - Resonant transformer - Generation of impulse voltages : Marx Circuit - Generation of Switching Surges - Impulse current generator - Triggering and control of impulse voltage generators. (9)

MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS : DC voltages measurement: Generating voltmeter - High Resistance with series ammeter – Measurement of high ac and impulse voltages: Capacitance Potential Dividers - Capacitance Voltage Transformers - Sphere Gap Measurements - Measurement of High Direct Currents: Hall Generators – Measurement of High Frequency and Impulse Currents - High current shunts - Rogowski Coils (9)

NON-DESTRUCTIVE TESTING : Measurement of direct current resistivity - dielectric loss and capacitance measurements: High-Voltage Schering-Bridge - Partial discharge (PD) measurements: Straight Detectors - Balanced Detection Method (8)

HIGH-VOLTAGE TESTING AND APPLICATION : Testing of Insulators and bushings - Testing of Isolators and circuit breakers - Testing of cables - Testing of Transformers - Testing of surge arresters - Application of high voltage engineering in food processing and biomedical industry –safety and electrical hazard. (9)

Total L: 45

TEXT BOOKS:
1. S.Naidu, V. Kamaraju, "High Voltage Engineering", 5th Edition, Tata McGraw Hill, New Delhi, 2013.
2. Peter Kuffel, W. S. Zaengl, "High Voltage Engineering: Fundamentals", Revised Edition, Elsevier India, New Delhi, 2013.

REFERENCES:
1. L.L. Alston, "High Voltage Technology", 1st Edition, Oxford University Press, London, 2011.
2. Wadhwa. C.L, "High Voltage Engineering", 3rd Edition, New age international publishers Ltd, New Delhi, 2012.
3. Subir Ray, "An Introduction to High Voltage Engineering", 2nd Edition, PHI Learning Private Limited, New Delhi, 2013.
4. Mazen Abdel-Salam, "High-Voltage Engineering: Theory and Practice", 2nd Edition, CRC Press, New York, 2018.

19E012 EMBEDDED SYSTEMS AND INTERNET OF THINGS

3 0 0 3

FUNDAMENTALS OF EMBEDDED SYSTEMS : Basic Terminologies – Characteristics of Embedded Computing Applications– Embedded Software Development Process – Challenges in Embedded System Design – Compiler Optimization Techniques – Performance Optimization – UML Diagrams - Examples (5)

EMBEDDED SYSTEM DESIGN USING MIXED SIGNAL PROCESSORS : GPIO- Interrupts –Timers – Watchdog Timers – Analog to Digital Converter – Serial Communication – Low Power Modes (10)

REAL-TIME OPERATING SYSTEMS : Concept of OS-based Software Development – Real-Time Operating Systems: Definition, Characteristics and Structure – Task Management: Classification, Structure, States, and Scheduling – Concept of Pseudo Multitasking and True Multitasking – Task Synchronization – Inter-task Communication – Features of FreeRTOS (10)

INTERNET OF THINGS : Introduction to Industry 4.0 – Machine to Machine (M2M) – Evolution of IoT - Consumer IoT vs Industrial IoT - Functional Components of a typical IoT System – Fog Computing - Introduction to Cloud Computing (6)

IOT PROTOCOLS : Physical and Data Link Layer Protocols: RFID: NFC, FFC, ZigBEE, Bluetooth Low Energy, Z- Wave, Wi-Fi, Wireless HART - Network Layer Protocols: IPv4, IPv6, TCP & UDP, 6LoWPAN - Application Layer Protocols: COAP, MQTT – Security Issues - IoT Applications: Health Care, Connected Vehicles, Smart Grid, Smart Home, and Smart City (14)

Total L: 45

TEXT BOOKS:
1. K V Shibu, "Introduction to Embedded Systems", 2nd Edition, McGraw Hill Education India Private Limited, India, 2017.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition, John Wiley and Sons Ltd, United Kingdom, 2012.

REFERENCES:
1. David A. Simon, "An Embedded Software Primer", 1st Edition, Pearson Education, India, 2002.
2. Qing Li, "Real-Time Concepts for Embedded Systems", 1st Edition, CRC Press, US, 2003.
3. Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Reed Elsevier Publications, Gurgaon, Haryana, 2009.
4. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014.

19E013 SYSTEM DESIGN USING FPGA

3 0 0 3

SYSTEM DESIGN USING PLDS AND CPLD : Structure of PLDs – PAL16L8, PAL16R6 - Complex PLDs (CPLDs) – Altera Max 7000 series – PLD design process – Design of combinational and sequential circuits using PLDs – Adder -Sequence detector – counters - shift register - Design of state machines using Algorithmic State Machines (ASM) chart as a design tool.(9)

INTRODUCTION TO FIELD PROGRAMMABLE GATE ARRAYS (FPGA) : FPGA Generic structure-Types of FPGA – FPGA Programming techniques –-Lookup table based FPGA- Multiplexer based FPGA – Xilinx Spartan II series – Logic Cell Array (LCA) – Configurable Logic Blocks (CLB) – Input/output Blocks (IOB) – Programmable Interconnection Points (PIP) – Introduction to ACT 2 family - FPGA Design examples. (9)

VERILOG HDL : Digital Design with VerilogHDL – Identifiers - compiler directives - Modules and ports -data types - operands and operators - gate level modeling–User Defined Primitives- data flow modeling - behavioral modeling - structural modeling – switch level modeling. (9)

FUNCTIONS AND RTL SYNTHESIS : Function and Task – Timing and Delays – Test benches – Design of combinational and Sequential circuits using Verilog – Verilog HDL synthesis – Verilog HDL constructs for logic synthesis – logic synthesis design flow – RTL to gates. (9)

TESTING IN DIGITAL CIRCUITS AND DESIGN FOR TESTABILITY : Fault Models – Fault detection – Test vector generation-Fault simulation - Detection of faults in combinational logic circuits –Stuck-at-fault model – Boolean Difference– Path Sensitising method – Design for testability – Adhoc techniques – Scan path –Boundary Scan - Built-in-self test. (9)

Total L: 45

TEXT BOOKS:
1. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education India, New Delhi, 2019.
2. Nelson V P, Nagale H T, Carroll B D, Irwin J D, "Digital Logic Circuit Analysis and Design", Prentice Hall International, New Jersey, 1996.

REFERENCES:
1. Wayne Wolf, "FPGA based system design", Pearson Education, India, 2015.
2. MichealD.Ciletti, "Advanced Digital Design with the Verilog HDL", Pearson Education, India, 2017.
3. Ming-Bo Lin, "Digital System Designs and Practices: Using Verilog HDL and FPGAs", Willey Indian Edition, India, 2012.
4. Bhasker J, "A Verilog HDL Primer", BS Publications, India, 2007.

19E014 VLSI DESIGN

3 0 0 3

OVERVIEW OF VLSI DESIGN AND BASIC ELECTRICAL PROPERTIES OF CMOS CIRCUITS : VLSI design process - Architectural design - Logical design - Physical design - Layout styles – Full-custom – Semi-custom approaches- Basic Electrical Properties of CMOS Circuits **:** MOS Transistor – Threshold voltage - Pass transistor - Transmission gate - Basic DC equations - Second order effects - MOS modules - Small signal AC characteristics - CMOS inverter - DC characteristics - Inverter delay – Power consumption in CMOS gates – Static dissipation Dynamic dissipation. (10)

VLSI FABRICATION TECHNIQUES : An overview of wafer fabrication - Wafer processing - Oxidation - Patterning - Diffusion - Ion implantation - Deposition - CMOS processes – Nwell - Pwell - Twintub - Silicon on Insulator – CMOS process enhancements - Interconnect - Circuit elements - Latchup - Latchup prevention techniques (8)

LAYOUT DESIGN RULES & PARAMETERS ESTIMATION : Layer representations - Stick diagrams-CMOS design style - Design rules - Need for design rules - Mead Conway design rules - CMOS n-well / p-well lambda based design rules - Simple layout examples. Sheet resistance - Resistance estimation - Capacitance estimation - Driving large capacitive loads. (8)

CMOS CIRCUIT COMBINATIONAL AND SEQUENTIAL LOGIC DESIGN : CMOS circuit families-Static CMOS-Ratioed circuits- Pseudo nMOS- Cascode voltage switch Logic-Dynamic circuits; Domino Logic-Pass transistor circuits- CMOS Transmission gates-Structured design - Simple combinational logic design examples - Parity generator – Multiplexers. Sequential logic design**:** Clocked sequential circuits –Single phase clocking -Max-delay Constraints- Min-delay Constraints - Two-phase clocking - Charge storage - clock skew- Clocked CMOS (C2MOS) - Logic-CMOS Dynamic register element - Dynamic shift register – Semi-static register – CMOS Latches- D- flip-flop. (10)

SUBSYSTEM DESIGN PROCESS : General arrangement of a 4-bit arithmetic processor - Design of a 4-bit shifter - Design of an ALU subsystem - Implementation of ALU functions with an adder - Carry look ahead adder – Multipliers – Serial-parallel multipliers - Pipelined multiplier array. (9)

Total L: 45

TEXT BOOKS:
1. Douglas A Pucknell, and Kamran Eshraghian, "Basic VLSI design", Prentice Hall of India, New Delhi, 2015.
2. Neil H E Weste, David Harris, "CMOS VLSI design: Circuits and System Perspective", Pearson Education, New Delhi, 2015.

REFERENCES:
1. Jan M Rabaey, Chandrakasan A, Nikolic B, "Digital Integrated Circuits", PHI Learning, NewDelhi, 2013..
2. Amar Mukherjee, "Introduction to nMOS and CMOS VLSI System Design", Prentice Hall, New Jersey, 1986.
3. Wayne Wolf, "Modern VLSI Design: Systems on Chip Design", Pearson Education, New Delhi, 2008.
4. John P. Uyemura, "Chip Design for Submicron VLSI Design: CMOS Layout and Simulation", Cengage Learning, New Delhi, 2010.

19E015 MIXED SIGNAL VLSI DESIGN

3 0 0 3

ANALOG CIRCUIT BUILDING BLOCKS : Switches- Active Resistors-Current Sources and Sinks-Current Mirrors – Simple – Wilson – Cascode - Folded – Cascode. Voltage and Current References – General biasing circuits for analog design – Supply Independent biasing-Temperature independent biasing- Band gap voltage references – Comparators- Multipliers (11)

CMOS AMPLIFIERS : MOS inverting amplifier - Improving the performance of inverting amplifier - Single stage MOS amplifiers. T- CS stage - CG stage - Source Follower- Frequency response of amplifiers. Cascode and Folded cascode stage - Current amplifiers - output amplifiers - Differential amplifiers (10)

CMOS OP-AMPS : CMOS operational amplifiers - Uncompensated and compensated Op Amps – Noise performance of Op-Amps - Design techniques with examples - High performance CMOS Op-Amps (7)

SWITCHED CAPACITOR CIRCUITS AND PHASE LOCKED LOOPS : Switched capacitor resistors - Switched capacitor amplifier- Switched capacitor integrators.- Basic Architecture of Phase Locked Loops (PLLs) – Charge Pump PLLs-Applications. (8)

DATA CONVERTERS : Data Converter fundamentals, DAC Architectures: Current Switched - Resistive - charge redistribution – Hybrid - Segmented D/A Converters. ADC architectures – Flash - Pipeline – Integrating - Successive Approximation and folding A/D Converters (9)

Total L: 45

TEXT BOOKS:
1. Phillip Allen, Douglas Holdberg , "CMOS Analog Circuit Design", Oxford University Press, New Delhi, 2014.
2. David A Johns, Ken Martin, "Analog Integrated Circuit Design", second, John Wiley and Sons, New York, 2013.

REFERENCES:
1. Behzad Razav, "Design of CMOS Integrated Circuits", Tata McGraw Hill, New Delhi, 2017.
2. Roubik Gregorian, Gabor C. Temes, "Analog MOS Integrated Circuits for Signal Processing", John Wiley & Sons, New York, 2013.
3. Randall L Geiger, Phillip E Allen and Noel R Strader, "VLSI Design Techniques for Analog and Digital Circuits", McGraw Hill, New Delhi, 1990.
4. Jacob Baker R, Lee H W and Boyce D E, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India, New Delhi, 2010.

19E016 VIRTUAL INSTRUMENTATION

3 0 0 3

VIRTUAL INSTRUMENTATION : Concept & Architecture – Role of Hardware and Software in Virtual Instrumentation - Advantages of Virtual instruments over Conventional Instruments. (4)

SOFTWARE OVERVIEW : Graphical Programming-Advantages- LabVIEW environment: Front panel - Controls palette- Controls and Indicators- Block diagram- Functions palette-Functions and Libraries - Data flow programming - Creating simple Virtual Instruments- Editing -Debugging and Running a Virtual Instrument - Creating SUBVIs. (6)

PROGRAMMING STRUCTURES : Control Structures: FOR loops - WHILE loops - Creation of Local and Global variables. Selection structures: CASE structure - Sequence structures - Flat and Stacked structures - Arrays: Creation and array operations. Clusters - Assembling and disassembling of elements using cluster operations. Waveform graphs and charts - String functions and File I/O functions. (12)

DATA ACQUISITION AND I/O FUNCTIONS : DAQ architecture - connecting signal to DAQ boards - DAQ Assistant and I/O functions in LabVIEW - Measurement and Automation Explorer. (7)

INSTRUMENT CONNECTIVITY : GPIB Hardware & Software specifications - Serial Communication - RS232 - RS 485 standards- PXI / PCI: Controller and Chassis Configuration - configuration using VISA. (7)

APPLICATIONS OF VIRTUAL INSTRUMENTATION : Image Acquisition - Machine vision system - Machine Vision Hardware and Software - Introduction to IMAQ and IMAQ Vision. Motion Control: Components of a motion control system - Software for configuration - Prototyping and Development - General Applications. (9)

Total L: 45

TEXT BOOKS:
1. Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW", Tata McGraw-Hill, New Delhi, 2010.
2. Jovitha Jerome, "Virtual Instrumentation using LabVIEW", Prentice Hall of India, New Delhi, 2011.

REFERENCES:
1. National Instruments, "LabVIEW: Basics I & II Manual", National Instruments, Bengaluru, 2005.
2. Garry W Johnson, Richard Jennings, "LabVIEW Graphical Programming", Tata McGraw Hill, New Delhi, 2011.
3. Jeffrey Travis, Jim Kring, "LabVIEW for Everyone: Graphical Programming Made Easy and Fun", 3rd Edition, Prentice Hall of India Learning Private Limited, New Delhi, 2006.
4. Rick Bitter, Taqi Mohiuddin, Matt Nawrocki, "LabView: Advanced Programming Techniques", 2nd Edition, CRC Press, USA, 2006.

19E017 COMMUNICATION SYSTEMS

3 0 0 3

AM SYSTEM : Introduction to communication systems - Amplitude modulation theory - Frequency Spectrum - Representation - Power relation - AM Generation - Class C power Amplifier - Evolution & Description of SSB - Balanced Modulator - Advantages of SSB Transmission - AM transmitter - AM receiver - AM envelope detector - Superheterodyne receiver. (9)

FM SYSTEM : Frequency Modulation - Phase Modulation - Representation and Frequency spectrum of FM wave - Effects of noise on carrier- Pre-emphasis and De-emphasis -FM Generation : Direct method - Stabilized reactance modulator - FM Transmitter - FM Receiver - Comparison of Wide band and Narrow band FM. (9)

DIGITAL COMMUNICATION SYSTEM : Advantages of Digital Data transmission - Sam pling - Pulse Code Modulation - Multiplexing - Source codes-Error control codes -Line codes. (9)

DIGITAL MODULATION SCHEMES : Digital amplitude modulation - Frequency Shift Keying and Phase Shift Keying - BPSK and QPSK- FSK transmitter and receiver. (9)

FIBRE OPTIC SYSTEM : History of fibre optics-Optical fibres versus Metallic cables-Optical fibre communication system-Light propagation through optical fibres-Fibre configurations-Acceptance angle and Acceptance cone- Losses in optical fibre cables - Light sources - Light detectors - Lasers. (5)

ADVANCED COMMUNICATION SYSTEMS : Cellular Telephone System - Spread Spectrum System – Multiple Access Techniques - Satellite Communication system (4)

Total L: 45

TEXT BOOKS:

1. George Kennedy, Bernard Davis, "Electronic Communication systems", 5th Edition, Tata McGraw-Hill, New Delhi, 2017.
2. Wayne Tomasi, "Advanced Electronic Communication Systems", 5th Edition, Pearson Education, New Delhi, 2013.

REFERENCES:

1. B.P.Lathi, "Modern Digital & Analog Communication Systems", 4th Edition, Oxford Publications, New York, 2017.
2. Theodore S Rappaport, "Wireless Communication", 2nd Edition, Pearson Education, New Delhi, 2018.
3. Simon Haykin, "Communication Systems", 5th Edition, Wiley Publications, Singapore, 2017.
4. Singal T L, "Wireless Communications", 1st Edition, Tata McGraw Hill, New Delhi, 2010.

19E018 AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS

3 0 0 3

INTRODUCTION : Current trends in modern automobiles – – Drive by wire Systems -Vehicle functional domains and their requirements - Components of an Automobile Electronic system and their functions: Sensors, Actuators, Control Units and Software structure of Control units. (6)

AUTOMOBILE ELECTRICALS AND ELECTRONICS : Basic Electrical Components in an automobile - Starting system (Battery, Ignition Switch, Solenoid, Starter, Neutral Safety Switch), Charging system (Alternator Drive Belt, Alternator, Voltage Regulator), Fuses. Overview of Vehicle Electronic system - Driver - Vehicle - Environment system (Control and monitoring systems, Electronic systems of the vehicle and the environment) -General instrumentation block diagram - Typical instrumentation cluster lay out. (10)

EMBEDDED SYSTEM IN AUTOMOTIVE CONTEXT : Embedded systems in typical modern automobile - Distributed systems, Embedded components -- Engine Management system - Diesel / Gasoline system, Components, System architecture (H/W, S/W) - Body electronics systems, - Infotainment systems – Navigation, Car radio. (10)

ELECTRONICS CONTROL UNITS (ECUS) : ECUs and vehicle subsystems - Electronic systems of Power train subsystem, Electronic systems of Chassis subsystem, Electronic systems of Body subsystems (Comfort and Passive safety), Multimedia subsystems. Automobile sensors and actuators, Engine management system, Vehicle safety systems, Environmental legislation (Pollution Norms - Euro / Bharat standards). (10)

DIAGNOSTICS AND AUTOMOTIVE NETWORKING PROTOCOLS : Diagnostics procedure: Introduction – Diagnostics theory – on board and off board diagnostics – Diagnostics Link Connector (DLC) - CAN bus topology – Data transmission – CAN protocol – Over view of CAN controller - LIN bus: overview – Data transmission system - LIN protocol. (9)

Total L: 45

TEXT BOOKS:

1. Tom Denton, "Automobile Electrical and Electronics systems", Routledge Taylor & Francis Group, London & New York, 2002.
2. Nicolas Navet and Francoise Simonot-Lion, "Automotive Embedded Systems Handbook", CRC Press, USA, 2013.

REFERENCES:

1. Michel Parent &FurnioHarshima, Ljubo vlacic, "Intelligent Vehicle Technologies: Theory and Applications", 1st Edition, Butterworth-Heinemann publications, New Delhi, 2001.
2. Ronald k.J, "Automotive Electronics Handbook", 2nd Edition, McGraw Hill Publications, Columbus, 2009.
3. Norman P. Mansour, William Ribbens, "Understanding of Automotive Electronics", 5th Edition, Butterworth- Heinemann, United Kingdom, 2014.
4. Robert Bosch , "Automotive Electrics Automotive Electronics", 5th Edition, Springer, Germany, 2010.

19E019 WEARABLE ELECTRONICS

3 0 0 3

INTRODUCTION : Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Recent developments – Global and Indian Scenario, Types of Wearable Systems, Components of wearable Systems, Physiological Parameters commonly monitored in wearable applications, Smart textiles, & textiles sensors, Wearable Systems for Disaster management, Home Health care, Astronauts, Soldiers in battle field, athletes, SIDS, Sleep Apnea Monitoring (8)

SMART SENSORS AND VITAL PARAMETERS : Vital parameters monitored and their significances, Bio-potential signal recordings (ECG, EEG, EMG), Dry Electrodes design and fabrication methods, Smart Sensors – textile electrodes, polymer

electrodes, non-contact electrodes, MEMS and Nano Electrode Arrays, Cuff-less Blood Pressure Measurement, PPG, Galvanic Skin Response (GSR), Body Temperature Measurements, Activity Monitoring for Energy Expenditure, Respiratory parameters. (9)

WEARABLE COMPUTERS : Flexible Electronics, Signal Processors, Signal Conditioning circuits design, Power Requirements, Wearable Systems Packaging, Batteries and charging, Wireless Communication Technologies and Protocols, Receiver Systems, Mobile Applications based devices. Data processing and validation – Signal Processing Algorithms in wearable Applications (10)

WIRELESS BODY AREA NETOWRKS : Wireless Body Area Networks – Introduction, Personal Area Networks (PAN), Application in Vital Physiological Parameter monitoring, Design of Sensor & Sink Nodes, Architecture, Communication & Routing Protocols, Security, Power and Energy Harvesting. (8)

ELECTRONIC TEXTILES : Concepts and development of electronic textile. Conductive Polymers and Fibers - Textile Fibres Used for Wearable Electronic Applications. Interfacing Circuits and Garments - Designing of Wearable fabrics integrated with Electronic materials and circuits. Design of Heat-Generating Circuit for Nichrome Fabric, Design of Communication Circuit for Copper Core Conductive Fabric. Design of Signal-Transferring Circuit form Optical Core Conductive Fabric. Design of Bullet Wound Intimation Circuit for Tele-intimation Fabric. (10)

Total L: 45

TEXT BOOKS:

1. Micheal R Neuman, Edward Sazonov, "Wearable Sensors: Fundamentals, Implementation and Applications",1st Edition, Elseiver, USA, 2014.
2. Xiao ming Tao, "Wearable Electronics and Photonics", 1st Edition, CRC press, Manchester, 2005.

REFERENCES:

1. Kate Hartman, "Wearable Electronics: Design, Prototype and wear your own interactive garments, Maker Media", 1st Edition, Maker Media, Inc, USA, 2014.
2. Elijah Hunter, "Wearable Technology", 1st Edition, Kindle Edition, USA, 2015.
3. Guang Zhong Yang, "Body Sensor Networks", 1st Edition, Springer, UK, 2014.
4. Xiaoming Tao, "Wearable Electronics and Photonic Wearable Electronics and Photonics, The Textile Institutes",1st Edition, CRC Press, Manchester, 2005.

19E020 ELECTRONIC PRODUCT DESIGN

3 0 0 3

INTRODUCTION: The basic product development process- Product planning- Design and engineering- Procurement- Manufacturing – Functionality- Performance- User interface - Form factor- Battery life- Cost- Time To Market (TTM)- Reliability-Marketing and distribution-Service and Support. (8)

SYSTEM DESIGN : Top down design-Product concept-Innovation-Creativity- Validation -Communication-Product requirements-System architecture development- Trade-off analysis- Cost modeling-Circuit design-Physical and mechanical design-Tolerance and reliability. (8)

ELECTRONIC PACKAGING: : IC packaging: Leaded package, TABITCP package-COB, flip-chip, BGA, CSP-Discrete components-Board to board connectors-substrates-Escape routing-PCA/module design metrics-Electronic packaging metrics-I/O hardware : buttons, switches, dials and touch screens, speakers , microphones, antennas, and external connectors. (8)

MECHANICAL DESIGN : Housings-EMI shielding-Thermal management: High level thermal analysis, thermal issues in notebook computers-mechanical integration-DFMA analysis - quality in the design process: Quality control -quality assurance-quality functional deployment-assignment matrices-checklist-quality in the design process-concurrent design-risk analysis-quality in production. (10)

PORTABLE ELECTRONICS : Digital and analog processing: microprocessor, logic devices, microcontrollers, DSP, analog devices, sensors, wireless communication, system memory and mass storage - Displays: Display technologies-LCD-micro display-pen input-power sources- Battery technologies: Ni-Cd, alkaline,Ni-MH,lithium ion, lithium polymer, photovoltaic cells, fuel cells-product implementation-high level power analysis-Case study: Cellular phones-portable PCs-Personal digital assistants-digital imaging products. (11)

Total L: 45

TEXT BOOKS:

1. Tony Ward and James Angus, "Electronic Product Design", 1st Edition, Chapman and Hall Publications, UK, 1996.
2. Bert Haskell, "Portable Electronics Product Design and Development: For Cellular Phones, PDAs, Digital Cameras, Personal Electronics and More", McGraw-HILL, Newyork, 2010.

REFERENCES:

1. Tim Williams, "EMC for Product Designers", 5th Edition, Newnes, UK, 2017.
2. Nigel Cross, "Engineering Design Methods: Strategies for Product Design", 4th Edition, Wiley, UK, 2008.
3. Kevin N Otto, Kristin L Wood, "Product design : techniques in reverse engineering and new product development", 4th Edition, Prentice Hall, New Delhi, 2009.
4. Jordan P. W, "Designing Pleasurable Products: An Introduction to the New Human Factors", 1st Edition, Taylor and Francis, London, 2002.

19E021 DIGITAL IMAGE PROCESSING

3 0 0 3

DIGITAL IMAGE FUNDAMENTALS & IMAGE TRANSFORMS : Introduction – Elements of visual perception – Image sampling and Quantization – Basic relationships between pixels -Image Transforms: DFT – properties –DWT – properties. (9)

IMAGE ENHANCEMENT : Intensity transformation functions – Histogram processing - Spatial filtering: Correlation and convolution – Smoothing filters – Sharpening filters. (9)

IMAGE RESTORATION : Noise models – Restoration in the presence of noise only: spatial filtering – Linear, position-invariant degradation – estimating the degradation function – Inverse filtering – Wiener filtering. (9)

IMAGE SEGMENTATION : Point detection- line detection - Edge detection - Thresholding - Region based segmentation: Region growing by pixel aggregation - Region splitting and merging. (9)

IMAGE COMPRESSION : Image compression model – Redundancy-Lossless compression – Run-length coding – Huffman coding – Lossy compression – predictive coding –JPEG standards of Image Compression. (9)

Total L: 45

TEXT BOOKS:
1. Gonzalez R.C, Woods R.E, "Digital Image Processing", 4th Edition, Pearson, New Delhi, 2018.
2. Jayaraman S, Esakkirajan S, Veerakumar T, "Digital Image Processing", Tata McGraw Hill, New Delhi, 2015.

REFERENCES:
1. Jain A.K, "Fundamentals of Digital Image Processing", Prentice Hall of India, New Delhi, 2019.
2. Sridhar S, "Digital Image Processing", Oxford University Press, New Delhi, 2013.
3. William K Pratt, "Digital Image Processing", 4th Edition, Wiley India, New Delhi, 2011.
4. Munesh Chandra Trivedi, "Digital Image Processing", 1st Edition, Khanna Publishing, New Delhi, 2014.

19E022 ADVANCED DATA STRUCTURES

3 0 0 3

INTRODUCTION : Introduction to Analysis of Algorithms– Best Case and Worst Case complexities - Amortized time complexity - Complexity for bubble sort, quick sort.- Introduction to Divide and Conquer Algorithms, Greedy Algorithms, Non-deterministic Algorithms. (8)

SEARCHING, HASHING AND AVL TREES : SEARCHING: Introduction to Linear Search, Binary Search, and Binary Search trees - HASHING: Hash function – separate chaining – open addressing – linear probing – quadratic probing – double hashing - rehashing - AVL TREES: Definition – Height – Searching – insertion and deletion of elements, AVL rotations – Analysis (13)

MULTIWAY SEARCH TREES : Indexed Sequential Access – m-way search trees – B-Tree – Searching, insertion and deletion - B+ trees – Tries - Red-Black trees. (8)

BINOMIAL HEAP AND FIBONACCI HEAP : Binomial trees and binomial heaps – Operations on binomial heap – Structure of Fibonacci heaps – merge heap operations, decreasing a key and deleting a node – Bounding the maximum degree. (8)

GRAPHS : Definition – Representations (Adjacency matrix, packed adjacency list and linked adjacency list) – Network representation – Shortest path algorithm - Graph search methods (Breadth First and Depth First Traversals) – Minimum spanning tree. (8)

Total L: 45

TEXT BOOKS:
1. Yedidayah Langsam, Moshe J. Augenstein, and Aaron M. Tanenbaum, "Data Structures using C and C++", 2nd Edition, Pearson Education Inc., New Delhi, 2019.
2. Thomas H. Cormen, Charles E. Leiserson, and Ronald L. Rivest, "Introduction to Algorithms", 3rd Edition, PHI Learning, New Delhi, 2018.

REFERENCES:
1. Mark Allen Weiss , "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education Inc., New Delhi, 2018.
2. Ellis Horowitz, Sartaj Sahni, and Susan Anderson - Freed , "Fundamentals of Data structures in C", 2nd Edition, Universities Press India Pvt. Ltd., Hyderabad, 2018.
3. Adam Drozdek , "Data Structures and Algorithms in C++", 4th Edition, Cengage Learning, New Delhi, 2013.
4. Puntambekar A , "Data Structures Using C++", Technical Publications, Gujarat, 2014.

19E023 COMPUTER NETWORKS

3 0 0 3

INTRODUCTION : Introduction to Computer networks-Layered Architecture -ISO/OSI Model-TCP/IP Protocol Suite- Type of networks-Network Topology-Study of L2, L3 switches and Routers- Physical layer-Transmission media- Signal encoding techniques (9)

DATA LINK LAYER : Link Layer services-Framing-Error Control- Flow Control-Media Access Control-CSMA/CD- Token Ring-FDDI-Circuit Switching- Packet Switching- Addressing- VLANs-Wireless LANs. (9)

NETWORK LAYER : Network Layer Functions- Internet Protocol-IP address assignment-ARP-Routing table lookup-Routing and forwarding-Subnets-CIDR-NAT-IPv6-Multicasting-Broadcasting (9)

TRANSPORT LAYER : Overview of Transport Layer-UDP-Reliable Byte Stream(TCP)-Connection Management- Flow Control-Retransmission-Congestion control-congestion Avoidance-State Transition Diagram (9)

APPLICATION LAYER : Traditional Applications- WWW- DNS-DHCP-SNMP- FTP-TELNET-HTTP-SMTP-MIME-IMAP- POP3-WEB mail - Firewalls (9)

Total L: 45

TEXT BOOKS:

1. James F. Kurose, Keith W. Ross, "Computer Networking-A Top-Down Approach Featuring the Internet", 6th Edition, Addison-Wesley, New Delhi, 2017.
2. William Stallings, "Data and Computer Communications", 10th Edition, Prentice Hall/Pearson, New Delhi, 2017.

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, "Computer networks- A Systems Approach", 5th Edition, Morgan Kaufmann Publishers, New Delhi, 2012.
2. Andrew S Tanenbaum, David Wetherall, "Computer Networks", 5th Edition, Pearson, New Delhi, 2017.
3. Douglas E. Comer, "Internetworking With TCP/IP Vol I: Principles, Protocols, and Architecture", 6th Edition, Prentice Hall/Pearson, New Delhi, 2014.
4. Behrouz A. Foruzan, "Data Communication and Networking", 5th Edition, McGraw-Hill, New York, 2017.

19E024 SOFTWARE PROJECT MANAGEMENT AND QUALITY ASSURANCE

3 0 0 3

INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT AND PROJECT PLANNING : Software development as a project, Stakeholders in software project, Software product, process, resources, quality, and cost; Objectives, issues, and problems relating to software projects. Project Planning - Steps in project planning, Alternatives in planning. (9)

PROJECT EVALUATION & EFFORT ESTIMATION : Strategic assessment, Technical assessment, Cost-benefit analysis, Cash flow forecasting, Cost-benefit evaluation techniques, Break-even analysis, and Risk evaluation. Project Approach - Choosing development technology and methodology, Choice of process model, Prototyping, Incremental delivery. Effort Estimation -Problems in software estimation, Effort estimation techniques, Expert judgment, Estimation by analogy, Delphi technique, Algorithmic methods, Top-down and bottom-up estimation, Function point analysis, Object points, COCOMO model.(9)

ACTIVITY PLANNING &RESOURCE ALLOCATION : Sequencing and scheduling projects, Network Planning models-Precedence network – Critical Path, Shortening project duration. Nature of project resources, identifying resource requirement of activities, Allocating and scheduling resources, cost of resources, Standard, planned, and actual cost, Cost variance, time-cost trade-off. (9)

CONTRACT AND RISK MANAGEMENT : Outsourcing of products and services, Types of contracts, Stages in contract placement, Terms of contract, Contract monitoring and Acceptance testing. Managing People- Organizational behavior, Recruitment and placement, Motivation, Group behavior, Individual and group decision making, Leadership and leadership styles, forms of organizational structures. Risk Analysis and Management - Nature and categories of risk in software development, risk Identification, Risk assessment, Risk mitigation, monitoring and management, Evaluating schedule risk using PERT. (9)

SOFTWARE QUALITY ASSURANCE AND CONFIGURATION MANAGEMENT : Planning for quality, Product versus process quality management, Procedural and quantitative approaches, Defect analysis and prevention, Statistical process control, Pareto analysis, Causal analysis, Quality standards, ISO 9000, Capability Maturity Model, Quality audit. Configuration Management - Configuration management process, Software configuration items, Version control, change control, Configuration audit, Status reporting. (9)

Total L: 45

TEXT BOOKS:

1. Bob Hughes, Mike Cotterell, "Software Project Management", 5th Edition, McGraw-Hill, London, 2011.
2. Pankaj Jalote, "Software Project Management in Practice", Pearson Education, London, 2002.

REFERENCES:

1. Rog Günther Ruhe, ClaesWohlin, "Software Project Management in a Changing World", Springer, London, 2014.
2. Stefan Wagner, "Software Product Quality Control", Springer, Berlin, 2013.
3. Roger S. Pressman, "Software Engineering: A Practitioner"s Approach", 8th Edition, McGraw-Hill, New York, 2014.
4. Ramesh Gopalaswamy, "Managing Global Software Projects", Tata McGraw-Hill, New Delhi, 2006.

19E025 ADVANCED COMPUTER ARCHITECTURE

3 0 0 3

MEMORY AND INPUT/OUTPUT SUBSYSTEMS : Introduction - Computer architectural classification: Flynn"s classification – Data flow versus Control flow computers – Parallelism in uniprocessor systems – Balancing of subsystem bandwidth – Parallel processing applications. Hierarchical Memory Structure: Memory hierarchy – Optimisation –Addressing schemes for main memory – Multiple module memories – Memory interleaving – Virtual Memory System: Concepts – Paged Memory System – Segmented memory System – Memory with Paged Segments – Memory allocation and Management: Classification of memory Policies – Optimal Load Control – Memory Management Policies – Cache Memory and Management: Characteristics – Cache Memory Organisation - Fetch and Main Memory Update Policies – Block Replacement Policies – Performance evaluation and enhancement – Input Output Subsystems: Characteristics – Interrupt Mechanisms and Special Hardware – I/O Processors and I/O Channels (12)

PIPELINING AND VECTOR PROCESSING : Principles of pipelining – Instruction and Arithmetic pipelines – Instruction prefetch and branch handling – Data buffering and Busing structures – Internal forwarding and Register tagging – Hazard detection and resolution – Job sequencing and Collision prevention – Vector Processing: Characteristics – Pipelined Vector Processing methods – Vectorization and Optimization methods. (9)

ARRAY PROCESSING : SIMD Array Processors - Masking and data routing mechanisms - Inter PE communications – Interconnection networks – Parallel Algorithms for Array Processors – Associative Array Processing-Systolic array processing (8)

MULTIPROCESSOR ARCHITECTURE : Functional structures: Loosely coupled multiprocessors – Tightly coupled multiprocessors – Processor characteristics for multiprocessing – Multiprocessor scheduling strategies – Interconnection networks– Parallel memory organization – Parallel Algorithms for Multiprocessors (8)

INTRODUCTION TO RISC ARCHITECTURE : Instruction execution characteristics – Instruction execution charts – Register files – Register optimization – Reduced Instruction Set Architecture – RISC pipelining – RISC versus CISC (8)

Total L: 45

TEXT BOOKS:

1. Hwang K, and Briggs F A, "Computer Architecture and Parallel Processing", Tata McGraw–Hill, New Delhi, 2016.
2. Stallings W, "Computer Organization and Architecture: Designing for Performance", Pearson Education, Chennai, 2018.

REFERENCES:

1. David Patterson and John L Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Elsevier, Waltham, 2012.
2. Kai Hwang, Naresh Jotwani, "Advanced Computer Architecture – Parallelism, Scalability and Programmability", Tata McGraw–Hil, New Delhi, 2013.
3. Jhon L Hennessey and David A Patterson, "Computer Architecture a Quantitative Approach", fifth, Elsevier, United States, 2012.
4. Sima D, Fountain T, Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, United States, 2000.

19E026 INTERNETWORKING AND APPLICATIONS

3 0 0 3

INTRODUCTION : Overview of the Internet – Protocol layering – LAN - WAN –IEEE 802.3 – Wireless LANS : 1EEE 802.11, Bluetooth, WiMax (9)

INTERNET PROTOCOL : IPv4 - IPv6 – IPv6 migration- Internet Addressing - Datagram delivery in IPv4 and IPv6 - ICMP in IPv4 and IPv6- ARP-NAT- Multicasting - Routing Algorithms: BGP-RIP-SPF (9)

TRANSPORT LAYER PROTOCOLS : User Datagram Protocols (UDP) – Transmission Control Protocol (TCP) – Client Server Model of Interaction – Sequential and concurrent servers - Socket API – Socket operations – Accessing Domain names (9)

NETWORK MANAGEMENT AND MULTIMEDIA APPLICATIONS : SNMP – MIB – ASN.1 Notation - Voice and Video over IP – RTP- RTCP – RSVP – Quality of service - Mobility – Mobile IP – IPv6 mobility support – Voice and Video over IP – Online Payments -Secure Electronic Transactions (SET) (9)

INTERNET SECURITY AND FIREWALL : IPsec- Information policy- secure socket layer- SSL – TLS- Firewalls and Internet Access- Firewall rules- Implementation and packet filters – VPN (9)

Total L: 45

TEXT BOOKS:
1. Douglas E Comer, "Internetworking with TCP/IP : Principles, Protocols and Architecture", 6th Edition, Prentice Hall, New Delhi, 2014.
2. Behraouz A Forouzan, "TCP/IP Protocol Suite", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011.

REFERENCES:
1. Andrew.STanenBaum, David T.Wetherall, "Computer Networks", Pearson Education, New Delhi, 2010.
2. Kurose James F, Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", 6th Edition, Addison- Wesley, New Delhi, 2017.
3. A.S.Godbole, Atulkahate, "Web Technologies:TCP/IP Architecture and Java Programming", Tata McGraw Hill, New Delhi, 2011.
4. Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtoroff, Thomas Schaeck, "Pervasive Computing – Technology and Architecture of Mobile Internet Applications", Pearson, New Delhi, 2012.

19E027 JAVA PROGRAMMING

3 0 0 3

OBJECT ORIENTATION IN JAVA : Introduction - Data Types - Operators - Declarations - Control Structures - Arrays and Strings - Input/output.-Java Classes - Fundamentals - Methods - Constructors - Scope rules - this keyword - object-based Vs object-oriented programming .- -Inheritance-Reusability - Composing class - Abstract classes - Abstract Functions - Method Overloading and Method Overriding- Wrapper Classes. (9)

PACKAGES AND INTERFACES : Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface - Applying Interface - Variables in Interfaces. (6)

EXCEPTION HANDLING : Fundamentals - Exception types - Uncaught Exception - Using Try and Catch – Multiple catch clauses - Nested Try statements - Throw - Throws - Java Built-in Exception - Creating the subclasses. (4)
MULTI THREADED PROGRAMMING : Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Main thread - Creating the Thread - Synchronization - Inter-thread Communication - Deadlock. (4)

I/O, APPLETS : I/O basics - Stream - Stream Classes - Predefined stream - Reading/Writing console input – Applet fundamentals - Native methods.- GUI Components - Applets - Java Scripts - AWT / Swings. (12)

NETWORK AND DATABASE PROGRAMMING : Fundamentals - Internet Addresses - Internet Protocols - DNS - Internet Services - Socket programming - U D P - TCP. JDBC - Database Connection and Table Creation - Execution of Embedded SQL Statements - ResultSet and ResultSetMetaData - Examples. (10)

Total L: 45

TEXT BOOKS:
1. Patrick Naughton, Herbert Schildt, "JAVA - The Complete Reference", Tata McGraw-Hill, New Delhi, 2011.
2. Deitel and Deitel, "JAVA - How to Program", Prentice Hall International, New Delhi, 2012.

REFERENCES:
1. Kennath Litwak, "Pure Java 2: A Code-Intensive Premium Reference", Tech Media Publications, New Delhi, 2010.
2. Cay S Horstmann, Gary Cornell, "Core Java Volume I & 2", Pearson Education, New Delhi, 2013.
3. Herbert Schildt, "JAVA - The Complete Reference", Tata Mc-Graw Hill, New Delhi, 2013.
4. Walter Slavic, "Absolute Java", Pearson Education, New Delhi, 2013.

19E028 RELATIONAL DATABASE MANAGEMENT SYSTEMS

3 0 0 3

INTRODUCTION : Databases – Conventional file Processing – Data Modeling for a database – Three level architecture – Data Independence – Components of a Database Management System – characteristics - Advantages and disadvantages of a DBMS - Data base administrator-functions and responsibilities - Data Modeling: ER model: Entities, Attributes, relationships – Weak and strong entity types – Design of Entity Relationship data models, EER Model - Conversion of EER to Relational Model (9)

RELATIONAL MODEL : Relational data model basics - properties of Relations- Domains and Key concept – Enforcing data integrity constraints - Relational algebra operations. (9)

RELATIONAL DATABASE MANIPULATION : Introduction to Structured Query Language(SQL) – SQL commands for defining database – Manipulations on database – Basic data retrieval operations - aggregate function- order by/group by clause- sub queries-in-any-all-views in SQL. (9)

DATA BASE DESIGN THEORY : Functional dependencies - Normal forms – Normalization: 1NF to 5NF- Domain Key Normal Form – losses join and dependency preserving decomposition (9)

DATABASE TRANSACTION & SECURITY : Transaction processing – properties - Concurrency control mechanism - security and integrity threats - Defense Mechanism. (9)

Total L: 45

TEXT BOOKS:
1. Abraham, Siberschatz, Henry.F.Korth, Sudharshan.S, "Database System Concepts", Tata McGraw-Hill, New Delhi, 2014.
2. Ramez Elmasri, Shamkant Navethe, "Fundamentals of Database Systems", Pearson Education, New Delhi, 2011.

REFERENCES:
1. Sumathi.S, Essakirajan.S, "Fundamentals of Relational Database Management Systems", Springer, New Delhi, 2008.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", Tata McGraw-Hill, New Delhi, 2014.
3. Thomas Connolly, Carolyn Begg, "Database system: A Practical Approach to Design, Implementation, and Management", Pearson Education, England, 2014.
4. Jeffrey A. Hoffer, Mary B Presscott, Fred R Mcfadden, "Modern database Management Systems", Pearson Education, Boston, 2007.

19E029 OPERATING SYSTEMS

3 0 0 3

INTRODUCTION : Operating system structure – Function – Evolutions of Operating Systems - Serial processing, Batch Processing, Multiprocessing, Time-sharing operating systems- Distributed OS - Multiprocessor OS– Real- time OS – Introduction to system calls- operating System Structures- Traditional UNIX structure – Structure of Mobile operating systems.(8)

PROCESS MANAGEMENT : Introduction to processes –Threads - Scheduling objectives - Scheduling Criteria - Types of scheduling algorithms – Performance comparison – Inter-process communications - Synchronization – Semaphores – Deadlock - Prevention, Recovery, Detection – Avoidance. (10)

MEMORY MANAGEMENT : Single contiguous allocation – Partitioned allocation – Paging – Virtual memory concepts – Swapping – Demand paging – Page replacement algorithms – Segmentation – Segmentation with paging. (9)

DEVICE AND FILE MANAGEMENT : Principles of I/O hardware – I/O software – Disks – Disk Scheduling Algorithms– File Systems – Files-Directories- File system implementation – Allocation methods – Security – Protection mechanisms. (9)

CASE STUDIES: : LINUX – History – Design Principles – Kernel modules – Process Management – Scheduling – Memory Management – File Systems – Input and Output . (5)

CASE STUDIES: : WINDOWS 7 Design Principles – System Components – File Systems Volume management and fault tolerance- Networking. (4)

Total L: 45

TEXT BOOKS:
1. Silberschatz A., Galvin P. B., Gagne G, "Operating System concepts Concepts", 9th Edition, Wiley India Pvt. Ltd, New Delhi, 2015.
2. Deitel H. M., Deitel P. J., Choffnes D. R, "An Introduction to Operating Systems", 3rd Edition, Pearson Education, New Delhi, 2013

REFERENCES:
1. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Pearson Education Inc, New Delhi, 2014.
2. Andrew S. Tanenbaum, Albert S. Woodhull, "Operating Systems: Design and Implementation", 3rd Edition, Pearson Education Inc.,, New Delhi, 2012.
3. Mukesh Singhal and Niranjan G. Shivaratis, "Advanced Concepts in Operating Systems", Tata McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2013.
4. Dhamdhere D. M, "Operating Systems: A Concept - based Approach", 3rd Edition, Tata McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2014.

19E030 NEURAL NETWORKS AND FUZZY SYSTEMS

3 0 0 3

INTRODUCTION TO NEURAL NETWORKS : Fundamentals Concepts, Basic Models, Important Terminologies, McCulloch - Pitts Neuron, Linear Separability, Hebb Network, Perceptron, Adaline, Madaline - Architecture, algorithm and Simple Applications (9)

NEURAL NETWORKS BASED ON PATTERN ASSOCIATION AND COMPETITION : Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero-associative and Auto-associative Net, Bidirectional Associative Memory - Architecture, Algorithm and Simple Applications., Backpropagation - Architecture, Algorithm and Applications. Unsupervised Learning - Kohonen Self-Organising Maps, ART1 and ART2 and Counter Propagation (9)

FUZZY LOGIC : Introduction, Classical and Fuzzy Sets: Properties and Operations, Crisp and Fuzzy Relations - Cardinality, Properties and Operations, Composition, Tolerance and Equivalence Relations, Simple Problems. (9)

MEMBERSHIP FUNCTIONS : Features of membership function, Standard forms and Boundaries, fuzzification, membership value assignments, Fuzzy to Crisp Conversions, Lambda Cuts for fuzzy sets and relations, Defuzzification methods.(9)

APPLICATIONS OF NEURAL NETWORKS AND FUZZY LOGIC : Applications of Neural Networks: Pattern Recognition - Image compression – Communication - Control systems - Applications of Fuzzy Logic: Fuzzy Process Control - Fuzzy Optimization - Fuzzy Logic Controllers. (9)

Total L: 45

TEXT BOOKS:
1. Sivanandam S N, Sumathi S, Deepa S N, "Introduction to Fuzzy Logic using MATLAB", Springer-Verlag, Berlin Heidelberg, 2010.
2. Sivanandam S N, Sumathi S, Deepa S N, "Introduction to Neural Networks using MATLAB 6.0", Tata McGraw- Hill, New Delhi, 2014.

REFERENCES:
1. Laurene Fausett , "Fundamentals of Neural Networks", Pearson Education India, New Delhi, 2008.
2. Timothy Ross , "Fuzzy Logic with Engineering Applications", Mc Graw-Hill, Singapore, 2010.
3. Zimmermann H J , "Fuzzy Set Theory and its Applications", Allied Publisher, New Delhi, 2013.
4. Sivanandam S N, Deepa S N , "Principles of Soft Computing", Wiley India (P) Ltd, New Delhi, 2011.

19E031 LINUX ARCHITECTURE

3 0 0 3

INTRODUCTION : Evolution of Linux OS – Main characteristics of Linux – Typical Linux distributions – Linux directory structure – User and super/root users – Access rights – Home directory – Overview of shell and GUI. (9)

LINUX KERENAL ARCHITECTURE : Layer diagram of OS - Hardware Abstraction Layer (HAL) – Memory manager – Scheduler – File system – I/O subsystem – Networking subsystem – IPC – User space. (9)

LINUX FILE SYSTEM : Layers of Linux file system – Structure of inode – Process file system – System programming concepts – API & ABIs – C library and compiler (9)

DEVICE DRIVER : PC I/O architecture – Classification of Linux devices: character and block devices – Port I/O – PCI and ISA bus – Polling, interrupt, and waiting queue – Device Files - Device driver Registration – Device driver initialization – I/O operation - Typical Linux driver – Dynamic and static drivers (10)

SYSTEM START UP : System start up (Booting) Methods - Kernel modules – Linking and unlinking of modules – On Demand modules linking. (8)

Total L: 45

TEXT BOOKS:
1. Michael beck, Harald bohme, Mirko dziadzka, Ulrich Kunitz, "Linux Kernel Programming", 3rd Edition, Pearson Education, Newdelhi, 2002.
2. Robert Love, "LINUX system programming", 3rd Edition, Publishers & Distributors Pvt. Ltd., New Delhi, 2007.

REFERENCES:
1. P.Raghavan, Amol Lad, Sriram Neelakandan, "Embedded Linux system design and development", Tailor & amp; Francis Group, New Delhi, 2016.
2. Daniel P.Bovet, Marco Cesati, "Understanding the Linux kernel", Third, Shroff publishers & distributors Pvt Ltd., New Delhi, 2005.
3. M.Tim Jones, "GNU/Linux Application Programming", Wiley Dreamtech India Pvt. Ltd,, New Delhi, 2005.
4. Jonathan Corbet, Alessandro Rubin, Greg Kroah-Hartman, "Linux Device Drivers", 3rd Edition, ORELLY, USA, 2005.

19E032 TOTAL QUALITY MANAGEMENT

3 0 0 3

EVOLUTION OF QUALITY MANAGEMENT : History of quality, Definition of quality, Dimensions of quality, Quality Planning, Principles of TQM, Contributions of Quality Gurus: Deming – Juran – Crosby, Cost of Quality. (9)

TQM PRINCIPLES : Customer satisfaction, Service Quality, Customer feedback, Teams, Quality Circles, Continuous Process Improvement, Juran Trilogy, Kaizen, 5S. (9)

STANDARDS / MODELS / METHODOLOGY : ISO standards: overview – clauses - advantages, CMM, CMMi, PCMM: Structure - Process areas - Characteristics of maturity levels, Six Sigma: evolution – DMAIC – DFSS - Advantages / disadvantages of standards / models / methodology. (9)

MEASUREMENT, ANALYSIS AND IMPROVEMENT : QMS in Software Organization, Software Quality Assurance Plans, Product Quality and Process Quality, Software Measurement and Metrics, Inspections (9)

TQM TOOLS : Benchmarking – Reasons and Process, Quality function deployment, House of Quality, Seven QC tools, Control charts, Management tools (9)

Total L: 45

TEXT BOOKS:
1. Dale H.Besterfield, Carol Besterfield, Geln and Mary, "Total Quality Management", Pearson Education, New Delhi, 2003.
2. Nina S Godbole, "Software Quality Assurance: Principles and Practice", Narosa Publishers, New Delhi, 2007.

REFERENCES:
1. Logothetics, "Managing for Total Quality - From Deming to Taguchi and SPC", Prentice Hall, New Delhi, 2002.
2. Subburaj Ramasamy, "Total Quality Management", Tata McGraw-Hill, New Delhi, 2005.
3. Juran J.M, and Gryna F.M, "Quality Planning and Analysis - From Product Development Through Use", Tata McGraw Hill, New Delhi, 2001.
4. Deming W.E, "Out of the Crisis", MIT Press, Cambridge, MA, 2000.

ONE-CREDIT COURSES

19EF01 LV SWITCHGEARS

1 0 0 1

CONTACTORS : Introduction to LV Switchgear – Typical industrial electrical layout. Introduction to contactors – Difference between switch and contactor – Types of contactors – Utilization category – Selection of contactors –Name plate details – Limits of operation – Special types of contactors (3)

RELAYS AND FUSES : Introduction to overload relay – Types of overload relay – Types of motor failures – Utilization category and trip class – Selection of overload relay – Introduction to Fuses. HRC fuse – Types and Utilization category. Introduction to digital protection techniques (3)

SWITCHES AND STARTERS : Introduction to switch – Types of switches – Utilization category – Selection of switches. Introduction to motor starters – Types of starters – Control and Power wiring circuits – Selection of starters – Types of timers (3)

CIRUIT BREAKER : Introduction to circuit breaker – Types of circuit breaker – Selection of Air circuit breaker – Introduction to MCCB and MCB – Difference between relay and release (2)

HANDS ON TRAINING : Assembling and maintenance of contactors - Testing the pickup and drop off voltages in contactors - Testing of thermal overload relay - Control wiring practice on DOL and Star Delta Starter - Demo on various LV Switchgear products (4)

Total L: 15

REFERENCES:
1. Wadhwa C L, "Electrical Power Systems", New Age International, New Delhi, 2010.
2. Madhava Rao T S, "Power Systems Protection : Static Relay with Microprocessors Application", Tata McGraw- Hill, New Delhi, 2004.

19EF02 ENERGY AUDITING AND CONSERVATION TECHNIQUES

1 0 0 1

INTRODUCTION : Mandatory Auditing requirements – Audit purpose, scope and frequency - Energy Auditing & Conservation concepts and its Importance – Energy conservation opportunities in electrical power supply sector - The Energy Conservation Act, 2001 and its features (3)

ENERGY AUDIT METHODOLOGY AND MANAGEMENT SYSTEM : Overview of Electrical energy audit, tools for electrical energy audit- billing, tariff, demand, power factor and load factor. Duties and responsibilities of energy systems auditors (3)

ENERGY CONSERVATION IN ELECTRICAL SYSTEMS : Overview of Electrical energy requirements-pumps, fans, lighting and Variable Speed Drives. Electrical energy conservation- industrial motors, air conditioning and refrigeration systems (3)

ENERGY AUDITING IN INDUSTRIAL LIGHTING AND GREEN BUILDINGS : Choice of lighting, energy saving, control of lighting, lighting standards, lighting audit, use of different lighting technologies, electronic ballast. Overview of Green buildings (3)

DEMONSTRATION SESSIONS : Power factor Measurement & Compensation Techniques - Energy Saving Techniques - Lighting, air conditioning, pumps & fans - Case studies and exercises (3)

Total L: 15

REFERENCES:
1. Donald R Wulfinghoff, "Energy Efficiency Manual", Energy Institute Press, USA, 1999.
2. Tripathy S C, "Electrical Energy Utilization and Conservation", Tata McGraw-Hill, New Delhi, 1991.
3. Thiruvengadam S, Srinivasan P S, "Energy Management In Electrical Energy System", ISTE Publication, New Delhi, 1999.

19EF03 ELECTRICAL SAFETY STANDARDS AND PRACTICES

1 0 0 1

INTRODUCTION : Introduction and characteristics of conductors and insulators (1)

PRINCIPLES OF ELECTRIC SAFETY : Basic definition and principles of Electric Safety. Earth Effects when current passing through human body (2)

RULES & REGULATIONS : Electricity Acts, Rules & Regulations, Earthing Practices, Introduction to IEEE standards (2)

PROTECTION : Safety against Over voltages-Safety against Static Electricity-Protective Equipments (2)

STANDARDS : Electrical Standards – Indian Scenario (2)

SAFETY PRECAUTIONS : Indoor safety precautions in indoor equipments - Outdoor safety precautions (2)

CASE STUDY : Electrical Emergencies, Factors and study of Electrical Accidents - Case Study and remedial measures, Definition and study of Arc injuries (2)

ELECTRICAL SAFETY : Determining Safe Approach Distance - Determining Arc Hazard Category, Fire extinguishers for electrical safety (2)

Total L: 15

REFERENCES:

1. Kenneth G. Mastrullo, Ray A. Jones, "The Electrical Safety Program Book", Jones and Bartlett Publishers, London, 2003.
2. Palmer Hickman, "Electrical Safety-Related Work Practices", Jones & Bartlett Publishers, London, 2009. TANGEDCO.

19EF04 AUTOMOTIVE ELECTRICAL SYSTEMS

1 0 0 1

INTRODUCTION : Major components of an Automobile Systems and its functions - Overview of four stroke I.C.engine -Four Cylinder Engine – Spark firing sequence (2)

AUTOMOBILE ELECTRICAL AND ELECTRONIC SYSTEMS AND COMPONENTS : Block diagram of Automobile electrical system - Typical wiring diagram - Starter system: General layout - Basic starting circuit - Ignition system: Battery and magneto types - Battery ignition system for four cylinder engine - Ignition system circuit - Distributed ignition coil and ignition advance. Charging system: Typical alternator in common use - cut-out and regulator - Lighting & accessories system - Wiper motor – circuit diagram of wind screen wiper motor and washer (5)

SENSORS AND ACTUATORS : Physical Variables to be measured in automobiles: Position sensor: Magnetic reluctance and Hall effect sensor - Temperature sensor: Coolant temperature - Speed sensor – Fuel level sensor - Acceleration sensor - Actuator: Principle of solenoid and Fuel injector (4)

DIAGNOSTICS AND COMMUNICATION BUS : Block diagram of Engine control unit -Diagnostics procedure: Introduction – Diagnostics theory – On board and Off-board diagnostics – Diagnostics Link Connector – Vehicle condition monitoring - CAN bus - topology – Data transmission – CAN Protocol – Overview of CAN controller – LIN bus: overview – Data Transmission System – LIN protocol (4)

Total L: 15

REFERENCES:

1. Tom Denton, "Automobile Electrical and Electronics systems", Taylor & Francis, London, 2012.
2. KK Jain, RB Sharma, "Automobile engineering", Tata McGraw Hill, New Delhi, 2011.
3. William B. Ribbens, Norman P. Mansour, "Understanding of Automotive Electronics", Butterworth-Heinemann, United Kingdom, 2003.
4. Automotive Electrics/ Automotive Electronics, 5th Edition, Robert Bosch GmbH, 2004.

19EF05 CAD TOOLS FOR VLSI DESIGN AUTOMATION

1 0 0 1

INTRODUCTION TO VLSI DESIGN PROCESS : Design flow – Role of CAD tools in the design process (2)

DESIGN CAPTURE : Features of Mentor Graphics-Design Architect IC, a tool for schematic capture, netlisting, simulation setup and results viewing - Creating an Inverter using DA_IC- ELDO simulator (3)

SIMULATION : Features of Advance MS simulator, a tool for verification platform for AMS design and verification - Exercises (4)

PHYSICAL LAYOUT : Features of the IC Station Tool Suite for full custom IC design flow editing, Schematic-driven layout and top-level floor planning/routing – Exercises (3)

PHYSICAL VERIFICATION : Features of Calibre LVS for physical verification tool, for layout versus schematic – Exercises (3)

Total L: 15

REFERENCES:

1. Michael John Sebastian Smith, "Application-Specific Integrated Circuits", Addison-Wesley, New Delhi, 2010.
2. WayneWolf, "Modern VLSI Design: Systems on Chip Design", Pearson Education, New Delhi, 2007.

19EF06 DIGITAL DESIGN WITH VERILOG HDL

1 0 0 1

INTRODUCTION : Digital Design, Verification, and Hardware description languages (2)

VERILOG FOR DESIGN : Introduction to Logic Synthesis, Synthesizable Constructs -Inferring Combinational Circuit elements-Inferring Sequential Circuit elements -State Machines -Counters -Encoders/Decoders -Synthesis of Loops -Data Path - Design Partitioning / Methodology -Synthesizable Code-care about, Sensitivity list and Simulation Synthesis mismatch conditions (3)

VERILOG FOR VERIFICATION : Delay Modeling in Verilog on Briefly behavioral constructions, Fork-join, Events - Clock Generation -Data Generation, Deterministic, Random -Some Systems Tasks -TestBench Architecture (3)

DESIGN EXAMPLES : RISC Stored Program Machine -UART Design (3)

MINI PROJECT IMPLEMENTATION : Mini Projects Specification and Scope Discussions (2), REVIEW OF PROJECTS-Presentation by student groups (15 min per student group), Feedback on the Design Project(1) (4)

Total L: 15

REFERENCES:

1. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL", Pearson Education, New Delhi, 2017.
2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Chennai, 2019.

19EF07 GRAPHICAL PROGRAMMING

1 0 0 1

INTRODUCTION TO GRAPHICAL PROGRAMMING : Graphical Programming vs Coventional Programming - Features of LabVIEW - Data Flow Programming - Customizing Virtual Instruments - (2)

MODULAR PRORAMMING : Sub-VI Creation - Debugging Techniques - Examples (2)

ARRAYS AND CLUSTERS : Concept of Polymorphism - Error Clusters (3)

LABVIEW STRUCTURES : For Loop - While Loop - Case Structures - Sequence Structures (5)

STRINGS AND FILE I/O : String Functions - File I/O Operations (3)

Total L: 15

REFERENCES:

1. Rick Bitter, Taqi muhiuddin, Matt Nowrocki, "LabVIEW Advanced Programming Techniques", 2nd Edition, CRC Press, USA, 2007.
2. Gary W. Johnson; Richard Jennings, "LabVIEW Graphical Programming", 4th Edition, McGraw-Hill, New Delhi, 2006.

19EF08 ADVANCED GRAPHICAL PROGRAMMING

1 0 0 1

DATA ACQUISITION : DAQ Architecture - DAQ Assistant - Measurement and Automation Explorer (2)

LOCAL AND GLOBAL VARIABLES (2)

REENTRANT VIRTUAL INSTRUMENTS (1)

OBJECT ORIENTED PROGRAMMING IN LABVIEW (3)

REMOTE DATA MANAGEMENT : Data Socket - LabVIEW Web Server - Viewing and Controlling Front Panels Remotely - Viewing and Controlling Front Panels in LabVIEW - Viewing and Controlling Front Panels from a Web Browser (3)

IMAGE ACQUISITION AND PROCESSING IN LABVIEW (2)

PROJECT MANAGEMENT IN LABVIEW (2)

Total L: 15

REFERENCES:

1. Rick Bitter, Taqi muhiuddin, Matt Nowrocki, "LabVIEW Advanced Programming Techniques", 2nd Edition, CRC Press, USA, 2007.
2. Gary W. Johnson; Richard Jennings, "LabVIEW Graphical Programming", 4th Edition, McGraw-Hil, New Delhi, 2006.

19EF09 LOW POWER MICROCONTROLLERS AND APPLICATIONS

1 0 0 1

ARCHITECUTRE OF MSP430 : CPU Core Features - Programmer's Model - Clock System Configuration – Getting started with CCS IDE (3)

ON-CHIP PERIPHERALS OF MSP430 : GPIO - Timers - Watchdog Timers - ADC - Serail Communication: I2C, SPI, UART (10)

LOW POWER MODES IN MSP430 : Developing Applications in Various Low Power Modes (2)

Total L: 15

REFERENCES:

1. John Davies, "MSP430 Microcontroller Basics", 1st Edition, Newnes, USA, 2008.
2. Chris Nagy, "Embedded System Design using the TI MSP430 Series", 1st Edition, Newnes, USA, 2003.

19EF10 CONTROLLER DESIGN AND SIMUALTION USING DSPACE

1 0 0 1

SOFTWARE/ HARDWARE SETUP : Introduction to ControlDesk Next Generation- ControlDesk platform management- Introduction to Real-Time Interface I/O implementation with Real-Time Interface (5)

CONTROLDESK PROJECT AND EXPERIMENT MANAGEMENT : ControlDesk instrumentation - Introduction to Grid-Tied Inverter and Solar PV Grid Tied-Inverter (3)

CONTROLDESK BASIC DATA ACQUISITION : Basics on bus communication using ControlDesk - Multitasking and interrupt handling - Programming S-functions (3)

FEATURES OF DSPACE : Features of dSPACE prototyping systems and single-processor systems, and the use of dSPACE in applications like Solar PV GridTied Inverter (4)

Total L: 15

REFERENCES:

1. Jerry Ventre, Roger A. Messenger, "Photovoltaic System Engineering", CRC Press, 2014.

19EF11 SOLAR PV SYSTEMS DESIGN SIMULATION MONITORING AND CONTROL

1 0 0 1

INTRODUCTION TO PV SYSTEM DEISGN : Solar PV Fundamentals - PV Modules, PV Inverters, DC & AC Configurations, and Parameters & Datasheet Approach, MET Parameters, Weather Monitoring S, Modems & Protocols (2)

SOLAR PRO USER INTERFAC : Setting up of a Solar PV System using Simulation Wizard, 3D CAD Interface, File formats, Export / Import Capabilities, System Requirements, Shortcut keys. Choosing the Data Source - Meteorological Data, PV database, Inverter Database (2)

CONFIGURATION OF PV SYSTEM : Assessment of Loads to be Connected, Selection of Right Inverters & PV modules. Creating a String, Creating an Array, PV Array Configuration, PV Inverter Configuration, PV Electrical Assembly Configuration, PV Module Mounting Configuration & PV Module Tracking Configuration, Electrical BOM Preparation (4)

3D DESIGN FEATURES : Building and Surrounding Objects - Setting up of Building Parameters, Setting up of Surrounding Buildings or Structures, Setting up of Plants, Trees and Vegetation (2)

SIMULATION & REPORT GENERATION : Time Trackers, I-V curve simulation, Shadow analysis, Power generation, PV system cost & Financial analysis, PV Array layout, Power generation and loss diagram, Performance Ratio Analysis. Economic viability and Cost effectiveness of project, Print options and export options of variable parameters (2)

MONITORING OF SOLAR PV POWER PLANT : Remote Monitoring, Real – Time Monitoring, Multiple Inverter Monitoring, Interfacing of Hardware- Solar Link Zero- Modem, Routers, Modbus – Internet Gateway, Cloud Data, RS-485, RS-232 Serial, USB, Ethernet and DVI-D ports (3)

Total L: 15

REFERENCES:

1. Roger A. Messenger, Jerry Ventre, "Photovoltaic System Engineering", CRC Press, USA, 2004.

19EF12 POWER ELECTRONICS IN MORE-ELECTRIC AIRCRAFT

1 0 0 1

INTRODUCTION TO AIRCRAFT ELECTRICAL SYSTEM : Power sources: Aircraft Batteries – Lead Acid Batteries, VRLA Batteries, NiCd Batteries, Generators, Main Engine, Auxiliary Power Unit; Primary and Secondary Power Distribution System (3)

MORE ELECTRIC AIRCRAFT ARCHITECTURE : Migration from conventional fixed frequency electrical system to variable frequency electrical system, Advantages of More Electric Aircraft. Introduction to working principle of various Electrical Loads in Conventional and More Electric Aircraft. Electrical Loads in conventional aircraft – Avionics, Cabin Lighting, In-Flight Entertainment, Pumps and Fans. New Electrical Loads in More Electric Aircraft – Cabin Pressurisation Compressor, Air Conditioning, Ice Protection, Flight Control Actuator, Landing Gear, Electrical Taxi System, Braking System, Fuel Pumping (4)

RECTIFIERS, INVERTERS AND MOTOR CONTROLLERS IN AIRCRAFT : Starter Generator System in Aircraft: Main Engine and APU start System. Multipulse Rectifiers – Autotransformer Rectifier Units as front end converter. How design of Inverters for motor controllers in Aircraft is different from that for conventional industrial application. 2- Level and 3-Level inverters for motor control – Brushless DC motor control and Sensorless Vector control (4)

CASE STUDIES & PROJECT : Introduction to DO-160 standard and how that influences the design of power converter in aircraft. Practical Design of Power Electronic converters for real life Aero application: Case Study: Design of Exciter Power Supply – Design for space and weight optimization while meeting DO-160 standard (4)

Total L: 15

REFERENCES:

1. E.H.J. Pallett, "Aircraft Electrical Systems", 3rd Edition, Pearson, 1997.
2. Thomas Eismin, "Aircraft Electricity and Electronics", 6th Edition, McGraw-Hill Education, 2013.
3. Ramesh K. Agarwal, "Recent Advances in Aircraft Technology", Intechopen, 2012.

19EF13 FIELD PROGRAMMABLE ANALOG ARRAY FOR ANALOG SYSTEM DESIGN

1 0 0 1

INTRODUCTION : Overview of Analog Design - Introduction to FPAA and its advantages - Role of EDA tool in Analog Design process (1)

CONFIGURABLE ANALOG MODULES : Introduction to Anadigm`s inbuilt Analog Functions (CAM) - Generation of Clock Signals - Signal Delay - Performance of CAM. (1)

SIMULATION : Features of ANADIGMDESIGNER2 EDA tool for simulating the analog design. (1)

FPAA IO INTERFACING : Interfacing of input and output signals to the FPAA - Rauch Filter - Output Buffer (1)

PHYSICAL REALIZATION : Configuring the FPAA with analog design - Real time verification. (3)

STATIC CONFIGURATION : Full Wave Rectifier - Tone Generation and Notch filter - Voltage Controlled Oscillator - Pulse Width Modulation - Phase Detector. (2)

DYNAMIC RECONFIGURATION : Reconfigurable Analog design using FPAA, Various methods of Reconfiguration - Real time verification - Programming the PIC controller. (3)

MINI PROJECTS : Specification and Scope Discussions (3)

Total L: 15

REFERENCES:

1. Thomas L. Floyd, "Instructor"s Resource Manual to Accompany Electronic Design", 8th Edition, Pearson Education Ltd, New Delhi, 2008.
2. Thomas L. Floyd, "Electronic devices Conventional Current Version", 9th Edition, Pearson Education Ltd, New Delhi, 2014.

19EF14 SYSTEMS ENGINEERING FOR AUTOMOTIVE APPLICATIONS

1 0 0 1

INTRODUCTION : Systems, Systems Engineering and System on Systems Design Models flow: Waterfall, Spiral and INCOSEVEE model Product development flow Values of Systems Engineering (3)

ROLES OF SYSTEM ENGINEER : Understanding the Systems Engineering goal, Significance of documentation, Knowing about DSM (Design structure matrix), Interdisciplinary role of Systems Engineering, Behavioral aspects of Systems Engineering (3)

PROCESS : Requirements process, Baseline creation (1)

INNOVATION IN SYSTEM ENGINEERING : Creativity characteristics, About TRIZ, Ideality, Contradictions and approach to resolve Innovation in Technical systems: Architectural Innovation (3)

DESIGN PROCESS : Definitions, Axioms, Design Matrices, Types and examples, Constraints (2)

SYSTEM RELIABILITY : Definition, Approach to achieve system reliability, significance of Reuse, Failure Mode Effects Analysis (FEMA) (2)

EXAMPLE SYSTEM DESIGN : Designing an Automotive ECU (1)

Total L: 15

REFERENCES:

1. INCOSE Systems Engineering Handbook , "A Guide for System Life Cycle Processes and Activities", 4th Edition, Wiley, New Jersey, 2015.
2. Alexander Kossiakoff, William N. Sweet, Samuel J. Seymour, Steven M. Biemer , "Systems Engineering Principles and Practice", 2nd Edition, Wiley, New Jersey, 2011.
3. Benjamin S. Blanchard, John E. Blyler , "System Engineering Management", 5th Edition, Wiley, New Jersey, 2016.

19EF15 ELECTRICAL VEHICLES

1 0 0 1

INTRODUCTION TO ELECTRIC VEHICLES : Social and environmental importance of electric vehicles. – Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. (3)

HYBRID ELECTRIC VEHICLES : History of Hybrid Electric Vehicles - Energy consumption Concept of Hybrid Electric Drive - Architecture: Series Hybrid Electric Drive, Parallel hybrid electric drive. - Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Super Capacitors. (3)

ELECTRIC PROPULSION UNIT : Electric components, Configuration and control of drives - DC Motor - Induction Motor - Permanent Magnet Motor - Switch Reluctance Motor - Drive system efficiency - Energy storage for EV and HEV - Energy storage requirements, Battery parameters, Modelling of Battery. (5)

POWER ELECTRONIC CONVERTERS : Power Electronic Converter for Battery Charging - Charging methods for battery - Design of Z-converter for battery charging. - Case Study: Design of a Battery Electric Vehicle (BEV). (4)

Total L: 15

REFERENCES:

1. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, London, 2009.
2. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC Press, London, 2010.
3. Sheldon S. Williamson , "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, London, 2013.
4. C.C. Chan and K.T. Chau, "Modern Electric Vehicle Technology", OXFORD University Press, New York, 2001.
5. Chris Mi, M. Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles Principles And Applications With Practical Perspectives", Wiley Publication, UK, 2011.
6. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, UK, 2003.

19EF16 PHASOR MEASUREMENT UNITS AND APPLICATIONS

1 0 0 1

INTRODUCTION : Phasor Measurement Units (PMUs), Global Positioning System (GPS), Functional requirements of PMUs and Phasor Data Concentrators (PDCs), Phasor estimation of nominal frequency inputs. (2)

TRANSIENT RESPONSE : Transient response of Instrument Transformers, Transient response of Filters, Transient response

during Electromagnetic and Power Swings, Impact of Transient Response of Phasor Measurements. (2)

APPLICATIONS OF PHASOR MEASUREMENT UNITS : Phasor Measurements Unit based Adaptive Protection of Transmission Lines, Out-of-Step protection, Adaptive System Restoration, Phasor Measurement units in Large Scale Integration of Wind and Solar Energy systems, Introduction to Wide Area Monitoring, Protection and Control (WAMPAC). Deployment of large scale PMUs in Utilities, Globally and in Indian Power sector. (8)

STANDARDS : Synchrophasor Standards - IEEE C37.118.1-2011, IEEE C37.118a-2014, IEC 61850 & IEEE C37.118, Evaluation / Validation of PMU-Total Vector Error (TVE) both Steady State and Dynamic/Transient conditions. IEEE C37.118.2-2011. (3)

Total L: 15

REFERENCES:

1. A.G.Phadke, J.S. Thorp, "Synchronized Phasor Measurements and Their Applications", 2nd Edition, Springer Publications, New York, 2017.
2. IEEE Standards, "IEEE Synchrophasor Test Suite Specification", Version 2, IEEE Publishing, USA, 2015.
3. IEEE Standards, "IEEE C37.118.1a-2014, IEEE Standard for Syncrophasor Measurements for Power Systems", IEEE Publishing, USA, 2014.
4. IEEE Standards, "IEEE C37.242, 2013 - Guide for Synchronization, Calibration, Testing, and Installation of Phasor Measurement Units (PMU) for Power System Protection and Control", IEEE Publishing, USA, 2013.
5. IEEE Standards, "IEEE C37.244, 2013 - Guide for Phasor Data Concentrator (PDC) Requirements for Power System Protection, Control, and Monitoring.", IEEE Publishing, USA, 2013.
6. IEEE Standards , "IEEE C37.118-2, 2011 - Standard for Synchrophasor Data Transfer for Power Systems", IEEE Publishing, USA, 2011.

19EF17 INDUSTRIAL DRIVES FOR AUTOMATION

1 0 0 1

INTRODUCTION : Construction and Principle of operation of PMSM and SynRM – AC drive Hardware Blocks – Control Blocks – Automatic Motor Adaptation – Parameterization of Drives (Local and Remote) (4)

CONFIGURATIONS OF DIFFERENT I/O CONTROL : Digital Input and output – Analog Input and output Control-word access – Motion control - Sequential Logic Control (SLC) - Parameterization for different communication protocol: RS 485 – MODBUS - PROFIBUS (3)

CONFIGURATION FOR DIFFERENT APPLICATIONS : AQUA – HVAC – Automation – Master/ Slave control (4)

PRACTICAL : Performance characterization of PMSM and SynRM - Conveyor control – Cascaded Pump Control – Synchronization of Drives with Master Slave Control (4)

Total L: 15

REFERENCES:

1. W. Bolton, "Programmable logic controllers", Elsevier Ltd, 2015.
2. Gordon Clarke, Deon Reyneders, Edwin Wright, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related systems", Newnes Publishing, 2004.

19EF18 DATA SCIENCE AND ANALYTICS FOR ELECTRICAL ENGINEERS

1 0 0 1

INTRODUCTION TO DATA AND MACHINE LEARNING (DATA SCIENCE) : Data Warehouse / business Intelligence-Big Data-Machine Learning-Deep Learning-How these technologies evolved and interconnected (2)

REVIEW OF BASIC ANALYTICS METHODS USING R : Phase 1: Discovery-Phase 2: Data Preparation-Phase 3: Model Planning-Phase 4: Model Building-Phase 5: Communicate Results / Visualization-Phase 6: Operationalize / Optimize model – Demo-Lab Assignment. (6)

INTRODUCTION TO ADVANCED ANALYTICS - THEORY AND METHODS : Unsupervised Learning-K-means Clustering-Association Rules-Regression Analysis-Linear-Logistics- Supervised Learning- Naive Bayesian Classifier-Decision Trees-Time Series Analysis-Text Analysis. (6)

USE CASES OF BIG DATA AND MACHINE LEARNING FOR ELECTRICAL ENGINEERS : Smart Meters & Smart Grid (1)

Total L: 15

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning", 2nd Edition, PHI learning Pvt. Ltd, New Delhi, 2015.
2. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", 1st Edition, Packt Publishing Ltd, Mumbai, 2013.

19EF19 ELECTRICAL POWER ON-BOARD WAR VESSELS AND AIRCRAFT

1 0 0 1

AC AND DC ELECTRICAL POWER GENERATION AND DISTRIBUTION (PGD) ON BOARD FIGHTER AIRCRAFT : Purpose and tasks – Power Supply requirements – Units of Installation, general layout and Functioning – Principle of Operation and Functional Block Diagram – Interconnectivity with other Systems – Operational Limitations – Serviceability Checks. (5)

AC AND DC ELECTRICAL POWER GENERATION AND DISTRIBUTION ON BOARD A MILITARY HELICOPTER : Types of Supplies –Specifications – Protection and Control Units – Onboard and external AC and DC Power supply system Description with Diagrams. (3)

PGD ONBOARD WARSHIPS : Types of electrcialsupplies and power generation – Distributing systems – Design considerations for various classes and sizes of ships – Comparison of AC and DC ships – Challenges and special considerations in design of PGDfor warships. (5)

PGD ONBOARD SUBMARINES : Types of supplies, sources of power and distribution systems – Issues related to design for various classes and sizes of Submarines – Challenges in design of PGD for Submarines. (2)

Total L: 15

REFERENCES:

1. Raunek Kantharia, "A Guide to Ship"s Electro-Technology, Part I, For Marine Engineers and Electrical Officers", Marine Insight Publishers, Kochi, 2013.
2. Mukund R. Patel, "Shipboard Electrical Power Systems", 1st Edition, CRC Press, United States, 2017.
3. Indian Navy, "OEM Supplied Technical Manuals of Ships, Aircraft and Submarines of Navy", Kochi, 2008.

19EF20 AEROSPACE AVIONICS

1 0 0 1

FLIGHT CONCEPT : Theory of Flight and Control Surfaces - Evolution of Avionics - Aircraft Cockpit Systems - Tactical Systems - Aircraft Power Plant Systems and Armament Systems on board an aircraft - Space avionics - Challenges in the design of Avionics for Space Vehicles. (3)

AIR NAVIGATION SYSTEMS : Electrical Navigation Systems - Compass-Inertial Navigation Systems (INS). (2)

AIRCRAFT FLIGHT INSTRUMENTS : Air Data Systems/ Air Data Computers - Pitot Static Systems - Air Speed Indicator - Vertical Speed Indicator - Altimeters-Artificial Horizon or Attitude Indicator - Flight Directors. (5)

CRITICAL AIRCRAFT AVIONICS SYSTEMS : Automatic Flight Control Systems -Automatic Flight Guidance Systems-Autopilot-Collision Avoidance Systems-Flight Data Recorders-Cockpit Voice Recorders. (5)

Total L: 15

REFERENCES:

1. E H J Pallett, "Aircraft Instruments", 2nd Edition, Pearson Education, New Delhi, 2009.
2. S. Nagabhushana, N. Prabhu, "Principles of Modern Avionics", 1st Edition, IK International Publishing House Pvt Ltd, New Delhi, 2018.
3. Cary Spitzer, Uma Ferrel, Thomas Ferrell, "Digital Avionics Handbook", 3rd Edition, CRC Press, Taylor & Francis Group, UK, 2017.
4. Ian Moir, Allan Seabridge, "Military Avionics Systems", 3rd Edition, Wiley & sons, India, 2006.

19EF21 1-D MODEL BASED SYSTEM DESIGN FOR CONTROL SYSTEM APPLICATIONS

1 0 0 1

INTRODUCTION TO ALTAIR ACTIVATE : Basic Network Theorems verification -Op-amp circuit - Realizing RLC circuits in Signal based /State space and Physical Based modeling. (5)

HYBRID SIMULATION : continuous and discrete blocks - Co-simulation - with Multi-body dynamics with Activate software - Co-simulation of Electromagnetic Devices - System Simulation- Custom Block creation - Model Exchange and Co-simulation with Functional Mock-up Interface - Application Case study using Altair Activate Software. (5)

INTRODUCTION TO ALTAIR EMBED : Simulation Environment - Building blocks and software features –- SIL/MIL - PIL– HIL - Application development on launchpad - GPIO – ADC -PWM - SPI/I2C Introduction to Motor Control and using BOOSTXL DRV8301, F28069M Launch pad. (5)

Total L: 15

19EF22 PRINTED CIRCUIT BOARD DESIGN AND ITS FABRICATION

1 0 0 1

PCB DESIGN PROCESS AN OVERVIEW : Conception Level Introduction: Specifying Parts- Packages and Pin Names- The Partlist- The Netlist- Parts- Routing- Adding Text- Plot and Drill Files- PCB Layout- Layer List and Selection Mask- Panning and Zooming-Projects-PCB Elements (2)

PCB DESIGN WORK FLOW : Board Outline; Parts – Anatomy of a Part- Part list- Editing Parts- Reference Designator- Mounting Holes- Nets- Ratlines and Routing- Nets – Netlist -Ratlines-Vias- Modifying Traces- Swapping Pins- Importing Netlist- Copper Areas- Text; Solder Mask Cutouts- Groups- Design Rule Checking- Exporting Drill and Gerber Files- Drills- Footprints and Libraries Adding and Editing Pins- Polylines. (3)

APPLICATION ORIENTED DESIGN AND FABRICATION : Creating the Project - Drawing the Board Outline - Adding Mounting Holes-Placing Parts- Adding Parts and Editing Nets- Power plane- Ratlines and Routings- Fabrication , Checking Design Rules, Generating Gerber and Drill Files, Fabrication Process and Methodology. (1)

INTRODUCTION TO PCB DESIGN SOFTWARE : Learn about design preparation- Import logic design data- Learn about design rule- Component placement- Interactively route nets- Run the automatic router- Learn about the manufacturing output and documentation. (5)

HIGH SPEED DESIGN : Design Concept – Layout techniques – DDR Routing – Signal Integrity – Power Integrity – PCB Simulation concepts - Design Problems – Case Studies (4)

Total L: 15

REFERENCES:

1. IPC Standards, "SM750 Component Packaging and Inter connecting with emphasis on Surface Mounting", IPC Standards, United States, 1988.
2. IPC Standards, "7351 B Generic Requirements for surface mount design And land pattern standard", IPC Standards, United States, 2010.
3. IPC Standards, "2221A Generic Standard on Printed Board Design", IPC Standards, United States, 2003.
4. James C. Blankenhorn , "SMT High Density Design and DFM", SMT Plus, United States, 1996.

19EF23 DIGITAL SYSTEM DESIGN AND VERIFICATION USING SYSTEM VERILOG

1 0 0 1

INTRODUCTION : : Digital Design and Verification, and Hardware description/verification language (HDL/HVL). (1)

SYSTEM VERILOG BASICS : : Verification Guidelines, Data types, Procedural Statements and Routunes, Connecting testbench and design (4)

OOPS AND RANDOMIZATION : : Basic OOP (Object Oriented Programming), Randomization, Threads and IPC (Inter-Process Communication), Introduction to Advanced OOP and guidelines. (4)

TESTBENCH EXAMPLES : : Test Bench for ATM switch (3)

MINI PROJECT IMPLEMENTATION : Mini Projects Specification and Scope Discussions, REVIEW OF PROJECTS- Presentation by student groups (15 min per student group), Feedback on the Design Project (3)

Total L: 15

REFERENCES:

1. Chris Spear, Greg Tumbush, "System Verilog for Verification – A guide to Learning the Test bench Language Features", 3rd Edition, Springer, New York, 2012.
2. J.Bhasker, "A system Verilog Primer", BS publications, Hyderabad, 2016.

19EF24 METROLOGY FOR ELECTRICAL ENGINEERS

1 0 0 1

BASIC METROLOGY : Understanding metrology Vocabulary, Measurement significance and application - Common metrology terminologies. Calibration – Objective and benefits of calibration (2)

TRACEABILITY AND SI UNITS : Traceability and its importance - International Metrology Structure, Calibration Hierarchy, Importance of SI Units and types of SI Units (2)

STANDARDS USED IN ELECTRICAL CALIBRATION : Absolute, Primary, secondary, working and census standards, measurement setup - Interpretation of specifications of various calibration standards and Device Under Calibration (DUCs) - Metrology standardization documents (3)

CALIBRATION PROCEDURES FOR VARIOUS ELECTRICAL T & M INSTRUMENTS : Methods of Calibration - Calibration procedure of Voltmeter, Multimeter - Calibration procedure of DMM, Oscilloscopes, clamp meter, Panelmeters - Case studies (4)

MEASUREMENT UNCERTAINTY : Overview on Uncertainty – reason for uncertainty - its importance - Type A and type B uncertainty - Sensitivity coefficients – uncertainty evaluation - best practice - Uncertainty in practice & Case studies (4)

Total L: 15

REFERENCES:

1. Mike Cable, "Calibration: A Technicians Guide", ISA Publisher, 2005. International Organization for Standardization, Geneva, Switzerland, 1993, NABL.

19EF25 EMBEDDED LINUX

1 0 0 1

INTRODUCTION : Evolution of Linux OS – Typical Linux distributions – Linux directory structure – User and super/root users – access rights – Home directory – Overview of shell -Core Embedded Linux concepts- Including Board Support Package (BSP) - Software Development Kit (SDK) (3)

EMBEDDED LINUX ARCHITECTURE : Layer diagram of OS - Hardware Abstraction Layer (HAL) - Memory manager – scheduler – file system – I/O subsystem – Networking subsystem -Block diagram of Embedded Linux system - Cross compilation tool chain – Boot loaders - Linux kernel - Device trees - Board support package (BSP) (5)

EMBEDDED LINUX DEVELOPMENT ENVIRONMENT : Development environment through SDK - Deploy Linux to embedded system through a BSP - Build / deploy and debug software in cross-environment - Host vs target - Serial line communication program - Transferring files to target using NFS. (3)

EMBEDDED LINUX BUILD SYSTEM : Introduction - Linux Root file system - Yocto build system - Cross compilation of user space packages - Basic System and Application Programming: Time Storm eclipse - Debugging – profiling - target (inside QEMU). (4)

Total L: 15

REFERENCES:

1. Jon Masters, Karim Yaghmour, Philippe Gerum, Gilad Ben-Yossef, "Building Embedded Linux Systems", O'Reilly Media, Inc, USA, 2008.
2. Christopher Hallinan, "Embedded Linux Primer: A Practical, Real-World Approach", 2nd Edition, Prentice Hall, Boston, 2011.
3. Daiane Angolini, Otavio Salvador, "Embedded Linux Development using Yocto Projects", Packt Publishing, USA, 2017.
4. Marco Cesati, Daniel P. Bovet, "Understanding the Linux Kernel", O'Reilly Media, USA, 2000.
5. DougAbbott, "Embedded Linux Development Using Eclipse", Newnes, UK, 2008.
6. Alex Gonzalez, "Embedded Linux Development Using Yocto Project Cookbook", 2nd Edition, O'Reilly Media, USA, 2018.

19EF26 INTERNET OF THINGS USING CC3200

1 0 0 1

INTRODUCTION TO INTERNET OF THINGS (IOT) : Basic Terminologies - Architecture of a typical IoT System – Examples - Challenges in the design process of IoT – Overview ARM Cortex M4 Architecture Core -Getting started with Code Composer Studio (3)

FEATURES OF CC3200 WI-FI PROCESSOR : Programmer"s Model of CC3200 Simplelink Wi-Fi Processor - Low Power Modes of CC3200 - Embedded Software Development Process – Features of TI RTOS - Configuration of TI RTOS for CC3200 Simplelink, Simplelink Wi-Fi Certification (2)

WIRELESS LOCAL AREA NETWORK : Basics of WLAN - WLAN Standards – WLAN Devices: Access Point, Station - WLAN Network Establishment (2)

SOFTWARE DEVELOPMENT TOOLS FOR PROGRAMMING CC3200 : Getting started with Code Composer Studio - Configuration with Pin-Mux Tools - Debugging with Uniflash Tools - HTML Page Download (2)

PROGRAMMING CC3200 : Features of CC3200 On-chip Peripherals – General Purpose I/O Programming in CC3200 – Interfacing a sensor with CC3200 using On-chip ADC – Interrupt Structure of CC3200 – Serial Communication in CC3200 – Overview of Client-Server Model – MQTT Protocol – Cloud Computing Overview – Simple IoT Applications using CCS Software (6)

Total L: 15

REFERENCES:

1. Jonathan W Valvano, "Introduction to Arm(r) Cortex-M Microcontrollers", 5th Edition, Create Space Independent Publishing Platform, US, 2012.
2. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide", 1st Edition, Morgan Kaufmann, US, 2004.

LANGUAGE ELECTIVES

19G001 COMMUNICATION SKILLS FOR ENGINEERS

0 0 4 2

COMMUNICATION CONCEPTS :
Process of Communication
Inter and Intrapersonal Communication
Inter and Intrapersonal Communication Activities (9)

FOCUS ON SOFT SKILLS :
Etiquette — Work Place etiquette — Telephone etiquette
Body Language
Persuasive Communication
Public Speaking
Critical Reasoning and Conflict Management based on Case Studies
Group Communication
Meetings
Interview Techniques (14)

TECHNICAL WRITING :
Technical Writing Principles
Style and Mechanics
Technical Definitions – Physical, Functional and Process Descriptions
Technical Report Writing
Preparing Instructions and Manuals
Interpretation of Technical Data (15)

BUSINESS CORRESPONDENCE :
Writing Emails
Preparing Resumes
Memos
Technical and Business Proposals (7)

TECHNICAL COMMUNICATION :
Seminars
Process Description and Group Discussions
Use of Visual Aids (15)

Total P: 60

TEXT BOOKS:
1. Faculty Incharge, "Course Material on Communication Skills for Engineers", PSG College of Technology, Coimbatore, 2019

REFERENCES:
1. Jeff Butterfield, "Soft Skills for Everyone", Cengage Learning, New Delhi, 2013
2. Jean Naterop B and Rod Revell, "Telephoning in English", Cambridge University Press, Cambridge, 2011
3. David A Mc Murrey and Joanne Buckley, "Handbook for Technical Writing", Cengage Learning, New Delhi, 2011
4. Simon Sweeney, "English for Business Communication", Cambridge University Press, New Delhi, 2012

19G002 GERMAN- LEVEL A1.1

0 0 4 2

GUTEN TAG! :
1. To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages
2. Vocabulary: related to the topic
3. Grammar: W — Questions, Verbs & Personal pronouns I. (10)

FREUNDE, KOLLEGEN UND ICH :
1. To speak about hobbies, jobs, learn numbers from 20; build dialogues and frame simple questions & answers
2. Vocabulary: related to the topic
3. Grammar: Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural (10)

IN DER STADT :
1. To know places, buildings, question, know transport systems, understand international words; build dialogues and write short sentences
2. Vocabulary: related to the topic
3. Grammar: Definite & indefinite articles, Negotiation, Imperative with Sien verbs (12)

GUTEN APPETIT! :
1. To speak about food, shop, converse; Vocabulary: related to the topic; build dialogues and write short sentences

2. Grammar: Sentence position, Accusative, Accusative with verbs, personal pronouns & prepositions, Past tense of haben & sein verbs (13)

TAG FŸR TAG/ZEIT MIT FREUNDEN :
1. To learn time related expressions, speak about family, about birthdays, understand & write invitations, converse in the restaurant; ask excuse, fix appointments on phone
2. Vocabulary: related to the topic
3. Grammar: Time related prepositions, Possessive articles, Modalverbs (15)

Total P: 60

TEXT BOOKS:
1. Dengler Stefanie, "Netzwerk A1.1", Klett-Langenscheidt Gmbh., München, 2013
2. Sandra Evans, Angela Pude, "Menschen A1", Hueber Verlag, Germany, 2012

REFERENCES:
1. Stefanie Dengler, "Netzwerk A1", Klett-Langenscheidt Gmbh, München, 2013
2. Hermann Funk, Christina Kuhn, "Studio d A1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2009
3. Rosa-Maria Dallapiazza, "Tangram Aktuell 1 (Deutsch als Fremdsprache)", Max Hueber Verlag., Munchen, 2004
4. Christiane Lemcke und Lutz Rohrmann, ""Grammatik Intensivtrainer A 1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2012

19G003 FRENCH LANGUAGE LEVEL 1

0 0 4 2

PARTS OF SPEECH :
1. inviter et répondre à une invitation, Pronoms sujets
2. L'article définis, l'article indéfinis
3. Conjugation : présent, adjectifs possessifs
4. interrogation, décrire les personnes
5. La vie de quatre parisiens de professions différentes (12)

ELEMENTS OF GRAMMAR :
1. Exprimer l'ordre et l'obligation demander et commander
2. l'adjectif possessifs, l"article partitif, l'article démonstratif, négation ne
3. pas, l'article contracté
4. verbe pronominaux
5. prepositions (12)

SENTENCE STRUCTURE :
1. Raconter et reporter-donner son avis
2. Futur simple, pronom complètement d'objet direct, passé composé
3. plusieurs région de France, imparfait, pronom y/en, imparfait (12)

TENSES AND NUMBERS :
1. Demander l'autorisation-passé récent, futur proche
2. La vie administrative et régionale, Pluriel des noms, moyens de transport (12)

DISCOURSE :
1. le discours rapporté, décrire un lieu, exprimer ses préférences
2. décrire la carrière, discuter d"système éducation de France
3. parler de la technologie de l'înformation (12)

Total P: 60

TEXT BOOKS:
1. Christine Andant étal, "À propos (livre de l'élève", LANGER., New Delhi, 2012
2. Myrna Bell Rochester, "Easy French Step By Step", McGraw Hill Companies., USA, 2008

REFERENCES:
1. Michael D. Oates, "Entre Amis: An Interactive Approach", 5th Edition, Houghton Mifflin, 2005.
2. Bette Hirsch, Chantal Thompson, "Moments Literaries : An Anthology for intermediate French",
3. Simone Renaud, Dominique van Hooff, "En bonne forme".

19G004 BASIC JAPANESE

0 0 4 2

JAPANESE PEOPLE AND CULTURE :
1. Basic greetings and responses
2. Basic script — Method of writing hiragana and katakana — Combination sounds and simple words

3. Self introductions: “Hajimemashite” -Demonstratives “Kore”, “Sore”, “Are” — Demonstrative “Kono”, “Sono”, “Ano”
4. Possessive noun particle “no” — Japanese apartments: Greeting your neighbor (12)

PATICLE “NI (AT)” FOR TIME :
1. kara (from) ~ made(until) — Particle “to (and)”
2. Time periods: Days of the week, months, time of day –Verbs (Present / future and past tense)
3. Telephone enquiry: Asking for a phone no. And business hours- Destination particle “e”. (12)

LIKES AND DISLIKES :
1. Potential verbs (wakarimasu and dekimasu) — “Kara (~ because)”
2. Adverbs — Asking some one out over the phone-Verbs denoting presence
3. Introduction to Adjectives (na and ii type) -Verb groups — I, II and III — Exercises to group verbs- Please do (te kudasai)
4. Present continuous tenses (te imasu) — Shall I? (~ mashou ka) — Describing a natural phenomenon (It is raining) (12)

DIFFERENT USAGES OF ADJECTIVES :
1. Comparison — Likes and dislikes — Going to a trip- Need and desire (ga hoshii) — Wanting to . . . (Tabeti desu)- Going for a certain purpose (mi –ni ikimasu)
2. Choosing from a menu-Adjectives (“i” and “na” type) — Adjectives (Positive and negative useage) (12)

ROLE PLAYS IN JAPANESE :
1. Framing simple questions & answers
2. Writing Short paragraphs & Dialogues
3. A demonstration on usage of chopsticks and Japanese tea party (12)

Total P: 60

TEXT BOOKS:
1. Minna no Nihongo, Honsatsu Roma, "ji ban (Main Textbook Romanized Version)",International publisher — 3A Corporation, Tokyo, 2012

REFERENCES:
1. Eri Banno et.al, "Genki I: An Integrated Course in Elementary Japanese I -Workbook", 1999
2. Tae Kim, "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", 2014
3. Minna No Nihongo, "Translation & Grammatical Notes In English Elementary".

ENGLISH

19GF01 INTERPERSONAL AND ORGANIZATIONAL COMMUNICATION

1 0 0 1

INTRA ORGANIZATIONAL COMMUNICATION : Communication Networks in an Organization; Intra- organizational communication (2)

INTER ORGANIZATIONAL COMMUNICATION : Flow Nomenclature; Workplace diversity and intercultural aspects of communication (2)

COMMUNICATION FUNCTIONS IN ORGANIZATIONS : Teamwork and team dynamics; Conflict resolution strategies and styles; Leading and influencing others-facilitation skills (3)

WRITTEN COMMUNICATION : Email Writing, Professional Reports, and Memos (4)

INTERPERSONAL SKILLS : Nature and Dimensions of Interpersonal Communication; Personality and Communication styles; Active listening and intentional responding; Working with emotional intelligence (4)

Total L: 15

REFERENCES:
1. Bagchi Subroto, "The Professional", Penguin Publications, UK, 2011.
2. PMBOK guide, "A Guide to the Project Management Body of Knowledge", Project Management Institute Inc, USA, 2013.

19GF02 HUMAN VALUES THROUGH LITERATURE

1 0 0 1

PROSE : Kalam"s vision of college education in Wings of fire - Emerson"s advocation of independence of Human will in Self-reliance - Harmony in Education-views of Betrand Russel (4)

POETRY : Maintaining Human relations in Robert Frost"s Mending Wall - Quest for identity and freedom in Kamala Das"s An Introduction (2)

DRAMA : Statesmanship and friendship in Girish Karnad"s Tughlaq (3)

ONE-ACT PLAY : The theme of love in Chekhov"s The Bear (3)

SHORT STORY : Empathy in Somerset maugham"s Mr. Know-all - Family bond in Anita Desai"s Devoted son (3)

Total L: 15

TEXT BOOKS:
1. Faculty - Department of English, "Course materials", PSG College of Technology, Coimbatore, 2019.

REFERENCES:
1. Abrams M .H, Harpham, "A Glossary of Literary Terms", Cengage, Boston, 2015.
2. Scholes R, et.al., "Elements of Literature", IV, Indian Rpt. OUP, New Delhi, 2013.

HUMANITIES

19OFA1 EXPORT – IMPORT PRACTICES

1 0 0 1

INTRODUCTION : Export – Import Business – Preliminaries for starting Export – Import Business Registration. (3)

EXPORT PROCEDURES: : Obtaining an Export License – Export Credit Insurance – Procedures and Documentation (4)

FOREIGN EXCHANGE : Finance for Exports – Pricing - Understanding Foreign Exchange Rates. (3)

IMPORT PROCEDURES : Import Policy – License - Procedure and Documentation. (3)

EXPORT INCENTIVES : Incentives - Institutional support (2)

Total L: 15

REFERENCES:
1. Ramagopal C, "Export Import Procedures - Documentation and Logistics", New Age International, 2014.
2. Cherian and Parab, "Export Marketing", Himalaya Publishing House, New Delhi, 2008.
3. Parul Gupta, "Export Import Management", MC-Graw Hill, 2017.
4. Justin Paul, Rajiv Aserkar, "Export Import Management", Oxford, 2013.

19OFA2 INSURANCE - CONCEPTS AND PRACTICES

1 0 0 1

INTRODUCTION TO INSURANCE AND RISK MANAGEMENT : Origin, History, Nature and Scope of insurance – Meaning, types and significance of risk. (3)

INSURANCE LAWS AND REGULATIONS : Insurance Act, IRDA Act, Consumer Protection Act, Ombudsman Scheme. (2)

INSURANCE UNDERWRITING AND RISK MANAGEMENT : Meaning of underwriting and underwriter, guidelines and steps in the process of underwriting – characteristics, significance and principles of risk management. (4)

FINANCIAL ASPECTS OF INSURANCE MANAGEMENT : Role and functions of financial institutions, determination of premium for various insurance products. (3)

SETTLEMENT OF INSURANCE CLAIMS : Documents needed during various claims, Factors affecting insurance claims (3)

Total L: 15

REFERENCES:
1. Scott Harrington, Gregory Niehaus, "Risk Management and Insurance", McGraw Hill Education, 2017.
2. George E Rejda, "Principles of Risk Management & Insurance", Pearson Education, 2017.
3. John Hull, "Risk Management & Financial Institution", John Wiley and Sons, 2018.
4. Arjun Mittal, D D Chaturvedi, "Insurance and Risk Management", Scholar Tech Press, 2017.

19OFA3 PUBLIC FINANCE

1 0 0 1

INTRODUCTION: Nature and Scope of public finance – Principles of taxation. (2)

PUBLIC REVENUE AND TAXATION: Sources of Revenue – Tax and non-tax revenue – Classification of Taxes, GST.

(4)

PUBLIC EXPENDITURE: Importance – Types – Causes of increase in public expenditure – Effects of public expenditure in India. (3)

DEFICIT FINANCING AND BUDGET: Sources of public debt – Debt redemption – Budget – Types – Preparation of Budget in India. (3)

FEDERAL FINANCE: Centre-State financial relations – Finance commissions. (3)

TOTAL: 15

REFERENCE BOOKS:

1. Richard A Musgrave and Peggy B Musgrave, "Public Finance in Theory and Practice" – Tata McGraw Hill Education, New Delhi, 2004.
2. Bhatia H.L, "Public Finance" – Vikas Publishing House, 29th Edition, New Delhi, 2012.
3. David N Hyman, "Public Finance: A contemporary application of theory and policy", 11th Edition, Cengage Publication, Noida, 2014.
4. Santhosh Dalvi and Krishnan Venkatasubramanian, "An introduction to Goods and Service Tax: The biggest tax reform in India", CCH Publisher, New Delhi, 2015.

19OFA4 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

1 0 0 1

INVESTMENT ENVIRONMENT : Financial Markets - Classification - Financial Instruments – Security Trading. (2)

TYPES OF SECURITIES : Trading – Orders, Margin Trading – Clearing and Settlement Procedures. (5)

SECURITY ANALYSIS I : Industry Analysis –Estimation of Rates of Return. (2)

SECURITY ANALYSIS II : Company Analysis –– Estimation of Rates of Return. (2)

PORTFOLIO MANAGEMENT : Measuring Risk and Returns and Treatment in Portfolio Management. (4)

Total L: 15

REFERENCES:

1. William F Sharpe, Gordon J. Alexander, Jeffery V Bailey , "Investments", Prentice Hall, 2012.
2. Prasanna Chandra, "Investment Analysis and Portfolio Management", TATA McGraw Hill Publishing, 2011.
3. Ranganathan, "Investment Analysis and Portfolio Management", Pearson, 2004.
4. Bhalla V K, "Investment Management", TATA McGraw Hill Publishing, 2011

B.E

Electrical and Electronics Engineering Degree Programme
(Sandwich)

Regulations & Syllabi under CBCS

2019

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

(Autonomous college affiliated to Anna University, Chennai)

2019 REGULATIONS FOR FIVE YEAR BE DEGREE (SANDWICH) PROGRAMMES*

(for the batches of students admitted in 2019 - 2020 and subsequently under Choice Based Credit System)*

NOTE: The regulations hereunder are subject to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of students (including those already undergoing the programme) as may be decided by the Academic Council.

1. (a) PRELIMINARY DEFINITIONS AND NOMENCLATURE

In the following Regulations, unless the context otherwise requires

i) **"Programme"** means Degree Programme, that is **BE / BTech Degree Programme.**

ii) **"Branch"** means specialization or discipline of BE / BTech Degree Programme, like Civil Engineering, Textile Technology, etc.

iii) **"Course"** means a theory or practical course that is normally studied in a semester, like Mathematics, Physics, etc.

iv) **"University"** means **Anna University.**

(b) CONDITIONS FOR ADMISSION

Students for admission to the BE / BTech degree programme will be required to satisfy the conditions of admission thereto prescribed by the University and Government of Tamil Nadu.

2. DURATION OF THE PROGRAMME

i) **Minimum Duration:** The programme will extend over a period of five years* leading to the Degree of Bachelor of Engineering (Sandwich) of the Anna University. The five academic years will be divided into ten semesters with two semesters per academic year. Each semester shall normally consist of 90 working days including examination days.

ii) **Maximum Duration:** The student shall complete all the passing requirements of the BE Sandwich degree programme within a maximum period of 9 years (8 years for lateral entry); these periods reckoned from the commencement of the semester to which the student was first admitted to the programme.

3. BE DEGREE (SANDWICH) PROGRAMMES OFFERED

The following are the branches of study under Sandwich BE degree programme.

BE Electrical and Electronics Engineering (Sandwich)
BE Mechanical Engineering (Sandwich)
BE Production Engineering (Sandwich)

4. STRUCTURE OF PROGRAMMES

(i) The course work of the odd semesters will normally be conducted only in odd semesters and that of the even semesters only in even semesters.

* Provision is made for lateral entry of students in the third semester of the programme in all branches of study and they will be required to satisfy the conditions of admissions thereto prescribed by the University and Government of Tamil Nadu.

(ii) **Curriculum:** The curriculum will comprise courses of study as given in section 13 infra in accordance with the prescribed syllabi. The hours / week listed in section 13 infra for each of

the course refer to periods/week. The five year sandwich programme students will have to undergo Industrial Training for nine semesters in addition to the theory and laboratory courses undertaken by the students of four year B.E. Regular programme.

(iii) **Electives:** Every student shall opt electives from the list of electives relating to his/her degree programme as given in section 13 in consultation with the Tutor, Programme Co-ordinator and the HoD. The student will be required to study different types of electives like „science electives", „humanities electives", „open electives" and „professional electives". A student shall undergo 3 open elective courses and 6 professional elective courses and open electives and professional electives will spread over from 5th semester to 10th semester. **Minimum number of credits to be earned for courses under the category „Open Electives" is 9. Minimum number of credits to be earned for courses under the category „Professional Electives" is 18.** Open electives are the elective courses offered by a department for students of other branches and professional electives are courses offered by a department to the students of their own branches.

(iv) **Project Work:** Every student shall be required to undertake a suitable project in industry / research organization / department in consultation with the Head of the Department and the faculty guide and submit the project report thereon at the end of the semesters in which the student registered, on dates announced by the College/Department. A student shall register for the Project Work I and Project Work II respectively in 9th and 10th semester.

(v) **Online Courses:** Students can register and earn credits for online courses approved by department committee consisting of HoD, Programme Coordinator, Tutor and Subject Expert. Students who complete relevant online courses (having 3 credits only) successfully to a maximum of 9 credits may obtain exemption from studying three Professional Electives. Similarly, students who complete relevant online courses (having 3 credits only) successfully to a maximum of 6 credits may obtain exemption from studying two Open Electives. The list of online courses is to be approved by Chairman Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the subsequent Academic Council meeting. The Committee will monitor the progress of the student and recommend the grade or evaluate the candidate in 100% Continuous Assessment (CA) pattern, if necessary. Candidates may do online courses from fifth to seventh semester for getting exemption from professional electives and from third to seventh semesters for getting exemption from open electives. Any online course undergone by a student during break of study period shall not be considered for exempting a professional elective/open elective course

(vi) **Self Study Courses:** A student without current reappearance courses and /or redo courses can opt for one course as a Self Study course, which may be either an Open Elective or a Professional Elective by getting prior approval from the HoD who will nominate a faculty for the periodic monitoring and evaluation of the course.

(vii)(a) **Induction Programme:** All students shall undergo induction program in the first semester for a duration of three weeks as per the guidelines of All India Council for Technical Education (AICTE). A student completing the induction programme will be awarded **completed** grade and only the students who complete the induction programme shall be considered as eligible for award of degree subject to satisfying other conditions. A student who does not complete the induction program in the first semester shall Redo the same in the subsequent semester.

(b)**Internship**

Every student has to earn minimum 14 credits (Recommended credit range 14-20) of Internship/ Entrepreneurial activities / Project work/ Seminar and Inter/ Intra Institutional Training as a part of his BE/BTech degree programme. It should be noted that for these activities, one credit is equivalent to minimum 40 hours of work. Various activities as per

AICTE guidelines under internship is provided in the scheme under the category of Employability Enhancement Courses.

(c) **ACTIVITY POINT PROGRAMME (ADDITIONAL REQUIREMENT FOR EARNING BE/BTech Degree**

Every student shall have to earn prescribed number of activity points detailed below relating to entrepreneurial capabilities and societal commitment from 2nd semester to 6th semester.

Level of entry in degree course	**Total years for points**	**Minimum points**
1st Year	1st to 5th Year	100
2nd Year (3rd Sem.) through lateral entry or transfer from other University	2nd to 5th Year	80

A student shall earn 20 points in each semester from 2nd semester (3rd semester for later entry) to 6th semester the activities shall consists of participation of the student in NSS/NCC/Sports/Sansad Adarsh Gram Yojna (SAGY). These activities will be coordinated by the student department and 3 hours of participation in activity will be taken as 1 activity point these points will not be accounted for CGPA calculation.

A student completing the minimum number of activity points in a semester will be awarded **completed** grade and only the student who secure **completed** grade in all specified semesters shall be considered as eligible for award of degree subject to satisfying other condition. A student who fails to secure the specified number of activity points in a semester shall Redo the same in the subsequent semester

The Details of implementation (semester wise) is provided. One activity point is considered equivalent to 3 hours of activity.

Semesters	Responsibility	Supporting agency	points
2	Respective department	NSS/NCC/TRAINING & PLACEMENT/TECHNICAL ASSOCIATIONS/SPORTS	20
3			20
4			20
5			20
6			20

These activities will be coordinated by the respective department with the support of NSS / NCC / Sports / Sansad Adarsh Gram Yojna (SAGY) Coordinator or Training and Placement Officer (TPO) of the Institute. The student will be provided with a certificate from the concerned coordinator and Institutional Head. These points will not be accounted for CGPA calculation. The student may choose any relevant (techno-economic-societal) activity as per their liking in order to earn the Activity points.

(ix) **One-Credit Courses**: Students can also opt for one credit industry oriented courses of 15 hours duration which will be offered by experts from industry / other institution on specialized topics related to their branches of study. Students can complete such one credit courses during the semesters 3 to 7 as and when these courses are offered by different departments. A student will also be permitted to register for the one credit courses offered by other departments provided the student has fulfilled the necessary pre-requisites of the course subject to approval by both the Heads of Departments. There is no limit on the number of one credit courses a student can register and successfully complete during the above period. If a student wishes to avail exemption of professional electives, he/she can do so by exercising his/her option in writing to the respective Head of the Department during the beginning of the prefinal / final semester (i.e., semester 7/8) by following the equivalence

norm that one professional elective is equivalent to three one credit courses completed by the student. The grades of the students completing the one credit courses will be finalized based on absolute grading system listed in 8(iii)(b) infra. The grades earned by the students for the one-credit courses which are not opted for conversion into an elective, will not be included in the computation of CGPA.

However number of professional electives for which the student seeks exemption in having studied online courses and/or one credit courses shall not exceed three under any circumstance.

(x) **Course Enrollment and Registration**

a) Each student, on admission shall be assigned to a Tutor who shall advise and counsel the student about the details of the academic programme and the choice of courses considering the student"s academic background and career objectives.

b) Each student on admission shall register for all the courses prescribed in the curriculum in the student"s first and second semester of study. In the case of lateral entry students, they shall register for all the courses prescribed in the curriculum in the third semester of study.

c) From third semester onwards, (fourth semester in the case of lateral entry students) a student has the option to drop a maximum of two theory courses except Professional Core Courses in a semester. A student has the option to study two additional theory courses in a semester from third semester onwards. These courses can be open electives in third and fourth semesters and/ or professional electives from fifth semester onwards. The maximum number of credits the student can register in a particular semester cannot exceed 30 credits including courses for which the student has registered for redoing (section 5, iii (a)).

d) In case of a student dropping a course of study (other than professional core courses) in one semester, he/she shall register for that course in the next given opportunity and earn necessary attendance in that course exclusively to become eligible to appear for the semester examination in that course.

e) The courses to be offered in a semester for candidates who need to reappear(as per 5 (iii) infra) or having attendance shortage etc., will be decided by HoD.

f) After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the semester end examinations.

The enrollment for all the courses of the Semester II will commence 10 working days prior to the last working day of Semester I. The student shall confirm the enrollment by registering for the courses within the first five working days after the commencement of the Semester II.

The enrollment for the courses of the Semesters III to X will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the Tutor. If the student wishes, the student may drop or add courses subject to eligibility within five working days after the commencement of the concerned semester and complete the registration process duly authorized by the Tutor.

(xi) **Credit assignment:** Each course is assigned certain number of credits based on the following:

Contact Period per week	**Credits**
One Lecture Period	1
One Tutorial Period	1
Two Practical Periods(Laboratory / Project Work/ etc.)	1

The Contact Periods per week for Tutorials and Practical shall be in multiples of 2. The exact number of credits assigned to the different courses is shown in section 13.

(xii) **Minimum credits:** The minimum number of credits to be earned through successful completion of the courses of study in the respective branch listed in section 13 infra, by a student to qualify for the award of degree is provided below.

Branch of Study	Minimum number of credits to be earned through successful completion of the courses of study of the respective branch listed in section 13 infra, for the award of degree	
	for entry at first semester	**for *lateral entry* at third semester**
BE Sandwich Programmes		
Electrical and Electronics Engineering	165	127
Mechanical Engineering	165	125
Production Engineering	165	126

(xiii) **Medium of instruction: Medium of instruction:** English is the medium of instruction for examinations, project report etc. other than elective language courses.

5. REQUIREMENTS OF ATTENDANCE AND PROGRESS

i. A student will be qualified to appear for semester end examinations in a particular course of a semester only if

a) he / she has satisfied the attendance requirements as per the norms given below:
- Shall secure not less than 75% attendance in that course
- If a student secures attendance 65% or more but less than 75% in any course in the current semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level Sports events with prior permission from the Chairman, Sports Board and Head of the Department concerned, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examination of that course.

b) his / her progress has been satisfactory and
c) his / her conduct has been satisfactory.

ii. A student shall normally be permitted to appear for Semester end examination of the course if the student has satisfied the attendance requirements (vide Clause 5(i) supra) and has registered for examination in those courses of that semester by paying the prescribed fee.

iii. a) Students who do not satisfy clause 5(i) supra will not be permitted to appear for the Semester End Examination/ Evaluation of that course. The student has to register and redo that course in a subsequent semester when it is offered next, earn necessary attendance and CA mark and appear for semester end examinations.

b) If the total number of "Redo" courses at the end of any EVEN semester is more than SIX, the student will not be eligible to register for next immediate odd and further semester courses.

Such students will be permitted to register for those courses only when offered next, subject to fulfillment of the above condition.

c) If a student with more than SIX "Redo" courses is in the last batch of his/her current regulation, then

i) the courses which he/she has to redo in the next regulation instead of the redo courses in the current regulation,

ii) the passed courses in the current regulation which could be / could not be found equivalent to courses in next regulation for the purpose of calculation of CGPA and

iii) the courses in next regulation which he/she has to study on own without attendance requirement

shall be identified and the student be permitted to redo the courses under new regulation accordingly.

iv. A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

v. In respect of students who complete a part of the academic programme either one or two semesters under the student exchange scheme in approved foreign Universities, the transfer of credits of equivalent courses completed by them in the foreign university will be approved; and in the case of the remaining courses of the respective semester(s) which they have not studied in the respective regulation, they shall register for those courses within the next two or subsequent semesters on a self-study basis. Such an appearance of the student in those courses will be treated as first appearance for the purpose of classification. (Vide sections infra 10 (A,B,C &D))

6. DISCIPLINE

i) Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the college. The Head of the Institution shall constitute a disciplinary committee to enquire into acts of indiscipline and notify the punishment

ii) If a student indulges in malpractice in any of the examinations, he / she shall be liable for punitive action as decided by the Board of Examiners.

7. PROCEDURE FOR REJOINING THE PROGRAMME

A student who desires to rejoin the programme after a period of discontinuance or who upon his/her own request is permitted by the authorities to repeat the study of any semester, may join the semester which he/she is eligible or permitted to join, only at the time of its normal commencement for a regular batch of students and after obtaining the approval from the Commissioner of Technical Education and the University. No student will however be enrolled in more than one semester at any time.

8. ASSESSMENT AND PASSING REQUIREMENTS

i) **Assessment:** The assessment will comprise of Final Examination (FE) and /or Continuous Assessment (CA), carrying marks as specified in the scheme in section 13 infra. The CA marks will be awarded on assessing the student continuously during the semester as per guidelines 8(vii) infra. The assessment for theory courses carrying CA and FE components will be done on relative grading system. Other courses (Laboratory Course, Summer term Course, Industry Visit and Lecture, Industry Visit, Inplant Training, Industrial Training, Mini Project, One Credit courses, Project Work I and II, etc) will be assessed by absolute grading system. However, for the purpose of reporting the performance of a student, letter grades and grade points will be awarded as per section 8(iii)

ii) **Semester End Examinations:** Semester end examinations will normally be conducted during October / November and during March / April of each year. Reappearance examinations may be conducted at such times as may be decided by the college.

A student will be permitted to appear for the final semester examination in a course only if he/she has completed the study of that course.

iii) **Grade and Grade Point:** Each student, based on his / her performance, will be awarded a final grade and grade point as given below for each course at the end of each semester by following relative grading system and absolute grading system.

a. Relative Grading System

In this system, the grades are awarded to the students based on their performance relative to others in Theory courses having Continuous Assessment (CA) and Final Examination (FE) components.

For each theory course, the total mark M [ie., the sum of Continuous Assessment marks (CA) and Final examination marks (FE)] is computed for every candidate.

The students who secure a mark as detailed below are declared as fail (RA) in a theory course.

Marks scored in FE is less than 45% (or) M less than 50% of total marks	Grade : RA

Note:

- "RA" denotes reappearance in a course

After omitting the marks (M) of all failed candidates, the statistical parameters Mean (μ) and Standard Deviation (σ) of the distribution of marks are computed as given below for the remaining candidates (passed).

$$\mu = \frac{1}{n}\sum_{j=1}^{n} M_j \qquad \sigma = \sqrt{\frac{\sum_{j=1}^{n}(M_j - \mu)^2}{n}}$$

where, M_j – Total mark of the „j"th student passed in the course
n – Number of students who passed the examination in that particular course.

Then letter grade and grade point to each student are awarded based on the μ and σ as detailed below.

Total Mark, M secured by the student (CA +FE)	**Grade**	**Relative Grade Point, g**
M ≥ [(μ+1.5σ)]	O	10
μ+0.52σ ≤ M < μ+1.5σ	A+	9
μ − 0.25σ ≤ M < μ+0.52σ	A	8
μ –1.08σ ≤ M < μ−0.25σ	B+	7
M < μ – 1.08σ	B	6
Withdrawal from examination	W	0
Reappearance	RA	0
Shortage of Attendance	SA	0

Note:

- If the total number of candidates passed is less than 10, the grades shall be awarded as per Absolute Grading System otherwise Relative Grading System may be followed.
- No „O" grade shall be awarded if scored mark is less than 75.
- If the maximum marks awarded in a course is greater than or equal to 95% and if the number of candidates getting „O" Grade is less than 7% of the total number of candidates, then some candidates with A+ grade may be awarded „O" grade. In such a

case some candidates having „A" grade may be awarded „A+" grade, some candidates having „B+" grade may be awarded „A" grade and some candidates having „B" grade may be awarded „B+" in order to ensure that a minimum of 7% of the candidates are awarded „O" grade, 23% of the candidates are awarded „A+" grade, 30% of the candidates are awarded „A" grade and 26% are awarded „B+" grade.

b. Absolute Grading System

In absolute grading system, the letter grade and grade points are awarded to each student based on the percentage of marks secured by him/her in all courses like Laboratory Course, Summer term Course, Industry Visit and Lecture, Industry Visit, Inplant Training Industrial Training I – IX, Mini Project, One Credit courses, Project Work I and II, etc. except theory courses having CA and FE components, as detailed below.

Range of percentage of total marks	Letter grade	Grade Point g
90 to 100	O	10
80 to 89	A+	9
70 to 79	A	8
60 to 69	B+	7
50 to 59	B	6
0 to 49 or less than 45% in final examination	RA	0
Withdrawal from examination	W	0
Shortage of Attendance	SA	0

- "RA" denotes Reappearance in a course.

The grades RA and SA will not figure in the grade sheet.

c. For online courses the following grading pattern is applicable in case of credit transfer and CGPA calculations.

Range of percentage of total marks	Letter grade	Grade Point g
90 to 100	O	10
76 to 89	A+	9
60 to 75	A	8
50 to 59	B+	7
40 to 49	B	6

iv) **a) Cumulative Grade Point Average:**

After the completion of the programme, the Cumulative Grade Point Average (CGPA) from the semester in which the student has joined first (first semester for regular & third semester for lateral entry students) to the final semester is calculated using the relationship:

$$CGPA = \frac{\sum g_i * C_i}{\sum C_i}$$

where, g_i is Grade point secured for i^{th} course.
C_i is Credit allotted for the i^{th} course.

b) Training Grade Point Average (TGPA):

The Industrial Training courses I – IX will be evaluated independently and a separate Training Cumulative Grade Point Average (TGPA) will be computed using the above formula, based on the grade points earned by the students in the Industrial Training Courses.

v) **Passing a course:**

a. A student shall be deemed to have passed a theory course with CA and FE components. if

i) he/she secures at least 45% of the total marks in the final examination and
ii) he/she secures not less than 50% of total marks [CA and FE put together] prescribed for the course shall be declared to have passed the course and acquired the relevant number of credits.

A student is deemed to have passed in any other course like Laboratory Course, Summer term Course, Industry Visit, Inplant Training, Mini Project and Project Work I & II etc. with CA and FE components (except theory course with CA and FE components) or in any course carrying only Continuous Assessment marks if the total mark secured by him/her is at least 50% of total marks.

b. A student who is absent or has failed in the semester end examinations in any theory course has to register for the examination in that theory course when it is offered next time either by retaining or by not retaining the CA marks already earned.

I. A student after choosing the option as not retaining CA in second attempt shall have to continue to register for further appearances in that options only till he/she obtains a pass
II. A student after choosing the option as retaining CA in second attempt may continue to appear for further appearances in that option or at any time can switch over to the option **not retaining to CA** which shall be final till he/she obtains a pass

c. A student who after having earned necessary attendance, is absent for semester end examination or has failed in any other course like Laboratory Course, Summer term Course, Industry Visit, Inplant Training, Mini Project and Project Work I etc. with CA and FE components (except theory course with CA and FE components) or in any course carrying only Continuous Assessment marks will register for the examinations when it is conducted next time and will be solely assessed in the final examinations carrying the entire marks of that course.

d. A student who has earned necessary attendance in the course Project work II but does not submit the report on Project Work II on or before the date specified by the college / department, he/she shall be deemed to have failed in the Project work II and awarded grade RA and will have to register for the same at the beginning of the subsequent semester, redo and submit the project report at the end of that semester and appear for the final examination, the CA mark earned afresh.

e. A student who has earned necessary attendance in the course Project work II but whose project report is not accepted for reasons of incompleteness or other serious deficiencies will be treated as „absent" and will have to register for the same at the beginning of the subsequent semester, redo and submit the project report at the end of that semester and appear for the final examination, the CA mark earned afresh.

f. A student who has submitted the report on Project Work II, but could not appear for the semester end examination on the scheduled date, shall be deemed to have failed in the Project work II and awarded grade RA and will have to register for the same at the beginning of the subsequent semester, Redo and submit the project report at the end of

that semester and appear for the final examinations, the CA mark earned afresh. The same shall be applicable also to candidates who fail in the Project work.

g. If a student is absent or has failed in an elective course, he/she may register for the same course as detailed in v (b) above or for any other elective in the subsequent semester by registering afresh.

h. A student who is not eligible to write the semester end examinationin any course due to lack of attendance, will be awarded grade SA and the student has to register for that course again, when offered next, attend the classes and fulfill the attendance requirements as per section 5 supra. If the course, in which the student has lack of attendance, is a Professional Elective or an Open Elective, the student may register for the same or any other Professional Elective or Open Elective course respectively in the subsequent semesters.

i. A student after registering for a course may withdraw his / her registration between first & second CA Test on valid reasons.

j. Out of the required six Professional Electives to be studied, a student has to study a minimum of three Professional Electives from the list of Professional electives prescribed in their scheme of courses of study / those courses approved by the department committee with the Head of the Department as the Chairman (in case of credit transfer while undergoing programme in other Universities/Institutions as approved by the head of the Institution). The remaining three Professional electives can be studied either from the list of electives prescribed in the scheme of study of the department of the student/other departments or as online courses / special courses (vide clause 4.(v) supra) by obtaining equivalence or by studying required number of One / Two Credit Courses etc.

   If a student has studied more than six professional electives totally, three Professional Electives with highest grade among all Professional Electives prescribed in the scheme and the three courses with next highest grade among all remaining courses will be considered for calculation of CGPA; however the grades obtained in all other remaining courses will also appear in the grade sheet.

k. If a student has studied more than three open elective courses, then three open elective courses with higher grades alone will be considered for CGPA calculation. The grades obtained in other elective courses will also appear in the mark sheet.

l. If a student does not clear an one credit course it will be treated as a course „withdrawn" by a student; One credit courses will be evaluated by the course instructor / department faculty concerned and will carry a total of 100 marks for continuous assessment; out of which 75 marks will be for final test to be scheduled by the course instructor / department faculty concerned.

m. A student who is absent in the final semester examination of a course after registering for the same will be considered to have appeared and failed in that examination and awarded grade RA.

vi) **Reappearance Examinations:**

For Reappearance Examinations/ Examinations in any course under REDO category, absolute grading will be followed irrespective of whether the grading was originally under Relative Grading System or Absolute Grading System

vii) **Scheme of Evaluation**

a. Theory Courses with Tutorial Component (CA: 50% + FE: 50%)

Total: 100 Marks

CA Distribution:

(i) Assignment Presentation	10 Marks
(ii) Assessment Tutorial I	05 Marks
(iii) Assessment Tutorial II	05 Marks
(iv) Internal Tests (Best 2 out of 3):	30 Marks
• Test I (conducted for 50 marks)	30 Marks
• Test II (conducted for 50 marks)	30 Marks
• Test III (conducted for 35 marks)	30 Marks
Final Examination (FE)	50 Marks

Note:

1. **a)** Theory courses with tutorial component- Separate tutorial note books/files are to be maintained by the students for regular class room tutorials and **two assessment tutorials** have to be conducted and marks entered in e-assessment.

   b) Assessment Tutorial I is of **open book type**, to be conducted as per schedule in the allotted halls.

   c) Assessment Tutorial II is of surprise type. The 5 marks allotted must be the best out of a minimum of two surprise Tutorials to be conducted by the faculty concerned.

   d) During tutorial sessions, if requested the students may be **guided** by faculty to solve problems.

2. Assignment Presentation for the first **and final year students** shall be conducted by the **faculty concerned** as per his/her own schedule. For **others** it shall be conducted by the faculty concerned as per the **schedule prescribed in academic calendar**.

b. Theory Courses with no Tutorial Component (CA: 50% + FE: 50%)

Total: 100 Marks

CA Distribution:

(i) Assignment Presentation	10 Marks
(ii) Objective Tests I (Surprise type)	05 Marks
(iii) Objective Tests II (Surprise type)	05 Marks
(iv) Internal Tests (Best 2 out of 3):	30 Marks
• Test I (conducted for 50 marks)	30 Marks
• Test II (conducted for 50 marks)	30 Marks
• Test III (conducted for 35 marks)	30 Marks
Final Examination (FE)	50 Marks

Note:

1. Theory courses with no tutorial component- Objective Type Tests I and II- The 5 marks allotted for Objective Type Test I must be the best out of a minimum of two surprise tests to be conducted by the faculty concerned. A similar procedure is to be adopted for the award of the 5 marks allotted for the objective Type Test II.

2. Assignment Presentation for the first **and final year students** shall be conducted by the **faculty concerned** as per his/her own schedule. For **others** it shall be conducted by the faculty concerned as per the **schedule prescribed in academic calendar**.

c. Summer Term Courses (CA: 50% + FE: 50%) **Total : 100 Marks**

- **CA Distribution**

(i) Presentation - I (At the middle of II week) 25 Marks

(ii) Presentation - II (At the end of III week) 25 Marks

(iii) **Final Examination**

a) Report 30 Marks

b) Viva voce 20 Marks

d. Laboratory Courses (CA: 50% + FE: 50%) **Total : 100 Marks**

- **CA Distribution:**

(i) I Cycle

- Pre-laboratory Reports & Observations 10 Marks
- Individual Report 15 Marks

(ii) II Cycle

- Pre-laboratory Reports & Observations 10 Marks
- Individual Report 15 Marks

(iii) **Final Examination**

a) Lab examination 30 Marks

b) Viva Voce* 20 Marks

e. Industry Visit and Lecture / Industry Visit (CA : 100%) **Total: 100 Marks**

- **CA Distribution:**

(i) Presentation / Report 80 Marks

- Presentation I /Report I 25 Marks
  Viva Voce I 15 Marks
- Presentation II /Report II 25 Marks
  Viva Voce II 15 Marks

(ii) Viva Voce* 20 Marks

- Minimum of 2 Industry Visits, at least one shall be associated with PSG II / PSG Foundry Division
- Minimum of 2 Lectures by External Experts

f. Inplant Training (CA: 50% + FE: 50%) **Total: 100 Marks**

- **CA Distribution:**

(i) Record / Report 50 Marks

(ii) Final Examination / Presentation 30 Marks

(iii) Viva Voce* 20 Marks

g. Industrial Training (CA: 50% + FE: 50%) **Total: 100 Marks**

- **CA Distribution:**
  - (i) Test / Viva Voce — 50 Marks
    - Test I — 10 Marks
    - Viva Voce I (based on daily observation) — 15 Marks
    - Test II — 10 Marks
    - Viva Voce II (based on daily observation) — 15 Marks
  - (ii) **Final Examination** — 50 Marks
    - Final Examination / Mini Project — 25 Marks
    - Viva Voce# — 25 Marks

h. <u>Mini Project (CA: 50% + FE: 50%)</u> **Total: 100 Marks**

- **CA Distribution:**
  - (i) Presentation - I — 20 Marks
    - Guide — 10 Marks
    - Committee — 10 Marks
  - (ii) Presentation – II — 30 Marks
    - Guide — 15 Marks
    - Committee — 15 Marks
  - (iii) **Final Examination** — 50 Marks
    Project Report Evaluation & Viva Voce
    - Guide — 25 Marks
    - Committee — 25 Marks

i. Project Work I (CA: 50% + FE: 50%) **Total : 100 Marks**

- **CA Distribution:**
  - (i) Review - I — 20 Marks
    - Guide — 10 Marks
    - Committee[$] — 10 Marks
  - (ii) Review – II — 30 Marks
    - Guide — 15 Marks
    - Committee[$] — 15 Marks
  - (iii) **Final Examination**
    Project Report Evaluation & Viva Voce — 50 Marks
    - Guide — 25 Marks
    - Committee[$] — 25 Marks

j. <u>Project Work II (CA : 50% + FE : 50%)</u> **Total : 100 Marks**

- **CA Distribution:**
  - (i) Review - I — 20 Marks
    - Guide — 10 Marks
    - Committee[$] — 10 Marks
  - (ii) Review - II — 30 Marks
    - Guide — 15 Marks
    - Committee[$] — 15 Marks
- **Final Examination (FE)** — 50 Marks
  - External — 25 Marks

- Thesis Evaluation 10 Marks
- Presentation & Viva Voce 15 Marks

- Internal 25 Marks
  - Thesis Evaluation 10 Marks
  - Presentation & Viva Voce 15 Marks

k. <u>Mandatory Course/AICTE Activity Point Programme (CA: 100%)</u> Total: 100 Marks

(i) Assessment - I 50 Marks

(ii) Assessment – II 50 Marks

l. <u>Soft Skills Development/Business and Managerial Communications/ Quantitative and Reasoning Skills (CA: 100%)</u> Total: 100 Marks

(i) Basic Test 50 Marks
(ii) Advanced Test 50 Marks

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* - by external examiner
# - by internal & external examiner

$ - In respect of Project Work I & II carried out and reviewed in the departments, the review committee shall comprise of at least three senior faculty nominated by the HoD.

However, in respect of Project Work II carried out in industry, the committee nominated for the second review at industry includes one faculty deputed by the department and one mentor from respective industry.

9. QUALIFYING FOR THE AWARD OF DEGREE

A student shall be declared to have qualified for the award of the BE (Sandwich) Degree provided

i) the student has successfully completed the course requirements and has passed all the prescribed courses of study of the respective programme listed in section 13 within the duration specified in section 2 and

ii) no disciplinary action is pending against the student.

10. CLASSIFICATION OF DEGREE

Classification of a student while awarding the degree will not be affected if the student has to REDO courses which are Mandatory in nature (i.e. having no credit but whose completion is compulsory for the award of degree

A) <u>FIRST CLASS WITH DISTINCTION:</u>

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction.

* Should have passed the semester end examination in all the courses of all the ten semesters in his/her First appearance within 6 years, which includes authorized break of study of one year. Withdrawal from examination (vide clause 11) will not be considered as an appearance.

* Should have secured a CGPA of not less than 8.50.

* Should not have been prevented from writing semester end examination due to lack of attendance in any of the courses.

B) FIRST CLASS:

A student who satisfies the following condition shall be declared to have passed the examination in First Class.

* Should have passed the semester end examination in all the courses of all ten semesters within 6 years, which includes one year of authorized break of study (if availed) or prevention from writing the semester end examination due to lack of attendance (if applicable)

* Should have secured a CGPA of not less than 7.

C) SECOND CLASS :

All other students (not covered in clauses A and B) who qualify for the award of the degree shall be declared to have passed the examination in Second class.

D) RANK :

A student shall be eligible for award of ranking only if he/she has passed the examination in first class with distinction or first class in having passed all the courses in first attempt. Those who have availed the provision of break of study / withdrawal will not be eligible for rank.

11. WITHDRAWAL FROM EXAMINATION

i) A student may, for valid reasons, be granted permission to withdraw from appearing for the examination in any course or courses of only one semester if he/she does not have any history of reappearance courses at the time of request for withdrawal. Prior permission for withdrawal from semester examinations is to be obtained from Principal. Also, only one application for withdrawal is permitted for that semester examination in which withdrawal is sought. Withdrawal may be granted only once during one semester examination throughout the period of study what so ever the reasons may be.

ii) Withdrawal application shall be valid only if the student is otherwise eligible to write the examination and if it is made prior to the commencement of the examination in that course or courses and also recommended by the Head of the Department.

12. TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

i) A student is not normally permitted to temporarily break the study. However, if a student intends to temporarily discontinue the programme in the middle for valid reasons (such as accident or hospitalization due to prolonged ill health) and to rejoin the programme in a later respective semester, he/she shall apply to the Principal through the Head of the Department and stating the reasons therefore.

ii) A student is permitted to rejoin the programme at the respective semester as and when it is offered after the break subject to the approval of Commissioner of Technical Education and Anna University, Chennai, and shall be governed by rules and regulations in force at the time of rejoining.

iii) The duration specified for passing all the courses for the purpose of classification (vide sections 10 supra) shall be increased by the period of such break of study permitted.

iv) The total period for completion of the programme reckoned from the commencement of the semester to which the student was first admitted shall not exceed the maximum period specified in section 2 (ii) supra irrespective of the period of break of study in order that he/she may be qualified for the award of the degree.

v) If any student is detained for want of requisite attendance, progress and conduct, the period spent in that semester shall not be considered as permitted 'Break of Study' and section 12 (iii) supra is not applicable for such cases.

13. Courses of Study and Scheme of Assessment

BE ELECTRICAL AND ELECTRTONICS ENGINEERING (SANDWICH) (2019 Regulations)
(Minimum credits to be earned: 165)

Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 1									
19E101	Calculus and its Applications	3	1	0	4	50	50	100	BS
19E102	Physics	3	0	0	3	50	50	100	BS
19E103	Chemistry of Electronic Materials	3	0	0	3	50	50	100	BS
19E104	Problem Solving and C Programming	2	0	0	2	50	50	100	ES
19G105	English Language Proficiency	2	1	0	3	50	50	100	HS
19E111	Electrical Engineering Drawing	0	0	4	2	50	50	100	ES
19E112	Problem Solving and C Programming Laboratory	0	0	2	1	50	50	100	ES
19IP15	Induction Programme **	0	0	0	0	-	-	-	MC
19E100	Industrial Training I	0	0	10	5%	100	0	100	EEC
	Total 21 periods	**13**	**2**	**6+10**	**18+5%**	**450**	**350**	**800**	
SEMESTER 2									
19E201	Complex Variables and Transforms	3	1	0	4	50	50	100	BS
19E202	Semiconductor Devices	3	0	0	3	50	50	100	BS
19E203	Applied Electrochemistry	3	0	0	3	50	50	100	BS
19E205	Basics of Mechanical Engineering	3	0	0	3	50	50	100	ES
19G_____	Language Electives	0	0	4	2	100	0	100	HS
19E110	Basic Sciences Laboratory	0	0	4	2	50	50	100	BS
19E200	Industrial Training II	0	0	10	5%	100	0	100	EEC
19E210	Engineering Practices	0	0	2	1	50	50	100	ES
19E215	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
Semester 2- Summer Term									
19E213	Internship €	0	0	0	2£	100	0	100	EEC
	Total 23 periods	**12**	**1**	**10+10**	**20+5%**	**600**	**300**	**900**	

**	As per norms
%	Will be counted for TGPA computation
*	- As per AICTE Norms; Total 60 Hrs; Grade: Completed/Not Completed; Not counted for CGPA
CA	Continuous Assessment
FE	Final Examination
€	This course will be conducted prior to the commencement of the third semester for a period of 3 weeks
£	For internship, one credit is equivalent to minimum 40 hours of work as per norms

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BE ELECTRICAL AND ELECTRTONICS ENGINEERING (SANDWICH) (2019 Regulations)

Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 3									
19E204	Electric Circuits	3	1	0	4	50	50	100	ES
19E301	Linear Algebra and Numerical Analysis	3	1	0	4	50	50	100	BS
19E303	Electromagnetic Theory	3	0	0	3	50	50	100	ES
19E305	DC Machines and Transformers	3	0	0	3	50	50	100	PC
19O306	Economics for Engineers	3	0	0	3	50	50	100	HS
19K312	Environmental Science **	2	0	0	0	-	-	-	MC
19E211	Circuits & Devices Laboratory	0	0	4	2	50	50	100	ES
19E311	DC Machines and Transformers Laboratory	0	0	2	1	50	50	100	PC
19E300	Industrial Training III	0	0	10	$5^{\%}$	100	0	100	EEC
19E315	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
	Total 25 periods	**17**	**2**	**6+10**	**$20+5^{\%}$**	**450**	**350**	**800**	
SEMESTER 4									
19E302	Network Theory	2	2	0	4	50	50	100	ES
19E304	Electronic Circuits	3	0	0	3	50	50	100	ES
19E401	Probability and Statistics	2	1	0	3	50	50	100	BS
19E402	Measurements and Instrumentation	3	0	0	3	50	50	100	PC
19E404	Induction and Synchronous Machines	3	0	0	3	50	50	100	PC
19E310	Electronic Circuits Lab	0	0	2	1	50	50	100	ES
19E511	Induction and Synchronous Machines Laboratory	0	0	4	2	50	50	100	PC
19Q413	Soft Skills Development	0	0	2	1	100	0	100	EEC
19E400	Industrial Training IV	0	0	10	$5^{\%}$	100	0	100	EEC
19E415	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
19O412	Indian Constitution **	2	0	0	0	-	-	-	MC
	Total 26 periods	**15**	**3**	**8+10**	**$20+5^{\%}$**	**550**	**350**	**900**	

** As per norms
% Will be counted for TGPA computation
* - As per AICTE Norms; Total 60 Hrs; Grade: Completed/Not Completed; Not counted for CGPA
CA Continuous Assessment
FE Final Examination

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BE ELECTRICAL AND ELECTRTONICS ENGINEERING (SANDWICH) (2019 Regulations)

Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 5									
19E403	Digital Electronics	2	2	0	4	50	50	100	PC
19E405	Control Systems	3	0	0	3	50	50	100	PC
19E406	Electrical Power Generation Systems	3	0	0	3	50	50	100	PC
19E505	Power Electronics and Applications	3	1	0	4	50	50	100	PC
19E410	Instrumentation and Control Laboratory	0	0	2	1	50	50	100	PC
19E411	Digital Electronics Laboratory	0	0	2	1	50	50	100	PC
19Q513	Business and Managerial Communications	0	0	2	1	100	0	100	EEC
19E500	Industrial Training V	0	0	10	5%	100	0	100	EEC
19E501	Linear Integrated Circuits	3	0	0	3	50	50	100	PC
19E515	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
	Total 23 periods	**14**	**3**	**6+10**	**20+5%**	**550**	**350**	**900**	
SEMESTER 6									
19E502	Embedded Controllers	3	0	0	3	50	50	100	PC
19E504	Electrical Machine Design	2	2	0	4	50	50	100	PC
19E602	Digital Signal Processing	3	0	0	3	50	50	100	PC
19E603	Transmission and Distribution	3	1	0	4	50	50	100	PC
19E510	Power Electronics and Embedded Controllers Laboratory	0	0	2	1	50	50	100	PC
19E610	Digital Signal Processing and Linear Integrated Circuits Laboratory	0	0	2	1	50	50	100	PC
19Q613	Quantitative and Reasoning Skills	0	0	2	1	100	0	100	EEC
19E600	Industrial Training VI	0	0	10	5%	100	0	100	EEC
19E615	Activity Point Programme *	-	-	-	Grade	-	-	-	MC
	Total 20 periods	**11**	**3**	**6+10**	**17+5%**	**500**	**300**	**800**	

At the end of 6th semester, the students are required to earn the minimum number of activity points from the AICTE mandated ACTIVITY POINT PROGRAMME to qualify for the award of BE/BTech degree (Refer Section 4 (vii) (c) of 2019 Regulations)

% Will be counted for TGPA computation
* - As per AICTE Norms; Total 60 Hrs; Grade: Completed/Not Completed; Not counted for CGPA
CA Continuous Assessment
FE Final Examination

CAT - Category; BS - Basic Science; HS - Humanities and Social Sciences; ES - Engineering Sciences; PC - Professional Core; PE - Professional Elective; OE - Open Elective; EEC - Employability Enhancement Course; MC – Mandatory Course.

BE ELECTRICAL AND ELECTRTONICS ENGINEERING (SANDWICH) (2019 Regulations)

Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 7									
19E503	Computer Architecture	3	0	0	3	50	50	100	PC
19E604	Data Structures using C++	2	2	0	4	50	50	100	PC
19E	Professional Elective - 1	3	0	0	3	50	50	100	PE
19E620	Innovation Practices	0	0	2	1	100	0	100	EEC
19E700	Industrial Training VII	0	0	10	5%	100	0	100	EEC
	Total 12 periods	**8**	**2**	**2+10**	**11+5%**	**350**	**150**	**500**	
SEMESTER 8									
19E601	Electric Drives and Control	3	0	0	3	50	50	100	PC
19E701	Power System Protection and Switchgear	3	0	0	3	50	50	100	PC
19E702	Power System Analysis	2	2	0	4	50	50	100	PC
19E___	Professional Elective II	3	0	0	3	50	50	100	PE
19____	Open Elective I	3	0	0	3	50	50	100	OE
19E611	Electric Drives and Control Laboratory	0	0	2	1	50	50	100	PC
19E710	Power System Laboratory	0	0	2	1	50	50	100	PC
19E800	Industrial Training VIII	0	0	10	5%	100	0	100	EEC
	Total 20 periods	**14**	**2**	**4+10**	**18+5%**	**450**	**350**	**800**	

% Will be counted for TGPA computation
CA Continuous Assessment
FE Final Examination

CAT - Category; BS - Basic Science; HS - Humanities and Social Sciences; ES - Engineering Sciences; PC - Professional Core; PE - Professional Elective; OE - Open Elective; EEC - Employability Enhancement Course; MC – Mandatory Course

BE ELECTRICAL AND ELECTRTONICS ENGINEERING (SANDWICH) (2019 Regulations)

Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 9									
19E___	Professional Elective III	3	0	0	3	50	50	100	PE
19E___	Professional Elective IV	3	0	0	3	50	50	100	PE
19E___	Professional Elective V	3	0	0	3	50	50	100	PE
19____	Open Elective II	3	0	0	3	50	50	100	OE
19E720	Project Work I	0	0	4	2	100	0	100	EEC
19E900	Industrial Training IX	0	0	10	$5^{\%}$	100	0	100	EEC
	Total 16 periods	**12**	**0**	**4+10**	**$14+5^{\%}$**	**400**	**200**	**600**	
SEMESTER 10									
19E	Professional Elective VI	3	0	0	3	50	50	100	PE
19E820	Project Work II	0	0	8	4	50	50	100	EEC
	Total 11 periods	**3**	**0**	**8**	**7**	**100**	**100**	**200**	

%	Will be counted for TGPA computation
CA	Continuous Assessment
FE	Final Examination

CAT - Category; BS - Basic Science; HS - Humanities and Social Sciences; ES - Engineering Sciences; PC - Professional Core; PE - Professional Elective; OE - Open Elective; EEC - Employability Enhancement Course; MC – Mandatory Course

PROFESSIONAL ELECTIVES

Group A: Electrical/Power

19E001 Flexible AC Transmission Systems
19E002 Special Machines and Controllers
19E003 Utilization and Conservation of Electrical Energy
19E004 Advanced Control Systems
19E005 Smart Grid
19E006 Industrial Automation
19E007 HVDC Transmission
19E008 Power Quality Management
19E009 Power System Operations and Control
19E010 Hybrid Electric Vehicles
19E011 High Voltage Engineering

Group B: Electronics / Embedded

19E012 Embedded Systems and Internet of Things
19E013 System Design using FPGA
19E014 VLSI Design
19E015 Mixed Signal VLSI Design
19E016 Virtual Instrumentation
19E017 Communication Systems
19E018 Automotive Electrical and Electronics Systems
19E019 Wearable Electronics
19E020 Electronic Product Design
19E021 Digital Image Processing

Group C : Computer

19E022 Advanced Data Structures
19E023 Computer Networks
19E024 Software Project Management and Quality Assurance
19E025 Advanced Computer Architecture
19E026 Internetworking and Applications
19E027 Java Programming
19E028 Relational Database Management Systems
19E029 Operating systems
19E030 Neural Networks and Fuzzy Systems
19E031 Linux Architecture
19E032 Total Quality Management

ONE-CREDIT COURSES

19EF01 LV Switchgears
19EF02 Energy Auditing and Conservation Techniques
19EF03 Electrical Safety Standards and Practices
19EF04 Automotive Electrical Systems
19EF05 CAD Tools for VLSI Design Automation
19EF06 Digital Design with Verilog HDL
19EF07 Graphical Programming
19EF08 Advanced Graphical Programming
19EF09 Low Power Microcontrollers and Applications
19EF10 Controller Design and Simualtion Using Dspace
19EF11 Solar PV Systems Design Simulation Monitoring and Control
19EF12 Power Electronics in More-Electric Aircraft
19EF13 Field Programmable Analog Array for Analog System Design
19EF14 Systems Engineering for Automotive Applications
19EF15 Electrical Vehicles
19EF16 Phasor Measurement Units and Applications
19EF17 Industrial Drives for Automation
19EF18 Data Science and Analytics for Electrical Engineers
19EF19 Electrical Power on-board War Vessels and Aircraft
19EF20 Aerospace Avionics
19EF21 1-D Model Based System Design for Control System Applications
19EF22 Printed Circuit Board Design and its Fabrication
19EF23 Digital System Design and Verification Using System Verilog
19EF24 Metrology for Electrical Engineers
19EF25 Embedded Linux
19EF26 Internet of Things using CC3200

LANGUAGE ELECTIVES

19G001 Communication Skills for Engineers
19G002 German- Level A1.1
19G003 French Language Level 1
19G004 Basic Japanese

ENGLISH
19GF01 Interpersonal and Organizational Communication
19GF02 Human Values Through Literature

HUMANITIES
19OFA1 Export – Import Practices
19OFA2 Insurance - Concepts and Practices
19OFA3 Public Finance
19OFA4 Security Analysis and Portfolio Management

Summary of Credit Distribution

BE ELECTRICAL AND ELECTRONICS ENGINEERING (SANDWICH)												
S. No	**Course Category**	**Credits Per Semester**										**Total Credits**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
1	HS	3	2	3	0	0	0	0	0	0	0	8
2	BS	10	12	4	3	0	0	0	0	0	0	29
3	ES	5	4	9	8	0	0	0	0	0	0	26
4	PC	0	0	4	8	19	16	7	12	0	0	66
5	PE	0	0	0	0	0	0	3	3	9	3	18
6	OE	0	0	0	0	0	0	0	3	3	0	6
7	EEC	0+5%	0+2+5%	0+5%	1+5%	1+5%	1+5%	1+5%	0+5%	2+5%	4	12
8	MC	-	-	-	-	-	-	-	-	-	-	-
	TOTAL	**18+5%**	**18+2+5%**	**20+5%**	**20+5%**	**20+5%**	**17+5%**	**11+5%**	**18+5%**	**14+5%**	**7**	**165**

% Will be counted for TGPA (Training Grade Point Average) computation

CAT - Category; BS - Basic Science; HS - Humanities and Social Sciences; ES - Engineering Sciences; PC - Professional Core; PE - Professional Elective; OE - Open Elective; EEC - Employability Enhancement Course; MC – Mandatory Course.

19E100 INDUSTRIAL TRAINING I

0 0 10 5*

MODULE 1 – INTRODUCTION TO INDUSTRIAL ENVIRONMENT AND PRACTICES: Definition of industry, types of industry - product, process, hybrid; Different scales of operations - large, medium, small, tiny; Industry definitions and examples; Organizational structure and various departments, functions within an industry; Equipment and personal industrial safety (general and electrical) and discipline outside industries. [10]

MODULE 2 - FAMILIARIZATION OF MECHANICAL HAND TOOLS: Screw drivers, spanners, pliers, hammers, chisels and wrenches; Dismantling and assembly - CPU, pump, etc. [10]

MODULE 3 - FAMILIARIZATION OF ELECTRICAL AND ELECTRONICS TOOLS: Tester, clamp meter, multi meter, crimper, wire cutter, Philip screw drivers, soldering iron etc; Simple exercises - checking the fuse, junction box wiring, soldering a circuit, crimping of wires and USB socket. [10]

MODULE 4 - FAMILIARIZATION OF CARPENTRY HAND TOOLS: Chisel, mallets, jack planes, mortise gauge, hand saw, etc; Simple exercises - sawing and planning, nailing a wooden box, making of different type of joints, making a table /wooden box/ models. [10]

MODULE 5 - FAMILIARIZATION OF FITTING TOOLS: Files, hacksaw, tri-square, rulers, punches, chisel, etc; Simple exercises - filing, marking, cutting, fitting, forming. [10]

MODULE 6 - FAMILIARIZATION OF MEASURING TOOLS AND INSTRUMENTS: Measuring tape, foot ruler, vernier, micrometer, calipers, bore-dial, gauges, anemometer, hygrometer/sling psychrometer, thermo-couples, pyranometer, etc; Measurement of various pump components, wind speed, humidity, temperature, and radiation. [10]

MODULE 7 - FAMILIARIZATION OF PLUMBING TOOLS: Pipe wrench, threading die, etc; Simple exercises - threading of pipes, construction of water line using GI and PVC fittings etc. [20]

MODULE 8 - FAMILIARIZATION OF FOUNDRY TOOLS: Moulding boxes, board, trowels, riser and sprue pins, vent wires, strike bar, bellows, rammers, etc; Simple exercises - moulding of solid pattern, split pattern, core making, gate , runner and riser cutting, casting of simple component with aluminum etc. [20]

MODULE 9 - FAMILIARIZATION OF CIVIL TOOLS: Trowels, plumb block, water level, spirit level, etc; Simple exercises - making of small model with cement mortar, stacking of bricks as a wall, fabrication of reinforcement structures in MS, etc. [20]

MODULE 10 - CONCEPTS OF BASIC SCIENCE: Hands-on experiments relating to concepts of Basic Physics and Chemistry – Forces, Hooke's Law, Newton's Law, Work Energy Theorem, gyroscope, flow sensors, models mimicking human mechanisms – applications in industry. [20]

MODULE 11 - INDUSTRIAL VISITS: Motor and pump manufacturing, engineering machinery manufacturing and foundry. [10]

Total: P: 150

REFERENCES:

1. Module-wise "Industrial Training Manual" prepared by Training Department, PSG Industrial Institute.

19E200 INDUSTRIAL TRAINING II

0 0 10 5*

MODULE 1 – INTRODUCTION TO INDUSTRIAL SAFETY: Procedure, equipment, safety programme, safety standards, OSHA act, first aid and safety symbols. [10]

MODULE 2- DISMANTLING AND ASSEMBLY OF DOMESTIC APPLIANCES - Wet grinder, mixie, electric iron box, fan, etc. [10]

MODULE 3 – EXPOSURE AND HANDS ON EXERCISES ON DOMESTIC ELECTRICAL WIRING - Tube light fitting, two-way switch, fan and regulator, motor starter, etc. [10]

MODULE 4 – HANDS ON EXERCISES ON ELECTRONIC COMPONENTS: PC boards, bread boards, gates, microprocessors and other electronic components. [20]

MODULE 5 - DISMANTLING AND ASSEMBLY OF HYDRAULIC COMPONENTS - Water taps, flush tanks, hand pump and gear pump, valves, etc. [20]

MODULE 6 - HANDS ON EXERCISES ON ROTATING MACHINES – MONOBLOCK PUMPS - Winding, assembly, stator and rotor fabrication, inspection, painting, testing, balancing, and machining etc. [10]

MODULE 7 - HANDS ON EXERCISES ON ROTATING MACHINES – SUBMERSIBLE PUMPS - Winding, assembly, stator and rotor fabrication, inspection, painting, testing, balancing, and machining etc. [10]

MODULE 8 - HANDS ON EXERCISES – BASIC FOUNDRY PRACTICES – Understanding of fundamental Foundry processes and practices – melting, pouring, pattern-making, machining, testing and inspection. [10]

MODULE 9 - HANDS ON EXERCISES - BASIC LATHE ASSEMBLY – Headstock, tailstock, apron and feedbox, gearbox assembly. [10]

MODULE 10 – BASIC SCIENCE CONCEPTS: Hands-on experiments with wireless sensors – acceleration, pressure, light, current, voltage, heart rate, conductivity, spirometer, CO2, O2 - applications in Industry. [20]

MODULE 11 – INDUSTRIAL VISITS TO VARIOUS PROCESS INDUSTRIES [20]

Total: P: 150

REFERENCES:

1. Module-wise “Industrial Training Manual” prepared by Training Department, PSG Industrial Institute.

19E300 INDUSTRIAL TRAINING III

0 0 10 5*

MODULE 1 - ELECTRICAL MOTOR AND PUMP ASSEMBLY I : Motor - Induction motor- parts and materials - principles of working – construction - preparation of exploded view of TEFC motor assembly - testing and inspection - industrial applications. **Pump**: Principle of operation - parts and materials- working- pump casing - types of impeller - specifications - industrial applications. [20]

MODULE 2 - ELECTRICAL AND ELECTRONICS MEASUREMENTS - Electrical: Definition of instruments – classification - absolute - secondary: indicating instruments, recording, integrating, and electro mechanical- ammeter - voltmeter – wattmeter – energy meter - transformer- transducer- CRO – DSO – Megger - digital multimeter - Industrial applications. **Electronics:** analog meter - MI-MC- Industrial applications . [10]

MODULE 3 - E-LEARNING USING ELECTRICAL SOFTWARE PORTAL – On-line training modules in areas specific to Industry aspects of Electrical and Electronics Engineering. [30]

MODULE 4 – **EARTHING AND LIGHTNING ARRESTER -** Earthing **–** Types of Earthing and their operating principles and applications – Lightning Arrester – Working Principle. [10]

MODULE 5 - WELDING: Introduction- types of welding- arc welding- MIG and TIG welding -gas welding- working principle – types of welding joints and their applications [20]

MODULE 6 - TURNING: Types of Lathes and their electrical characteristics and control systems - parts and materials- principle- construction- working -assembly – testing- painting- applications. [20]

MODULE 7 - FOUNDRY ELECTRICAL PRACTICES - Moulding boxes, board, trowels, riser and spruce pins, vent wires, strike bar, bellows, rammers; Simple exercises – types of foundry machines and equipment – electrical characteristics and control systems [10]

MODULE 8 - CNC MACHINES : CNC - Open and closed loop Systems - Motion Control systems -Elements of CNC systems - Input devices – CPU / Machine Control unit - Machine tool driving systems - Types of motors used in CNC – feedback devices – Display unit machine axes – Machine programming -advantages and disadvantages- Industrial applications. [20]

MODULE 9 - INDUSTRIAL VISITS: Visits to Industry specific to the topics within the other modules, and submission of a report on Industrial applications of these topics. [10]

Total: P: 150

REFERENCES:

1. Sharma PC, "Machine Tools and Tool Design", S. Chand & Company, 2004.
2. Sawhney AK, "Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai& Sons Company,2004.
3. Parmar RS , "Welding, Turning Process & Technology", Khanna Publisher,2011.
4. Naidu MS, Kamaraju V, Wadhwa CL,"High Voltage Engineering", McGraw-Hill Education-Europe ,2006.

19E400 INDUSTRIAL TRAINING IV

0 0 10 5*

MODULE 1 – ELECTRICAL PARAMETERS IN MACHINING OPERATIONS - Electrical characteristics and control mechanisms in Drilling, Milling, Boring, Broaching and Vertical Turret Lathe. [20]

MODULE 2 - PCB LAYOUT & FABRICATION - Designing and Layout of PCB's – applications of PCB's in different types of Industries - Trouble shooting and Testing [20]

MODULE 3 - ELECTRICAL MOTOR AND PUMP ASSEMBLY II - Winding – Types of Winding, Slots, Insulation - **Testing -** Megger Test, High Voltage and Resistance testing**.** [20]

MODULE 4 - E-LEARNING USING ELECTRICAL SOFTWARE PORTAL – On-line training modules in areas specific to Industry aspects of Electrical and Electronics Engineering. [30]

MODULE 5 – AUTOMOTIVE WIRING - Types of automotive wiring in 2-wheelers and 4-wheelers - Battery types – Alternator – Relays and other protection devices. [20]

MODULE 6 – COMPUTER ASSEMBLY – Parts and function - assembly –installation - trouble shooting, [10]

MODULE 7 – TRANSFORMERS - Types of transformers - function – working principle - windings-advantages and disadvantages – Industrial applications. [10]

MODULE 8 – CIRCUIT BREAKERS – Types of circuit breakers – need, Miniature Circuit Breakers, nomenclature and applications – hands-on experiments on load and circuit breakers. [10]

MODULE 9 - INDUSTRIAL VISITS: Visits to Industry specific to the topics within the other modules, and submission of a report on Industrial applications of these topics. 10]

Total: P: 150

REFERENCES:

1. Dasgupta Indrajit,"Design of Transformers", Tata McGraw-Hill Publishing Company, New Delhi,2002.
2. Singh Ravindra P.,"Power system switchgear and protection", PHI Learing Pvt.Ltd., 2009.
3. Volk Michael ,"Electrical motor & Pump Assembly", Taylor &Francis, 2008.
4. Khandpur RS ,"PCB Design, fabrication, Assembly & testing", Tata McGraw-Hill Education, 200

19E500 INDUSTRIAL TRAINING V

0 0 10 5*

MODULE 1 – PROJECT MANAGEMENT I - Ongoing in-campus projects **-** Project formulation and definition of scope and objectives – Project Charter and Plan – Project methodology and status monitoring and reporting – tracking milestones – managing resources, risks and variances. [40]

MODULE 2 – E-LEARNING USING ELECTRICAL AND ELECTRONICS SOFTWARE PORTAL – On-line electrical and electronics related modules in areas of Internet of Things, Business Excellence, Quality, Safety, Industry 4.0. [30]

MODULE 3 – INDUSTRIAL AUTOMATION - Hands-on exercises in advanced Industrial Automation Laboratories relating to Electro-hydraulics, Electro-pneumatics, Mechatronics, Drives and Controls, Industry 4.0 kits. [60]

MODULE 4 – INDUSTRIAL VISIT – Visit to an Industry specific to the topics within the other modules, and submission of a report on Industrial applications of these topics. [20]

Total: P: 150

REFERENCES:

1. Walter RB, "Hydraulic & electric hydraulic control system",1991.
2. Obodovski, Daniel ," The silent Intelligence : The internet of things", Elsevier Science,2013.
3. Asfakhi C.Ray & Rieske, David W," Industrial safety and health management 6th edition",Pearsons Education, 2009.
4. Schwab, Klaus ,"The fourth industrial revolution", Penguin Books Ltd, 2016.

19E600 INDUSTRIAL TRAINING VI

0 0 10 5*

MODULE 1 – PROJECT MANAGEMENT II - Ongoing in-campus projects **-** Data analytics and project dashboard preparation – project financial planning. [40]

MODULE 2 – E-LEARNING USING ELECTRICAL AND ELECTRONICS SOFTWARE PORTAL – On-line electrical and electronics related modules in areas of Internet of Things, Business Excellence, Quality, Safety, Industry 4.0. [30]

MODULE 3 – INDUSTRIAL AUTOMATION - Hands-on exercises in advanced Industrial Automation Laboratories relating to Electro-hydraulics, Electro-pneumatics, Mechatronics, Drives and Controls, Industry 4.0 kits. [60]

MODULE 4 – INDUSTRIAL VISIT – Visit to an Industry specific to the topics within the other modules, and submission of a report on Industrial applications of these topics. [20]

Total: P: 150

REFERENCES:

1. Obodovski ,Daniel ,"The silent Intelligence : The internet of things", Elsevier Science , 2013.
2. Asfakhi C.Ray & Rieske, David W," Industrial safety and health management 6th edition , Pearsons Education ,"2009.
3. Klaus Schwab ,"The fourth industrial revolution", Penguin Books Ltd, 2016.
4. Krishnan R" Electric motor drives : modeling, analysis and control", Prentice Hall ,2015.

19E700 INDUSTRIAL TRAINING VII

0 0 10 5*

EXTERNAL INTERNSHIP –Internship at a suitable manufacturing industry and / or university within India or overseas as per the timeline indicated in the scheme of syllabus. (150)

Norms and guidelines for internship:

The students of seventh semester will undergo Internship as detailed below.

No. of working hours - 8 hours per day or as instructed by the industry; students will strictly follow the industry norms and timings.

During the course of internship, students will study the following with respect to the industry, with specific emphasis on work allocation as provided by the Industry supervisor:Industry profile, product range, catalogue, infrastructure, turnover, labor force, industrial structure, location, layout, ISO9000 and other standards, product development, manufacturing and material handling systems, and quality systems.

Evaluation of students' performance during the internship will be carried out through faculty visit to industry, presentation, viva-voce and technical report.

Students will identify the scope for future assignments which could be extended as projects.

Total: P: 150

REFERENCES:
As this is an industry-oriented course, students will be governed by the regulations of the industry they are assigned to, and hence no specific reference books are prescribed.

19E800 INDUSTRIAL TRAINING VIII

0 0 10 5*

MODULE 1 – INDUSTRIAL STATUTES AND GOVERNANCE : Governance aspects of an Industry - Wages and salary administration, Welfare Benefits – ESI, PF, Bonus, Incentive schemes - Statutes and Labour Laws. Standing Orders - Disciplinary action and domestic enquiry - Negotiations with unions on wages and Bonus - Representation before Tribunals, Labour Court - Training and Development – career planning and performance appraisals - Rewards and Incentive schemes - Counselling and attrition planning – exit interviews - Pollution norms and Workmen's Compensation Act. [70]

MODULE 2 – INDUSTRY OPERATIONS AND FINANCIAL INDICES – Industry Operational parameters and indices, Financial performance indicators, Assets and Capital Management - Balance sheets and annual reports , Pollution compliance reports. [60]

MODULE 3 – TOTAL QUALITY MANAGEMENT – TQM Evolution, Quality Gurus, Deming's 14 points, Customer Satisfaction, 5S, Six Sigma, CMM, Quality Management Tools - Industrial Safety and standards - Indian Standards relating to Manufacturing and Electrical Engineering. [20]

Total: P: 150

REFERENCES:

1. R.K.Jain, Sunil S.Rao, "Industrial Safety, Health and Environment Management Systems", Khanna Publishers, 2000
2. Taxmann, Labour Laws, Taxmann's Store, 2019
3. James Riggs, David Bedworth, Sabah Randhawa, "Engineering Economics", 4th edition, Tata McGraw Hill, 2004
4. Nandan H., "Fundamentals of Entrepreneurship" , Prentice Hall India, New Delhi, 2013

19E900 INDUSTRIAL TRAINING IX

0 0 10 5*

MODULE 1 – ENVIRONMENTAL AND SOCIETAL IMPACT OF INDUSTRY : Corporate Social Responsibility relevant to an Industry – societal and environmental issues relating to Industry and their possible solutions – regional, state, national and global statistics relating to Manufacturing and Industry. [50]

MODULE 2 – PREPARATION OF INDUSTRY ANNUAL REPORT – Factors and parameters relating to various aspects of Industry, and preparation of an Industry Annual Report. [100]

Total: P: 150

REFERENCES:

1. R.K.Jain, Sunil S.Rao, "Industrial Safety, Health and Environment Management Systems", Khanna Publishers, 2000
2. Taxmann, Labour Laws, Taxmann's Store, 2019
3. James Riggs, David Bedworth, Sabah Randhawa, "Engineering Economics", 4th edition, Tata McGraw Hill, 2004
4. Nandan H., "Fundamentals of Entrepreneurship" , Prentice Hall India, New Delhi, 2013