

**B.E**  
**Electronics and Communication Engineering**  
**Degree Programme**

**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.

<b>BE</b>	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 programme) 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<sup>th</sup> semester to 8<sup>th</sup> 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<sup>th</sup> semester and for Project Work II in the 8<sup>th</sup> 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 2<sup>nd</sup> semester to 6<sup>th</sup> semester.

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

A student shall earn 20 points in each semester from 2<sup>nd</sup> semester (3<sup>rd</sup> semester for later entry) to 6<sup>th</sup> 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 &	20
3		PLACEMENT/TECHNICAL	20
4		ASSOCIATIONS/SPORTS/	20
5		ENTREPRENEURSHIP/APPROVED	20
6		EXTRA CURRICULAR ACTIVITIES	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
<b>BE Programmes</b>		
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
<b>BTech Programmes</b>		
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%	Grade :
(or)	RA
M less than 50% of total marks	

### Note:

- "RA" denotes reappearance in a course

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

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

where,  $M_j$  – Total mark of the  $j^{\text{th}}$  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  $\mu$  and  $\sigma$  as detailed below.

Total Mark, M secured by the student (CA +FE)	Grade	Relative Grade Point, g
$M \geq [(\mu + 1.5\sigma)]$	O	10
$\mu + 0.52\sigma \leq M < \mu + 1.5\sigma$	A+	9
$\mu - 0.25\sigma \leq M < \mu + 0.52\sigma$	A	8
$\mu - 1.08\sigma \leq M < \mu - 0.25\sigma$	B+	7
$M < \mu - 1.08\sigma$	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
- he/she secures at least 45% of the total marks in the final examination and
  - 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.
- 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
  - 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. 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
<b>Final Examination (FE)</b>	<b>50 Marks</b>

**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 25 Marks  
(At the middle of II week)
  - (ii) Presentation - II 25 Marks  
(At the end of III week)
- **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
- **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
	<ul style="list-style-type: none"> <li>• Minimum of 2 Industry Visits, at least one shall be associated with PSG II / PSG Foundry Division</li> <li>• Minimum of 2 Lectures by External Experts</li> </ul>		
<b>f. Inplant Training (CA: 50% + FE: 50%)</b>			<b>Total: 100 Marks</b>
• <b>CA Distribution:</b>			
(i) Record / Report			50 Marks
(ii) Final Examination / Presentation			30 Marks
(iii) Viva Voce*			20 Marks
<b>g. Industrial Training (CA: 50% + FE: 50%)</b>			<b>Total: 100 Marks</b>
• <b>CA Distribution:</b>			
(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		
• <b>Final Examination</b>			50 Marks
▪ Final Examination / Mini Project	25 Marks		
▪ Viva Voce#	25 Marks		
<b>h. Mini Project (CA: 50% + FE: 50%)</b>			<b>Total: 100 Marks</b>
• <b>CA Distribution:</b>			
(i) Presentation - I			20 Marks
▪ Guide			
▪ Committee			
(ii) Presentation – II			30 Marks
▪ Guide			
▪ Committee			
• <b>Final Examination</b>		50 Marks	
Project Report Evaluation & Viva Voce			
▪ Guide	25 Marks		
▪ Committee	25 Marks		
<b>i. Project Work I (CA: 50% + FE: 50%)</b>			<b>Total : 100 Marks</b>
• <b>CA Distribution:</b>			
(i) Review - I			20 Marks
▪ Guide	10 Marks		
▪ Committee\$	10 Marks		
(ii) Review – II			30 Marks
• Guide	15 Marks		
▪ Committee\$	15 Marks		
(iii) <b>Final Examination</b>			
Project Report Evaluation & Viva Voce			50 Marks
▪ Guide	25 Marks		
▪ Committee\$	25 Marks		
<b>j. Project Work II (CA : 50% + FE : 50%)</b>			<b>Total : 100 Marks</b>

- **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. Mandatory Course/AICTE Activity Point Programme (CA: 100%) Total: 100 Marks**

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

**I. Soft Skills Development/Business and Managerial Communications/Quantitative and Reasoning Skills (CA: 100%) Total: 100 Marks**

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

\* - 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) FIRST CLASS WITH DISTINCTION:**

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 ELECTRONICS AND COMMUNICATION 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									
19L101	Calculus and its Applications	3	1	0	4	50	50	100	BS
19L102	Physics	3	0	0	3	50	50	100	BS
19L103	Chemistry of Electronic Materials	3	0	0	3	50	50	100	BS
19L104	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
19L110	Engineering Graphics	0	0	4	2	50	50	100	ES
19L111	Basic Sciences Laboratory *	0	0	4	2	50	50	100	BS
19L112	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									
19L201	Complex Variables and Transforms	3	1	0	4	50	50	100	BS
19L202	Materials Science	2	0	0	2	50	50	100	BS
19L203	Industrial Electrochemistry	2	0	0	2	50	50	100	BS
19L204	Electron Devices	3	0	0	3	50	50	100	ES
19L205	Circuit Theory	3	1	0	4	50	50	100	ES
19L210	Language Elective	0	0	4	2	50	50	100	HS
19L211	Devices and Circuits Laboratory	0	0	4	2	50	50	100	ES
19L212	Python Programming Laboratory	0	0	4	2	50	50	100	ES
19L215	Activity Point Programme #	-	-	-	-	-	-	-	MC
Semester 2- Summer Term									
19A213	Internship €	0	0	0	2 €	100	0	100	EEC
Total 27 periods		13	2	12	23	500	400	900	

\* Physics and Chemistry Lab

\*\* As per norms

CA Continuous Assessment

FE Final Examination

# As per AICTE Norms; Total 60 hrs; Grade : Completed / Not Completed; Not Counted

€ 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

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 ELECTRONICS AND COMMUNICATION ENGINEERING****(2019 Regulations)**

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING (2019 Regulations)									
Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 3									
19L301	Linear Algebra and Numerical Analysis	3	1	0	4	50	50	100	BS
19L302	Analog Electronics	3	0	0	3	50	50	100	PC
19L303	Digital Electroncis	3	0	0	3	50	50	100	PC
19L304	Electromagnetic Fields and Waves	3	1	0	4	50	50	100	PC
19L305	Data Structures and Algorithms	2	2	0	4	50	50	100	ES
19O306	Economics for Engineers	3	0	0	3	50	50	100	HS
19L310	Analog Electronics Laboratory	0	0	2	1	50	50	100	PC
19L311	Digital Electronics Laboratory	0	0	2	1	50	50	100	PC
19K312	Environmental Science **	2	0	0	0	-	-	-	MC
19L315	Activity Point Programme #	-	-	-	-	-	-	-	MC
Total 27 periods		19	4	4	23	400	400	800	
SEMESTER 4									
19L401	Probability and Random Processes	3	1	0	4	50	50	100	BS
19L402	Linear Integrated Circuits	3	0	0	3	50	50	100	PC
19L403	Signals and Systems	3	0	0	3	50	50	100	PC
19L404	Measurements and Instrumentation	2	1	0	3	50	50	100	PC
19L405	Computer Architecture	3	1	0	4	50	50	100	PC
19L406	Antennas and Wave Propagation	3	1	0	4	50	50	100	PC
19L410	Linear Integrated Circuits Laboratory	0	0	2	1	50	50	100	PC
19L411	Signals and Systems 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
19L415	Activity Point Programme #	-	-	-	-	-	-	-	MC
Total 29 periods		19	4	6	24	500	400	900	

\*\* As per norms

CA Continuous Assessment

FE Final Examination

# As per AICTE Norms; Total 60 hrs; Grade : Completed / Not Completed; Not Counted

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 ELECTRONICS AND COMMUNICATION ENGINEERING****(2019 Regulations)**

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING									
		Periods / week				Maximum Marks			
Course Code	Course Title	Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 5									
19_____	Open Elective I	3	0	0	3	50	50	100	OE
19L502	Communication Engineering	3	0	0	3	50	50	100	PC
19L503	Microprocessors and Microcontrollers	3	0	0	3	50	50	100	PC
19L504	Control Systems	3	0	0	3	50	50	100	PC
19L505	Computer Networks	3	1	0	4	50	50	100	PC
19L_____	Professional Elective I	3	0	0	3	50	50	100	PE
19L510	Communication Engineering Laboratory	0	0	2	1	50	50	100	PC
19L511	Microprocessors and Microcontrollers Laboratory	0	0	2	1	50	50	100	PC
19Q513	Business and Managerial Communications	0	0	2	1	100	0	100	EEC
19L515	Activity Point Programme #	-	-	-	-	-	-	-	MC
Total 25 periods		18	1	6	22	500	400	900	
SEMESTER 6									
19L601	Digital Signal Processing	3	0	0	3	50	50	100	PC
19L602	Digital Communication	3	0	0	3	50	50	100	PC
19L603	VLSI Design	3	0	0	3	50	50	100	PC
19L604	Embedded Systems and IoT	3	1	0	4	50	50	100	PC
19L605	Digital Image Processing	3	0	0	3	50	50	100	PC
19L610	Digital Signal Processing Laboratory	0	0	2	1	50	50	100	PC
19L611	VLSI Design Laboratory	0	0	2	1	50	50	100	PC
19L620	Innovation Practices	0	0	4	2	100	0	100	EEC
19Q613	Quantitative and Reasoning Skills	0	0	2	1	100	0	100	EEC
19L615	Activity Point Programme #	-	-	-	-	-	-	-	MC
19L_____	Professional Elective II	3	0	0	3	50	50	100	PE
Total 29 periods		18	1	10	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)

CA Continuous Assessment

FE Final Examination

# As per AICTE Norms; Total 60 hrs; Grade : Completed / Not Completed; Not Counted

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 ELECTRONICS AND COMMUNICATION ENGINEERING****(2019 Regulations)**

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING									
Course Code	Course Title	Periods / week				Maximum Marks			
		Lecture	Tutorial	Practical	Credits	CA	FE	Total	CAT
SEMESTER 7									
19L701	Microwave Engineering	3	0	0	3	50	50	100	PC
19L702	Wireless Communication	3	0	0	3	50	50	100	PC
19L711	Microwave Engineering Laboratory	0	0	2	1	50	50	100	PC
19L712	Digital Communication Engineering Laboratory	0	0	2	1	50	50	100	PC
19L720	Project Work I	0	0	4	2	50	50	100	EEC
19L____	Professional Elective IV	3	0	0	3	50	50	100	PE
19L____	Professional Elective III	3	0	0	3	50	50	100	PE
19____	Open Elective II	3	0	0	3	50	50	100	OE
Total 23 periods		15	0	8	19	400	400	800	
SEMESTER 8									
19L____	Professional Elective V	3	0	0	3	50	50	100	PE
19L____	Professional Elective VI	3	0	0	3	50	50	100	PE
19L820	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

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**

### **ADVANCED COMMUNICATION SYSTEMS**

- 19L001 Satellite Communication
- 19L003 Fiber Optic Communication
- 19L004 Radar Communication
- 19L036 Digital Communication receivers

### **COMPUTER SCIENCE ELECTIVES**

- 19L002 Digital Switching Systems
- 19L029 Advanced Computer Architecture and Parallel Processing
- 19L030 Embedded Linux
- 19L031 Operating Systems
- 19L032 Relational Database Management Systems
- 19L033 Soft Computing Techniques
- 19L035 Computer and Machine Vision
- 19L038 Deep Learning

### **RADIO FREQUENCY SYSTEMS**

- 19L005 Radio Frequency Integrated Circuits
- 19L006 Computational Electromagnetics
- 19L007 Advanced Radiating System
- 19L008 Smart Antennas
- 19L037 EMC Test and Measurements

### **SIGNAL PROCESSING**

- 19L009 Speech Signal Processing
- 19L010 Multimedia Compression Techniques
- 19L011 Wavelets and its Applications
- 19L012 Advanced Digital Signal Processing
- 19L013 Pattern Recognition and Machine Learning
- 19L025 Digital Signal Processing System Design

### **NETWORKS**

- 19L014 Wireless Systems and Standards
- 19L015 Wireless Sensor Networks
- 19L016 Wireless Networking
- 19L018 Network Security
- 19L034 Software Defined Networking
- 19L017 Long Term Evolution Technologies

### **SYSTEM DESIGN**

- 19L019 FPGA Based System Design
- 19L026 Vehicular Systems and Networks
- 19L027 Advanced Processor Architectures
- 19L028 Real time systems

### **VLSI DESIGN**

- 19L020 Analog VLSI Circuits
- 19L021 Low Power VLSI Design
- 19L022 Nano Electronics
- 19L023 Device Modeling
- 19L024 System-on-Chip Design

## **LANGUAGE ELECTIVES**

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

## **ONE-CREDIT COURSES**

### **ELECTRONICS AND COMMUNICATION ENGINEERING**

- 19LF01 Linux and Scripting Languages
- 19LF02 Avionics
- 19LF03 System Level Verification Techniques and Methodologies
- 19LF04 Advanced Avionics
- 19LF05 E-Commerce Security
- 19LF06 Nano Technology
- 19LF07 Machine Vision Algorithms and System Design
- 19LF08 Routing Architecture and Design
- 19LF09 Automotive Controller Area Network and Security
- 19LF10 Underwater Tactical and Communication Engineering
- 19LF11 Embedded Processing With FPGAs
- 19LF12 ASIC Flow for Mixed Signal VLSI Design
- 19LF13 Design of satellite sub-systems and telemetry
- 19LF14 LoRa Gateway Design & Application
- 19LF15 5G Technology

### **HUMANITIES**

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

### **ENGLISH**

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

### Summary of Credit Distribution

BE ELECTRONICS AND COMMUNICATION 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	8	4	4	0	0	0	0	28
3	ES	5	11	4	0	0	0	0	0	20
4	PC	0	0	12	19	15	18	8	0	72
5	PE	0	0	0	0	3	3	6	6	18
6	OE	0	0	0	0	3	0	3	0	6
7	EEC	0	0+2	0	1	1	3	2	4	13
8	MC	-	-	-	-	-	-	-	-	-
	<b>TOTAL</b>	<b>20</b>	<b>21+2</b>	<b>23</b>	<b>24</b>	<b>22</b>	<b>24</b>	<b>19</b>	<b>10</b>	<b>165</b>

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 ELECTRONICS AND COMMUNICATION ENGINEERING

## SEMESTER - 1

### 19L101 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

### 19L102 PHYSICS

3 0 0 3

**OSCILLATORY MOTION:** Review of simple harmonic motion - Differential equation of SHM. Velocity and acceleration. Restoring force. Vibration of a spring and mass system. Frequency response, phase response and resonance. Analogy with LCR circuits and oscillators. Energy and energy loss. Damped oscillations. Significance in control systems, vibration and vibration isolation. (9)

**WAVE MOTION:** Definition of a plane progressive wave. Attenuation of waves. Representation of waves using complex numbers. Differential equation of a plane progressive wave. Phase velocity. Phase and phase difference. Solution of the differential equation of a plane progressive waveform of differential equation of 3-dimensional wave motion (no detailed solution). Introduction to numerical methods for solution of wave equation. Importance of spherical and plane wave fronts. (9)

**OPTICS:** Review of image formation in lenses and mirrors. Spherical and chromatic aberration. Methods of reducing aberrations (no derivations) - aspherical components, aperture control, multiple elements. Principle of adaptive optics. Role of actuators in adaptive optics. Fresnel mirrors- principle and applications for solar energy. Tracking of Fresnel mirrors. Interference and diffraction: Principle of Fabry-Perot interferometer. Diffraction due to circular apertures. Applications. Spectral distribution: emission, transmission and absorption spectra. Examples. (9)

**HEAT** : Review of thermal properties, Black body radiation, Specific heat capacity, thermal capacity and coefficient of linear thermal expansion. Methods of measurement of thermal expansion. Thermal stresses in composite structures due to non-homogeneous thermal expansion. Applications -The bimetallic strip. Differential equation of one-dimensional heat flow. Searle's apparatus and Lee's disc apparatus for determination of thermal conductivity. Thermal Insulation. Convection and radiation. Heat dissipation and heat sinking of electronic devices. (9)

**ELECTROMAGNETISM** : Review of definitions of fundamental terms. Permeability. Forces due to currents. Uniform and non-uniform magnetic fields. Static and time-varying magnetic fields. Electromagnetic induction. Expression for induced emf. Electric fields definition of fundamental terms. Dielectric constant, Permittivity. Dielectric displacement. Gauss theorem. Electromagnetic waves. Propagation of electromagnetic waves through isotropic media. Maxwell's equations and interpretation of Maxwell's equations. (9)

**Total L: 45**

**TEXT BOOKS:**

1. Richard Wolfson "Essential University Physics", Pearson Education., 2016 ,3<sup>rd</sup> Edition
2. Ghatak A "Optics", Tata McGraw-Hill India., 2017 , 6<sup>th</sup> Edition

**REFERENCES:**

1. Avadhanulu M. N "Engineering Physics", S. Chand & Co., 2010
2. Purcell E. M. "Electricity and Magnetism", Tata McGraw-Hill., 2017
3. Paul A. Tipler, Gene Mosca "Physics for Scientists and Engineers", W.H. Freeman and Company., New York, 2007 , 6<sup>th</sup> Edition
4. Crawford F. S "Waves", Berkeley Physics Course., 2017 , 1<sup>st</sup> Edition.

## 19L103 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-stoichiometric 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(T<sub>g</sub>) – factors affecting T<sub>g</sub> - 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", CRC Press., London, 2005. , 4<sup>th</sup> edition.
2. Cowie J.M.G, Valeria Arrighi "Polymers: Chemistry and Physics of modern materials", CRC Press., London, 2007. , 3<sup>rd</sup> edition.

**REFERENCES:**

1. Sam-Shajing Sun, Larry R. Dalton "Introduction to Organic Electronic and Optoelectronic Materials and Devices", CRC press., London, 2017. , 2nd edition
2. Stergios Logothetidis "Handbook of Flexible Organic Electronics Materials - Manufacturing and Applications", WoodHead publishing., London, 2015. , 1st edition
3. Peter Van Zant "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Mc Graw Hill,, 2014. , 6th edition
4. Anthony R. West "Solid state chemistry and its applications", John Wiley., USA, 2014. , 2nd edition.

## 19L104 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 – goto 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 Errors exercise (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 with 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 - Department of English "Course materials 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

**19L110 ENGINEERING GRAPHICS****0 0 4 2****INTRODUCTION**

- 1) Lettering practice
- 2) Geometric constructions
- 3) Dimensioning practice as per BIS conventions

**(12)****THEORY OF PROJECTION**

- 1) Projection of points and lines
- 2) Projection of planes
- 3) Projection of solids

**(12)****SECTIONS OF SOLIDS**

- 1) Sections of regular solids as per BIS conventions
- 2) Types of sections - sectional views of engineering components
- 3) Constructing sectional views

**(12)****DEVELOPMENT OF SURFACES**

- 1) Development of lateral surfaces of regular solids
- 2) Projection of truncated solids and simple engineering sheet metal components

**(12)****ORTHOGRAPHIC PROJECTION**

- 1) Projection of simple engineering components and missing view exercises
- 2) Modeling of simple engineering components using CAD software

**(12)****Total P: 60****TEXT BOOKS:**

1. Venugopal K, Prabhu Raja V "Engineering Graphics", New Age International Publishers., New Delhi, 2018 , 15<sup>th</sup> Multi color edition.
2. P.I Varghese "Engineering Graphics", McGraw Hill Education India Pvt. Ltd., New Delhi, 2013

**REFERENCES:**

1. K C John "Engineering Graphics for Degree", PHI learning private limited, 2009
2. Bureau of Indian Standards "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS., New Delhi, 2004

**19L111 BASIC SCIENCES LABORATORY****0 0 4 2****PHYSICS LABORATORY (ANY EIGHT EXPERIMENTS) :**

1. Determination of thermal conductivity of bad conductor using Lee's Disc method
2. Determination of fibre thickness — air wedge method
3. Determination of wavelength of mercury spectrum using transmission grating
4. Measurement of vibration frequency of electrically maintained tuning fork using Melde's apparatus
5. Determination of velocity of sound — Helmholtz resonator



6. Determination of Hysteresis loss of a ferromagnetic material
7. Determination of Temperature Coefficient of Resistance of metallic wire using post office box
8. Determination of capacitance using LCR bridge
9. Study of reverse bias characteristics of Germanium diode and determination of its bandgap
10. Thermistor: Measurement of temperature and bandgap

(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 Ferroxy indicator and determination of corrosion rate by current measurement.

(30)

**Total P: 60**

#### **REFERENCES:**

1. Department of Chemistry "Basic Science Laboratory Manual", 2019
2. Department of Physics "Physics Practicals", 2019
3. Wilson J. D. and Hernandez C. A. "Physics Laboratory Experiments", Houghton Mifflin Company, New York., 2009

### **19L112 PROBLEM SOLVING AND C PROGRAMMING LABORATORY**

**0 0 2 1**

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

(30)

**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

### 19L201 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 Fourier transform – DIT algorithm. (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 P Ltd., New Delhi, 2017
4. Dean G Duffy "Advanced Engineering Mathematics with MATLAB", CRC., USA, 2017

### 19L202 MATERIALS SCIENCE

2 0 0 2

**QUANTUM MECHANICS** : Wave particle duality, de Broglie waves- Heisenberg's uncertainty principle. Wave function-normalization. The wave equation. Schrodinger's equation of motion: Time dependent form, steady-state form. Particle in a box. Quantum Tunneling and applications to Scanning Tunneling Microscope and Tunnel diode. (8)

**ELECTRICAL PROPERTIES** : Conducting materials-quantum free electron theory -Fermi Dirac Statistics-Band theory of solids-the density of states. Dielectrics-types of polarization-measurement of dielectric permittivity-Loss factor-Dielectric loss mechanisms. Magnetostriction. Electron ballistics- materials for thermionic (7)

**PHYSICS OF SEMICONDUCTORS** : P type and N type semiconductors-the effective mass. Free electron and hole concentration in semiconductors. Band gap determination. Carrier concentration in n and p type semiconductor. P- N junction, rectifier equation - Hall effect-Quantum tunneling. Hetero junction-Quantum well, wire, dots - Optical properties of Semiconductors: LD, LED, Photo diode. Introduction to MEMS (8)

**MAGNETIC PROPERTIES** : Types of magnetic materials-domain theory – hysteresis - hard and soft magnetic materials – Applications - eddy current brakes, regenerative braking. Magnetic lenses. Superconductivity – Meissners effect - Josephson junction, SQUID magnetometer, applications. (7)

**Total L: 30**

**TEXT BOOKS:**

1. William D Callister Jr "Materials Science and Engineering - An Introduction", John Wiley and Sons Inc., New York, 2007 , 6<sup>th</sup> edition
2. Arthur Beiser "Concepts of Modern Physics", Tata McGraw Hill., India, 2002

**REFERENCES:**

1. James F Shackelford S "Introduction to Materials Science for Engineers", Macmillan Publishing Company., India, 1992, 3<sup>rd</sup> edition
2. Van Vleck "Elements of Material Science and Engineering", Pearson Education., India, 2008
3. Sze S.M "Physics of Semiconductor Devices", John Wiley and Sons., USA, 2007
4. Donald R Askeland, Wendelin J Wright "Essentials of Materials Science and Engineering", Cengage Learning., USA, 2013 , 3<sup>rd</sup> edition

**19L203 INDUSTRIAL ELECTROCHEMISTRY****2 0 0 2**

**ELECTROCHEMISTRY** : Conductance of strong and weak electrolytes, mobility of ions - transport number, 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. (6)

**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 – anodizing – determination of thickness of anodized film. Nature inspired coatings - superhydrophobic coatings, self healing coatings. Corrosion in electronic components – control by vapour phase inhibitors. (6)

**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 of Cu from PCBs, Electrophoretic painting, Electrochemical etching of semiconductors. (6)

**ELECTROCHEMICAL POWER SOURCES** : Batteries- types, characteristics. Fabrication and working of lechlanche cell, primary lithium cell, lead- acid battery, Ni-metal hydride and lithium ion batteries. Supercapacitors. Fuel cells - Classification, working principle, components, applications of proton exchange membrane, direct methanol and solid oxide fuel cells. Hydrogen as a fuel - production and storage. (6)

**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 – CO<sub>2</sub>, O<sub>2</sub> and NH<sub>3</sub> sensing. Sensors for health care – glucose and urea. (6)

**Total L: 30****TEXT BOOKS:**

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

**REFERENCES:**

1. Dell R. M. and Rand D. A. J "Understanding Batteries", Royal Society of Chemistry., UK, 2001. , 1<sup>st</sup> edition
2. Brian Eggins "Chemical Sensors and Biosensors", John Wiley & Sons., US, 2002. , 1<sup>st</sup> edition
3. Zaki Ahmad, Digby Macdonald "Principles of Corrosion Engineering and Corrosion Control", Butterworth- Heinemann., London, 2013. , 2<sup>nd</sup> edition
4. Shashi Chawla -A Textbook of Engineering Chemistry", Dhanpat Rai and Co., New Delhi, 2005, 1<sup>st</sup> edition

**19L204 ELECTRON DEVICES****3 0 0 3**

**SEMICONDUCTOR DIODE** : Review Of Properties of Semiconductor Materials - Theory of PN Junction Diode and Zener diode - V-I Characteristics and its Temperature dependence - Break down mechanisms - Diode Resistance and Capacitance - Diode

Models - Rectifiers - Clipper - Clamper - Voltage regulator - Tunnel Diode and Varactor Diode (9)

**BIPOLAR JUNCTION TRANSISTOR** : Transistor types - Transistor Action - Current Components - Ebers Moll Model - Configurations - Transistor as a Switch and Amplifier - Small Signal Low Frequency Hybrid Model - DC and AC Load Lines - Operating Point - Bias stability, Biasing Methods and Bias Compensation (9)

**FIELD EFFECT TRANSISTOR** : JFET and its Characteristics - JFET parameters and Configurations - MOSFET – Types - V-I Characteristics - Principle of operation - MOSFET Biasing - MOS Capacitor - MOSFET as switch - Comparison of FET and BJT (9)

**CMOS** : NMOS and PMOS transistors and their characteristics - Threshold voltage - MOS device equations - Second order effects - Small signal MOS model (9)

**POWER AND OPTO ELECTRONIC DEVICES** : Thyristor Families - SCR, DIAC, TRIAC - Operation and their Characteristics - Application - UJT- Operation - Characteristics - Equivalent Circuit – Applications - Opto Electronic Devices - Photoconductive, Photovoltaic, Photo-emissive Sensors - Laser diode - Photo diodes - Photo Transistors - Light emitters - Liquid Crystal Displays - Plasma and HDTV (9)

**Total L: 45**

**TEXT BOOKS:**

1. Millman J. , Halkias C. C. "Electronic Devices and Circuits ", Tata McGraw Hill, New Delhi, 2011.
2. Floyd T. L "Electronic Devices and Circuits", Pearson Education., New Delhi, 2011

**REFERENCES:**

1. Boylestad, R. L. and Nashelsky, L. "Electronic Devices and Circuit Theory ", Pearson Education, New Delhi, 2012
2. David A.Bell "Electronic Devices and Circuits", Prentice Hall of India., 2008
3. Robert T.Paynter "Introductory Electronic Devices and Circuits", Pearson Education., USA, 2009
4. Neil.H.E.Weste, Kamran Eshraghian "Principles of CMOS VLSI Design- A system perspective", Addison Wesley., New Delhi, 2009 , second edition

## 19L205 CIRCUIT THEORY

**3 1 0 4**

**CIRCUIT ANALYSIS** : Charge and Current, Voltage, Power and Energy, Network Elements - Current and Voltage sources. Kirchoff's Laws - Ohm's Law - Resistive circuits - Series and Parallel reduction method and analysis. Voltage and Current division. Source Transformation. Wye-Delta transformation, Duality - Mesh and Nodal analysis (10+3)

**NETWORKS THEOREMS AND GRAPH THEORY** : Superposition, Thevenin's and Norton's, Maximum power transfer, Reciprocity theorems, Tellegen's theorems - Network topology, matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. (10+3)

**AC CIRCUIT ANALYSIS** : Average and RMS values - Phasor representation of variables - Power triangle and average power - Mesh, Node and theorems, Resonance, Magnetically coupled circuits. (7+2)

**TIME DOMAIN ANALYSIS** : Source free RL and RC circuits, Transient Response of RL and RC circuits for DC excitation and Sinusoidal excitation. Frequency Domain Analysis: Transient Response of RL, RC, RLC circuits for DC and Sinusoidal excitation using Laplace transform, Network functions of single-port network, Driving point and transfer function of Two-port networks, Poles and Zeros of network functions. (11+5)

**ANALYSIS OF TWO PORT NETWORK** : Network parameters-Impedance, admittance, transmission and hybrid, Conversion formulae. Properties – reciprocity and symmetry - Equivalents of T,  $\Pi$ , Ladder, bridged T and Lattice networks. (7+2)

**Total L: 45 + T:15 = 60**

**TEXT BOOKS:**

1. Singh "Network Analysis and Synthesis", McGraw-Hill Education., New Delhi, 2013
2. Alexander C, Sadiku M. N. O "Fundamentals of Electric Circuits", Tata McGraw Hill., New Delhi, 2013
3. Sudhakar A, Shyamamohan S. Pillai "Circuits and Networks Analysis and Synthesis", McGraw Hill., New Delhi, 2015

**REFERENCES:**

1. Abhijit Chakrabarthy "Circuit Theory Analysis & Synthesis", Dhanpath Rai & Sons., New Delhi, 2011
2. Nahvi M, Edminister J. A "Theory and Problems Electric circuits", Tata McGraw Hill., New Delhi, 2011

**19L210 LANGUAGE ELECTIVE****0 0 4 2****19L211 DEVICES AND CIRCUITS LABORATORY****0 0 4 2**

1. Verification of Kirchhoff's Voltage and Current laws
2. Verification of Thevenin's theorem and Maximum Power Transfer Theorem
3. PN Junction Diodes and Rectifier circuits
4. Wave shaping circuits: Clippers and clampers
5. Zener Voltage Regulator
6. Evaluation of BJT Hybrid parameters
7. BJT Biasing Techniques
8. Series and parallel resonance circuits
9. MOSFET Characteristics and its application as a switch
10. Simulation : Verification of theorems
11. Simulation : BJT Characteristics
12. Simulation : CMOS characteristics
13. Simulation : Characteristics of Thyristor Family Devices

(60)

**Total P: 60****REFERENCES:**

1. ECE Department "Laboratory Manual".

**19L212 PYTHON PROGRAMMING LABORATORY****0 0 4 2****PROBLEM SOLVING RELATED TO THE FOLLOWING TOPICS:**

1. Programs related to integers, float, complex, Boolean data types in the shell
2. Input/output and conditional statements in scripts
3. Different operator and conversion functions
4. Loops : for and while
5. String datatype: Creation, Operations, Methods
6. Tuple data type: Creation, Operations, Methods
7. Set and frozen set datatypes: Creation, Operations, Methods
8. Dictionary datatype: Creation, Operations, Methods
9. Functions: definitions , parameter passing, returning datatypes
10. Lambda and recursive functions
11. Creating modules and packages
12. Handling exceptions
13. File handling

(60)

**Total P:60****REFERENCES:**

1. Mark Summerfield "Programming in Python 3: A Complete introduction to the Python Language", Addison- Wesley Professional., 2009
2. Reema Thareja "Python Programming : Using Problem Solving Approach", Oxford university Press., 2017

3. Paul Barry "Head First Python: A Brain-Friendly Guide", O'Reilly Media., 2016

## 19L213 INTERNSHIP

0 0 0 2

### MODULE- I ELECTRONICS

1. Preparation of Schematic using CAD tools
2. Design of PCB and fabrication
3. Assembling of components and testing
4. Prototype electronic products.

### MODULE- II MECHANICAL

1. Fitting - Tools, operations, exercises Make —L joint, types of joints.
2. Carpentry- Tools, carpentry process, carpentry exercises types of joints.
3. Sheet metal work - Tools, operations, exercises Make a Rectangular Tray in Galvanized Iron sheet

## SEMESTER - 3

### 19L301 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 EIGENVECTORS** : 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.

### 19L302 ANALOG ELECTRONICS

**3 0 0 3**

**POWER SUPPLIES** : Half wave and Full wave Rectifiers - Calculation of Ripple factor, Regulation, Rectification efficiency and TUF - Filters - L, C, L-Section and Pi - Voltage Regulators - Series and Shunt - Current limiting and protection circuits. (9)

**SINGLE STAGE AMPLIFIERS AND TUNED AMPLIFIERS** : BJT and MOSFET amplifiers - calculation of input and output impedance, voltage gain - Frequency Response of Common Source MOSFET Amplifier - Analysis of single tuned amplifiers (9)

**DIFFERENTIAL AMPLIFIERS** : BJT Current Mirrors- Simple, Widlar, Wilson - Differential amplifier- Differential and common mode gain - CMRR - Circuits for improving CMRR using active load - Cascode and Darlington amplifiers (9)

**POWER AMPLIFIERS AND FEEDBACK AMPLIFIERS** : Classification of Power Amplifiers-Class A/B/AB/C/D - Single ended and Push-pull configuration - Feedback Concepts - Effect of negative feedback on voltage and current feedback amplifier circuits (9)

**OSCILLATORS AND MULTIVIBRATORS** : Barkhausen criteria - Sinusoidal oscillators - RC, LC and Quartz - Frequency stability of oscillators - Non-sinusoidal oscillators - Multivibrators - Bistable, monostable and astable multivibrators - Schmitt Trigger (9)

**Total L: 45**

**TEXT BOOKS:**

1. Jacob Millman, Christos C Halkias, Satyabrata Jit, "Electronic Devices and Circuits", Fourth Edition, McGraw Hill Education, 2015.
2. Sedra and Smith, "Micro electronic Circuits", Seventh Edition, Oxford University Press, NY, USA, 2017.

**REFERENCES:**

1. Millman J, Taub H., "Pulse, Digital and Switching waveforms", Third, McGraw Hill International, 2011.
2. Donald L Schilling, Charles Belove, "Electronic Circuits", 3rd Edition, Tata McGraw-Hill, 2002.
3. Allen Mottershed, "Electronic Devices and Circuits", Prentice Hall of India, 2009.
4. David A Bell, "Electronic Devices and Circuits", Prentice Hall of India, New Delhi, 2008.

**19L303 DIGITAL ELECTRONICS**

**3 0 0 3**

**NUMBER SYSTEMS AND BOOLEAN ALGEBRA** : Number systems - Arithmetic operations-computer codes - Boolean algebra – basic postulates and theorems - canonical forms- Standard representation of logic functions- K-maps and Quine McClusky method- Modeling using Verilog. (9)

**COMBINATIONAL LOGIC DESIGN** : Binary / BCD adders, Subtractors, encoders, decoders, multiplexers and demultiplexers - Carry look ahead adder – Multiplier - magnitude comparator – ALU - Verilog implementation of Combinational logic circuits (9)

**SYNCHRONOUS SEQUENTIAL CIRCUITS** : Flip-flops- latches - Shift registers- synchronous counters- Design and analysis of clocked sequential circuits- state reduction techniques-Sequence detector- Verilog implementation of sequential logic circuits. (9)

**ASYNCHRONOUS SEQUENTIAL CIRCUITS** : Fundamental and pulse mode circuits-Design of fundamental mode asynchronous sequential circuits-Binary / BCD Ripple counter – Races - Hazards. (8)

**PROGRAMMABLE LOGIC DEVICES AND LOGIC FAMILIES** : Classification of memories, Read/write operations- Memory decoding and expansion, Static and Dynamic RAM- PLDs- Architecture and implementation - Digital logic families - Characteristics - TTL, ECL and CMOS logic. (10)

**Total L: 45**

**TEXT BOOKS:**

1. Morris Mano, and M.D. Ciletti , "Digital Design: with an introduction to Verilog HDL, VHDL and system verilog", 6<sup>th</sup> Edition, Pearson, New Delhi, 2018.
2. Joseph Cavanagh , "Digital Design and Verilog HDL Fundamentals", CRC Press, 2015.

**REFERENCES:**

1. Charles Roth, Lizy kurian john , "Digital Systems Design using Verilog", 1st Edition, cengage India private limited, 2016.
2. Floyd T L , "Digital Fundamentals", 11th Edition, Pearson education, New Delhi, 2015.
3. A Anandkumar , "Fundamentals of Digital circuits", 4th Edition, Prentice Hall of India, New Delhi, 2016.

**19L304 ELECTROMAGNETIC FIELDS AND WAVES****3 1 0 4**

**ELECTROSTATIC FIELDS :** Review of vector calculus and Co-ordinate systems - Electrostatic fields - Coulomb's Law and field intensity - Electric flux density - Gauss's law and its application - Electric potential - Relationship between E and V-Flux lines - Dipole- Energy density - Conductors - Boundary conditions in electrostatic fields – Boundary value problems (12+4)

**MAGNETOSTATIC FIELDS :** Biot-Savart's Law - Ampere's circuital law - Magnetic flux density and Maxwell's equations – Magnetic forces due to magnetic fields - Magnetic -Scalar and Vector potential - Magnetic Boundary conditions – Boundary value problems – Magnetic energy. (12+4)

**TIME VARYING FIELDS :** Faraday's Law – Equation of continuity - Inconsistency of Ampere's law - Maxwell's equations and their interpretation – Time varying Potentials (5+2)

**ELECTROMAGNETIC WAVES :** Uniform plane waves- Wave equation - Wave propagation in different media - Poynting Vector and Theorem – wave Polarization - Reflection of a plane wave at Normal and Oblique incidence - EMI / EMC Interference. (8+3)

**TRANSMISSION LINES AND WAVEGUIDES :** Transmission line-parameters-VSWR- reflection coefficient - stub matching using Smith chart - Rectangular waveguide – TE and TM modes and propagation characteristics – Impossibility of TEM waves. (8+2)

**Total L: 45 +T: 15 = 60****TEXT BOOKS:**

1. Sadiku M H , "Principles of Electromagnetics", Oxford University Press Inc, New Delhi, 2015.
2. William H Hayt , "Engineering Electromagnetics", 8th Edition, McGraw Hill international Edition, New Delhi, 2012.

**REFERENCES:**

1. David K Cheng , "Fields and Wave Electromagnetics", 2nd Edition, Pearson Education, 2013.
2. Umran S. Inan, Aziz Inan, Ryan Said , "Engineering Electromagnetics and Waves", 2nd Edition, Pearson, 2015.

**19L305 DATA STRUCTURES AND ALGORITHMS****2 2 0 4**

**INTRODUCTION: :** Data types – Abstract data types – Types of Data structures- Algorithms- properties – Design and development of algorithm - Recursive Algorithms- Analysis of Algorithms - Best case, Average case, Worst case - Asymptotic Notations. (6+6)

**LINEAR DATA STRUCTURES: :** Arrays-operations – Memory Representation- Row Major and Column Major – Multi Dimensional Arrays – Sparse Matrix, Dense Matrix. Stack: Array implementation – operations-Applications – Checking of well-formedness Parenthesis Infix to Postfix –Conversions. (6+6)

**QUEUES: :** Queue Operations-Circular Queue - Priority Queues - Array Implementation of Queue. Linked List: Types-Singly Linked List – Circularly Linked List – Doubly Linked List–List operations. (6+6)

**NONLINEAR DATA STRUCTURES: :** Trees-Terminologies - Binary trees – Representations – Operations – Traversals-Inorder, Preorder and Postorder- Binary Search Trees – Insertion and deletion. Graph: Terminologies - Breadth First Search algorithm- Depth First Search Algorithm. (6+6)

**SORTING AND SEARCHING : :** Bubble Sort – Insertion Sort – Radix Sort- Quick sort- Algorithms and Time Complexity. Linear Search – Binary Search – Hashing: Hash functions – Separate Chaining – Open Addressing – Linear Probing. (6+6)



**Total L: 30 +T: 30 = 60**

**TEXT BOOKS:**

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein , "Introduction to Algorithms", The MIT Press, 2014.
2. Mark Allen Weiss , "Data Structures and Algorithm Analysis in C++", Pearson Education, 2012.

**REFERENCES:**

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran , "Fundamentals of Computer Algorithms", Second, Universities Press, 2011.
2. Sahni Sartaj , "Data Structures, Algorithms and Applications in C++", Silicon Press, 2009.
3. Aaron M Tanenbaum, Moshe J Augenstein, Yedidyah Langsam , "Data structures using C and C++", PHI Learning, 2009.
4. G A V Vijayalakshmi Pai , "Data Structures and Algorithms Concepts, Techniques and Allocations", McGraw Hill Education (India) Private Limited, New Delhi, 2015.

## **190306 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.

## **19L310 ANALOG ELECTRONICS LABORATORY**

**0 0 2 1**

**HARDWARE EXPERIMENTS :**

- 1) Full Wave Rectifiers with and without filters
- 2) Series voltage regulators
- 3) BJT amplifiers.
- 4) FET amplifiers
- 5) RC phase shift and Colpitt's oscillators
- 6) Class B and Class AB amplifiers
- 7) Astable multivibrators
- 8) Monostable and Bistable multivibrators

- 9) Schmitt Trigger
  - 10) Feedback Amplifiers
- (20)

**SOFTWARE EXPERIMENTS :**

- 1) BJT current mirrors
  - 2) Differential amplifiers
  - 3) MOS CS amplifier with resistive load and current source load
- (10)

**Total P: 30**

**TEXT BOOKS:**

1. Millman J and Taub H , "Pulse, Digital and Switching waveforms", McGraw Hill International, New Delhi, 2011.
2. David A Bell , "Electronic Devices and Circuits", Prentice Hall of India, New Delhi, 2008.

## 19L311 DIGITAL ELECTRONICS LABORATORY

**0 0 2 1**

**HARDWARE EXPERIMENTS :**

- 1) Half adder and Full adder
  - 2) Code Conversion: BCD to Gray and Seven segment conversion
  - 3) Multiplexers/Demultiplexers
  - 4) Flip-flops
  - 5) Shift Registers
  - 6) Ring Counter and Johnson Counter
- (15)

**SOFTWARE EXPERIMENTS :**

- 1) Adder / Subtractor Circuits and BCD adder using verilog code
  - 2) Magnitude Comparator and ALU using verilog code
  - 3) Synchronous Counters using verilog code
  - 4) Asynchronous counters using verilog code
  - 5) Sequence Detector using verilog code
- (15)

**Total P: 30**

**TEXT BOOKS:**

1. Morris Mano, and M.D. Ciletti , "Digital Design: with an introduction to Verilog HDL, VHDL and system verilog", 6th Edition, Pearson Education, New Delhi, 2018.

## 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**

**19L401 PROBABILITY AND RANDOM PROCESSES**

**3 1 0 4**

**PROBABILITY** : Probability axioms, some consequences of the axioms, conditional probability, law of total probability, Baye's theorem, independence, sequential experiments and tree diagrams, reliability problems. (9+3)

**RANDOM VARIABLES** : Discrete random variables – probability mass function, binomial, Poisson and geometric random variables, cumulative distribution function, expectations. Continuous random variables – probability density function, uniform, exponential, Gaussian random variables, expectations. (9+3)

**PAIRS OF RANDOM VARIABLES** : Joint cumulative distribution function, joint probability mass function, marginal probability mass function, joint probability density function, marginal probability density function, expected values, independent random variables, covariance. (9+3)

**STOCHASTIC PROCESSES** : Types of stochastic processes – Poisson process, Brownian motion process, expected value and correlation, stationary processes, wide sense stationary stochastic process, cross-correlation. (9+3)

**RANDOM SIGNAL PROCESSING** : Linear filtering of a continuous-time stochastic process, linear filtering of a random sequence, power spectral density of a random sequence. (9+3)

**Total L: 45 + T: 15 = 60**

**TEXT BOOKS:**

1. Roy D. Yates and David J Goodman , "Probability and Stochastic Processes – A friendly Introduction for Electrical and Computer Engineers", Wiley India, New Delhi, 2014.
2. Saeed Ghahramani , "Fundamentals of Probability with Stochastic Processes", CRC Press, Taylor & Francis Group, USA, 2018.

**REFERENCES:**

1. Kishore S. Trivedi , "Probability and Statistics with reliability, queueing and computer science applications", PHI Learning Pvt Ltd, New Delhi, 2016.
2. Sheldon M. Ross , "Stochastic Processes", Wiley India, New Delhi, 2016.
3. Athanasios Papoulis and Unnikrishna Pillai S , "Probability, Random Variables and Stochastic Processes", Tata McGraw

Hill, New Delhi, 2011.  
4. William Feller, "An Introduction to probability theory and its applications", Wiley India, New Delhi, 2013.

## 19L402 LINEAR INTEGRATED CIRCUITS

3 0 0 3

**OPERATIONAL AMPLIFIERS AND ITS CHARACTERISTICS** : Operational Amplifier: Fundamental block diagram - Characteristics of an Ideal Operational Amplifier - DC and AC characteristics-frequency response - circuit stability (9)

**APPLICATION OF OPERATIONAL AMPLIFIERS** : Linear applications- DC&AC amplifiers, summing differential amplifier, instrumentation amplifier, V to I and I to V converters, Integrator, Differentiator. First/second order low/ high/ band pass, band reject active filters, All pass filter - Phase shift oscillator, Wein bridge oscillator, Square wave and triangular waveform generators. - Nonlinear applications - Comparators, Schmitt Trigger, Clipping and Clamping circuits, Absolute value circuits, Peak detectors, Sample and hold circuits, Log and antilog amplifiers. (9)

**555 FAMILY ICs AND PHASE LOCKED LOOP** : 555 Timer - monostable and astable modes of operation – Applications - Voltage Controlled Oscillator, Phase Locked Loop – operating principles and applications. (9)

**A-D AND D-A CONVERTERS** : Digital to Analog converters - Binary weighted and R-2R Ladder types - Analog to digital converters - Sample and Hold circuit - Continuous - Counter ramp, successive approximation, single, dual slope and parallel types - DAC/ADC performance characteristics and comparison. (9)

**VOLTAGE REGULATORS** : Fixed voltage regulators- adjustable voltage regulators - IC Voltage regulators—Buck & Boost regulators - Switching regulators (9)

Total L: 45

### TEXT BOOKS:

1. Roy Choudhury, "Linear Integrated Circuits", 4th Edition, Wiley Eastern, New Delhi, 2014.
2. James M. Fiore, "OP- AMPS and Linear Integrated Circuits-concepts and applications", 3rd Edition, cenage learning india,, NEW DELHI, 2019.

### REFERENCES:

1. Michael Jacob J, "Analog Integrated Circuits and Applications", 1st Edition, Prentice Hall of India,, New Delh, 2019.
2. Robert F Coughlin and Fedrick F Driscoll, "Operational amplifiers and linear Integrated Circuits", Fifth, Prentice Hall of India,, New Delhi, 2014.

## 19L403 SIGNALS AND SYSTEMS

3 0 0 3

**INTRODUCTION TO SIGNALS AND SYSTEMS** : Basic Continuous-time (CT) & Discrete-Time (DT) signals - Operations - Classification - Properties of CT & DT systems – Analysis of LTI systems - Convolution Sum - Convolution Integral – Properties (15)

**FOURIER ANALYSIS OF CT SIGNALS AND SYSTEMS** : Representation of CT periodic signals by Continuous Time Fourier Series - Convergence - Properties - Representation of CT aperiodic and periodic signals by Continuous Time Fourier Transform - Convergence - Properties - Frequency response of systems characterized by differential equations (8)

**FOURIER ANALYSIS OF DT SIGNALS AND SYSTEMS** : Representation of DT periodic signals by Discrete Time Fourier Series - Properties - Representation of DT aperiodic and periodic signals by Discrete Time Fourier Transform – Convergence - Properties - Frequency response of systems characterized by difference equations. (8)

**SAMPLING** : Representation of CT signals by samples – Impulse train sampling - Effects of under sampling - Reconstruction of CT signal from samples using interpolation (6)

**Z TRANSFORM ANALYSIS OF DT SIGNALS AND SYSTEMS** : z- transform - Properties - Inverse z-transform - Partial fraction and Cauchy Residue methods - Analysis of LTI systems using z transform- Stability and causality in z-domain - Solution of difference equations (8)

**Total L: 45**

**TEXT BOOKS:**

1. Alan V Oppenheim, Alan S Willsky, S Hamid Nawab , "Signals and Systems", second Edition, PHI Learning Private Limited, New Delhi, 2015.
2. Krishnaveni.V, Rajeswari.A , "Signals and Systems", First Edition, Wiley India Pvt.Ltd, 2012.

**REFERENCES:**

1. Haykin. S and Barry Van Veen , "Signals and Systems", Second Edition, John Wiley and Sons, 2012.
2. Hsu.H.P, Rakesh Ranjan , "Signals and Systems", Second Edition, Schaums's Outlines, Tata McGraw Hill, 2010.
3. Samir S. Soliman, Mandyam Dhati Srinath , "Continuous and Discrete Signals and Systems", Second Edition, Prentice-Hall International, 2011.
4. Luis F. Chaparro , "Signals and Systems Using MATLAB", 1st Edition, Academic Press, An Imprint of Elsevier, 2011.

## **19L404 MEASUREMENTS AND INSTRUMENTATION**

**2 1 0 3**

**MEASUREMENTS** : Significance and methods of measurements – Standards and their classification. calibration - functional elements of a measurement system - errors in measurements and statistical analysis – Introduction to VI software (4+2)

**INDICATING INSTRUMENTS** : PMMC Mechanism - D'ARSONAL Galvanometer - DC Ammeters and voltmeters - Measurement of resistance, inductance and capacitance using dc and ac bridges - AC voltmeters using rectifiers - digital voltmeters – Multimeter - VSWR meter - Frequency meter (6+3)

**SIGNAL SOURCES AND ANALYSERS** : Function generator and pulse generators, Oscilloscopes – DSO and MSO, Harmonic Distortion and spectrum Analyzers, Digital Recorders and printers, 3D printing - Realization of signal sources and analyzers (7+3)

**TRANSDUCERS** : Classification and selection of Transducers - Strain, Load, Force, Displacement, Velocity, Acceleration - Pressure and Temperature Measurements – Microphone and speakers - Smart sensors and MEMS - Interfacing of transducers (6+4)

**DATA ACQUISITION SYSTEMS (DAS)** : Block Diagram – Specifications, various components and Applications of DAS - Realization of DAS (7+3)

**Total L: 30 +T: 15 = 45**

**TEXT BOOKS:**

1. Albert D Helfrich, Cooper. W.D , "Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, New Delhi, 2009.
2. Sawhney A K , "A course in Electrical and Electronic Measurement and Instrumentation", 19th Edition, Dhanpat Rai and Co. (P) Ltd, New Delhi, Reprint 2019.

**REFERENCES:**

1. Joseph J Carr , "Elements of Electronic Instrumentation and Measurement", Pearson Education, New Delhi, 2008.
2. Nakra B C, Choudhury K.K , "Instrumentation Measurement and Analysis", Tata McGraw Hill, New Delhi, 2004.
3. Jovitha Jerome , "Virtual Instrumentation Using LabView", Prentice Hall of India, New Delhi, 2010.
4. Garry M Johnson , "Lab View Graphical Programming", Tata McGraw Hill, New Delhi, 2010.

## **19L405 COMPUTER ARCHITECTURE**

**3 1 0 4**

**INTRODUCTION** : Generation of computer systems - Elements of computer - CPU organization - Instruction formats - Addressing modes - Instruction types - CISC and RISC architectures - Multicore architectures (9+3)

**DATA PATH DESIGN** : Fixed point arithmetic - adder / subtractor - Signed magnitude multiplication algorithm - Robertson multiplication algorithm - Booth's and modified Booths multiplication algorithm - non-restoring division algorithm - restoring division algorithm - floating point arithmetic - addition, subtraction, multiplication and division - ALU - Verilog implementation of datapath components (9+3)

**CONTROL LOGIC DESIGN** : Control organization - Hardwired Control - one flip flop per state - sequence register and

decoder - PLA control - Micro programmed control - performance enhancement techniques - parallel processing - arithmetic pipeline, instruction pipeline - Amdahl's law - Measuring CPU performance – Verilog implementation of control logic components (9+3)

**MEMORY ORGANIZATION** : Basic Concepts - Memory Hierarchy - Main Memory - Auxiliary Memory – Associative Memory - Cache and Virtual Memory - SDRAM, DDRAM, QDRAM - Flash memories (9+3)

**INPUT / OUTPUT AND SYSTEM ORGANIZATION** : Input / Output Interface - Synchronous Data Transfer - Asynchronous Data Transfer - Modes of data transfer - I/O Processor - Interrupts - vectored and non vectored – Communication methods - Buses - Bus control - Bus interfacing - Bus arbitration (9+3)

**Total L: 45 +T: 15 = 60**

**TEXT BOOKS:**

- 1.Morris Mano M , "Digital Logic and computer design", Pearson Education, New Delhi, 2013.
- 2.Hayes J P , "Computer architecture and Organization", McGraw Hill, New Delhi, 2012.

**REFERENCES:**

- 1.Stallings W , "Computer Organization and Architecture: Designing for performance, Pearson Education, New Delhi, Seventh Edition ,2005.", 2005.
- 2.Patterson D , Hennessy J , "Computer Organization and Design: The Hardware/Software Interface", Morgan Kaufmann Publishers, 2007.
- 3.Hayes J P , "Computer architecture and Organization", McGraw Hill, New Delhi, 2002.

## **19L406 ANTENNAS AND WAVE PROPAGATION**

**3 1 0 4**

**FUNDAMENTALS OF ANTENNA** : Types of antennas- Radiation mechanism- current distribution on a thin wire antenna- Antenna parameters- Radiation Pattern, Beam solid angle, Radiation intensity, Radiation Power density, Directivity, Gain, Effective aperture, Polarization, Bandwidth, Beam width, antenna impedance, Poynting vector-Friis Transmission formula, Duality of Antennas, Antenna and Transmission lines, Radiation from a dipole antenna. (9+3)

**SMALL ANTENNAS** : Radiation fields of point source, infinitesimal dipole, and half-wave dipole, Radiation resistance, Directivity and Design procedure- impedance matching of antennas- Smith chart, quarter wave matching (9+3)

**ANTENNA ARRAYS** : Definition, Power patterns, Array of two point sources – Pattern multiplication, Broad side array, End fire array, N-element linear array, Evaluation of null directions and maxima, amplitude distributions, Binomial arrays, Dolph - Chebyshev arrays (9+3)

**SPECIAL ANTENNAS** : Design procedure and Selection of antenna based on frequency of operation and application, Types of Antennas- Yagi -Uda , Turnstile, Log periodic, Loop and helical - normal mode and axial mode. Phased array- Rhombic - Horn - Reflector and their feed systems - Micro strip - Rectangular patch (9+3)

**ANTENNA MEASUREMENTS AND WAVE PROPAGATION** : Antenna ranges- Measurement of radiation pattern, Gain, directivity and impedance measurements- Polarization measurements- scale model measurements. Propagation in free space - Surface wave - structure of the ionosphere - determination of critical frequencies - maximum usable frequency - effect of the earth's magnetic field – ionospheric variations – fading – tropospheric propagation - space wave propagation- super refraction -refractive index of troposphere (9+3)

**Total L: 45 + T: 15 = 60**

**TEXT BOOKS:**

- 1.Balanis E S , "Antenna Theory Analysis and Design", 5th Edition, John Wiley and Sons Inc, Singapore, 2016.
- 2.Prasad K D , "Antennas and Wave Propagation", 12th Edition, Satya Prakash, Tech India Publications, New Delhi, 2019.

**REFERENCES:**

- 1.Harish A R, and Scahidananda M , "Antennas and Wave Propagation", 3rd Edition, Oxford University Press,, Chennai, 2018.
- 2.Edward C Jordan, Keith G Balmain , "Electromagnetic waves and Radiating systems", 5th Edition, Prentice Hall of India, New Delhi,2018.

## **19L410 LINEAR INTEGRATED CIRCUITS LABORATORY**

**HARDWARE EXPERIMENTS :**

- 1) Inverting, Non-Inverting and Differential amplifiers, Integrator and Differentiator
- 2) Rectifier using precision diodes
- 3) Active low-pass, High-pass and band-pass filters
- 4) Comparators and Schmitt Trigger using op-amp
- 5) Phase shift and Wien bridge oscillators using op-amp
- 6) Astable and monostable multivibrators using NE555 Timer.
- 7) Digital to Analog Converters and Analog to Digital converters
- 8) Low Dropout Voltage Regulator
- 9) Study of PLL characteristics

(20)

**SOFTWARE EXPERIMENTS :**

- 1) Instrumentation amplifier
- 2) Universal filter.
- 3) Analog multiplier
- 4) Voltage Controlled Oscillator.
- 5) Phase Locked Loop
- 6) Frequency Multiplier using IC PLL.

(10)

**Total P: 30****TEXT BOOKS:**

1. Roy Choudhury and Shail Jain , "Linear Integrated Circuits", 4th Edition, Wiley Eastern, Wiley Eastern, 2014.

**19L411 SIGNALS AND SYSTEMS LABORATORY****0 0 2 1****SOFTWARE EXPERIMENTS :**

- 1) Generation of Continuous Time (CT) signals and Discrete Time (DT) signals
- 2) Signal operations on CT and DT signals
- 3) Verification of CT and DT System properties
- 4) Linear Convolution
- 5) Analysis and Synthesis of CT periodic signals using Fourier Series and study of Gibbs phenomenon
- 6) Analysis and Synthesis of CT aperiodic signals using Fourier Transform
- 7) Analysis and Synthesis of DT periodic signals using Fourier Series
- 8) Analysis and Synthesis of DT aperiodic signals using Fourier Transform
- 9) Sampling and Reconstruction
- 10) Analysis of DT systems using z-transform

(30)

**Total P: 30****TEXT BOOKS:**

1. Krishnaveni.V, Rajeswari.A , "-Signals and Systems"", First Edition, Wiley India Pvt.Ltd, 2012.
  2. Luis F. Chaparro , "-Signals and Systems Using MATLAB"", 1st Edition, Academic Press, An Imprint of Elsevier, 2011.
- Department of ECE,PSG college of Technology, .

**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. Brijji Kishore Sharma , "Introdouction to the Consitution of India", 8th Edition, Prentice Hall of India, New Delhi, 2017.
2. Hoshiar Singh , "Indian Adminstration", 1st Edition, Pearson Education, New Delhi, 2011.
3. Jain M C , "The Consitution of India", 5th Edition, State Mutual Book & Periodical Service, Limited, New Delhi, 1988.
4. Shukla V N , "Consitution 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

(30)

**Total P: 30****REFERENCES:**

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

**SEMESTER - 5****19L502 COMMUNICATION ENGINEERING****3 0 0 3**

**AMPLITUDE MODULATION SYSTEMS :** Communication system model – Amplitude Modulation – DSBFC, DSBSC, SSB - Generation and detection of DSB-FC, DSB-SC, SSB waves, Vestigial Sideband Modulation, Independent Sideband Modulation - Comparison of AM systems - FDM (9)

**ANGLE MODULATION SYSTEMS :** FM and PM - Narrow band FM and Wideband FM - Bandwidth requirements- Carson's Rule - Pre emphasis, De-emphasis - Generation and demodulation of FM waves – FM Stereo Multiplexing. (9)

**NOISE IN COMMUNICATION SYSTEMS :** Types of Noise – Noise Calculations – Equivalent Noise Bandwidth – Noise Figure – Effective Noise Temperature – Narrowband Noise representation- Noise in CW Modulation systems, Noise in Linear Receiver using coherent detection, Noise in AM receivers using envelope Detection – Noise in FM receivers. (9)

**TRANSMITTERS AND RECEIVERS :** Transmitter characteristics & Classification - Low Level and High Level transmitters - AM broadcasting transmitters - Pilot carrier technique- FM transmitters. Receiver -characteristics and Classification- Tuned radio frequency receiver - Super heterodyne receiver – AM and FM receivers. (9)

**PULSE MODULATION SCHEMES :** Pulse Amplitude Modulation – TDM - Pulse Width Modulation – Pulse Position Modulation – Pulse Frequency Modulation –Quantization - PCM – Delta Modulation – Adaptive Delta Modulation – Delta Sigma Modulation - DPCM (9)

**Total L: 45****TEXT BOOKS:**

1. Simon Haykin , "Communication Systems", Wiley, 2014.
2. Kennedy G , "Electronic Communication systems", Tata McGraw Hill, 2017.

**REFERENCES:**

1. Herbut Taub, Donald L. Schilling, Goutam Saha, "Principles of Communication Systems", McGraw Hill, 2017.
2. Carlson A B, "Communication systems: An Introduction to signals and noise in electrical communication", McGraw Hill, 2010.
3. Dennis Roddy, John Coolen, "Electronic Communications", Prentice Hall of India, 2013.
4. Lathi B P, "Modern Digital and Analog communication Systems", Oxford University Press, 2017.

**19L503 MICROPROCESSORS AND MICROCONTROLLERS****3 0 0 3**

**MICROCONTROLLER ARCHITECTURE AND INSTRUCTION SET** : Functional block diagram of 8051-power supply, clock and reset circuits-program and data memory organization-addressing modes and instruction set – assembly language programming. (9)

**ON-CHIP PERIPHERALS AND PROGRAMMING** : Architecture and programming of Parallel Port - timer/counter – Serial Port: UART. Hardware and software Interrupts - Power saving modes. (9)

**OFF-CHIP PERIPHERALS INTERFACING AND PROGRAMMING** : Display interfacing: LED, 7-segment, LCD - Keyboard interfacing: Push-to-On switch and matrix keyboard - Data converters: ADC and DAC. (9)

**ARM CORTEX-M ARCHITECTURE** : ARM architecture, Programmers model, memory, Interrupts and exceptions - Memory Protection Unit (MPU) –Floating Point Unit (FPU) (9)

**ARM CORTEX INSTRUCTION SET** : Moving the data within the processor-memory access-arithmetic-logic- conversion- bit field-compare and test-program flow control-exception-sleep Mode, SIMD-Saturation-MAC-Floating Point Instructions. (9)

**Total L: 45****TEXT BOOKS:**

1. Muhammad Ali Mazidi, J.G. Mazidi, R.D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Second Edition, Pearson Education Limited, 2014.
2. Joseph Yiu, "The Definitive Guide to ARM Cortex M3 and Cortex M4 Processors", Third, Newnes, 2014.

**REFERENCES:**

1. Steve Furber, "ARM System-on – Chip Architecture", Second Edition, Addison Wesley, Pearson Education Limited, 2000.
2. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developers Guide: Designing and Optimizing System Software", Morgan Kaufmann, 2004.

**19L504 CONTROL SYSTEMS****3 0 0 3**

**INTRODUCTION** : Modeling of Electrical and Mechanical systems - Translational and Rotational systems – Block diagram – Signal flow graph - Mason's gain formula. (9)

**TIME AND FREQUENCY DOMAIN ANALYSIS** : Standard Test signals – Time response of second order systems - Performance specifications on system time response - Types of systems - Steady state error - Generalized error series - Introduction to PID Controllers –Performance specifications on system Frequency response – Correlation between time and frequency response. (9)

**STABILITY ANALYSIS** : Concepts of Stability - Routh Stability Criterion - Root locus technique (6)

**FREQUENCY RESPONSE PLOTS AND SYSTEM STABILITY** : Polar plot - Nyquist stability Criterion - Bode plot - Compensator design using Bode Plot. (12)

**STATE VARIABLE ANALYSIS** : Introduction –State space representation of continuous time systems using Physical and Phase Variables – Solution of state equations–Concepts of Controllability and Observability (9)

**Total L: 45****TEXT BOOKS:**

1. M. Gopal, "Control System – Principles and Design", 4th Edition, Tata McGraw Hill, 2012.

2. Norman Nise , "Control System Engineering", 6th Edition, John Wiley & Sons, 2019.

**REFERENCES:**

1. Benjamin.C.Kuo , "Automatic control systems", 7th Edition, Prentice Hall of India, 1995.
2. J.Nagrath, M.Gopal , "Control System Engineering", 5th Edition, New Age International Publishers, 2007.
3. Smaradhit Ghosh , "Control Systems Theory and Applications", Pearson Education Asia, 2012.
4. Katsuhiko Ogata , "Modern Control Engineering", 5th Edition, PHI, 2012.
5. S.K.Bhattacharya , "Control System Engineering", 3rd Edition, Pearson, 2013.

## **19L505 COMPUTER NETWORKS**

**3 1 0 4**

**INTRODUCTION AND QUEUING PRINCIPLES :** Network Criteria - Network Types - Transmission modes - Network Models: OSI Model, TCP/IP model - Digital to Digital Conversion – Digital Data Transmission - Transmission Media – Multiplexing – Switching - Connecting devices - Simple Queuing Models, M/M/n queues, M/G/1 queues, Queues with blocking and priority queues (12+3)

**DATA LINK LAYER :** Error Detection and Correction - Data Link Control and Protocols - Wired LANs: Ethernet, Token bus, Token ring, FDDI - Virtual LAN (9+3)

**NETWORK LAYER :** IPv4 addressing - Classful and Classless addressing, Subnetting – NAT – DHCP – ICMP – IGMP – Routing Algorithms: Distance Vector, Link State – Progression to IPv6 - Network Layer Performance (9+3)

**TRANSPORT LAYER :** Process to process delivery – UDP – TCP – SCTP – Congestion control – Quality of Service (8+3)

**APPLICATION LAYER :** Client Server Programming – WWW – HTTP – FTP – Email – Telnet – DNS – SNMP – VoIP (7+3)

**Total L: 45 + T: 15 = 60**

**TEXT BOOKS:**

1. Behrouz A Forouzan , "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, New Delhi, 2013.
2. Kurose James F, Keith W. Ross , "Computer Networking: A Top-Down Approach", 7th Edition, Pearson Education, New Delhi, 2016.

**REFERENCES:**

1. Andrew S Tanenbaum , "Computer Networks", Prentice Hall of India, New Delhi, 2011.
2. William Stallings , "Data and Computer Communication", Prentice Hall of India, New Delhi, 2014.
3. Larry L. Peterson, Bruce S. Davie , "Computer Networks: A Systems Approach", Morgan Kauffmann Publishers Inc, 2012.
4. Keizer G.E , "Local Area Networks", 2nd Edition, McGraw Hill, New Delhi, 2001.

## **19L510 COMMUNICATION ENGINEERING LABORATORY**

**0 0 2 1**

**HARDWARE EXPERIMENTS :**

- 1) Amplitude Modulation and Demodulation
- 2) DSB-SC Modulation and Demodulation
- 3) Pre emphasis and De emphasis circuits
- 4) Frequency Modulation and Demodulation
- 5) Automatic Gain Control circuits
- 6) Single tuned amplifier
- 7) Audio Amplifier
- 8) Pulse Modulation Scheme
- 9) TDM and FDM systems

(15)

**SOFTWARE EXPERIMENTS :**

- 1) PCM and DPCM
- 2) Delta Modulation and Adaptive Delta Modulation for speech signals
- 3) Figure of Merit Analysis of AM and FM

(15)

**Total P: 30**

**REFERENCES:**

1. Simon Haykin , "Communication Systems", Wiley, 2014.

**19L511 MICROPROCESSORS AND MICROCONTROLLERS  
LABORATORY**

**0 0 2 1**

**SOFTWARE EXPERIMENTS :**

- 1) Addition and Subtraction of Single and Multi byte data
- 2) Multiplication and Division of Single and Multi byte data
- 3) Searching the given number using Linear / Binary Search Algorithm
- 4) Sorting the given numbers using Bubble/Insertion Algorithm
- 5) Code Conversion Techniques

(15)

**HARDWARE EXPERIMENTS :**

- 1) Interfacing Display Unit
- 2) Interfacing Keyboard Unit
- 3) Timer/Counter Interfacing Techniques
- 4) Hardware and Software Interrupts
- 5) UART Programming Techniques

(15)

**Total P: 30**

**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

(30)

**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**

**19L601 DIGITAL SIGNAL PROCESSING**

**3 0 0 3**

**DISCRETE FOURIER TRANSFORM (DFT) :** Review of CTFT & DTFT - DFT – Properties - Radix 2 FFT algorithms - Decimation in time - Decimation in frequency - Use of FFT in Linear filtering - Filtering of long data sequences (8)

**DESIGN AND REALIZATION OF IIR FILTERS :** Review of design techniques for analog low pass filters - Design of IIR filters -

Approximation of derivatives - Impulse Invariance - Bilinear transformation - Butterworth and Chebychev Type 1 filters - Realization of IIR filters. (10)

**DESIGN AND REALIZATION OF FIR FILTERS :** FIR filters - Symmetric and anti symmetric FIR filters - Design of linear phase FIR filters using windows - Realization of FIR filters (10)

**ANALYSIS OF FINITE WORD LENGTH EFFECTS :** Representation of Numbers - Quantization of filter coefficients in IIR and FIR filters - Roundoff effects in Digital filters - Quantization effects in computation of DFT (10)

**PROGRAMMABLE DIGITAL SIGNAL PROCESSORS :** Introduction to Digital Signal Processors - Architecture of TMS320C6748 - Device characteristics - Memory mapping - Peripherals (7)

**Total L: 45**

**TEXT BOOKS:**

1. Lonnie C Ludeman , "Fundamentals of Digital Signal Processing", Wiley India, New Delhi, 2011.
2. John G Proakis and Dimitris G Manolakis , "Digital Signal Processing", Prentice Hall India, New Delhi, 2010.

**REFERENCES:**

1. Oppenheim A V , "Discrete Time Signal Processing", Prentice Hall India, New Delhi, 2010.
2. Mitra S K , "Digital Signal Processing – A Computer based Approach", Tata McGraw Hill, New Delhi, 2012.
3. Vinay K Ingle, John G Proakis , "Digital signal processing using MATLAB", Brooks / Cole, California, United States, 2011.

## **19L602 DIGITAL COMMUNICATION**

**3 0 0 3**

**INFORMATION THEORY :** Review of Probability theory and random process - Self information measure - Entropy function - Conditional Entropies - Mutual information - Redundancy - Efficiency and channel capacity - capacities of channels with symmetric noise structure Shannon's Hartley Law. (8)

**BASEBAND SIGNALLING :** Power Spectral Density - Concept of base band signaling - Signaling formats – Line coding - Optimum Filtering - Error due to Noise – ISI - Pulse Shaping - Scrambling and unscrambling - channel equalization, tapped delay line and Transversal filters (9)

**PASSBAND SIGNALLING :** Signal Space Analysis - Detection using matched filters for signals via AWGN channels - Analysis of coherent and non coherent detection Schemes for ASK, FSK, PSK, DPSK - M-ary signaling – MSK – GMSK – QAM - Probability of error for each scheme - Multicarrier modulation – OFDM (10)

**SPREAD SPECTRUM AND SYNCHRONIZATION :** PN sequences - Direct Sequence Spread spectrum – Frequency Hop Spread Spectrum - Need for Synchronization - Bit, word and frame synchronization - Early-Late Gate Synchronizer (9)

**ERROR CONTROL CODING :** Parity check codes - Linear block codes – Decoding of linear Block codes - Polynomial representation of code structures - cyclic codes - convolution codes –The Generating function-Viterbi Decoding algorithms - turbo codes (9)

**Total L: 45**

**TEXT BOOKS:**

1. Simon Haykin , "Digital Communications", John Wiley & Sons, Inc, Singapore, 2011.
2. Lathi B P , "Modern Digital and Analog communication Systems", Oxford University Press, 2010.

**REFERENCES:**

1. Proakis J G, Salehi M , "Digital Communications", Tata McGraw Hill, New Delhi, 2018.
2. Bernard Sklar , "Digital Communications- Fundamentals and applications", Pearson Education, New Delhi, 2009.
3. Reza F M , "An Introduction to information theory", McGraw Hill, New Delhi, 2010.
4. Sam Shanmugam K , "Digital and Analog communication systems", John Wiley Inc, Singapore, 2008.

## 19L603 VLSI DESIGN

3 0 0 3

**INVERTERS** : Review of MOS transistor equations -Passive load inverter- CMOS inverter – Transfer Characteristics, Power dissipation- Depletion mode and enhancement mode pull ups – Pseudo nMOS Inverter - Sheet resistance - Area Capacitance - Inverter delay and Logical Effort (9)

**LOGIC DESIGN** : Combinational logic circuits - Static CMOS logic: Complementary CMOS, Ratioed logic, Pass- Transistor, Transmission gate - Dynamic CMOS logic – Performance, Noise considerations, domino, npCMOS logic - Sequential logic circuits - static and dynamic flip-flops (10)

**SUBSYSTEM DESIGN** : Design of adders-Static adder, Mirror adder, Carry Look Ahead adder, Binary adder – Multipliers-Array multiplier, Carry Save multiplier, Booths and Modified Booths multiplier - Barrel shifter, Logarithmic shifter (10)

**MEMORY DESIGN** : CAM memory,4x4 -OR ROM, NOR ROM, NAND ROM cell array,6-T SRAM cell,3-T DRAM cell, Memory peripheral circuitry-Address Decoders-Sense amplifiers-Power dissipation in memories (9)

**VLSI LAYOUT DESIGN AND FABRICATION TECHNIQUES** : Layout styles – Full custom and Semi custom approaches - Layout Design Rules – CMOS nwell process rules - Stick diagram - Layout examples – Fabrication techniques - Wafer processing - Oxidation - Patterning - Diffusion - Ion implantation - Deposition - CMOS processes : nWell, Twin tub, Silicon on Insulator (7)

**Total L: 45**

### TEXT BOOKS:

- 1.Neil H E Weste , Kamran Eshraghian , "Principles of CMOS VLSI Design: A system Perspective", Addison Wesley, 2009.
- 2.Jan M Rabaey , Anantha Ch , "Digital Integrated Circuits- A Design Perspective", Prentice hall of India, 2016.

### REFERENCES:

- 1.Caver Mead , Lynn Conway , "Introduction to VLSI Systems", Addison-Wesley, 1980.
- 2.Douglas A Pucknell , Kamran Eshraghian , "Basic VLSI Design", Prentice Hall of India, 2011.
- 3.Amar Mukherjee , "Introduction to nMOS and CMOS VLSI System Design", Prentice Hall, 1986.
- 4.Ajay Kumar Singh , "Digital VLSI Design", PHI Learning Private Limited, 2011.

## 19L604 EMBEDDED SYSTEMS AND IOT

3 1 0 4

**INTRODUCTION** : Characteristics of embedded systems - Design challenges - Design flow - Specifications and modeling - Design model - Product design life cycle - Wired and wireless communication protocols - I2C , SPI, CAN, BLUETOOTH, WiFi, ETHERNET (10+3)

**ARCHITECTURE OF ARM CORTEX M4 MICRO CONTROLLER** : General purpose I/O - System clock - Watch dog timer - Micro DMA - Low power modes - Interrupts (10+3)

**PERIPHERAL INTERFACING** : Timers - RTC - ADC - Analog comparator - DAC - Motion control peripherals - PWM, QEI - Interfacing : Display, Keyboard, stepper motor and DC motor (9+3)

**REAL TIME OPERATING SYSTEMS** : OS services - Process management - Scheduling Algorithms - RMA & EDF - Inter process communication techniques - Device driver - Interrupt handling (8+3)

**IOT** : Characteristics - Physical Design - Layered protocols - Logical design - Communication models - Enabling technologies - Cloud and APP facilities for IoT - Case study on IoT applications (8+3)

**Total L: 45 + T: 15 = 60**

### TEXT BOOKS:

- 1.Bai Y , "Practical Micro Controller Engineering with ARM technology", John Wiley and Sons, 2015.
- 2.Bahga A, Madiseti V , "Internet of things : A Hands - on approach", University Press, Hyderabad, 2017.

**REFERENCES:**

1. Arnold s Berger , "Embedded systems Design: An introduction to Processes, tools and Techniques", CMP books, 2002.
2. TI Team , "Tiva TM4C123GH6PM Micro controller Data Sheet" , .
3. RajKamal , "Embedded systems : architecture, programming and design", Tata McGraw Hill, 2011.
4. Marwedel P , "Embedded system Design", Springer, New York, 2006.

**19L605 DIGITAL IMAGE PROCESSING****3 0 0 3**

**DIGITAL IMAGE FUNDAMENTALS** : Two dimensional signals and systems - Mathematical preliminaries, Image sensing and acquisition-CCD, CMOS, X-Ray, CT, MRI, Ultrasound, SAR, IR, Thermal-Imaging , Image processing system- Image formation- Sampling and Quantization - Neighbours of pixel – Distance measures, Color models (8)

**IMAGE TRANSFORMS** : Discrete Fourier transform - properties – Discrete Cosine Transform - Properties - KL Transform and SVD. (8)

**IMAGE ENHANCEMENT** : Point Operations - Histogram Equalization technique - Spatial Filtering – Low pass filtering, Median filtering , Sharpening Filters - frequency domain – Homomorphic filtering, Color Image enhancement. Case Study: Image enhancement, noise removal operations in an image. (10)

**IMAGE COMPRESSION** : Image Compressions models - Variable length coding - Bit plane coding — Predictive coding – JPEG, MPEG-2 Case Study: JPEG image compression using DCT coding (9)

**IMAGE SEGMENTATION AND REPRESENTATION** : Discontinuity detection : Point, Line and Edge , Gradient operators , combined detection - Thresholding – Region based segmentation - Representation schemes: chain codes - Boundary descriptors: Simple, Shapes , Texture – Morphology : dilation and erosion, opening and closing. Case Study: Image Analysis: License plate detection, CT image analysis, crack detection, Missing component detection. (10)

**Total L: 45****TEXT BOOKS:**

1. Rafael C Gonzalez, Richard E Woods , "Digital Image Processing", 4th Edition, Pearson, India, 2018.
2. Jayaraman S, Esakkirajan S, Veerakumar T , "Digital Image Processing", 1st Edition, Tata McGraw Hill, New Delhi, 2009.

**REFERENCES:**

1. Anil K Jain , "Fundamentals of Digital Image Processing", Prentice Hall of India Pvt Ltd, New Delhi, 1995.
2. Rafael C Gonzalez, Richard E. woods, Steven L. Eddins , "Digital Image Processing Using MATLAB", Tata McGraw Hill, New Delhi, 2010.
3. Al.Bovik , "The Essential Guide to Image Processing", Academic Press, India, 2009.

**19L610 DIGITAL SIGNAL PROCESSING LABORATORY****0 0 2 1****SOFTWARE EXPERIMENTS:**

- 1) FFT Algorithms
- 2) Filtering of long data sequences
- 3) IIR filter design using bilinear transformation
- 4) FIR filter design using windows
- 5) Analysis of Finite word length effects

(15)

**HARDWARE EXPERIMENTS:**

- 1) Signal generation
- 2) Arithmetic operations
- 3) Linear convolution
- 4) FIR filter
- 5) IIR filter

(15)

**Total P: 30**

**TEXT BOOKS:**

1. Vinay K Ingle and John G Proakis , "Digital signal processing using MATLAB", , Brooks / Cole, California, United States, 2011.

**REFERENCES:**

1. Mitra S K , "Digital Signal Processing – A Computer based Approach", Tata McGraw Hill, New Delhi, 2010.
2. Vinay K Ingle, John G Proakis , "Digital signal processing using MATLAB", United States, Brooks / Cole, California, 2011.

**19L611 VLSI DESIGN LABORATORY****0 0 2 1****SOFTWARE EXPERIMENTS:**

- 1) Characteristics of NMOS and PMOS transistors
- 2) Design and Simulation of nMOS inverter, CMOS inverter, Pseudo nMOS inverter and obtaining its Transfer characteristics, Noise Margin
- 3) Power analysis of nMOS inverter, CMOS inverter and Pseudo NMOS inverter
- 4) Design of combinational Static CMOS circuits - Complementary CMOS, Pass transistors, Transmission gates
- 5) Design of combinational Dynamic CMOS circuits –Domino, npCMOS logic
- 6) Design and Simulation of simple combinational and sequential circuits using CMOS gates (encoder, multiplexer, code converters, counters, registers)
- 7) Design and Simulation of static and dynamic flipflops – C2MOS, Pseudostatic, NORACMOS
- 8) Design and Simulation of subsystem modules-Adders, Multipliers
- 9) Layout design of Digital logic circuits

(24)

**HARDWARE EXPERIMENTS:**

- 1) FPGA implementation of subsystem modules-Carry Look Ahead Adder, Multipliers

(6)

**Total P: 30****19L620 INNOVATION PRACTICES****0 0 4 2****PREPARING A PROJECT – BRIEF PROPOSAL:**

- 1) Problem Identification
- 2) A Statement of system / process specifications proposed to be developed (Block diagram / concept tree)
- 3) List of possible solutions including alternatives and constraints
- 4) Cost benefit analysis
- 5) Time line of activities
- 6) Report preparation highlighting the design finalization

(13)

**IMPLEMENTATION OF THE PROTOTYPE:**

- 1) Preparation of hardware modules
- 2) Integration of hardware modules
- 3) Development of software modules
- 4) Implementation of software modules
- 5) Testing and Validation

(40)

**PRESENTATION OF THE PROTOTYPE:**

- 1) Implementation Phase ( Hardware / Software / both )
- 2) Testing and validation of the developed system
- 3) Learning in the project

(2)

**CONSOLIDATED REPORT PREPARATION:**

(5)

**Total P: 60**



## 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

(30)

**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.

## SEMESTER - 7

### 19L701 MICROWAVE ENGINEERING

3 0 0 3

**INTRODUCTION** : Microwave frequencies - Microwave systems - High frequency limitations of conventional tubes- Two cavity Klystron and Reflex klystron - Magnetron oscillator- Microwave solid devices: Microwave Transistors - Gunn diode oscillators-microwave network analysis-Scattering matrix. (9)

**THEORY AND DESIGN OF FERRIMAGNETIC COMPONENTS** : Basic properties of ferrite material - Plane wave propagation in Ferrite medium - Ferrite based isolator-Phase Shifters-Circulator - S-matrix representation – Active Microwave Circuits: Detectors and Mixers (9)

**MICROWAVE PASSIVE COMPONENTS** : Microwave Resonators, Series and Parallel Resonant Circuits - Transmission Line Resonators - Power Dividers and Directional Couplers, Properties , T-Junction Power Divider, Quadrature Hybrid Couplers. - Microwave Filters-Design by the Insertion Loss Methods- Transforms- Implementation. (12)

**DESIGN OF MICROWAVE AMPLIFIERS AND OSCILLATORS** : Characteristics of RF Transistors- Gain and Stability - Single- Stage Transistor Amplifier Design - Oscillator Design (6)

**MICROWAVE COMMUNICATION SYSTEMS** : Simplified microwave system - need for diversity-frequency and space diversity-Microwave radio stations-system gain. - Microwave radio stations-system gain (9)

**Total L: 45**

### TEXT BOOKS:

1. David M Pozar , "Microwave Engineering", Fourth Edition, John Wiley and Sons, 2012.
2. Tomasi W , "Advanced Electronics communication System", Sixth Edition, Prentice Hall Inc, New Delhi, 2014.

### REFERENCES:

1. Reinhold Ludwig , Pavel Bretchko , "RF Circuit Design", Asia Publication, 2011.
2. Collin R E , "Foundations of Microwave Engineering", John Wiley and Sons Inc., 2011.

3. Tomasi W , "Advanced Electronics communication System", Prentice Hall Inc, 2005.
4. Liao Y.S , "Microwave devices and circuits", New Delhi, 2008, .

## 19L702 WIRELESS COMMUNICATION

**3 0 0 3**

**INTRODUCTION:** Introduction to wireless communication systems - Cellular concept- system design fundamentals Handoff Strategies- Interference and system capacity, Improving Coverage and Capacity (9)

**WIRELESS CHANNEL MODELING :** Free space propagation model, Reflection- Diffraction – Scattering - Log-normal shadowing. Small-scale multipath propagation, Types of small scale fading, Rayleigh and Ricean distribution, Input /output model of the wireless channel - Time and frequency coherence - Statistical channel models (9)

**MULTIPLE ACCESS SCHEMES AND DIVERSITY :** FDMA, TDMA, CDMA, SDMA and CSMA, OFDMA. Diversity Techniques – Frequency diversity, Time diversity, Code diversity, Antenna diversity –RAKE Receiver - SIMO, MISO, MIMO, MIMO-OFDM Technique (9)

**CAPACITY OF WIRELESS CHANNELS :** AWGN channel capacity – capacity of flat fading channels , Frequency- selective fading channels, Multiuser capacity, Downlink channel capacity, Uplink channel capacity, Outage capacity (9)

**EVOLUTION OF WIRELESS TECHNOLOGIES :** Mobile Technologies - GSM, 3G, 4G (LTE) and 5G technologies, Wireless LAN Technologies and WLL (9)

**Total L: 45**

### TEXT BOOKS:

1. Andrea Goldsmith , "Wireless Communications", Cambridge University Press, 2012.
2. David Tse, Pramod Viswanath , "Fundamentals of Wireless Communication", Cambridge University Press, 2015.

### REFERENCES:

1. Kamil Feher , "Wireless Digital Communications, Modulation & Spread Spectrum Applications", PHI, 2015.
2. William C. Y. Lee , "Mobile Communication Engineering", McGraw Hill, 2014.
3. Theodore S. Rappaport , "Wireless Communications", Pearson Education, 2017.
4. Andreas F. Molisch , "Wireless Communications", Wiley, 2011.

## 19L711 MICROWAVE ENGINEERING LABORATORY

**0 0 2 1**

### HARDWARE EXPERIMENTS :

- 1) Study of Klystron oscillator characteristics.
- 2) Study of GUNN diode characteristics
- 3) Determination of Directional Coupler characteristics
- 4) Determination of VSWR and reflection coefficient.
- 5) Determination of radiation pattern of horn antenna
- 6) Determination of radiation pattern and return loss of planar antenna.

(15)

### SOFTWARE EXPERIMENTS :

- 1) Design and Simulation of Low pass and High pass filter.
- 2) Design and Simulation of Microstrip line
- 3) Design and Simulation of Filter using Microstrip line
- 4) Design and Simulation of Branch line coupler
- 5) Design and simulation of RF amplifier
- 6) Study of measurement of S-parameters of micro strip components using vector network analyzer

(15)

**Total P: 30**

### REFERENCES:

1. David M Pozar , "Microwave Engineering", John Wiley and Sons, 2011.

## 19L712 DIGITAL COMMUNICATION ENGINEERING LABORATORY

0 0 2 1

### HARDWARE EXPERIMENTS:

- 1) Linear Block Coder and decoder
- 2) Cyclic Coder and decoder
- 3) Convolutional Coder
- 4) Power spectral density of different type of Line codes
- 5) Error performance of ASK,FSK and PSK schemes
- 6) Spread Spectrum Systems - DSSS ,FHSS

(15)

### SOFTWARE EXPERIMENTS:

- 1) Viterbi decoder for decoding Convolutional codes
- 2) Tapped-Delay equalizer
- 3) Error performance of OFDM
- 4) Vector Signal Analysis of different modulation schemes
- 5) RAKE receiver
- 6) Modeling wireless fading channels
- 7) Early-Late Gate Synchronizer

(15)

**Total P: 30**

### REFERENCES:

1. Proakis J G, Salehi M , "Contemporary communication systems using MATLAB", PWS Publishing company, 2013.
2. Dennis Silage , "Digital Communication Systems Using MATLAB and Simulink", Bookstand Publishing, 2016.

## 19L720 PROJECT WORK I

0 0 4 2

Identification of a real time problem in thrust areas

Developing a mathematical model for solving the above problem

Finalization of system requirements and specification

Simulation / Implementation of different solutions for the problem based on literature survey

Future trends in providing alternate solutions

Consolidated report preparation of the above

**Total P: 60**

## SEMESTER - 8

## 19L820 PROJECT WORK II

0 0 8 4

Identification of a real time problem in thrust areas

Developing a mathematical model for solving the above problem Finalization of system requirements and specification

Simulation / Implementation of different solutions for the problem based on literature survey

Future trends in providing alternate solutions

Consolidated report preparation of the above

**Total P: 120**

## PROFESSIONAL ELECTIVES

### 19L001 SATELLITE COMMUNICATION

3 0 0 3

**ELEMENTS OF SATELLITE COMMUNICATIONS AND ORBITAL ASPECTS** : Brief history and current state of Satellite Communications - Satellite systems, Transmission and Multiplexing-Modulation-Multiple access-advent of Digital satellite communications. The Equations of the Orbit - Locating the Satellite in the Orbit - Orbital elements - Look angle - Elevation and Azimuth calculations - Geostationary orbit - Visibility - Orbital perturbations - Orbital effects in Communication system performance. (12)

**EXPANDABLE LAUNCH VEHICLE** : Space Transportation System (STS) - The mechanics of Launching a Synchronous satellite - The rocket equation - Powered flight - Injection into final orbit and orbital manoeuvres - Mission possibilities - Low thrust variations. (8)

**SPACE CRAFT** : Space craft subsystems - Altitude and Orbit Control System - Telemetry, Tracking and Command (TT&C) - Power systems - Description of communication system - Transponder - Implementations – Transmission Impairments - Space Craft Antennas - Equipment reliability. (8)

**SATELLITE LINK** : Basic Transmission Theory - System noise temperature and G/T ratio - Calculation of system noise temperature - Noise figure - Downlinks and Uplinks - Limits on link performance - Design of Satellite links for specified (C/N) - Rain attenuation model, Modulation and Multiplexing techniques (8)

**SATELLITE SERVICES AND EARTH STATION** : MSAT service, BSAT service, RADARSAT service, SAR SAT service, INTELSAT service, INMART SAT service, VSAT service, Satellite Navigation and the Global positioning system, chandrayaan, Earth station design for Low system noise temperature (9)

Total L: 45

#### TEXT BOOKS:

- 1.Tri T Ha , "Digital Satellite Communications", Tata McGraw Hill, 2014.
- 2.Timothy Pratt, Charles W Bostian, Jeremy Allnutt , "Satellite Communications", John Wiley and Sons, 2015.

#### REFERENCES:

- 1.Richaria M , "Satellite Communication Systems Design Principles", McGraw Hill, 2012.
- 2.Emanuel Fthenakis , "Manual of Satellite Communications", McGraw Hill, 2014.
- 3.Coolen M , "Satellite Communication", IEEE Publication, 2010.
- 4.Dennis Roddy , "Satellite Communications", Fourth, McGraw Hill, 2017.

### 19L002 DIGITAL SWITCHING SYSTEMS

3 0 0 3

**DIGITAL SWITCHING** : Functions of a switching system- Classification- - Message, packet and circuit switching - Electronic switching-Reed electronic systems - Switching networks- Single stage networks - cross point switches - gradings- forms of grading - Link systems-2, 3 and 4 stage networks - - Space and Time switching - time division switching networks - PBX switches (13)

**SWITCHING SYSTEMS CONTROL AND SIGNALLING METHODS** : Introduction-digital switching system fundamentals and evolution - call processing functions-common control-stored program control - Processor- Distributed processing - software-The 5ESS switching system - Review of dc signaling over audio frequency lines FDM carrier systems-Out-band and in -band signaling-PCM signaling - Inter register signaling- common channel signaling- Digital customer line signaling (13)

**TRAFFIC ENGINEERING** : Introduction to traffic and queuing Theory - Network Traffic Load and Parameters – Grade of Service Blocking Probability - Incoming traffic and service time characterization (7)

**TELEPHONE NETWORK ORGANISATION** : Analog and Digital networks - Subscriber Loop System – Switching Hierarchy and Routing - Transmission Plan and Transmission Systems - Numbering, Charging (6)

**MOBILE SWITCHING** : The cellular concept - analog and digital network elements - channels-initialization- signaling - channel assignment-handoff digital cells.-fading and path loss - digital cells-fading and path loss (6)

**Total L: 45**

**TEXT BOOKS:**

- 1.Flood J E , "Telecommunications switching, Traffic and Networks", Pearson Education Ltd., 2011.
- 2.Viswanathan T , "Telecommunication Switching Systems and Networks ", Prentice Hall of India, 2015.

**REFERENCES:**

- 1.StephenW Gibson , "Cellular Mobile Radio Telephones", Prentice Hall of India, 2015.
- 2.John Ronayne , "An Introduction to Digital Communications switching", Wheeler publishing, 2012.
- 3.David J Goodman , "Wireless Personal Communication Systems", Addison Wesley Inc., 2010.

### **19L003 FIBER OPTIC COMMUNICATION**

**3 0 0 3**

**INTRODUCTION** : Optical Spectral bands - Evolution of fiber optical system -Elements of Optical Fiber Systems - - Optical Fiber Modes and Configurations- Mode theory of Circular Wave guides - Single Mode Fiber - Graded Index fiber - Fiber Materials- Signal degradation in fibers-Advantages and applications of fiber optic transmission systems. (9)

**OPTICAL TRANSMITTER** : Optical sources- Light-Emitting Diodes (LEDs)- Laser Diodes -Light Source Linearity - Reliability Considerations-Comparison and applications - Transmitter Design. (9)

**OPTICAL RECEIVER** : Photo detectors-Photodiodes - Avalanche photo diodes- Comparisons of photo detector- Receiver Noise and sensitivity-Digital Receiver Performance-BER Calculation-Eye Diagrams. (9)

**SYSTEM CONFIGURATIONS** : Optical link design - Optical Power Launching and Coupling -System Design considerations - Optical amplifiers - EDFA - Raman amplifier- Multiplexing strategies - Wavelength division multiplexing ,OTDR. (9)

**ADVANCES IN OPTICAL FIBER SYSTEMS** : DWDM -SONET/SDH - Wavelength Routing Networks - Optical switches - Optical fiber LAN link - Ultra High Capacity Networks - OTN-Optical networking technology in enterprise. (9)

**Total L: 45**

**TEXT BOOKS:**

- 1.Keiser G , "Optical Fiber Communications", McGraw Hill, 2014.
- 2.John M. Senior , "Optical Fiber Communications Principles and Practice", PHI, 2014.

**REFERENCES:**

- 1.Rajiv Ramasami Kumar and Sivarajan N , "Optical Networks A Practical Perspective", Morgan Kaufmann Publishers, 2011.
- 2.Uyless Black , "Optical Networks-Third Generation Transport Systems", Pearson Education, 2012.
- 3.G.P. Agrawal , "Fiber optic Communication Systems", Fouth, John Wiley and sons, 2012.
- 4.K. Mynbaev and Lowell L Scheiner , "Fiber Optic Communication Technology", Prentice Hall, 2001.

### **19L004 RADAR COMMUNICATION**

**3 0 0 3**

**INTRODUCTION TO RADAR** : Basics of radar, EM Waves & properties- applications of radar, radar frequencies- radar block diagram, Radar Coordinates, Radar equation for hard targets and the SNR-radar cross section of targets, Radar Resolution Elements, Pulse, CW and FMCW Radars-configurations, transmitter power- pulse repetition frequency, Duty Ratio, Pulse Compression, Coding (9)

**DETECTION OF SIGNALS IN NOISE AND RADAR WAVEFORMS** : probability density functions – probabilities of detection and false alarm-matched filter receiver-detection criteria – integration of radar pulses - constant-false alarm rate receivers - Radar Waveforms, Pulse Compression, Ambiguity Diagram. (9)

**RADAR TRANSMITTER AND RECEIVER** : Introduction- Types of Transmitters - linear-beam power tubes- solid-state RF power sources- magnetron- Klystron, crossed-filed amplifier- radar receiver- receiver noise figure- super heterodyne receiver, Digital Receivers, duplexers and receiver protectors- radar displays-Human Machine Interface(HMI) (9)

**RADAR ANTENNA** : Functions of radar antenna- antenna parameters- antenna radiation pattern and aperture illumination - reflector antennas- electronically steered phased array antennas- phase shifters – frequency - scan arrays-- architectures for phased arrays , radiators for phased arrays- mechanically steered planar array antennas- radiation pattern synthesis -effect of errors on radiation patterns - low side lobes antennas. (9)

**MTI AND PULSE DOPPLER RADAR** : Introduction to Doppler and MTI radar- delay –line cancellers- staggered pulse repetition frequencies- doppler filter banks- digital MTI processing - Moving target detector- limitations to MTI performance- pulse Doppler radar-MTD, Tracking radar- monopulse tracking- conical scan and sequential lobing- comparison of trackers. tracking accuracy- low-angle tracking- Atmospheric & Weather Radars: Precipitation Radars, Doppler Weather Radar, Polarimetric Radar, Clear Air Radars. (9)

**Total L: 45**

**TEXT BOOKS:**

1. Merril I Skolnik , "Introduction to Radar Systems", Mc Graw-Hill, 2017.
2. Peebles P Z , "Radar Principles", Wiley, 2016.

**REFERENCES:**

1. Richard J Doviak , Dusan S Zrnic , "Doppler Radar and Weather Observations", Academic Press, 2014.
2. Brangi V N, Chandrasekar V , "Polarimetric Doppler Weather Radar", Cambridge University Press, 2012.
3. Richards M A, Scheer J A and Holm W A , "Principles of Modern Radar", Scitech Publishing, 2014.
4. Levanon N , "Radar Signals", Wiley-IEEE Press, 2012.

## **19L005 RADIO FREQUENCY INTEGRATED CIRCUITS**

**3 0 0 3**

**BASIC OF RF ELECTRONICS AND ISSUES IN RFIC DESIGN** : Lumped element concept at RF - lumped and distributed regions lower frequency analog design - microwave design versus radio frequency integrated circuit design - Impedance levels for microwave and low-frequency analog design - noise - linearity and distortion in RF Circuits - dynamic range - filtering issues (7)

**SEMICONDUCTOR DEVICE MODELING OF TECHNOLOGY** : Basic operation and characteristic of bipolar junction transistor - Small -signal model of bipolar transistor - high frequency effects - noise in bipolar transistors - base shot noise-noise sources in the transistor model - bipolar transistor design considerations-CMOS transistor - impedance matching - tapped capacitors and inductors - the concept of mutual inductance - tuning a transformer - bandwidth of an impedance transformation network - quality factor of an LC resonator. (8)

**DESIGN OF PASSIVE CIRCUIT ELEMENTS IN IC TECHNOLOGIES** : Technology backend and metallization in IC technologies - sheet resistance and skin effect -parasitic capacitance and inductance - current handling in metal lines - design of inductors and transformers - characterization of inductor-layout of spiral inductors - on-chip transmission lines - high frequency measurements of on-chip passives - common De-Embedding techniques - packaging (8)

**LOW NOISE AMPLIFIER** : Basic amplifiers - amplifiers with feedback - noise in amplifiers - linearity in amplifiers - differential pair and other differential amplifiers - low-voltage topologies for LNAs and the use of on-chip transformers - DC bias networks - temperature effects - broad band LNA design (11)

**MIXERS AND VOLTAGE-CONTROLLED OSCILLATORS** : Mixers: mixing with nonlinearity - controlled transconductance mixer - double- balanced mixer - mixer with switching of upper quad - analysis of switching modulator - mixer noise - linearity - improving isolation - image reject - single -sideband mixers - CMOS mixers -Analysis of an oscillator as a feedback system - phase noise - VCO automatic -amplitude control circuits (11)

**Total L: 45**

**TEXT BOOKS:**

1. John Rogers , Calvin Plett , "Radio Frequency Integrated Circuit Design", Artech House, 2011.
2. Radmanesh M M , " Radio Frequency and Microwave Electronics, ", Asia, 2011.

**REFERENCES:**

1. Less Besser , Rowan Gllmore , " Practical RF Circuit Design for Modern Wireless Systems," , Artech House, 2011.
2. Stephan A Mass , "Non-Linear Microwave and RF circuits", Artech House, 2008.
3. Ferri Losee , "RF Systems, Components and Circuits handbook", Artech house, 2018.

## 19L006 COMPUTATIONAL ELECTROMAGNETICS

3 0 0 3

**EM REVIEW** : E-field - permittivity – Coulomb's Law - Flux of a vector field – Gauss's Law for E fields (Integral) - divergence – Gauss's Law for E fields (Differential) B-field - permeability - Biot-Savart law – Gauss's law for B fields (integral and differential) - Divergence Theorem - circulation of a vector field - curl - Stokes Theorem. Gradient. Laplacian. Poisson and Laplace equations. Ampere-Maxwell Law - Faraday-Maxwell Law. Continuity equation. Constitutive equations. (9)

**NUMERICAL DIFFERENTIATION** : Forward difference - backward difference - central difference. Higher order derivatives. Partial derivatives. Solution of Linear Systems: Matrix equivalent. Solution sets. Direct vs iterative methods. Sparse matrices. Libraries. Gaussian Elimination. Gauss-Seidel method. Numerical Integration Riemann Sums Left/right-point rules Midpoint - trapezoid - Simpsons rules Error bounds-Numerical Integration Examples (9)

**METHOD OF MOMENTS** : Greens Functions; Surface equivalence principle; Electrostatic formulation; Magnetostatic formulation; Electric Field Integral Equation; Magnetic Field Integral Equation; Direct and Iterative Solvers; (9)

**FINITE DIFFERENCE TIME DOMAIN METHODS** : 1D wave propagation - yee Algorithm - Numerical dispersion and stability - perfectly matched absorbing boundary conditions - Dispersive materials. Antenna and scattering problems with FDTD - non-uniform grids - conformal grids – periodic structures. (10)

**APPLICATIONS OF CEM** : Antennas - biological electromagnetic effects - electronic packing and high speed circuits - microwave devices and circuits - environmental issues. surveillance and intelligence gathering - homeland security - signal integrity. (8)

**Total L: 45**

### TEXT BOOKS:

- 1.Walton C Gibson , "The Method of Moments in Electromagnetics", CRC Press, 2014.
- 2.Peterson, Scott L Ray and Raj Mittra , "Computational Methods for Electromagnetics", IEEE Press Series on Electromagnetic Wave Theory, 1998.

### REFERENCES:

- 1.Roger F Harrington , "Field Computation by Moment Methods", IEEE Press, 1993.
- 2.Taflov A , Hagness SC , "Computational Electrodynamics: The Finite Difference Time Domain Method", Artech House, 2004.

## 19L007 ADVANCED RADIATING SYSTEM

3 0 0 3

**ANTENNA FUNDAMENTALS** : Antenna fundamental parameters Radiation integrals - Radiation from surface and line current distributions - dipole - monopole - loop antenna; Mobile phone antenna- base station - hand set antenna; Image; Induction - reciprocity theorem - Broadband antennas and matching techniques - Balance to unbalance transformer - Introduction to numerical techniques. (9)

**RADIATION FROM APERTURES** : Field equivalence principle - Radiation from Rectangular and Circular apertures - Uniform aperture distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna - aperture blockage - and design consideration. (9)

**ARRAY ANTENNA** : Uniform array; Phased array - beam scanning - grating lobe - feed network - Linear array synthesis techniques - Binomial and Chebyshev distributions - Super Directivity - Planar array- Circular array- Design problems. (9)

**MICRO STRIP ANTENNA** : Radiation Mechanism and Excitation techniques : Microstrip dipole; Patch - Rectangular patch - Circular patch - and Ring antenna - radiation analysis from cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Applications of microstrip array antenna. (9)

**EMC ANTENNA AND ANTENNA MEASUREMENTS** : Concept of EMC measuring antenna; Tx and Rx antenna factors; Log periodic dipole - Bi-conical - Ridge guide - Multi turn loop; Antenna measurement and instrumentation - Gain - Impedance and

antenna factor measurement; Antenna test range Design.

(9)

**Total L: 45**

**TEXT BOOKS:**

1. Balanis A, "Antenna Theory Analysis and Design", Second, John Wiley and Sons, New Delhi, Reprint 2018.
2. John D Krauss, "Antennas", 3rd Edition, Mc Graw-Hill, Inc, New York, 2018.

**REFERENCES:**

1. Bahl I J, Bhartia P, "Microstrip Antennas", 2nd Edition, Artech House, New York, 2015.
2. Stutzman W L, Thiele G A, "Antenna Theory and Design", 2nd Edition, John Wiley and Sons Inc., Singapore, 2014.

## **19L008 SMART ANTENNAS**

**3 0 0 3**

**INTRODUCTION :** Antenna gain, Phased array antenna, power pattern, beam steering, degree of freedom, optimal antenna, adaptive antennas, smart antenna - key benefits of smart antenna technology, wide band smart antennas, Digital radio receiver techniques and software radio for smart antennas. (9)

**NARROW BAND PROCESSING :** Signal model conventional beamformer, null steering beamformer, optimal beamformer, Optimization using reference signal, beam space processing. (8)

**ADAPTIVE PROCESSING :** Sample matrix inversion algorithm, unconstrained LMS algorithm, normalized LMS algorithm, Constrained LMS algorithm, Perturbation algorithms, Neural network approach, Adaptive beam space processing, Implementation issues. (9)

**BROADBAND PROCESSING :** Tapped delay line structure, Partitioned realization, Derivative constrained processor, Digital beam forming, Broad band processing using DFT method. (9)

**DIRECTION OF ARRIVAL ESTIMATION METHODS :** Spectral estimation methods, linear prediction method, Maximum entropy method, Maximum likelihood method, Eigen structure methods, MUSIC algorithm – root MUSIC and cyclic MUSIC algorithm, the ESPRIT algorithm. **DIVERSITY COMBINING:** Spatial diversity selection combiner, switched diversity combiner, equal gain combiner, maximum ratio combiner, optical combiner. (10)

**Total L: 45**

**TEXT BOOKS:**

1. Lal Chand Godara, "Smart Antennas", 1st Edition, CRC press, 2016.
2. Balanis A, "Antenna Theory Analysis and Design", 4th Edition, John Wiley and Sons, New York, 2015.

**REFERENCES:**

1. Joseph C Liberti Jr, Theodore S Rappaport, "Smart Antennas for Wireless Communication: IS-95 and Third Generation CDMA Applications", Prentice Hall, 1999.
2. Robert A. Monzingo, R.L. Haupt, T.W. Miller, "Introduction to Adaptive Arrays", Yesdee Publishing Pvt. Ltd, 2012.

## **19L009 SPEECH SIGNAL PROCESSING**

**3 0 0 3**

**SPEECH SIGNAL MODELLING :** Speech signal characteristics and classifications - Speech production mechanism - Acoustic Theory of speech production - Source - Filter model - Lossless Tube Models - Digital Model of speech signals. (9)

**SPEECH SIGNAL ANALYSIS :** Time domain Analysis for speech processing - Short time energy and magnitude - short time average zero crossing - Speech vs silence discrimination - Pitch period estimation using autocorrelation function - Short time Fourier analysis- Definition and properties - Design of digital filter banks - Pitch detection - Analysis and synthesis. (12)

**SPEECH CODING IN TIME DOMAIN :** Linear predictive coding (LPC) - principle - solution of LPC equation – Cholesky decomposition method - Durbin's method - Lattice formulation (6)

**SPEECH CODING IN FREQUENCY DOMAIN :** Frequency domain interpretation of LPC - LPC Applications - CELP - Subband



coding - Transform coding - Vocoders and cepstral vocoders - Vector quantiser coders (6)

**SPEECH RECOGNITION** : Problems in ASR - Dynamic Time warping - Isolated word recognition - pattern matching – Speaker independent recognition- Pattern classification – Connected word recognition – Speaker identification/Verification - Hidden Markov model (12)

**Total L: 45**

**TEXT BOOKS:**

1. Rabiner L R , Schaffer R W , "Digital Processing of Speech Signals", Pearson Education - India, 2015.
2. Thomas F Quatieri , "Discrete –Time Speech Signal Processing", Pearson Education - India, 2015.

**REFERENCES:**

1. Owens FJ , "Signal Processing of Speech", Macmillan, 2015.
2. Rabiner L R , K Juang B H , "Fundamentals of speech Recognition", Pearson Education - India, 2015.
3. John R Deller Jr, John H L Hansen, John G Proakis , "Discrete Time Processing of Speech Signal", IEEE press, 2015.

## 19L010 MULTIMEDIA COMPRESSION TECHNIQUES

**3 0 0 3**

**INTRODUCTION** : Compression Techniques - Overview of information theory - lossless and lossy coding– Multimedia components and their characteristics -Text, sound, images, graphics, animation, video- Huffman coding – Non-Binary Huffman codes – adaptive Huffman coding (8)

**ARITHMETIC CODING AND DICTIONARY TECHNIQUES** : Introduction- coding a sequence – generating deciphering the tag – Generating a binary code –Static and Adaptive dictionary – LZ77, LZ78, LZW approach – Applications - Facsimile encoding – run length coding – MH, MR, MMR and JBIG. Scalar and Vector Quantization (10)

**AUDIO COMPRESSION** : Audio compression techniques - frequency domain and filtering - basic sub-band coding - application to speech coding - G.722 - application to audio coding - MPEG audio - silence suppression – speech compression techniques –Vocoders. (10)

**IMAGE COMPRESSION** : Predictive techniques - DPCM, DM - DCT, JPEG, Wavelet based compression: quad-trees, EZW, SPIHT, JPEG-2000. (9)

**VIDEO COMPRESSION** : Video signal representation –Motion compensation – MPEG standards - Motion estimation techniques - H.261 family of standards - Motion video compression (8)

**Total L: 45**

**TEXT BOOKS:**

1. Sayood Khaleed , "Introduction to data compression", 5th Edition, Morgan Kauffman, 2017.
2. Yun Q. Shi, Huifang Sun , "Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards", third Edition, CRC Press, 2019.

**REFERENCES:**

1. Salomon D , "Data Compression The Complete Reference", Springer, 2014.
2. Salomon D , "A Guide to Data Compression Methods", Springer, 2012.

## 19L011 WAVELETS AND ITS APPLICATIONS

**3 0 0 3**

**FOURIER ANALYSIS** : Fourier basis & Fourier Transform – failure of Fourier Transform – Need for Time-Frequency Analysis – Heisenberg's Uncertainty principle – Short time Fourier transform (STFT)- short comings of STFT- Need for Wavelets (9)

**CWT AND MRA** : Wavelet basis – Continuous time Wavelet Transform (CWT) – need for scaling function – Multi-Resolution Analysis (MRA) – important wavelets: Haar, Mexican hat, Meyer, Shannon, Daubachies (9)

**INTRODUCTION TO MULTIRATE SYSTEMS** : Decimation and Interpolation in Time domain - Decimation and Interpolation in

Frequency domain – Multi rate systems for a rational factor (9)

**FILTER BANKS AND DWT** : Two channel filter bank – Perfect Reconstruction (PR) condition – relationship between filter banks and wavelet basis – DWT – Filter banks for Daubechies wavelet function. (9)

**ADVANCED TOPICS AND APPLICATIONS** : Introduction to Multiwavelets, Multidimensional wavelets – wavelet packet transform, Feature extraction using wavelet coefficients, Image compression, Wavelet based denoising (9)

**Total L: 45**

**TEXT BOOKS:**

- 1.Jaideva C Goswami, Andrew K Chan , "Fundamentals of Wavelets – Theory, Algorithms and Applications", John Wiley & Sons, Singapore, 2011.
- 2.Soman K P, Ramachandran K I , "Insight into wavelets from Theory to practice", Prentice Hall, New Delhi, 2010.

**REFERENCES:**

- 1.Sidney Burrus C , "Introduction to Wavelets and Wavelets Transforms", Prentice Hall, New Delhi, 2002.
- 2.Stephane G Mallat , "A Wavelet Tour of Signal Processing", Academic Press, India, 2009.
- 3.Raghuveer M Rao, Ajit S Bopardikar , "Wavelet Transforms: Introduction to Theory & Applications", Wavelet Transforms: Introduction to Theory & Applications, New Delhi, 2003.

## 19L012 ADVANCED DIGITAL SIGNAL PROCESSING

**3 0 0 3**

**INTRODUCTION** : DT signals and DT systems - DTFT - Random variables and random process – Autocorrelation function - Power spectral density (5)

**MULTIRATE SIGNAL PROCESSING** : Down sampling - Up sampling - Noble identities - cascading sampling rate convertors - Decimation with transversal filters - interpolation with transversal filters - decimation with polyphase filters - interpolation with polyphase filters - decimation and interpolation with rational sampling factors - multistage implementation of sampling rate convertors (10)

**POWER SPECTRUM ESTIMATION** : Non parametric methods - Periodogram - Modified Periodogram - Bartlett - Welch & Blackman Tukey methods - Performance comparison - Parametric methods - Auto Regressive spectrum estimation - Relationship between autocorrelation and model parameters - Moving Average and Auto Regressive Moving Average spectrum estimation (10)

**ADAPTIVE FILTERS** : Introduction to Wiener Filter - Adaptive Filter Applications - System identification - Inverse modeling - Prediction - Interference Cancellation - Adaptive linear combiner - Performance function - Gradient and Minimum Mean Square error - Gradient search by steepest descent method - LMS algorithm - Convergence of LMS algorithm - Learning curve - Introduction to RLS algorithm (10)

**WAVELET TRANSFORMS** : Need for Time Frequency Analysis - Short time Fourier transform - shortcomings of STFT - Need for Wavelets - Continuous time Wavelet Transform - Multi Resolution Analysis - Haar and Daubechies wavelet functions - Introduction to Discrete Wavelet Transform (10)

**Total L: 45**

**TEXT BOOKS:**

- 1.Monson H.Hayes , "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, 2015.
- 2.Ifeachor E C, Jervis B. W. , "Digital Signal Processing: A Practical Approach", Prentice Hall, 2015.

**REFERENCES:**

- 1.K.P.Soman, K.I.Ramach, N.G.Resmi , "Insight into Wavelets from Theory to Practice", Third Edition, PHI Learning Private limited, 2015.
- 2.Jaideva C Goswami , Andrew K Chan , "Fundamentals of Wavelets – Theory, Algorithms and Applications", John Wiley and Sons, 2015.

## 19L013 PATTERN RECOGNITION AND MACHINE LEARNING

3 0 0 3

**PATTERN CLASSIFIER** : Pattern recognition overview-Feature extraction-Statistical Pattern Recognition-Supervised & Unsupervised Learning; Bayes decision Theory, Linear discriminant functions, Pattern classification by distance functions – Minimum distance pattern classifier (9)

**STRUCTURAL PATTERN RECOGNITION** : Elements of formal grammars –String generation as pattern description – Recognition of syntactic description –Parsing –Stochastic grammars and applications –Graph based structural representation (8)

**COMPUTATIONAL LEARNING THEORY** : Basics , Types of Learning - Designing a learning system – concept learning - Find-s – Candidate Elimination - PAC Learnability- Sample complexity for finite and Infinite hypothesis spaces-VC Dimension (9)

**LINEAR MODELS** : Linear Models For Regression – Linear Regression Models, Maximum Likelihood Estimation - Least Squares, The Bias-Variance Decomposition, Bayesian Linear Regression, Linear Models for Classification, Linear Discriminant Analysis. (9)

**NEURAL NETWORKS AND KERNEL METHODS** : : Neural Networks - Feed-forward Networks - Network Training - Delta Rule- Gradient Descent - Error Backpropagation - Constructing KernelsRadial Basis Function Networks. Gaussian Processes - Maximum Margin Classifiers – SVM (10)

**Total L: 45**

### TEXT BOOKS:

- 1.Christopher Bishop , "Pattern Recognition and Machine Learning", Springer-Verlag, New York, 2013.
- 2.Narasimha Murty, Susheela Devi V , "Pattern Recognition: An Algorithmic Approach", Pattern Recognition: An Algorithmic Approach, India, 2011.

### REFERENCES:

- 1.Tom M. Mitchell , "Machine Learning", McGraw Hill, 1997.
- 2.Trevor Hastie, Robert Tibshirani, Jerome Friedman , "The Elements of Statistical Learning - Data Mining, Inference, and Prediction", 2nd Edition, Springer-Verlag, New York, 2013.
- 3.Sergios T, Konstantinos K , "Pattern Recognition", 4th Edition, Academic Press, 2008.

## 19L014 WIRELESS SYSTEMS AND STANDARDS

3 0 0 3

**INTRODUCTION TO CELLULAR STANDARDS** : 2G GSM - Cell structure - Frequency Bands and Channels- Call processing - Identity numbers - Frame structure - Interfaces - GMSK modulation - Voice and data processing - GPRS - EDGE - EDGE+ - CDMA signal processing - IS-2000 system - Frequency bands - Channel allocation - CDMA cell capacity - services provided by IS-2000 - 1xEVDO signal processing and data services-3G UMTS signal processing - WCDMA - HSPA - HSPA+ - Towards 4G - LTE and LTE advanced. (9)

**WIRELESS SYSTEMS** : Advanced Mobile Phone Systems (AMPS) - Characteristics - Operation - General Working of AMPS Phone System - Global System for Mobile Communication - Frequency Bands and Channels - Frames - Identity Numbers - Layers - Planes and Interfaces of GSM - International Mobile Telecommunications (IMT-2000) - Spectrum Allocation - Services provided by 3G Cellular Systems - Harmonized 3G Systems - Universal Mobile Telecommunications Systems (UMTS). (9)

**THE IEEE 802.11 WLAN STANDARD** : Introduction to IEEE 802.11 - General Description - Medium Access Control (MAC) - Physical Layer for IEEE 802.11 Wireless LANs; Radio systems - IR Systems Applications. (9)

**THE IEEE 802.16 WIMAX STANDARD** : Introduction to IEEE 802.16 - General Description - Medium Access Control (MAC) - Radio systems - Physical Layer- Evolution to 802.16m - Bluetooth - Zigbee (9)

**RECENT ADVANCES** : Introduction - Ultra Wide Band (UWB) Technology - Characteristics - Signal Propagation - Current

Status and Applications - Advantages - Disadvantages - Challenges and Future Directions.

(9)

**Total L: 45**

**TEXT BOOKS:**

1. Assuncion Santamaria, Francisco Lopez-Hernandez, "Wireless LAN Standards and Applications", Artech House, 2001.
2. Dharma Prakash Agarwal, Qing-An Zeng, "Introduction to Wireless and Mobile Systems", Vikas Publishing House, 2004.

**REFERENCES:**

1. Neeli Prasad, An, "WLAN System & Wireless IP for Next Generation Communications", Artec House, 2002. 2009.

## **19L015 WIRELESS SENSOR NETWORKS**

**3 0 0 3**

**INTRODUCTION :** Challenges and constraints - Comparison of sensor network with ad hoc network - WSN Applications - case studies related to Structural monitoring - Healthcare, Precision Agriculture - Underground mining (9)

**ARCHITECTURE :** Single node architecture - sensing subsystem - processing subsystem - communication interfaces - Operating systems - Network architecture - Sensor network scenarios - Design principles – Gateway Concepts. (9)

**MEDIUM ACCESS CONTROL :** MAC protocols - MAC low duty cycle protocols and wakeup concepts - contention-based protocols - SMAC, IEEE 802.15.4 MAC (9)

**ROUTING IN WIRELESS SENSOR NETWORKS :** Energy-efficient unicast - Broadcast and multicast - Data centric Routing protocols in WSNs - Data Aggregation, Hierarchical Routing protocols - Location based routing protocols (9)

**NODE AND NETWORK MANAGEMENT :** Power Management - Local Power Management Aspects - Time Synchronization in Wireless Sensor Networks - Ranging techniques - Range based Localization - range free localization (9)

**Total L: 45**

**TEXT BOOKS:**

1. Holger Karl, Andreas Willig, "Protocol and Architecture for Wireless Sensor Networks", John Wiley publication, 2007.
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley, 2010.

**REFERENCES:**

1. Fei Hu, Xiaojun Cao, "Wireless Sensor Networks, Principles and Practice", CRC Press, 2010.
2. Sudip Misra, Isaac Woungang, Subhas Chandra Misra, "Guide to Wireless Sensor Networks", Springer, 2009.
3. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John Wiley & Sons, 2007.
4. Ian Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", John Wiley & Sons, USA, 2010.

## **19L016 WIRELESS NETWORKING**

**3 0 0 3**

**WIRELESS LOCAL AREA NETWORK :** Introduction to Wireless LANs – Topologies, IEEE 802.11 WLAN – Architecture and Services, Physical Layer- MAC SubLayer – MAC Management SubLayer, Other IEEE 802.11 Standards - HIPERLAN, WiMAX. (8)

**ADHOC WIRELESS NETWORKS :** Characteristics of Adhoc Networks, MAC Protocols – Routing Protocol - TCP Over Ad Hoc Wireless Networks (9)

**WIRELESS PERSONAL AREA NETWORKS :** Introduction to Bluetooth - Architecture, Protocol Stack, Topology, Application. Wireless Sensor Network – Architecture, Data Dissemination and Gathering. Zigbee Technology – Components, Network topologies and architecture (9)

**MOBILE NETWORK AND TRANSPORT LAYER :** TCP Enhancements for Wireless Networks – Implementation of Wireless TCP – Mobile IP and Session Initiation Protocol (7)

**WIRELESS WIDE AREA NETWORKS** : GSM network Architecture , channels , Call procedures, hand off procedures. CDMA System Architecture, Channels, hand off procedure. Digital cellular technology – Evolution, W-CDMA air interface, CDMA 2000 cellular technology. Introduction to 4G and 5G technologies (12)

**Total L: 45**

**TEXT BOOKS:**

- 1.Vijay.K. Garg , "Wireless Communication and Networking", Morgan Kaufmann Publishers, 2017.
- 2.Siva Ram Murthy C, Manoj B S , "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall, 2017.

**REFERENCES:**

- 1.T L singal , "Wireless communications ", Mcgraw Hill Education, 2016.
- 2.PahalavanK , Krishnamurthy P , "Principles of Wireless Networks - A Unified Approach", Prentice Hall, 2002.
- 3.William Stallings , "Wireless Communications and Networks", 2nd Edition, Pearson/ Prentice Hall India, 2007.

## 19L017 LONG TERM EVOLUTION TECHNOLOGIES

**3 0 0 3**

**LTE INTRODUCTION AND NETWORK ARCHITECTURE** : Motivation to LTE - Evolution of Architecture - Standardization process in 3GPP - Technologies for LTE - Network Architecture - Core Network - Access Network - Roaming Architecture - Protocol Architecture - Quality of service and EPS Bearers - S1 and X2 E-UTRAN Network Interfaces. (9)

**CONTROL PLANE AND USER PLANE PROTOCOLS** : Radio Resource Control - PLMN and Cell Selection - Paging - User Plane Protocol Stack - Packet Data Convergence Protocol - Radio Link Control - Medium Access Control. (8)

**ORTHOGONAL FREQUENCY DIVISION MULTIPLE ACCESS & MIMO TECHNIQUES** : History of OFDM Development - OFDM- OFDMA - Parameter Dimensioning. Fundamentals of Multiple antenna theory - MIMO Signal Model – Single User MIMO - Multi User MIMO - MIMO Schemes in LTE. (9)

**PHYSICAL LAYER FOR DOWNLINK** : Transmission Resource Structure - Signal Structure - Downlink operation. Synchronization and Cell Search - Synchronization sequences and cell search in LTE - Coherent versus Non-Coherent Detection. (9)

**PHYSICAL LAYER FOR UPLINK** : Uplink Physical Layer Design - SC- FDMA Principle - SC-FDMA Design in LTE. Uplink Physical channel structure - Physical uplink shared Data channel Structure - Uplink control channel Design - Multiplexing of control signaling - ACK/NACK Reception - Uplink transmission procedures- Timing Control - Power control. (10)

**Total L: 45**

**TEXT BOOKS:**

- 1.Stefania Sesia, Issam Toufik , Matthew Baker , "LTE – The UMTS Long Term Evolution: From Theory to Practice", John Wiley & Sons, 2011.
- 2.Christopher Cox , "An introduction to LTE – LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications", John Wiley & Sons, 2014.

**REFERENCES:**

1. Moray Rumney , "LTE and Evolution to 4G Wireless: Design and Measurement Challenges", Agilent Technologies, 2013.

## 19L018 NETWORK SECURITY

**3 0 0 3**

**SECURITY PROBLEM** : Security Problem in Computing-Security services - Attacks-Mechanism-Points of security vulnerability - Methods of defense-Controls-Effectivenessof control -Introduction t cryptography and steganography - Plan of attack-attack on encryption - Standards-Standard setting organizations (9)

**SYMMETRIC CRYPTOGRAPHY** : Encryption and Decryption-substitution-transposition - Block ciphers-Data Encryption Standard- -advance Encryption Standard-Triple DES-RC5,Stream cipher- RC4 - Block Cipher modes - Differential & Linear Cryptanalysis (9)

**PUBLIC KEY ENCRYPTION** : Number Theory basics - RSA-key management-Diffie-Hellman key exchange - Elliptic curve cryptography (9)

**MESSAGE AUTHENTICATION** : Requirements of authentication - HASH functions –SHA algorithm-MD5 - HMAC- Digital signature standards (9)

**NETWORK AND SYSTEM SECURITY** : Authentication applications - E-mail Security - IP security - Web security - Intruders -malicious Software - Firewalls (9)

**Total L: 45**

**TEXT BOOKS:**

1. William Stallings , "Cryptography & Network Security: Principles & Practices", Seventh Edition, Pearson Education Limited, 2017.
2. Behrouz A. Forouzan , "Cryptography & Network Security", Third, Tata McGraw hill, 2015.

**REFERENCES:**

1. Charles P. Pleege , "Security in Computing", Fifth edition, Prentice Hall, 2015.

## **19L019 FPGA BASED SYSTEM DESIGN**

**3 0 0 3**

**FPGA DESIGN FLOW AND ARCHITECTURES** : Digital IC design flow-The role of FPGAs in digital design–Goals and techniques–Hierarchical design-CAD Tools. FPGA architectures–Configurable logic blocks-configurable I/O blocks–Programmable interconnect–clock circuitry–Xilinx FPGA architecture–Programming Technologies: Antifuse, SRAM, EPROM,EEPROM. (9)

**VERILOG HDL** : HDL overview-Modules and ports-compiler directives-data types-operands and operators-gate level modeling-data flow modeling-behavioral modeling-structural modeling–primitives-Tasks and functions- Writing test bench. (9)

**ARCHITECTING SPEED AND TIMING ISSUES** : High Throughput - Low Latency - Timing - Add Register Layers, Parallel Structures, Flatten Logic Structures, Register Balancing, reorder Paths. CLOCKING AND METASTABILITY: Set up time hold time–setup time hold time violations-critical path-calculation of maximum clock frequency– metastability - synchronizers-design examples. (9)

**ARCHITECTING AREA AND POWER** : Architecting Area - Rolling Up the Pipeline - Control-Based Logic Reuse - Resource Sharing - Impact of Reset on Area - Resources Without Reset, Resources Without Set, Resources Without Asynchronous Reset, Resetting RAM, Utilizing Set/Reset Flip-Flop Pins. Architecting Power - Clock Control, Clock Skew, Managing Skew, Input Control, Reducing the Voltage Supply, Dual-Edge Triggered Flip- Flops, Modifying Terminations. (9)

**EMBEDDED SYSTEM DESIGN WITH FPGA** : Processors - Interfaces - Zynq System-on-chip Development - IP based Design - Hardware-Software Co-design for Zynq - Software Development Tools - Real-time Applications. (9)

**Total L: 45**

**TEXT BOOKS:**

1. Michael D. Ciletti , "Advanced Digital Design with the Verilog HDL", Second Edition, Pearson, 2011.
2. Steve Kilts , "Advanced FPGA Design Architecture, Implementation, and Optimization", First Edition, John Wiley & Sons, Inc., Hoboken, New Jersey, 2007.

**REFERENCES:**

1. Crockett H. Louise, Ross A. Elliot, Martin A. Enderwitz , "The Zynq Book Embedded Processing with the ARM Cortex-A9 on the Xilinx Zynq-7000 All Programmable SoC", First Edition, Strathclyde Academic Media, 2014.
2. Charlet H. Roth, Lizy Kurian John, Byeong Kil Lee , "Digital Systems Design using Verilog", Cengage Learning, 2016.
3. Zainalabedin Navabi , "Verilog Digital System Design", Second Edition, McGraw-Hill Education, 2005.
4. Ming-Bo Lin , "Digital System Designs and Practices: Using Verilog HDL and FPGAs", First Edition, Wiley, 2008.

## **19L020 ANALOG VLSI CIRCUITS**

**3 0 0 3**

**INTEGRATED CIRCUIT DEVICES MODELING** : Semiconductors and pn junctions - MOS transistors - Advanced MOS

modeling - Bipolar junction transistors and its modeling (9)

**ANALOG CIRCUIT BUILDING BLOCKS** : Switches - Active resistors - Current sources and sinks - Current mirrors - Simple Cascade and Wilson Current Mirrors - Voltage and current references - Analog multipliers - (9)

**AMPLIFIERS** : MOS and BJT amplifiers , Frequency Response - CMOS and BJT differential amplifiers - Characterization of Op-Amp - Design of two stage op-amp - Op-amps with output stage - Comparators – Two Stage and Latched Comparators - PLL (9)

**D/A AND A/D CONVERTERS** : Analog signal processing -Parallel D/A converter: Current scaling , Voltage scaling and Charge scaling - Serial D/A converters - A/D converters: Serial A/D converters, Successive approximation A/D - parallel - High performance A/D converters - Oversampling Converters. (9)

**FILTERS** : Active RC Filters - Low pass filters - High pass filters - Bandpass filters - Switched capacitor filters. (9)

**Total L: 45**

**TEXT BOOKS:**

1. Jacob Baker Lee H W and Boyce D E , "CMOS Circuit Design, Layout and Simulation", Fourth, John Wiley & Sons, New Jersey, 2019.
2. David A Johns and Ken Martin , "Analog Integrated Circuit Design", Second, John Wiley & Sons, USA, 2013.

**REFERENCES:**

1. Phillip Allen and Douglas R Holdberg , "CMOS Analog Circuit Design", Third, Oxford University Press, New York,, 2013.
2. Behzad Razavi , "Design of Analog CMOS Integrated Circuits", Second-Indain, Tata McGraw Hill, New Delhi, 2017.
3. Randall L Geiger Phillip E Allen and Noel R. Strader , "VLSI Design techniques for Analog and Digital Circuits", McGraw Hill, New Delhi, 2010.

## **19L021 LOW POWER VLSI DESIGN**

**3 0 0 3**

**PRINCIPLES OF LOW POWER VLSI DESIGN** : Need for Low power VLSI chips - Sources of Power Dissipation – Dynamic Power Dissipation - Charging and Discharging of Capacitance – Short Circuit Current in CMOS Circuits - CMOS Leakage current – Static Current - Basic Principles of Low Power VLSI Design (9)

**POWER ANALYSIS** : Simulation power Analysis - Gate-Level Analysis - Architecture level Analysis – Data Correlation Analysis – Monte Carlo Simulation - Probabilistic Power Analysis Techniques (9)

**POWER REDUCTION AT THE CIRCUIT LEVEL** : Transistor and Gate Sizing – Equivalent Pin Ordering – Network Restructuring and Reorganization – Special Latches and Flip Flops – Low Power Digital Cell Library – Adjustable Device Threshold Voltage (9)

**POWER REDUCTION AT THE LOGIC LEVEL** : Gate Reorganization – Signal Gating – Logic Encoding – State Machine Encoding – Precomputation Logic (7)

**POWER REDUCTION AT THE ARCHITECTURE AND SYSTEM LEVEL** : Power and Performance management – Switching Activity Reduction – Parallel Architecture with Voltage Reduction – Flow Graph Transformation - ADVANCED TECHNIQUES : Adiabatic Computation - Pass Transistor Logic Synthesis - Power Reduction in Clock Networks - CMOS Floating Node - Low Power Bus-Software power estimation and optimization techniques (11)

**Total L: 45**

**TEXT BOOKS:**

1. Gary K Yeap , "Practical Low Power Digital VLSI Design", Kluwer academic publishers, 2002.
2. Kaushik Roy , Sharat C. Prasad , "Low Power CMOS VLSI circuit Design", John Wiley & Sons, 2009.

**REFERENCES:**

1. Kuo J B , Lou J H , "Low Voltage CMOS VLSI Circuits", John Wiley & Sons, 2001.
2. AP Chandrakasan, RW Brodersen , "Low Power Digital CMOS Design", Kluwer Academic Publishers, 1995.

## 19L022 NANO ELECTRONICS

3 0 0 3

**OVERVIEW** : Nano devices, Nano materials, Nano characterization. Definition of Technology node, Basic CMOS Process flow - MOS Scaling theory, Issues in scaling MOS transistors : Short channel effects, Description of a typical 65 nm CMOS technology - Requirements for Non classical MOS transistor. (8)

**MOS CAPACITOR** : Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO<sub>2</sub> vs High - k gate dielectrics. Integration - issues of high - k . Interface states, bulk charge, band offset, stability, reliability - Qbd high field, possible candidates, CV and IV techniques. (10)

**METAL GATE TRANSISTOR** : Motivation, requirements, Integration Issues - Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot. (7)

**SOI NANO TRANSISTOR** : SOI - PDSOI and FDSOI. Ultrathin body SOI - double gate transistors, integration issues. Vertical transistors - FinFET and Surround gate FET. Metal source/drain junctions - Properties of Schotky junctions on Silicon, Germanium and compound semiconductors - Workfunction pinning. (10)

**HETERO STRUCTURE BASED DEVICES** : Type I, II and III Heterojunction, Si - Ge heterostructure, hetero structures of III - V and II - VI compounds - resonant tunneling devices, MODFET/HEMT, Carbon nanotubes based devices – CNFET, characteristics, Spin - based devices – spinFET, characteristics. (10)

**Total L: 45**

### TEXT BOOKS:

- 1.Mircea Dragoman, Daniela Dragoman. , "Nanoelectronics Principles and Devices", Second, Artech house, 2008.
- 2.Shunri Oda, David Ferry , "Silicon Nanoelectronics", Taylor & Francis, 2006.

### REFERENCES:

- 1.Hanson. , "Fundamentals of Nanoelectronics", Pearson Education, 2009..
- 2.E. Kasper, D. J. Paul. , "Silicon Quantum Integrated Circuits Silicon-Germanium Heterostructures Devices: Basics and Realisations", Springer, 2005.
- 3.H.R. Huff, D.C. Gilmer. , "H.R. Huff and D.C. Gilmer. High Dielectric Constant Materials for VLSI MOSFET Applications , .", Springer, 2005.
- 4.Mark Lundstrom and Jing Guo. , "Nanoscale Transistors: Device Physics, Modeling and Simulation Springer", Springer, 2005.

## 19L023 DEVICE MODELING

3 0 0 3

**INTRODUCTION TO SEMICONDUCTOR PHYSICS AND DIODE MODELLING** : Quantum Mechanics – Boltzman transport equation - Continuity equation - Poisson equation, Junction and Schottky diodes in monolithic technologies - static and dynamic behavior - small and large signal models - SPICE models. (10)

**INTEGRATED MOS CAPACITANCE** : Band diagram - flatband condition and flat band voltage - surface accumulation, surface depletion - threshold condition and threshold voltage, charge versus gate voltage, MOS C - Characteristics, Poly Si gate depletion - effective Increase In Tox (10)

**VLSI FABRICATION TECHNIQUES** : An overview of wafer fabrication, wafer processing - oxidation - patterning - Diffusion - Ion implantation - Deposition - Silicon Gate nmos process - CMOS process - nwell - pwell - Twin tub - Silicon on Insulator - CMOS process enhancements - Interconnects circuit elements (9)

**INTEGRATED MOS TRANSISTOR** : nMOS and PMOS Transistor - Threshold voltage - Threshold voltage equations - MOS device equations - Basic DC equations Second order effects - Small signal AC Characteristics - MOS models SPICE model, EKV Model, BSIM Model. Technology scaling for cost, speed and power consumption, Subthreshold Current –Subthreshold Swing, Threshold voltage Roll Off - Short Channel Leakage, reducing gate insulator electrical thickness And Tunneling Leakage, Short Channel Effects. (10)

**INTEGRATED THIN BODY AND MULTIGATE TRANSISTOR** : Ultra Thin body, SOI and Multigate MOSFET - FINFET.



MOSFET Compact Model for Circuit Simulation using Verilog A.

(6)

**Total L: 45**

**TEXT BOOKS:**

- 1.Chenming C.Hu , "Modern Semiconductors for Integrated Circuits Prentice Hall", First, Prentice Hall, 2010.
- 2.Tyagi M S , "Introduction to Semi-conductor Materials and Devices", John Wiley, 2008..

**REFERENCES:**

- 1.Richard S. Muller, Theodore I. Kamins , "Device Electronics for Integrated circuits", John Wiley, 2003..
- 2.Yannis Tsividis , "Operation and Modeling of the Mos transistor", Oxford University Press, .
- 3.Neil Weste and David Harris , "A Circuits and Systems Perspective", Pearson., 2010.

## **19L024 SYSTEM-ON-CHIP DESIGN**

**3 0 0 3**

**SOC INTRODUCTION** : Driving Forces for SoC- Components - Generic template- Design flow- Hardware/Software nature- Design Trade-Offs-Major Applications-SYSTEM-LEVEL DESIGN: Processor selection-Concepts in Processor Architecture: Instruction set architecture (ISA) -Robust processors: Vector processor, VLIW, Superscalar, CISC, RISC—Processor evolution: Soft and Firm processors, Custom-Designed processors-IP based design- on-chip memory (10)

**SYSTEM-LEVEL INTERCONNECTION** : On-chip Buses: basic architecture, topologies, arbitration and protocols, Bus standards: AMBA, CoreConnect, Wishbone, Avalon-Network-on-chip: Architecture-topologies-switching strategies- routing algorithms-flow control,quality-of-service-Reconfigurability in communication architectures (9)

**CO-DESIGN CONCEPTS** : Nature of hardware & software- quest for energy efficiency- driving factors for hardware- software codesign- Codesign space-Dualism of Hardware design and Software design-Modeling Abstraction Level-Concurrency and Parallelism- Hardware Software tradeoffs- Introducing Dataflow modelling (9)

**SOC IMPLEMENTATION** : Study of Microblaze RISC processor - Real-time operating system (RTOS), peripheral interface and components, High-density FPGAs-Introduction to tools used for SOC design: Xilinx SoC based development kit (12)

**SOC TESTING** : Manufacturing test of SoC: Core layer, system layer, application layer-P1500 Wrapper Standardization-SoC Test Automation (STAT) (5)

**Total L: 45**

**TEXT BOOKS:**

- 1.Michael J.Flynn, Wayne Luk , "Computer system Design: System-on-Chip", Wiley-India, 2012.
- 2.Sudeep Pasricha, Nikil Dutt , "On Chip Communication Architectures: System on Chip Interconnect", Morgan Kaufmann Publishers, 2008.

**REFERENCES:**

- 1.W.H.Wolf , "Computers as Components: Principles of Embedded Computing System Design", Elsevier, 2008.
- 2.Patrick Schaumont , "A Practical Introduction to Hardware/Software Co-design", 2nd Edition, Springer, 2012.
- 3.Lin, Youn-Long Steve , "Essential issues in SOC design: designing complex systems-on-chip", Springer, 2006.

## **19L025 DIGITAL SIGNAL PROCESSING SYSTEM DESIGN**

**3 0 0 3**

**COMPUTATIONAL ACCURACY IN DSP IMPLEMENTATIONS** : Number Formats for Signals and Coefficients in DSP systems: Fixed Point Format, Double Precision Fixed Point Format, Floating Point Format, Block Floating Point Format. Dynamic Range and Precision - Sources of Error in DSP Implementations - A/D Conversion Errors – DSP Computational Errors - D/A Conversion Errors. (9)

**ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES** : Basic Architectural Features-DSP Computational Building Blocks: Hardware Multiplier, Barrel Shifter, MAC Unit-Bus Architecture and Memory-Data Addressing Capabilities- Address Generation Unit- Speed Issues: Hardware Architecture - Parallelism – Pipelining – System level Parallelism and Pipelining-

Architecture of TMS320C6748 Processors.

(9)

**DEVELOPMENT TOOLS FOR DSP IMPLEMENTATIONS** : Introduction to Code Composer Studio (CCS) – DSP Software Development using CCS- Implementation of Basic DSP Algorithms: Q-notation, Convolution, FIR Filters, IIR Filters , Decimation Filters, PID Controller, Adaptive Filters –2D Signal Processing: Matrix Multiplication (9)

**IMPLEMENTATION OF FFT ALGORITHMS** : FFT Algorithm for DFT Computation- Butterfly Computation – Overflow & Scaling – Bit Reversed Index Generation-8-point FFT Implementation on DSP processor- Computation of the Signal Spectrum (9)

**INTERFACING SERIAL CONVERTERS TO A PROGRAMMABLE DSP DEVICE** : Synchronous Serial Interface- Multichannel Buffered Serial Port (McBSP)-McBSP Programming-CODEC Interface-CODEC Programming- CODEC, DSP Interface. (9)

**Total L: 45**

**TEXT BOOKS:**

1. Julien Osmalskyj, Jean-Jacques Embrechts , "Digital Signal Processing Application on the Texas Instrument C6748 Processor", Texas Instruments, 2014.
2. John G Proakis, Dimitris G Manolakis , "Digital Signal Processing", Prentice Hall India, 2013.

**REFERENCES:**

1. Venkataramani B, Bhaskar M , "Digital Signal Processors: Architecture, Programming & Applications", Tata McGraw Hill, 2015.
2. TI , "Technical Reference Manuals for TMS320C6748", Texas Instruments, 2016.
3. Oppenheim A V , "Discrete Time Signal Processing", Prentice Hall India, 2014.
4. Mitra S K , "Digital Signal Processing – A Computer based Approach", Tata McGraw Hill, 2013.

## **19L026 VEHICULAR SYSTEMS AND NETWORKS**

**3 0 0 3**

**BODY AND CONVINIENCE ELECTRONICS** : Electronics in automotive , central body control module system - Lighting and Indicators - external lights, head light reflectors, lighting circuits - Gas discharge and LED lighting - Advanced lighting technology, new developments - Body electrical and electronics systems - washers, wipers, horns - Obstacle avoidance - Cruise control, seats, mirrors - Passenger compartment climate control - Ac unit design and operation - Climate control systems - Comfort and convenience system in door and roof (12)

**VEHICLE SAFETY SYSTEMS** : Basic security - Top of the range security - Security coded ECU - Air bags and belt tensioners - Other security and control systems - Obstacle avoidance RADAR - Tire Pressure warning - Noise control - (6)

**POWER TRAIN SYSTEM** : Engine Management system - Combined ignition and fuel management – Exhaust emission control for diesel emissions - complete vehicle control system - Electric vehicles - Hybrid vehicles - - (9)

**AUTOMOTIVE NETWORKING** : Bus systems - Technical principles - Buses for motor vehicles : CAN, FLEXRAY, LIN, MOST, ETHERNET, PS15 - Introduction to AUTOSAR (8)

**VEHICULAR ADHOC NETWORKS** : Special Characteristics , Technical Challenges - DSRC spectrum and applications for VANET - IEEE Standards for MAC Protocols - CLuster based and Distributed MAC Protocols - Requirements for routing protocols and classifications - Network Mobility problems - NEMO basic support protocol (10)

**Total L: 45**

**TEXT BOOKS:**

1. Tom Denton , "Automobile Electrical and Electronic Systems", 3rd Edition, Routledge Taylor and Francis Group, New york, 2000.
2. Bosch , "Automotive Handbook", 8th Edition, Wiley Eastern, Germany, 2011.

**REFERENCES:**

1. Nicholas Navet , Francois Simonot-Lion , "Automotive Embedded Systems Handbook", New York 2009, 2009.
2. Dominique Paret , "Multiplexed Networks for Embedded Systems CAN, LIN, FlexRay, Safe", England, 2008.
3. Tom Denton , "Automobile Mechanical and Electrical systems", 2nd Edition, Routledge Taylor and Francis Group, New york, 2018.
4. Hassnaa Moustafa, Yan Zhang , "Vehicular Networks - Techniques, Standards and applications", CRC Press, 2009.

## 19L027 ADVANCED PROCESSOR ARCHITECTURES

3 0 0 3

**PARALLEL PROCESSING, MEMORY AND INPUT-OUTPUT SUBSYSTEMS** : Trends towards Parallel Processing - Parallel Computer Structures - Architectural Classification Schemes - Parallel Processing Applications. Hierarchical Memory Structure - Virtual Memory System - Cache Memories - Input-Output Subsystems (9)

**PRINCIPLES OF PIPELINING AND VECTOR PROCESSING** : Principles of Linear Pipelining- Classification of Pipeline Processors-General Pipelines and Reservation Tables- Interleaved Memory Organizations- Principles of Designing Pipelined Processors- Characteristics of Vector Processing-Pipelined Vector Processing Methods - Architecture of Cray-I Vector Processor. (9)

**STRUCTURES AND ALGORITHMS FOR ARRAY PROCESSORS** : SIMD Array Processors: SIMD Computer Organization - Making the data routing mechanism. SIMD Interconnection Networks: Static Vs Dynamic Networks - Mesh-Connected Illiac Network - Cube Interconnection Networks - Barrel Shifter and Data Manipulator- Parallel Algorithms for Array Processors: SIMD Matrix Multiplication - Parallel Storing on Array Processors and SIMD Fast Fourier Transform (9)

**MULTIPROCESSOR ARCHITECTURE, PROGRAMMING, CONTROL AND ALGORITHMS**: Loosely Coupled Multiprocessors-Tightly Coupled Multiprocessors-Processor Characteristics for Multiprocessing. Interconnection Networks: Time shared or Common Buses- Crossbar Switch and Multiport Memories-Inter-process Communication Mechanisms: Process Synchronization Mechanisms - Synchronization with Semaphores - Conditional Critical Sections and Monitors. System Deadlocks and Protection: System Deadlocks and Protection - Deadlock Prevention and Avoidance- Deadlock Detection and Recovery and Protection Schemes. (9)

**MSP430 MICROCONTROLLER AND TMS320C6713 DSP PROCESSOR** : Introduction- - MSP 430 Architecture - Features - Digital I/O : Input Registers - Output Registers - Direction Registers - Pull Up and Pull down Enable Registers Function Select Registers - Configuring Unused Port Pins Digital I/O Registers -TMS320C6000 family overview- Typical Applications - TMS320C67x DSP features and Options - Architecture - CPU-CPU Data Paths - Functional Units - On-chip Peripherals: DMA - EDMA - HPI - McBSP and Timers. (9)

**Total L: 45**

### TEXT BOOKS:

- 1.Venkataramani B, Bhaskar M , "Digital Signal Processors: Architecture, Programming & Applications", Tata McGraw Hill Publishing Company Ltd., 2010.
2. TI Team , "MSP430X2xx Family User's Guide", Texas Instruments, .

### REFERENCES:

1. Kai Hwang , Faye A Briggs , "Computer Architecture and Parallel Processing", New York, 1985.

## 19L028 REAL TIME SYSTEMS

3 0 0 3

**INTRODUCTION** : Basic Real-Time system concepts – Characteristics of Real-Time systems – Design challenges Examples (5)

**SOFTWARE REQUIREMENTS ENGINEERING** : Requirements Engineering process – Types of requirements – Requirements Specification – Formats methods in Software specification – Structural Analysis and Design – Object-Oriented Analysis and Unified Modeling Language – Requirements Validation and Review (10)

**HARDWARE AND SOFTWARE SYSTEM DESIGN** : Basic Architecture – Hardware interfacing – CPU – Memory – Input/Output – Enhancing performance – Other special devices. Properties of Software – Basic Software Engineering principles – Design Activity – Procedure-Oriented Design – Object-Oriented Design (13)

**REAL-TIME OPERATING SYSTEMS** : Real-Time kernels – Foundations of RTOS – Intertask communication and synchronization – Memory management (8)

**PERFORM ANALYSIS AND OPTIMIZATION** : Performance Analysis – I/O Performance – Performance Optimization Results of Compiler Optimization – Analysis of Memory Requirements – Reducing Memory Utilization (9)

**Total L: 45**

**TEXT BOOKS:**

1. Krishna C M, Kang G Shin , "Real-Time System", 1st Edition, Tata McGraw Hill, New Delhi, 2017.
2. Philip A. Laplante , "Real Time Systems Design and Analysis-An Engineers Handbook", 3rd Edition, IEEE Computer Society Press, 2008.

**REFERENCES:**

1. PRASAD K V K K , "Embedded/Real-Time Systems: Concepts, Design and Programming BLACK BOOK", 1st Edition, Dreamtech Press, New Delhi, 2015.
2. Herman Kopetz , "Real-Time Systems", Springer, New York, 2011.

## 19L029 ADVANCED COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

**3 0 0 3**

**INTRODUCTION TO PARALLEL PROCESSING** : Evolution of computer systems. Generation of computer systems – Trends towards parallel processing- Parallel processing mechanisms- parallel computer structure- Architectural classification schemes – Application (8)

**MEMORY AND I/O SUBSYSTEMS, PIPELINING** : Hierarchical Memory structure – Virtual memory system - cache memory management- Memory allocation and management – I/O subsystems pipelining: Principles - Classification of pipeline processors - Reservation tables – Interleaved memory organization – Design of arithmetic pipeline – Design of instruction pipeline. (10)

**VECTOR AND ARRAY PROCESSING** : Need – Basic vector processing architecture - Issues in vector processing – Vectorization and optimization methods. Array processing: SIMD Array processors – SIMD interconnection networks – Parallel algorithms for array processors – associative array processing (9)

**MULTIPROCESSOR ARCHITECTURE** : Functional structures - Interconnection network – Multi cache problems and solutions – Exploiting concurrency for multiprocessing (9)

**PRINCIPLES OF PARALLEL ALGORITHM DESIGN** : Design approaches-Design issues-Performance measures and analysis-Complexities-Anomalies in parallel algorithms - Pseudo code conventions for parallel algorithms- Comparison of SIMD and MIMD algorithms. (9)

**Total L: 45**

**TEXT BOOKS:**

1. Kai Hwang, Naresh Jotwani , "Advanced Computer Architecture - Parallelism, Scalability, Programmability", Tata McGraw Hill, 2011.
2. John L Hennessy , "Computer Architecture a Quantitative Approach", Fifth Edition, Morgan Kaufmann, 2011.
3. Seyed Roosta , "Parallel Processing and Parallel Algorithms", Springer Series, 2000.

## 19L030 EMBEDDED LINUX

**3 0 0 3**

**INTRODUCTION** : Embedded Linux - Real Time Linux - Types of Embedded Linux - Reason for choosing Linux - Design and Implementation methodology - Types of Host/Target Development setup - Types of hosts/Target Debug setup (9)

**ARCHITECTURE OF EMBEDDED LINUX** : Generic architecture of an Embedded Linux System - System Startup - Types of Boot configuration - Selecting the kernel - Configuring the kernel - Compiling the kernel - Installing the kernel. (9)

**DEVELOPMENT TOOLS** : GNU Cross-platform development tool chain - debugging - tracing & profiling tools - binary utilities - kernel debugging - debugging in Embedded Linux applications (9)

**REAL-TIME LINUX** : Real-Time Operating System - Interrupt latency - ISR duration - Scheduler latency - Scheduler duration - User space Real Time - Real-Time programming in Linux (9)

**PORTING APPLICATIONS** : Introduction to Beagle bone - Porting of Embedded Linux prebuilt images - Bone script (9)

**Total L: 45**

**TEXT BOOKS:**

1. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef , "Building Embedded Linux Systems", 2nd Edition, Shroff Publishers and Distributors, Mumbai, 2014.
2. P. Raghavan, Amol Lad , Sriram Neelak , " Embedded Linux System Design and Development", Auerbach Publications, 2019.

**REFERENCES:**

- 1.Christopher Hallinan , "Embedded Linux Primer", 2nd Edition, Prentice Hall, 2011.
- 2.Derek Molloy , "Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux", Second, John Wiley & Sons, Indiana, 2019.

**19L031 OPERATING SYSTEMS****3 0 0 3**

**INTRODUCTION** : Operating system - Functions - Evolution of Operating Systems - Structure of operating system - Monolithic and Micro Kernel structures. - Linux Architecture - Kernel - Shell Programming (8)

**PROCESS MANAGEMENT** : Introduction to processes - Scheduling objectives - Scheduling Criteria - Types of scheduling algorithms - Performance comparison - Inter-process communications - Synchronization - Semaphores - Deadlock - Prevention, Recovery, Detection and Avoidance - Classical problems in concurrency - Threads, Thread models - Multithreading. (14)

**MEMORY MANAGEMENT** : Introduction - Contiguous allocation - Buddy System - Paging - Structure of Page Table - Swapping - Segmentation - Segmentation with paging - Virtual Memory concepts - Demand Paging - Page Replacement Algorithms (8)

**FILE MANAGEMENT** : File Systems - Files - Directories - File System Implementation - Allocation methods - Free Space management - Security - Protection mechanisms. - Disk structure - Disk Scheduling Algorithms - RAID Levels (8)

**LINUX** : Process Management - Memory Management - File Systems - Input and Output - Inter-process Communication - Network Structure - Security (7)

**Total L: 45****TEXT BOOKS:**

- 1.Silberschatz A, Galvin P, Gagne G, "Operating System Concepts", 9th Edition, John Wiley & Sons, Singapore, 2018.
- 2.William Stallings, "Operating Systems: Internals and Design Principles", 9th Edition, Pearson, New Delhi, 2019.

**REFERENCES:**

- 1.Ann McIver McHoes, Ida M Flynn, "Understanding Operating Systems", Cengage Learning India Pvt Ltd, USA, 2017.
- 2.Mukesh Singhal, Niranjana G Shivaratis, "Advanced Concepts in Operating Systems", 0th Edition, McGraw-Hill Education (I) P Limited, Chennai, 2016.
- 3.Harvey M Deitel, Paul J Deitel, David R Choffness, "Operating Systems", 3rd Edition, Pearson Education, Chennai, 2013.

**19L032 RELATIONAL DATABASE MANAGEMENT SYSTEMS****3 0 0 3**

**BASIC CONCEPTS** : Introduction to databases – Characteristics of database approach – Advantages of using DBMS – Database concept and architecture – Data Abstraction – Data Models – Instances and Schema – Data Independence – Schema Architecture – The Database System Environment: Components of a DBMS – Database Languages – Database Administrator – Database Users (8)

**DATA MODELING** : Introduction – Conceptual modeling: Entities, attributes, relationships –associations- roles and structural constraints – Weak and Strong entity types – Design of Entity Relationship data models (ERD) – Enhanced ER model: Specialization and Generalization – constraints-Aggregation — Applications (9)

**RELATIONAL MODEL** : Introduction to Relational Data Model – Basic concepts – Enforcing data Integrity constraints – Relational Algebra: Unary Relational Operations, Set theory Operations – Binary relational operations-additional operations- Queries using relational algebra. FILE ORGANIZATION: Storage device characteristics – Operations on file – Serial files – Sequential files – Index sequential files – Direct files – Indexing (8)

**SQL PROGRAMMING** : Introduction to Structured Query Language (SQL) – datatypes- Data definition Language- , Constructing database, Manipulations on database – Basic data retrieval operations – Advanced Queries in SQL – Functions in SQL – Aggregation – Categorization – Updates in SQL – Views in SQL (10)

**DATA BASE DESIGN THEORY :** Data base design process – Relational Database Design – Relation Schema – Anomalies in a database – Functional dependencies – Axioms – Normal forms based on primary keys – Second Normal form, Third Normal form, Boyce – Codd Normal form – Examples – Conversion of ERD into tables. **DATABASE SECURITY, INTEGRITY CONTROL:** Security and Integrity threats – Defense mechanisms – Transaction and concurrency control mechanisms (10)

**Total L: 45**

**TEXT BOOKS:**

1. Silberschatz A, Korth H, Sudarshan S, "Database System Concepts", 6th Edition, Tata McGraw Hill, 2013.
2. Elmasri R, Navathe S B, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.

**REFERENCES:**

1. Date C J, Kannan A, Swamynathan S, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management System", 3rd Edition, Tata McGraw Hill, 2007.
3. Bob Bryla, Kevin Loney, "Oracle 12c: The Complete Reference", Oracle press, 2014.

## 19L033 SOFT COMPUTING TECHNIQUES

**3 0 0 3**

**INTRODUCTION :** Neural Network Architectures, Characteristics, Learning methods. Basic models -applications. Fuzzy logic: Introduction -crisp sets-fuzzy sets -crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence. Genetic algorithm-Introduction -biological background -traditional optimization and search techniques -Genetic basic concepts (9)

**NEURAL NETWORKS :** McCulloch-Pitts neuron -linear separability -hebb network -supervised learning network: perceptron networks -adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN-associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, Kohonen self organizing feature maps (9)

**FUZZY SYSTEMS :** Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts -methods -fuzzy arithmetic and fuzzy measures: fuzzy arithmetic -extension principle - fuzzy measures -measures of fuzziness -fuzzy integrals -fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making. (10)

**GENETIC ALGORITHMS :** Search space -general genetic algorithm –operators -Generational cycle -stopping condition – constraints -classification -genetic programming –multilevel optimization –real life problem-advances in GA (8)

**HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS :** Neuro-fuzzy hybrid systems -genetic neuro hybrid systems - genetic fuzzy hybrid, fuzzy genetic hybrid systems -simplified fuzzy ARTMAP -Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers (9)

**Total L: 45**

**TEXT BOOKS:**

1. Timothy J Ross, "Fuzzy Logic with Engineering Applications", UK, 2010.
2. Sivanandam S N, Deepa S, "Principles of Soft Computing", 3rd Edition, Wiley India Pvt Ltd, 2018.

**REFERENCES:**

1. Rajasekaran S, Vijayalakshmi Pai G A, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications", 2nd Edition, Prentice Hall of India, 2017.
2. Jang J.S.R, Sun C T, Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall, New Jersey, 2004.
3. Laurene V Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Prentice Hall, 2008.

## 19L034 SOFTWARE DEFINED NETWORKING

**3 0 0 3**

**EVOLUTION AND SOFTWARE DEFINED NETWORKING (SDN) CHARACTERISTICS :** Introduction –

Centralized/Distributed Control and Data Planes – Fundamental Characteristics of SDN - SDN Operation, Devices Network Virtualization: Concepts, Applications, Existing Network Virtualization Frameworks (9)

**SDN IMPLEMENTATION AND OPENFLOW :** SDN design - Separation of the control and data planes - Edge- oriented networking - Telecommunication SDN attributes – Telecommunication services – Realisation of SDN using software – OpenFlow: Overview, Channel, Controller Modes, Configuration and management protocol (9)

**SDN CONTROLLERS :** Introduction - General Concepts – Different controllers: NOX, POX, Ryu, Trema, Floodlight and OpenDaylight - Realisation of Controllers using software (9)

**SDN DEVELOPMENT :** Existing network limitations - Programmable networks – Network and application information - Legacy to SDN – Protocols in the context of SDN – Additional SDN Protocol Models - Additional SDN Controller Models - Additional Application Models (9)

**SDN APPLICATIONS AND OTHER ENVIRONMENTS :** Application Types: Reactive and Proactive applications, Internal and External applications - Wide Area Networks - Service Provider and Carrier Networks – Campus Networks - Mobile Networks - Optical Networks (9)

**Total L: 45**

**TEXT BOOKS:**

1. Patricia A. Morreale, James M. Anderson , "Software Defined Networking: Design and Deployment", 1st Edition, CRC Press, 2014.
2. Paul Goransson, Chuck Black, Timothy Culver , "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann, 2016.

**REFERENCES:**

1. Rajesh Kumar , "Software Defined Networking – a definitive guide", Smashwords Edition, 2013.
2. Thomas D. Nadeau, Ken Gray , "SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies", 1st Edition, O'Reilly Media, 2013.

## **19L035 COMPUTER AND MACHINE VISION**

**3 0 0 3**

**INTRODUCTION :** Embedded system overview and applications - features and architecture considerations-ROM - RAM - timers - data and address bus - Memory and I/O interfacing concepts - memory mapped I/O. CISC Vs RISC design philosophy - Von-Neumann Vs Harvard architecture - instruction set - instruction formats - and various addressing modes. Fixed point and floating point arithmetic operations. (6)

**BASIC EMBEDDED PROGRAMMING TECHNIQUES :** Introduction to TIVAARM Cortex M4 - Key Features - Functional Block Diagram - Pin Configuration - I/O pin multiplexing - pull up/down registers - GPIO control - Memory Mapped Peripherals - programming System registers - Watchdog Timer - need of low power for embedded systems - System Clocks and control - Hibernation Module on Tiva - Active vs Standby current consumption. Introduction to Interrupts - Interrupt vector table - interrupt programming. (11)

**TIMERS, PWM AND MIXED SIGNAL PROCESSING :** Timer - Basic Timer - Real Time Clock (RTC) - Timing generation and measurements - Analog interfacing and data acquisition: ADC - Analog Comparators - DMA - Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI). (11)

**HARDWARE/SOFTWARE INTEGRATION :** Host and Target Machines. In-System Programming (ISP)-In-Application Programming (IAP)-Getting Embedded Software into Target System: Programmers. Display - Keyboard - Relay - Stepper and DC Motor Interfacing. (9)

**REAL TIME OPERATING SYSTEMS :** Survey of Software Architectures - Tasks and Task States - Tasks and Data - Semaphores and Shared Data - Message Queues - Mailboxes and Pipes - Timer functions - Events - Memory Management and Interrupt Routines in RTOS Environment. Study of embedded product design with real time concepts using RTOS (8)

**Total L: 45**

**TEXT BOOKS:**

1. Jonathan W Valvano , "Introduction to Arm Cortex -M Microcontrollers", 2012.
2. David E Simon , "An Embedded Software Primer", Pearson Education Asia, 2009.

**REFERENCES:**

1. Rajkamal , "Embedded Systems: Architecture, Programming and Design", Tata McGraw-Hill, 2008.
2. Andrew Sloss & Dominic Symes & Chris Wright , "ARM System Developer's Guide, 1st Edition, Elsevier, Morgan Kaufmann Publishers 2004.", 2004.

**19L036 DIGITAL COMMUNICATION RECEIVERS****3 0 0 3**

**BASEBAND COMMUNICATION** : Baseband PAM, Clock Synchronizers - Error tracking and spectral line generating synchronizers, Squaring synchronizers, Mueller and Muller synchronizers (9)

**PASSBAND COMMUNICATION** : Passband Transmission, Receivers for PAM, Sufficient Statistics for Reception in Gaussian Noise, Optimum ML receivers - Synchronized detection, Digital matched filter (9)

**SYNCHRONIZATION ALGORITHMS** : ML synchronization algorithms – Estimator Structures for Slowly Varying Synchronization Parameters, Non-Data Aided and Data Aided algorithms. Timing parameter and carrier phase estimation, Phasor Locked Loop (9)

**PERFORMANCE ANALYSIS OF SYNCHRONIZERS** : Tracking Performance of Carrier and Symbol Synchronizers, Feedback and feed forward synchronizers. Cycle slipping, Acquisition of carrier phase and symbol timing (9)

**RECEIVERS FOR FADING CHANNELS** : Characterization of Fading channels, Detection and parameter synchronization on Fading channels, Receiver structures for fading channels – Outer and Inner receivers, parameter synchronization for flat fading and selective fading channels (9)

**Total L: 45****TEXT BOOKS:**

1. H. Meyer, M. Moeneclaey, S. A. Fechtel , "Digital Communication Receivers", Wiley, 2015.
2. U. Mengali, A. N. D. Andrea , "Synchronization Techniques for Digital Receivers", Kluwer, 2014.

**REFERENCES:**

1. Proakis J G, Salehi M , "Digital communications", Tata McGraw Hill, New York, 2018.
2. Rohde U L, Whitaker J C, Zahnd H , "Communications Receivers", McGraw-Hill, 2017.
3. Bernard Sklar , "Digital Communications- Fundamentals and applications", Prentice Hall, 2017.
4. Lathi B P , "Modern Digital and Analog communication Systems", Oxford University Press, 2017.

**19L037 EMC TEST AND MEASUREMENTS****3 0 0 3**

**NATURE AND ORIGINS OF ELECTROMAGNETIC COMPATIBILITY** : Introduction – Visualising the EMI problem - Source of EMI – EMI coupling to victim equipments - Intersystem and Intrasystem EMI – Historical background - Technical disciplines and Knowledge areas within EMC - Electrical engineering – Physics –Mathematical modeling – Limited chemical knowledge – - System engineering – Legal aspects of EMC. (9)

**EMC STANDARDS AND SPECIFICATIONS** : The need for standards and specifications – The need to meet EMC standards - Derivation of military standards – Derivation of commercial standards– - Outline of EMC testing - Types of EMC testing – Preconformance test measurements - Implication of repeatability of EMC measurements - Introduction to EMC test sensor - Conduction and Induction couplers – Radiative coupling - EMC antennas. (9)

**MEASUREMENT DEVICES FOR CONDUCTED EMI** : Introduction – Measurement by direct connection - Inductively coupled devices - EMC antennas – Basic antenna parameters - Antennas for radiated emission testing – Wideband antennas - Magnetic field antennas – Use of antennas for radiated susceptibility testing - Type of antennas used in susceptibility testing – Standards requiring immunity tests (9)



**RECEIVERS, ANALYSERS AND MEASUREMENT EQUIPMENT :** EMI receiver - Spectrum Analyzers - RF power meter  
Frequency meters - Instrumentation for susceptibility testing – Automatic EMC tests - Electromagnetic transient testing –  
Transient types – Continuous and transient signal – - ESD-electrostatic discharge (9)

**DESIGNING TO AVOID EMC PROBLEMS :** Intrasytem and Intrasytem EMC – - Design for formal EMC compliance  
Achieving product EMC :checklists for product development and testing - Introduction – Developing an approach to EMC  
design - Process flow chart, - EMC strategy – Self certification. (9)

**Total L: 45**

**TEXT BOOKS:**

- 1.David Morgan , "A Handbook for EMC Testing and Measurement", IET Electrical Measurement, 2012.
- 2.Tim Williams , "EMC for Product Designers", 5th Edition, Newnes Elsevier, 2017.

**REFERENCES:**

1. Clayton R. Paul , "Introduction to Electromagnetic Compatibility", Wiley Press, 2014.

## **19L038 DEEP LEARNING**

**3 0 0 3**

**INTRODUCTION :** Motivation for deep learning - Machine learning Basics: Learning algorithms - Overfitting - Underfitting -  
Hyper parameters Estimators - Validation - Maximum Likelihood estimation - Bayesian Statistics - Challenges in Machine  
Learning (6)

**DEEP LEARNING NETWORKS :** Gradient based learning - Hidden Units - Architectural design - Back - propagation for MLP -  
Regularization - Parameter Regularization - Data Augmentation - Dropout - Optimization algorithms - Adaptive learning rates  
(8)

**CONVOLUTIONAL NEURAL NETWORK :** Architecture - Pooling - Convolution and its variants - CNN for Image Recognition  
(9)

**SEQUENCE MODELING :** Recurrent Neural Networks(RNN) - Bi - directional RNN, Encoder Decoder Architecture - Recursive  
Nets - LSTM - Gated RNN - RNN for Sentiment Analysis (11)

**DEEP LEARNING MODELS :** Autoencoders - Deep Boltzmann Machine - Deep Belief Networks - Architecture - Greedy  
Learning – Speech Processing and Recognition using DBN (11)

**Total L: 45**

**TEXT BOOKS:**

- 1.Ian Goodfellow, YoshuaBengio, Aaron Courville , "Deep Learning", MIT Press, USA, 2016.
- 2.Adam Gibson, Josh Patterson , "Deep Learning A practitioner's approach", O'Reilly, USA, 2016.

**REFERENCES:**

- 1.Yusuke Sugomori , "Deep Learning: Practical Neural Networks with Java", Packt Publisher, New York, 2016.
- 2.Jeff Heaton , "Artificial Intelligence for Humans: Deep Learning and Neural Networks", Lightning Source Inc, Tennessee,  
2015.

## **LANGUAGE ELECTIVES**

### **19G001 COMMUNICATION SKILLS FOR ENGINEERS**

**0 0 4 2**

**COMMUNICATION CONCEPTS :**

Process of Communication  
Inter and Intrapersonal Communication  
Inter and Intrapersonal CommunicationActivities

(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 FÜR 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., München, 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'un système éducation de France
3. parler de la technologie de l'information (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", MCGrawhill Companies., USA, 2008

### REFERENCES:

1. Michael D. Oates "Entre Amis: An Interactive Approach", Houghton Mifflin., 2005 , 5th
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 —~~K~~re", —~~S~~re", -Are" — Demonstrative —~~K~~no", —~~S~~no", —Ao"
4. Possessive noun particle -no" — Japanese apartments: Greeting your neighbor (12)

### PARTICLE "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 pasttense)
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 (–"iand –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", .,

## ONE-CREDIT COURSES

### 19LF01 LINUX AND SCRIPTING LANGUAGES

**1 0 0 1**

**INTRODUCTION TO LINUX** : The Linux Shell Environment – Files and Directories – Entering Commands on Linux Systems – Command Options and Arguments – Customizing Environment – Linux Features (2)

**EDITOR** : Text editing with vi editor – Starting vi – Different Modes of Operation – Advanced Editing with vi (2)

**THE SHELL** : : The Common Shells – Necessity of the Shells – Wildcards Usage – Standard Input and Output - Shell Variables – Command Substitution – Running Commands in the Background – Job control (3)

**SHELL PROGRAMMING** : Shell Scripts – Providing Arguments to Shell Programs – Shell Output and Input – Conditional Execution – Looping – Command Line Options in Shell Scripts – Arithmetic Operations – Debugging Shell Programs (3)

**PERL** : Basic Perl Concepts – File handles – Scalar Variables – Arrays and Lists – Pattern Matching and Regular Expressions – Trouble shooting Perl Scripts (3)

**TCL** : Basic Tcl Concepts – Features – Programs (2)

**Total L: 15**

**TEXT BOOKS:**

1. Douglas Host, Rachel Klee, James Farber and Dick Rosinski, Ken Rosen , "The Complete Reference", McGraw Hill, New York, 2007.
2. John C. Welch, and Micah Anderson, Eric Foster-Jonson , "Shell Scripting", Wiley India Pvt. Ltd, New Delhi, 2008.

### 19LF02 AVIONICS

**1 0 0 1**

**INTRODUCTION TO FLIGHT-THEORY OF FLIGHT AND CONTROL SURFACES** : Brief about Avionics - Evolution of Avionics - Brief about various Avionic systems on board an aircraft - Power supply systems-Electrical Power Sources-Power generation and distribution systems - Navigation Systems-Electrical Navigation Systems- Compasses, Inertial Navigation Systems (INS) (3)

**RADIO NAVIGATION SYSTEMS** : Automatic Direction Finder (ADF) -Global Positioning System (GPS) -Very High Frequency Omni-Range (VOR)-Instrument Landing System (ILS) -Air Traffic Control System (ATC) -Distance Measuring Equipment (DME) -Ground Proximity Warning System (GPWS)-Traffic Collision Avoidance System (TCAS)- Weather Radar (4)

**FLIGHT INSTRUMENTS** : Air Data Systems/ Computers (ADS/ADC), Pitot Static Systems-Air Speed Indicator (ASI)- Vertical Speed Indicator (VSI)-Barometric Altimeters-Radio Altimeters-Artificial Horizon or Attitude Indicator-Flight Directors (FD) (3)

**POWER PLANT SYSTEMS** : Communication systems-VHF, HF, Data-link, Voice scramblers - Automatic Flight Control Systems (AFCS)-Automatic Flight Guidance Systems (AFGS)-Autopilot - Miscellaneous systems-Collision Avoidance Systems (CAS), Flight Data Recorders (FDR), Cockpit Voice Recorders (CVR) - Space avionics- Challenges in design (5)

**Total L: 15**

**TEXT BOOKS:**

- 1.E H J Pallett , "Aircraft Instruments and Integrated Systems", First Edition, Avionics Communications, 1992.
- 2.Dr Albert Helfrick , "Principles of Avionics", 8th Edition, Avionics Communications, 2013.
- 3.Ian Moir and Allan Seabridge , "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", 3rd Edition, Wiley, 2011.

**19LF03 SYSTEM LEVEL VERIFICATION TECHNIQUES AND METHODOLOGIES**

**1 0 0 1**

**SYSTEM VERILOG FOR VERIFICATION** : Data types – Function and task - Basic OOP – Class Methods – Handling objects – Public and local variables. (3)

**SYSTEM LEVEL VERIFICATION ENVIRONMENT AND COMPONENTS** : Basic component in Verification -- Driver – Stimulus generator – Monitor – Scoreboard – Checker -- Creating test bench. (3)

**STIMULUS – COVERAGE AND ASSERTIONS** : Generating different type of stimulus – Constrained Random Stimulus generation – Directed stimulus Generation -- Coverage Driven Simulation – Assertion based Simulation. (3)

**INTRODUCTION TO OVM** : Introduction to OVM - OVM class and its hierarchy – OVM test bench and environment – Basics of Transaction-Level Modeling (TLM) – OVM components – Developing Reusable OVM Components (3)

**CASE STUDY** : Sample architecture – Creating verification environment– Creating the test plan – Creating test case Reusable - Transaction Level Models - Managing Simulations - Regression. (3)

**Total L: 15**

**TEXT BOOKS:**

- 1.Janick Bergeron , "Writing Test Benches Using System Verilog", First Edition, Springer, 2009.
- 2.Mark Glasser , "Open Verification Methodology Cookbook", Springer, 2009.
- 3.Chris Spear, Greg Tumbush , "System Verilog for Verification - A Guide to Learning the Testbench Language Features", Third Edition, Springer, 2012.
- 4.Andreas Meyer , "Principles of Functional Verification", Newnes, 2003.

**19LF04 ADVANCED AVIONICS**

**1 0 0 1**

**LAYOUT OF A CONVENTIONAL COCKPIT AND DISADVANTAGES** : Configuration of a typical Integrated Avionics Systems- Glass Cockpit Systems-Flight Management Systems (FMS)-Electronic Flight Instrument System (EFIS) - Units of EFIS-EFIS units signal interfacing (with block diagram)-Functions of each unit-Display system-Symbol Generator and Card Interfacing- Control Panel-Electronic Attitude Director Indicator (EADI)-Electronic Horizontal Situation Indicator (EHSI)-Engine Indicating and Crew Alerting System (EICAS)-Explanation of functions of units with functional diagram - Electronic Centralised Aircraft Monitoring System (ECAM) (6)

**ADVANCED RADAR SYSTEMS** : Helmet Mounted Target Designation System (HMTDS)-Full Authority Digital Engine (or electronics) Control (FADEC)-Avionics of Unmanned Aerial Vehicles (UAV) - All Electric Aircraft-Design of In-flight Entertainment Systems (3)

**TACTICAL MISSION SYSTEMS** : Concept of a Tactical Mission System-Systems of a typical Tactical Mission System: Radio Sonic System(RSS), Magnetometric Measurement System (MMS), Control Computer System (CCS), Infra-Red Television System (IRTV) (4)

**DATA BUSES** : Avionics Standard Communications Bus (ASCB), ARINC-429-RS-404, RS 429, MIL-STD-1553 - Space Shuttle Avionics (2)

**Total L: 15**

**TEXT BOOKS:**

- 1.RPG Collinson , "Introduction to Avionics Systems", Third Edition, Springer, Jun 2011.
- 2.E H J Pallett , "Aircraft Instruments and Integrated Systems", First Edition, Avionics Communications, 1992.

**19LF05 E-COMMERCE SECURITY**

**1 0 0 1**

**INTRODUCTION** : Introduction to e-Commerce - Infrastructure – Benefits, limitations - Security Threats, Vulnerabilities – Standards-IEEE (3)

**SECURITY MECHANISMS** : Legal issues – Cyber Crimes - key management and certificates - payment security services - communication network and network access layer security - Internet layer security and transport layer security - application layer security - hypertext transfer protocol - web server security - web client security, mobile code security - mobile agent security - mobile commerce security, digital signature certificates – eCards Security – mobile payment technology –Payment Card Industry Data Security Standard PCI / DSS. (6)

**HANDS-ON TRAINING** : Modeling and design of a secure Web/Mobile based e-commerce application, securing internal network, and providing secure employee/user authentication. (6)

**Total L: 15**

**TEXT BOOKS:**

- 1.Yun Zhao Chwan-Hwa (John) Wu and J. David Irwin , "Introduction to Computer Networks and Cybersecurity", 1st Edition, CRC Press, 2013.
- 2.Anup K, Ghosh , "E-Commerce Security and Privacy", Kluwer Academic Publishers, 2001.
- 3.Ford W Baum M , "Secure Electronic Commerce: Building the Infrastructure for Digital Signatures and Encryption", Prentice Hall, New Delhi, 2001.

**19LF06 NANO TECHNOLOGY**

**1 0 0 1**

**QUANTUM PHENOMENA** : Limitation of classical physics – plank's quantum hypothesis – wave nature of particle – uncertainty principle. (2)

**MATERIALS** : Free electron and band theory of solids, metals, insulators, semiconductors, semiconductor device concepts. (2)

**NANO DEVICE FABRICATION** : Overview of nano devices and materials requirement, Physical Vapour deposition, Chemical Vapour Deposition, solgel process, Photolithography, electron beam lithography, imprint lithography, etching. (4)

**NANO DEVICES** : Nano MOSFET performance metrics, transport in nano MOSFET, Nano actuators, Nano Cantilevers. (3)

**NANOCHARACTERIZATION AND SIMULATION TECHNIQUES** : Thickness measurement using reflectance and ellipsometry techniques, AFM, FTIR, XRD, SEM, TEM, Simulation techniques and tools. (4)

**Total L: 15**

**TEXT BOOKS:**

- 1.Aruldas G , "Quantum Mechanics", PHI Learning Pvt.Ltd, New Delhi, 2011..
- 2.William D Callister, David G. Rethwisch , "Materials Science and Engineering", Wiley Publications, New Jersey, 2010.
- 3.Mick Wilson, Kamali Kannangara, Geoff smith , "Nanotechnology: Basic Science and Emerging Technologies", Overseas press, New Delhi, 2005.
- 4.Rainer Waser , "Nanoelectronics and Information Technology: Advanced Electronic Materials Novel and Devices", Wiley Vch Verlag, Weiheim, 2005.

## 19LF07 MACHINE VISION ALGORITHMS AND SYSTEM DESIGN

1 0 0 1

**INTRODUCTION** : Difference between Image processing, Machine Vision and Computer Vision, Applications - Industrial automation and quality inspection, Tracking, Gesture Recognition, Object detection and recognition, Face detection and recognition, Vision for robot control and 3D Reconstruction. (3)

**CAMERA, LENS AND LIGHTING** : Pinhole Camera, Image Formation, Projective Geometry, Lenses and Camera System, Various types of Sensors, Lighting methods, Camera Interfaces, Image transfer to a computer, Representation of an image in a computer (3)

**IMAGE PROCESSING IN MACHINE VISION** : Histogram, Thresholding, Otsu's Method, Adjacency, Morphology, Flood Fill, Connected Component Analysis, Perimeter, Chamfering, Moments, Compactness, Eccentricity, Convolution, Gaussian Pyramid, Edge Detection, Filtering, Segmentation. (3)

**BUILDING A MACHINE VISION SYSTEM** : System Setup, Pre-processing, Core Algorithm and Post Processing, Ablative Analysis, Cross Validation, ROC Curves, Supervised Learning, Unsupervised Learning, Cutting Edge of Computer Vision. (3)

**CASE STUDIES** : Design of high speed pencil inspection and sorting system - Design of automated color registration control system for web offset printing machines - Design of high performance counterfeit currency detection system (3)

**Total L: 15**

### REFERENCES:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle , "Image Processing, Analysis, and Machine Vision", Cengage Learning, 2014.
2. Forsyth D, Ponce J , "Computer Vision: A Modern Approach", Prentice-Hall, 2015.
3. Trucco E, Verri A , "Introductory Techniques for 3-D Computer Vision", Prentice-Hall, 2010.
4. Szeliski R , "Computer Vision: Algorithms and Applications", Springer Verlag, 2011.

## 19LF08 ROUTING ARCHITECTURE AND DESIGN

1 0 0 1

**OVERVIEW** : OSI and TCP/IP Models, explanation of each layer along with real time example, IP Addressing schemes, IPV4 and IPV6 evolution, LAN, WAN, MAN, Networking devices (2)

**NETWORKING INFRASTRUCTURES AND DESIGNS** : Discovering Network Design Basics, Network design overview, Benefits of hierarchical network design, Network design methodology (3)

**ROUTING ARCHITECTURE** : Cisco Routers and its types , Types of Routing protocols, Static Routing, Dynamic routing, RIP, OSPF, EIGRP, BGP, Routing Technologies MPLS, L2VPN, L3VPN, IPSEC VPN (4)

**NETWORKING PHASES** : Planning & Design, Testing and Validation, Implementation and Deployment, Maintenance and change (3)

**DEMO** : Quick Demo with simulators on building Simple Network Topology -Vlan configurations, Static Routing, Any one routing protocol implementation (3)

**Total L: 15**

### TEXT BOOKS:

1. Kevin Wallace, Raymond Lacoste , "Cisco press, Routing and Switching Route 300 -101 Official Cert Guide", Cisco Press, 2014.

### REFERENCES:

1. David Hucaby , "Ccnr Routing and Switching Switch 300 -115 Official Cert Guide", Cisco press.

## 19LF09 AUTOMOTIVE CONTROLLER AREA NETWORK AND SECURITY

**1 0 0 1**

**INTRODUCTION** : Basics of automotive electronic control units and building blocks –exemplary ECU functionality – overview of automotive in vehicular architecture -Security Basics: Security goals–Security threats–Security Mechanisms–Application of security mechanisms in automotive systems (3)

**AUTOMOTIVE CAN NETWORKS** : Introduction -The CAN Standard-CAN Message--CAN Arbitration –Message Types-A Valid Frame-Error Checking and Fault Confinement -The CAN Bus-CAN Transceiver Features (4)

**AUTOMOTIVE DIAGNOSTICS OVER CAN** : On Board—Diagnostics –OBD Applications–Diagnostics Scan tool - OBD-II signal protocols–Diagnostics over CAN–Remote Diagnostics and Future trends (4)

**AUTOMOTIVE SECURITY VULNARABILITIES** : Security Vulnerabilities in vehicular networks -Security Vulnerabilities in Diagnostics networks -Security Vulnerabilities in multimedia systems–Exemplary CAR hack –Possible mitigations and Security measures (4)

**Total L: 15**

**TEXT BOOKS:**

1. William Stallings , "Cryptography and network security principles and practice", Prentice Hall of India, 2011.

**REFERENCES:**

1.Ronald K Jurgen , "Infotainment Systems on Fast Forward", SAE International, 2007.

2.Dennis , "Automotive Telematics: The One -stop Guide to In-vehicle Telematics and Infotainment Technology and Applications", Red Hat Publishing, 2002.

## **19LF10 UNDERWATER TACTICAL AND COMMUNINATION ENGINEERING**

**1 0 0 1**

**INTRODUCTION** : Scope of underwater Tactical and Communication Engineering- Understanding the Ocean - Characteristics of the Medium – Properties of Sound (2)

**PRINCIPLES OF UNDERWATER SOUND** : The Active and Passive SONAR Equations and their Limitations– Echo, Noise, Reverberation Level and their relationship with Range - Properties of Transducer Arrays - Transducer Calibration Methods - Product Theorem and the Mills Cross -Projector Source Level - Limitations on Sonar Power - Non-Linear Effects in Sonar - Explosions as Sources of Underwater sound. (4)

**PROPAGATION OF SOUND** : Losses - Absorption of Sound in the Sea - Velocity of Sound in the Sea - Ambient Noise - Scattering in the Sea - Reflection and Scattering by Targets – Detection of Signals in Noise and Reverberation - Design and prediction in Sonar systems (4)

**UNDERWATER COMMUNICATIONS** : Challenges – Methods of VLF communication – VLF broadcasting – Methods followed worldwide – Low Frequency Analysis and Recording (LOFAR) – Communication systems used on board Submarines. (2)

**SUBMARINES** : Roles – Design and Construction – Propulsion – Characteristics (1)

**SONOBUOYS** : Active and Passive Sonobuoys – Functions – Types –Bathythermograph (1)

**UNDERWATER WEAPONS** : Mines – Torpedoes – Rockets – Depth Charges (1)

**Total L: 15**

**REFERENCES:**



1. Robert J Urick , "The Principles of Underwater Sound", 3rd Edition, Peninsula Publishing, Feb 1997.
2. A.D. Waite , "Sonar for Practicing Engineers", 3rd Edition, John Wiley & Sons, Mar 2002.
3. LufenXu , "Digital Underwater Acoustic Communications", Academic Press, Sep 2016.
4. Willis J. Abbot , "Aircraft and Submarines-The Story of the Invention, Development, and Present-Day uses of War's Newest Weapons", Kindle, Amazon Asia-Pacific Holdings Private Limited, .

## 19LF11 EMBEDDED PROCESSING WITH FPGAS

1 0 0 1

**INTRODUCTION** : Review – Basics of embedded systems – Types of embedded systems – Microcontroller based, DSP based, PLD based - Introduction to smart systems – Components of smart systems – Need for FPGA's in embedded systems. (2)

**FPGA ARCHITECTURES** : Evolution of FPGA architecture – FPGA's for embedded systems – Architectural features of FPGA's for embedded systems – Soft and hard processor/controller IPs and features – Memory and I/O macros and its utilization – Layers in FPGA based embedded system. (3)

**HDL CODING FOR FPGA** : Coding guidelines for combinational and sequential logic circuits – Coding guidelines for memory and FSM in FPGA based designs – Memory modelling in FPGAs – IP based embedded design using FPGAs. (4)

**SOC DESIGN FLOW USING FPGAS** : Architecture –Bringing up of hardware abstraction layer – Board Support Packages (BSP's) for the target hardware – Developing applications for the target hardware, compilation and simulation of application – Integration of hardware and software components – Debugging the embedded system (4)

**CASE STUDY** : Real-time applications. (2)

**Total L: 15**

### TEXT BOOKS:

1. Michael D Ciletti , "Advanced Digital Design with Verilog HDL", Second Edition, Pearson education, 2017.
2. Ming-Bo Lin , "Digital System Designs and Practices: Using Verilog HDL and FPGAs", First Edition, John Wiley, 2016.
3. Rahul Dubey , "Introduction to Embedded System Design Using Field Programmable Gate Arrays", Springer-Verlag London Limited, 2009.
4. Louise H Crockett, Martin A. Enderwitz, Robert W. Stewart, and Ross A. Elliot , "The Zynq Book: Embedded Processing With the ARM® Cortex®A9 on the Xilinx®", Xilinx, 2016.

## 19LF12 ASIC FLOW FOR MIXED SIGNAL VLSI DESIGN

1 0 0 1

**INTRODUCTION** : VLSI Design Cycle - Role of CAD Tools in VLSI Design Process (2)

**LOGIC DESIGN** : Specification - Design Entry - RTL Coding – Schematic based Design - Logic Synthesis – Design Constraints - Synthesis for Low Power, Low Area and High Performance (3)

**PHYSICAL DESIGN AUTOMATION** : Partitioning –Floor Planning - Placement –Constraint Driven Design Flow – Pin Assignment – Challenges in Mixed Signal Circuit Implementation in a Monolithic Substrate (3)

**ROUTING AND TIMING CLOSURE** : Grid Routing and Global Routing - Detailed Routing and Clock Design - Clock Routing and Power/Ground Routing–Clock Tree Synthesis – Static Timing Analysis and Timing Closure, PVT Corners – Design for Manufacturability. (3)

**PHYSICAL DESIGN SIGN-OFF** : Physical Synthesis and Performance Driven Design Flow - Interconnect Modeling and Layout Compaction – Physical Design Verification (DRC, LVS, ERC), IR drop analysis, Electro-Migration Analysis, Cross-Talk (SI) analysis, Sign-off Timing analysis, Logical Equivalence checking – Back Annotation – GDS II Generation - Engineering Change Order – Package - Testing. CASE STUDY: Designs covering Spec to Sign-off. (4)

**Total L: 15**

### TEXT BOOKS:

1. Michael D Ciletti , "Advanced Digital Design with the Verilog HDL", Second Edition, Pearson Education, 2017.
2. Behzad Razavi , "Design of Analog CMOS Integrated Circuits", McGraw-Hill Education, 2016.
3. Andrew B Kahng, Jens Lienig, Igor L. Markov and Jin Hu , "VLSI Physical Design: From Graph Partitioning to Timing Closure", Springer, 2011.
4. Sherwani N A , "Algorithms for VLSI Physical Design Automation", Kluwer, 2007.
5. Micheli G D , "Synthesis and Optimization of Digital Circuits", Tata McGraw Hill, 2003.

## 19LF13 DESIGN OF SATELLITE SUB-SYSTEMS AND TELEMETRY

1 0 0 1

**INTRODUCTION** : Origin of Satellite Communications - Historical Back-ground - Basic Concepts of Satellite Communications - Frequency allocations for Satellite Services & Applications - Future Trends of Satellite Communications (4)

**ORBITAL MECHANICS AND LAUNCHERS** : Orbital Mechanics - Look Angle determination - Orbital perturbations – Orbit determination - launches and launch vehicles - Orbital effects in communication systems performance (3)

**SATELLITE SUBSYSTEMS** : Attitude and orbit control system – telemetry – tracking - Command and monitoring – power systems - communication subsystems - satellite antenna - equipment reliability and space qualification (4)

**EARTH STATION TECHNOLOGY** : Introduction – Transmitters – Receivers – Antennas - Tracking systems – Terrestrial interface - Primary power test methods (4)

**Total L: 15**

### TEXT BOOKS:

1. M. Richharia , "Satellite Communications and Design Principles", 2nd Edition, BS Publications, 2003.
2. D.C Agarwal , "Satellite Communication", 5th Edition, Khanna Publications, 2007.
3. K.N. Raja Rao , "Fundamentals of Satellite Communications", PHI, 2004.

### REFERENCES:

1. Dennis Roddy , "Satellite Communications", 2nd Edition, McGraw Hill, 1996.

## 19LF14 LORA GATEWAY DESIGN & APPLICATION

1 0 0 1

**INTRODUCTION TO LORA** : Introduction to LoRa –Radio Communication – Frequency Spectrum-Licensed and Unlicensed-Available Wireless Technologies and need for LoRa- Class A, Class B , Class C operation- Radio Propagation. (3)

**LORA TRANSCEIVER** : Power-Frequency-Bandwidth -AFC- BT product- LoRa Modulation- Chirp Spread Spectrum - Spreading Factor- Window Length -Transmission/Reception time. (3)

**LORA GATEWAY CONFIGURATION** : MAC Configuration-Channel Number/Frequency- Data Rate Selection- Gateway Parameters- Ip allocation- Up/Down Ports- Polling Rate- Polling Behaviour- Upstream/Downstream Data. (3)

**LORA WAN ARCHITECTURE** : Server Device Model- Local LoRa Server Port- Create /Update Application Server to Data base- Network Session Key- Application Session Key - Downlink- Queue - Application Testing. (3)

**CASE STUDIES** : LoRaWAN design Thinking- Microchip- Semtech -mbed -Kerlink-Multitech- gateway-comparison- selection- Use case driven Approach- Road map to Smart City Applications (3)

**Total L: 15**

### REFERENCES:

1. Pradeeka Seneviratne , "Beginning LoRa Radio Networks with Arduino: Build Long Range, Low Power Wireless IoT Networks", Apress, 2019.

## 19LF15 5G TECHNOLOGY

1 0 0 1

**MODELLING & SIMULATION OF END-TO-END COMMUNICATION SYSTEM** : Build an end-to-end QPSK model and analyze the system performance (Eye Diagram, Constellation, BER Curve Computation), Modelling RF Front-ends (6)

**ANTENNA AND ARRAY DESIGN** : Design, analysis, and visualization of antenna elements and arrays using either predefined elements with parameterized geometry or arbitrary planar elements. Gerber generation from design for manufacturing printed circuit board (PCB) antennas (4)

**OVER-THE-AIR-TESTING WITH SOFTWARE DEFINED RADIO HARDWARE (SDR)** : Introduction to Software Defined Radio, Radio I/O-Streaming with Real-World Signals using RTL-SDR/Adalm Pluto SDR Hardware (3)

**MODELLING & SIMULATION OF LTE & 5G WIRELESS COMMUNICATION SYSTEMS** : LTE Signal generation & analysis, 5G NR Fundamentals, 5G vs LTE- Main Physical Layer Differences, Applications & Use Cases, 5G NR Simulation .Wireless Technology Development with Model Based Design (Case Study) (2)

**Total L: 15**

#### REFERENCES:

1. Michael Rice , "Digital Communications - A Discrete-Time Approach", Prentice Hall, 2008.
2. Dalman, E., S. Parkvall, and J. Sköld , "4G, LTE-Advanced Pro and The Road to 5G", Third, Academic Press, 2016.

### 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 L: 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", Cengage Publication, 11th Edition, 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.

### 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 advocacy 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)

**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.