ACADEMIC REGULATIONS
COURSE STRUCTURE AND
DETAILED SYLLABUS

ELECTRONICS AND COMMUNICATION ENGINEERING

For

M. Tech. (Systems and Signal Processing)

(Three Year **Part Time** Programme)

JNTUH COLLEGE OF ENGINEERING HYDERABAD
(Autonomous)
Kukatpally, Hyderabad – 500 085, Telangana, India.

2016

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
COLLEGE OF ENGINEERING HYDERABAD
(AUTONOMOUS)
Kukatpally, Hyderabad – 500 085

ACADEMIC REGULATIONS 2015
for CBCS Based M.Tech. (Part- Time) Programmes
(Effective for the students admitted into I year from the
Academic Year **2016-17** and onwards)

1.0 Part-Time Post-Graduate Degree Programmes in Engineering & Technology (PTPGP in E & T):

JNTUH offers 3 Year (6 Semesters) Part-time **Master of Technology** (M.Tech.) Degree Programmes, under Choice Based Credit System (CBCS) at its Constituent Autonomous College - JNTUH College of Engineering Hyderabad with effect from the Academic Year 2016 - 17 onwards in the different branches of Engineering & Technology with different specializations.

2.0 Eligibility for Admission:

2.1 Admissions to the PTPGPs shall be made subject to the eligibility, qualifications and specializations prescribed by JNTUH College of Engineering Hyderabad, JNT University Hyderabad, for each Specialization under each M.Tech. Programme, from time to time.

2.2 Admission to the PTPGP shall be made either on the basis of the Merit Rank obtained by the qualifying candidate at an Entrance Test conducted by the Jawaharlal Nehru Technological University Hyderabad / on the basis of any other order of merit approved by the University, subject to reservations as prescribed by the Government from time to time.

2.3 Candidates seeking admission to programmes on a part time basis should be working in or around the place where the programme is being run after passing the qualifying examination.

2.4 The medium of instructions for all PG Programmes will be ENGLISH only.

3.0 M.Tech. Programme (PTPGP in E & T) Structure:

3.1 The M.Tech. Programmes in E & T of JNTUH-CEH are of Semester Pattern, with 6 Semesters constituting 3 Academic Years, each Academic Year having TWO Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 Weeks duration (inclusive of Examinations), with a minimum of 90 Instructional Days per Semester.

3.2 UGC/ AICTE specified Definitions/ Descriptions are adopted appropriately for various terms and abbreviations used in these PTPGP - Academic Regulations.

3.2.1 **Semester Scheme:**

Each Semester having - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as denoted are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' or 'COURSE' imply the same meaning here, and refer to 'Theory Subject', or 'Lab Course', or 'Design/ Drawing Subject', or 'Seminar', or 'Comprehensive Viva', or 'Project', as the case may be.

3.2.2 **Credit Courses:**

All Subjects (or Courses) are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Subject/ Course in a L: T: P: C (Lecture Periods: Tutorial Periods: Practicals Periods : Credits) Structure, based on the following general pattern …

- One hour/ Week/ Semester for Theory/ Lecture (L) Courses; and,
- Two hours/ Week/ Semester for Laboratory/ Practical (P) Courses or Tutorials (T).

Other student activities like Study Tour, Guest Lecture, Conference/ Workshop Participations, Technical Paper Presentations etc., and identified Mandatory Courses if any, will not carry Credits.

3.2.3 **Subject/ Course Classification:**

All Subjects/ Courses offered for the PTPGP are broadly classified as : (a) Core Courses (CoC), and (b) Elective Courses (EℓC).

- Core Courses (CoC) and Elective Courses (EℓC) are categorized as PS (Professional Subjects), which are further subdivided as – (i) PC (Professional/ Departmental Core) Subjects, (ii) PE (Professional/ Departmental Electives) , (iii) Seminar, (iv) Comprehensive Viva, and (v) Project Work (PW).

3.2.4 **Course Nomenclature:**

The Curriculum Nomenclature or Course-Structure Grouping for the M.Tech. Degree Programmes is as listed below …

S. No.	***Broad Course Classification***	***Course Group/ Category***	***Courses Description***	***Credits***
1)	Core Courses (CoC)	PC- Professional Core	Includes core subjects related to the Parent Discipline/ Department/ Branch of Engg.	20
2)	Elective Courses (EℓC)	PE– Professional Electives	Includes Elective subjects related to the Parent Discipline/ Department/ Branch of Engg.	32
3)	Core Courses	Project Work	M.Tech. Project or PG Project or PG Major Project	30
		Seminar	Seminar/ Colloquium based on core contents related to Parent Discipline/ Department/ Branch of Engg.	2
		Comprehensive Viva-voce	Viva-voce covering all the PG Subjects and related aspects	4
		Communication Skills/ Soft Skills	Lab oriented	2
Total Credits for PTPGP				**90**

4.0 Course Work:

4.1 A Student, after securing admission, shall pursue and complete the M.Tech. PTPGP in a minimum period of 3 Academic Years (6 Semesters), and within a maximum period of 6 Academic Years (starting from the Date of Commencement of I Year).

4.2 Each student shall Register for and Secure the specified number of Credits required for the completion of the PTPGP and Award of the M.Tech. Degree in respective Branch of Engineering with the chosen Specialization.

4.3 I &II Year is structured to provide typically 14 Credits (14 C) in each of the I and II Semesters, and III Year comprises of 34 Credits (34 C), totaling to 90 Credits (90 C) for the entire M.Tech. Programme.

5.0 Course Registration:

5.1 A 'Faculty Advisor' shall be assigned to each M.Tech. Programme with respective Specialization, who will advise the Students about the M.Tech. Programme Specialization, its Course Structure and Curriculum, Choice/ Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.

5.2 A Student may be permitted to Register for Subjects/ Courses of 'his CHOICE' with a typical total of 14 Credits per Semester in I &II Year (Minimum being 10 C and Maximum being 18 C, and 16 Credits (inclusive of Project) per V Semester in III Year (Minimum being 16 C and Maximum being 30 C), 18 credits (inclusive of Project) per VI Semester in III Year (minimum being 18 C and maximum 32 C), based on his interest, competence, progress, and 'PRE-REQUISITES' as indicated for various Subjects/ Courses, in the Department Course Structure (for the relevant Specialization) and Syllabus contents for various Subjects/ Courses.

5.3 Choice for 'additional Subjects/ Courses' in any Semester (above the typical 14/16/18 Credit norm, and within the Maximum Permissible Limit of 16/30/32 Credits, during I&II/ III Years as applicable) must be clearly indicated in the Registration, which needs the specific approval and signature of the Faculty Advisor/ Counselor on hard-copy.

5.4 Dropping of Subjects/ Courses in any Semester of I Year or II year may be permitted, ONLY AFTER obtaining prior approval and signature from the Faculty Advisor (subject to retaining a minimum of 10 Credits), 'within 15 Days of Time' from the beginning of the current Semester.

6.0 Subjects/Courses to be offered

6.1 A typical Section(or Class) sanctioned strength for each semester shall be 30.

6.2 A Subject/Course may be offered to the students ONLY if Minimum of 15 (1/2 of Section Strength) opt for the same. The Maximum strength of a Section is limited to 45(30+1/2 of the Section Strength).

7.0 Attendance Requirements:

7.1 A Student shall be eligible to appear for the End Semester Examination (SEE) of any Subject, if he acquires a minimum of 75% of attendance in that Subject for that Semester.

7.2 A Student's Seminar Report and Seminar Presentation shall be eligible for evaluation, only if he ensures a minimum of 75% of his attendance in Seminar Presentation Classes during that Semester.

7.3 Condoning of shortage of attendance up to 10% (65% and above, and below 75%) in each Subject or Seminar of a Semester may be granted by the College Academic Council on genuine and valid grounds, based on the Student's representation with supporting evidence.

7.4 A stipulated fee per Subject/Seminar shall be payable towards condoning of shortage of attendance.

7.5 Shortage of Attendance below 65% in any Subject/Seminar shall in NO case be condoned.

7.6 A Student, whose shortage of attendance is not condoned in any Subject(s) or Seminar in any Semester, is considered as 'Detained in that Subject(s)/ Seminar', and is not eligible to take End Examination(s) of such Subject(s) (and in case of Seminars, his Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he has to seek Re-registration for those Subject(s)/Seminar in subsequent Semesters, and attend the same as and when offered.

8.0 Academic Requirements:

The following Academic Requirements have to be satisfied, in addition to the Attendance Requirements mentioned in Item No. 7**.**

8.1 A Student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to each Subject/ Course, if he secures not less than 40% Marks (28 out of 70 Marks) in the End Semester Examination, and a minimum of 50% of Marks in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of Letter Grades, this implies securing B Grade or above in that Subject.

8.2 A Student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to - Seminar, and Comprehensive Viva-voce, if he secures not less than 50% of the total Marks to be awarded for each. The Student would be treated as failed, if he - (i) does not attend the Comprehensive Viva-voce as per the schedule given, or (ii) does not present the Seminar as required, or (ii) secures less than 50% of Marks (< 50 Marks) in -Seminar/ Comprehensive Viva-voce evaluations.
He may reappear for comprehensive viva where it is scheduled again; For seminar, he has to reappear in the next subsequent Semesters, as and when scheduled.

8.3 A Student shall - register for all Subjects covering 90 Credits as specified and listed in the Course Structure for the chosen PTPGP Specialization, put up all the Attendance and Academic requirements for securing 90 Credits obtaining a minimum of B Grade or above in each Subject, and 'earn all 90

Credits securing SGPA ≥ 6.0 (in each Semester) and final CGPA (ie., CGPA at the end of PTPGP) ≥ 6.0, to successfully complete the PTPGP.

8.4 Marks and Letter Grades obtained in all those Subjects covering the above specified 90 Credits alone shall be considered for the calculation of final CGPA, which shall be indicated in the Grade Card of III Year II Semester.

8.5 If a student registers for some more 'extra Subjects' (in the parent Department or other Departments/Branches of Engg.) other than those listed Subjects totaling to 90 Credits as specified in the Course Structure, the performances in those 'extra Subjects' (although evaluated and graded using the same procedure as that of the required 90 Credits) will not be taken into account while calculating the SGPA and CGPA. For such 'extra Subjects' registered, % marks and Letter Grade alone will be indicated in the Grade Card, as a performance measure, subject to completion of the Attendance and Academic Requirements as stated in Items 7 and 8.1 – 8.4 above.

8.6 Students who fail to earn 90 Credits as per the specified Course Structure, and as indicated above, within 6 Academic Years from the Date of Commencement of their I Year, shall forfeit their seats in M.Tech. Programme and their admissions shall stand cancelled.

8.7 When a Student is detained due to shortage of attendance in any Subject(s)/Seminar in any Semester, no Grade Allotment will be done for such Subject(s)/Seminar, and SGPA/ CGPA calculations of that Semester will not include the performance evaluations of such Subject(s)/Seminar in which he got detained. However, he becomes eligible for re-registration of such Subject(s)/Seminar (in which he got detained) in the subsequent Semester(s), as and when next offered, with the Academic Regulations of the Batch into which he gets readmitted, by paying the stipulated fees per Subject. In all these re-registration cases, the Student shall have to secure a fresh set of Internal Marks (CIE) and End Semester Examination Marks (SEE) for performance evaluation in such Subject(s), and subsequent SGPA/ CGPA calculations.

8.8 A Student eligible to appear in the End Semester Examination in any Subject, but absent at it or failed (failing to secure B Grade or above), may reappear for that Subject at the supplementary examination (SEE) as and when conducted. In such cases, his Internal Marks (CIE) assessed earlier for that Subject/ Course will be carried over, and added to the marks to be obtained in the supplementary examination (SEE), for evaluating his performance in that Subject.

9.0 Evaluation - Distribution and Weightage of Marks:

9.1 The performance of a Student in each Semester shall be evaluated Subject-wise (irrespective of Credits assigned) with a maximum of 100 Marks for Theory or Practicals or Seminar or Drawing/Design or Comprehensive Viva-voce etc; however, the M.Tech. Project Work (Major Project) will be evaluated for 200 Marks.

9.2 a) For Theory Subjects, CIE Marks shall comprise of - Mid-Term Examination Marks (for 25 Marks), and Assignment Marks (for 5 Marks).

b) During the Semester, there shall be 2 Mid-Term examinations. Each Mid-Term examination shall be for 25 Marks (with 120 minutes duration). The better performance out of these two Mid-Term Examinations shall be considered for the award of 25 Marks.

9.3 For Practical Subjects, there shall be a Continuous Internal Evaluation (CIE) during the Semester for 30 Internal Marks, and 70 Marks are assigned for Lab./Practicals End Semester Examination (SEE). Out of the 30 Marks for Internals, day-to-day work assessment in the laboratory shall be evaluated for 20 Marks; and the performance in an internal Lab./Practical Test shall be evaluated for 10 marks. The SEE for Lab./ Practicals shall be conducted at the end of the Semester by the concerned Lab. Teacher and another faculty member of the same Department as assigned by the Head of the Department.

9.4 There shall be a Seminar Presentation in II Year I(III) Semester or II(IV) Semester. For the Seminar, the Student shall collect the information on a specialized topic, prepare a Technical Report and submit to the Department at the time of Seminar Presentation. The Seminar Presentation (along with the Technical Report) shall be evaluated by Two Faculty Members assigned by Head of the Department, for 100 Marks. There shall be no SEE or External Examination for Seminar.

9.5 Each Student shall appear for a Comprehensive Viva-Voce at the end of the V Semester (III Year I Semester). The Comprehensive Viva-Voce shall be conducted by a Committee, consisting of three senior faculty members of Department nominated by the Head of the Department, and the performance evaluation shall be for 100 Marks. There are no Internal Marks for the Comprehensive Viva-Voce.

9.6 a) Every PTPGP Student shall be required to execute his M.Tech. Project, under the guidance of the Supervisor assigned to him by the Head of Department. The PTPGP Project shall start immediately after the completion of the II Year II(IV) Semester, and shall continue through III Year I (V) and II (IV) Semesters. The Student shall carry out the literature survey, select an appropriate topic and submit a Project Proposal within 6 weeks (immediately after his II Year II Semester (IV) End Examinations), for approval by the Project Review Committee (PRC). The PRC shall be constituted by the Head of Department, and shall consist of the Head of Department, Project Supervisor, and a Senior Faculty Member of the Department. The Student shall present his Project Work Proposal to the PRC (PRC-I Presentation), on whose approval he can 'REGISTER for the PG Project'. Every Student must compulsorily register for his M.Tech. Project Work, within the 6 weeks of time-frame as specified above. After Registration, the Student shall carry out his work, and continually submit 'a fortnightly progress report' to his Supervisor throughout the Project period. The PRC will monitor the progress of the Project Work and review, through PRC-II and PRC-III Presentations – one at the end of the III Year I (V) Semester, and one before the submission of M.Tech. Project Work Report/ Dissertation.

b) After PRC-III presentation, the PRC shall evaluate the entire performance of the Student and declare the Project Report as 'Satisfactory' or 'Unsatisfactory'. Every Project Work Report/ Dissertation (that has been declared 'satisfactory') shall undergo 'Plagiarism Check' as per the University/ College norms to ensure content plagiarism below a specified

level of 30%, and to become acceptable for submission. In case of unacceptable plagiarism levels, the student shall resubmit the Project Work Report, after carrying out the necessary modifications/ additions to his Project Work/ Report as per his Supervisor's advice, within the specified time, as suggested by the PRC.

c) If any Student could not be present for PRC-II at the scheduled time (after approval and registration of his Project Work at PRC-I), his submission and presentation at the PRC-III time (or at any other PRC specified dates) may be treated as PRC-II performance evaluation, and delayed PRC-III dates for him may be considered as per PRC recommendations. Any Student is allowed to submit his M.Tech. Project Dissertation 'only after completion of 40 weeks from the date of approval/registration' of his Project, and after obtaining all approvals from the PRC.

d) A total of 200 Marks are allotted for the M.Tech. Project Work, (out of which 100 Marks are allotted for internal evaluation and 100 Marks for external evaluation). For internal Evaluation of 100 marks, Project Supervisor shall evaluate for 60 marks based on the continuous Internal Evaluation(CIE) of the student's performance and combined PRC-I, II & III performance evaluation will be for 40 marks (to be awarded by PRC, as SEE).

9.7 a) The Student shall be allowed to submit his Project Dissertation, only on the successful completion of all the prescribed PG Subjects (Theory and Labs.), Seminar, Comprehensive Viva-voce etc. (securing B Grade or above), and after obtaining all approvals from PRC. In such cases, the M.Tech. Dissertations will be sent to an External Examiner nominated by the Principal of the College, on whose 'approval', the Student can appear for the M.Tech. Project Viva-voce Examination, which shall be conducted by a Board, consisting of the PG Project Supervisor, Head of the Department, and the External Examiner who adjudicated the M.Tech. Project Work and Dissertation. The Board shall jointly declare the Project Work Performance as 'satisfactory', or 'unsatisfactory'; and in successful cases, the External Examiner shall evaluate the Student's Project Work presentation and performance for 100 Marks (SEE).

b) If the adjudication report of the External Examiner is 'not favourable' , then the Student shall revise and resubmit his Dissertation after one Semester, or as per the time specified by the External Examiner and/ or the PRC. If the resubmitted report is again evaluated by the External Examiner as 'not favourable', then that Dissertation will be summarily rejected. Subsequent actions for such Dissertations may be considered, only on the specific recommendations of the External Examiner and/ or PRC.

c) In cases, where the Board declared the Project Work Performance as 'unsatisfactory', the Student is deemed to have failed in the Project Viva-voce Examination, and he has to reappear for the Viva-voce Examination as per the Board recommendations. If he fails in the second Viva-voce Examination also, he will not be considered eligible for the Award of the Degree, unless he is asked to revise and resubmit his Project Work by the Board within a specified time period (within 6 years from the date of commencement of his I Year I Semester).

10.0 Re-Admission / Re-Registration:

10.1 **Re-Admission for Discontinued Students:**
Students, who have discontinued the M.Tech. Degree Programme due to any reasons what so ever, may be considered for 'Readmission' into the same Degree Programme (with same specialization) with the Academic Regulations of the Batch into which he gets readmitted, with prior permission from the concerned authorities, subject to Item 4.1.

10.2 Re-Registration for Detained Students:
When any Student is detained in a Subject (s)/ Seminar due to shortage of attendance in any Semester, he may be permitted to re-register for the same Subject in the 'same category' (Core or Elective Group) or equivalent Subject if the same Subject is not available, as suggested by the Board of Studies of that Department, as when offered in the sub-sequent Semester(s), with the Academic Regulations of the Batch into which he seeks re-registration , with prior permission from the concerned authorities, subject to Item 4.1.

11.0 Grading Procedure:

11.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.

11.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured (Class Intervals)	*Letter Grade (UGC Guidelines)*	*Grade Points*
80% and above (≥ 80% , ≤ 100%)	O (Outstanding)	10
Below 80% but not less than 70% (≥ 70% , < 80%)	A^+ (Excellent)	9
Below 70% but not less than 60% (≥ 60% , < 70%)	A (Very Good)	8
Below 60% but not less than 55% (≥ 55% , < 60%)	B^+ (Good)	7
Below 55% but not less than 50% (≥ 50% , < 55%)	B (above Average)	6
Below 50% (< 50%)	F (FAIL)	0
Absent	**Ab**	**0**

11.3 A student obtaining F Grade in any Subject shall be considered 'failed' and is be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE Marks) in those Subjects will remain the same as those he obtained earlier.

11.4 A Letter Grade does not imply any specific % of Marks.

11.5 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course (excluding Mandatory non-credit Courses). Then the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a Course

11.6 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

SGPA = { $\sum_{i=1}^{N} C_i G_i$ } / { $\sum_{i=1}^{N} C_i$ } …. For each Semester,

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C_i is the no. of Credits allotted to the i^{th} Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i^{th} Subject.

11.7 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year second Semester onwards, at the end of each Semester, as per the formula

CGPA = { $\sum_{j=1}^{M} C_j G_j$ } / { $\sum_{j=1}^{M} C_j$ } … for all S Semesters registered
(ie., upto and inclusive of S Semesters, S ≥ 1),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1^{st} Semester onwards upto and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the j^{th} Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that j^{th} Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

11.8 For Merit Ranking or Comparison Purposes or any other listing, ONLY the 'ROUNDED OFF' values of the CGPAs will be used.

11.9 For Calculations listed in Item 11.5 – 11.8, performance in failed Subjects/ Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/ Courses will also be included in the multiplications and summations. However, Mandatory Courses will not be taken into consideration.

11.10 A student shall be declared successful or 'passed' in a Semester, only when he gets a SGPA ≥ 6.00 (at the end of that particular Semester); and a student shall be declared successful or 'passed' in the entire PGP, only when gets a CGPA ≥ 6.00; subject to the condition that he secures a GP ≥ 6 (B Grade or above) in every registered Subject/ Course in each Semester (during the entire PGP) for the Degree Award, as required.

11.11 After the completion of each Semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the Registered Students of that Semester, indicating the Letter Grades and Credits earned. It will show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned etc.), Credits earned, SGPA, and CGPA.

11.12 Passing Standards :

11.12.1 A Student shall be declared successful or 'passed' in a Semester, only when he gets a SGPA $\geq$ 6.00 (at the end of that particular Semester); and a Student shall be declared successful or 'passed' in the entire PGP, only when gets a CGPA $\geq$ 6.00; subject to the condition that he secures a GP $\geq$ 6 (B Grade or above) in every registered Subject/ Course in each Semester (during the entire PGP), for the Award of the Degree, as required.

11.12.2 After the completion of each Semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the Registered Students of that Semester, indicating the Letter Grades and Credits earned. It will show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned), Credits earned, SGPA, and CGPA etc.

12.0 Declaration of Results:

12.1 Computation of SGPA and CGPA are done using the procedure listed in 11.5 – 11.8.

12.2 For Final % of Marks equivalent to the computed CGPA, the following formula may be used ..

% of Marks = (CGPA – 0.5) x 10

13.0 Award of Degree and Class:

13.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PTPG Programme (PTPGP), and secures the required number of **90** Credits (with GP $\geq$ 6.0), shall be declared to have 'QUALIFIED' for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with specialization as he admitted.

13.2 **Award of Class**

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following four classes based on the % CGPA:

Class Awarded	CGPA
First Class with Distinction	≥ 7.75
First Class	6.75 ≤ CGPA < 7.75
Second Class	6.00 ≤ CGPA < 6.75

13.3 A student with final CGPA (at the end of the PTPGP) < 6.00 will not be eligible for the Award of Degree.

14.0 Withholding of Results:

14.1 If a Student has not paid fees to University/ College at any stage, or has pending dues against his name due to any reason whatsoever, or if any case of indiscipline is pending against him, the result of the Student may be withheld, and he will not be allowed to go into the next higher Semester. The Award or issue of the Degree may also be withheld in such cases.

15.0 Transitory Regulations:

15.1 A Student - who has discontinued for any reason, or who has been detained for want of attendance as specified, or who has failed after having undergone PTPGP, may be considered eligible for readmission to the same PTPGP with same set of Subjects/ Courses (or equivalent Subjects/ Courses as the case may be), and same Professional Electives (or from same set/category of Electives or equivalents as suggested), as and when they are offered (within the time-frame of 6 years from the Date of Commencement of his I Year I Semester).

16.0 Student Transfers:

16.1 There shall be no Branch/ Specialization transfers after the completion of Admission Process.

16.2 There shall be no transfer among the Constituent Colleges and Units of Jawaharlal Nehru Technological University Hyderabad.

17.0 Scope:

i) Where the words “he”, “him”, “his”, occur in the write-up of regulations, they include “she”, “her”, “hers”.
ii) Where the words “Subject” or “Subjects”, occur in these regulations, they also imply “Course” or “Courses”.
iii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.
iv) In case of any doubt or ambiguity in the interpretation of the above regulations, the decision of the Vice-Chancellor/ Principal is final.
v) The College may change or amend the Academic Regulations, and/ or Course Structure, and/ or Syllabi at any time, and the changes or amendments made shall be applicable to all Students with effect from the dates as notified by the University/ College.

18. MALPRACTICES RULES:

	Nature of Malpractices	Punishment
	If the candidate:	
1 (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
1 (b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled.
3	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	Refuses to obey the orders of the Chief Superintendent / Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining

		examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a 8police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the College / University for further action to award suitable punishment.	

19. GENERAL:

- **Credit**: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
- **Credit Point:** It is the product of grade point and number of credits for a course.
- The Academic Regulations should be read as a whole for the purpose of any interpretation.
- The University/College reserves the right of altering the Academic Regulations and/or Syllabus/Course Structure, as and when necessary. The modifications or amendments may be applicable to all the candidates on rolls, as specified by the University/College.
- Wherever the words 'he' or 'him' or 'his' occur in the above regulations, they will also include 'she' or 'her' or 'hers'.
- Wherever the word 'Subject' occurs in the above regulations, it implies the 'Theory Subject', 'Practical Subject' or 'Lab.' and 'Seminar'.
- In case of any ambiguity or doubt in the interpretations of the above regulations, the decision of the Vice-Chancellor will be final.

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JNTUH COLLEGE OF ENGINEERING HYDERABAD
M.Tech. (Systems & Signal Processing) – Part Time w.e.f. 2016-17

I – SEMESTER

S.No.	Subject	L	T	P	Credits
1	Random Processes and Queuing Theory	4	0	0	4
2	Advanced Digital Signal Processing	4	0	0	4
3	Elective-I	4	0	0	4
4	Signal Processing Laboratory	0	0	4	2
	Total Credits				**14**

II – SEMESTER

S.No.	Subject	L	T	P	Credits
1	Wireless Communications and Networks	4	0	0	4
2	Elective-II	4	0	0	4
3	Elective-III	4	0	0	4
4	Advanced Communications and Networking Laborato	0	0	4	2
	Total Credits				**14**

III – SEMESTER

S.No.	Subject	L	T	P	Credits
1	Adaptive Signal Processing	4	0	0	4
2	Elective-IV	4	0	0	4
3	Elective-V	4	0	0	4
4	Soft Skills Lab	0	0	4	2
	Total Credits				**14**

IV – SEMESTER

S.No.	Subject	L	T	P	Credits
1	Elective-VI	4	0	0	4
2	Elective-VII	4	0	0	4
3	Elective-VIII	4	0	0	4
4	Seminar	0	0	4	2
	Total Credits				**14**

V – SEMESTER

S.No.	Subject	L	T	P	Credits
1	Comprehensive Viva Voce				4
2	Project Phase -I				12
	Total Credits				**16**

VI – SEMESTER

S.No.	Subject	L	T	P	Credits
1.	Project Phase-II & Dissertation				18
	Total credits				**18**

Elective – I
1. Transform Techniques
2. Digital System Design with PLDs
3. Advanced Data Communications

Elective – II
1. Speech and Audio Signal Processing
2. VLSI Technology and Design
3. Spread Spectrum Communications.

Elective – III
1. Biomedical Signal Processing
2. CMOS Analog Integrated Circuit Design
3. Detection and Estimation Theory

Elective – IV
1. Coding Theory and Techniques.
2. TCP/IP and ATM Networks.
3. Optimization Techniques.

Elective – V
1. Digital Signal Processors and Architectures
2. Mobile Computing
3. Ad-hoc Wireless and Sensor Networks.

Elective – VI
1. Image and Video processing
2. 4G Technologies
3. VLSI Signal Processing

Elective – VII
1. Software Defined Radio
2. Network Security and Cryptography
3. Radar Signal Processing

Elective – VIII
1. Multi-Media and Signal Coding
2. Soft Computing Techniques
3. Advanced Computer Networks

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Systems & Signal Processing)

L	T	P	C
4	0	0	4

RANDOM PROCESSES AND QUEUING THEORY

Prerequisite: Probability Theory & Stochastic Processes

Course Objectives:

1. To expose the students to the random process and queuing theory related topics for their subsequent study of Computer Networks and wireless communication and Networks.

Course Outcomes:

Students will be able to**:**

1. Understand Random variables as an intrinsic need for the analysis of random phenomena.
2. Evaluate and apply moments and Characteristics functions.
3. Understand the concept of random process spectral density of stationary process.
4. Understand the concepts of Markov Chains and queuing theory.
5. Understand the concepts of M| M|1, M|M|1|K, M|G|1 queuing Process.
6. Understand the modeling of telecommunication networks using appropriate queuing process.

UNIT I: RANDOM VARIABLE

Random Variables-Basic Definitions and properties, Sum of independent random variables, Minimum and Maximum of random variables, Comparisons between random variables, Moments of the random variables, Random variables in the field of telecommunications, Transformations of random variables-The probability generating function, the characteristic function of a pdf, The Laplace Transform of a pdf, Methods for the generation of random variables- Method of the inverse of the distribution function, Method of the transformation.

UNIT II: RANDOM PROCESSES

The Random Process Concept, Concept of Stationarity and Statistical Independence, First Order Stationary Processes, Second Order and Wide Sense Stationary, (N-Order) and Strict Sense Stationarity, Time Averages and Ergodicity, Mean Ergodic Processes, Correlation Ergodic Processes, Autocorrelation Function and its Properties, Cross Correlation function and its properties, Covariance Functions, The Power Spectrum- Properties, Relationship between Power spectrum and Autocorrelation function.

UNIT III: Markov Chains and Queuing Theory

Queues, Poisson arrival process- Sum of independent Poisson processes, Random splitting of a Poisson process, Compound Poisson processes, Birth death Markov chains, Formulation of Hidden Markov Model (HMM), building, evaluation and decoding of HMM, Notations for Queuing systems, The Little Theorem, M/M/1 queue analysis, M/M/1/K queue analysis, M/M/S queue analysis, M/M/S/S queue analysis, The M/M/∞ queue analysis, Distribution of the queuing delays in the FIFO case- M/M/1 case, M/M/S case.

UNIT IV: M/G/1 Queuing Theory

M/G/1 queue, M/G/1 system delay distribution in the FIFO case, Laplace Transform numerical inversion method, Generalizations of the M/G/1 theory, Different imbedding instants in the M/G/1 theory, M/G/1 with geometrically distributed messages.

UNIT V: Local Area Network Analysis

Introduction, Contention based protocols- Aloha, Slotted Aloha, Aloha Protocol with ideal capture effect, CSMA Schemes, Demand assignment protocols-Polling protocol, Token passing protocol, Analysis of token and polling Schemes, R-Aloha, PRMA protocol, Comparisons between CSMA/CD and Token Protocols, Fixed assignment Protocols- FDMA, TDMA, Resource reuse in cellular systems, CDMA.

TEXTBOOK

1. Queuing Theory and Telecommunications Networks and Applications, Springer, Giovanni Giambene.
2. Probability, Random Variables & Random Signal Principles-Peyton Z. Peebles, TMH, 4th Edition,2001.
3. Digital Processing of Speech Signals. L.R Rabinar and R W Jhaung, 1978, PHI.

REFERENCE BOOKS:

1. Probability, Random Variables and Stochastic Processes – Athanasios Papoulis, S. Unnikrishna Pillai – TMH, 2008
2. Probability and Random Processes with Applications to Signal Processing – Henry Stark, John W. Woods, 3rd Edition, Pearson
3. Probability and Stochastic Processes – A Friendly Introduction for Electrical and Computer Engineers – Roy D. Yates, David J. Goodman.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Systems & Signal Processing)

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4	0	0	4

ADVANCED DIGITAL SIGNAL PROCESSING

Prerequisite: Digital Signal Processing

Course Objectives:

The objectives of this course are to make the student

1. Understand the design of various types of digital filters and implement them using various implementation structures and study the advantages & disadvantages of a variety of design procedures and implementation structures.
2. understand the concept and need for Multirate signal Processing and their applications in various fields of Communication & Signal Processing
3. understand difference between estimation & Computation of Power spectrum and the need for Power Spectrum estimation.
4. Study various Parametric & Non parametric methods of Power spectrum estimation techniques and their advantages & disadvantages
5. Understand the effects of finite word/register length used in hardware in implementation of various filters and transforms using finite precision processors.

Course Outcomes:

On completion of this course student will be able to

1. Design and implement a filter which is optimum for the given specifications.
2. Design a Mutirate system for the needed sampling rate and can implement the same using Polyphase filter structures of the needed order.
3. Estimate the power spectrum of signal corrupted by noise through a choice of estimation methods: Parametric or Non Parametric.
4. Can calculate the output Noise power of different filters due to various finite word length effects viz: ADC Quantization, product quantization, and can calculate the scaling factors needed to avoid Limit cycles: Zero input, overflow. Also they can decide the stability of the system by studying the effect due to coefficient quantization while implementing different filters and transforms.

UNIT –I:

Review of DFT, FFT, IIR Filters and FIR Filters.

Introduction to filter structures (IIR & FIR).Implementation of Digital Filters, specifically 2nd Order Narrow Band Filter and 1st Order All Pass Filter. Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Backward prediction error, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

UNIT -II:

Non-Parametric Methods:

Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman-Tukey methods, Comparison of all Non-Parametric methods

UNIT - III:

Parametric Methods:

Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation, Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

UNIT –IV:

Multi Rate Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion. Examples of up-sampling using an All Pass Filter.

UNIT –V:

Applications of Multi Rate Signal Processing

Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Subband Coding of Speech Signals, Quadrature Mirror Filters, Transmultiplexers, Over Sampling A/D and D/A Conversion.

TEXT BOOKS:

1. Digital Signal Processing: Principles, Algorithms & Applications - J.G.Proakis& D. G. Manolakis, 4th Ed., PHI.
2. Discrete Time signal processing - Alan V Oppenheim & Ronald W Schaffer, PHI.
3. DSP – A Practical Approach – Emmanuel C. Ifeacher, Barrie. W. Jervis, 2 ed., Pearson Education.

REFERENCE BOOKS:

1. Modern spectral Estimation: Theory & Application – S. M .Kay, 1988, PHI.
2. Multi Rate Systems and Filter Banks – P.P.Vaidyanathan – Pearson Education.
3. Digital Signal Processing: A Practitioner's Approach, Kaluri V. Rangarao, Ranjan K. Mallik ISBN: 978-0-470-01769-2, 210 pages, November 2006 John Weley.
4. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C.Gnanapriya, 2000,TMH

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JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Systems & Signal Processing)

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TRANSFORM TECHNIQUES
(Elective – 1)

Prerequisite: None

Course Objectives:
1. To learn basics of two dimensional transform.
2. Understand the various two dimensional transform definition, properties and applications.
3. Understand the design of filter Bank structure.
4. To learn the fundamentals of wavelet transform and special wavelets.

Course Outcomes:
1. The student will learn basics of two dimensional transforms.
2. Understand the definition, properties and applications of various two dimensional transform.
3. Understand the basic concepts of wavelet transform.
4. Understand the special topics such as wavelet packets, Bi-orthogonal wavelets e.t.c.

UNIT -I:
Fourier Analysis
Vector space, Hilbert spaces, Fourier basis, FT- Limitations of Fourier Analysis, Need for time-frequency analysis, DFT, 2D-DFT: Definition, Properties and Applications, IDFT, Hilbert Transform, STFT.

UNIT -II:
Transforms
Walsh, Hadamard, Haar and Slant Transforms, DCT, DST, KLT,– definition, properties and applications

UNIT -III:
Continuous Wavelet Transform (CWT)
Short comings of STFT, Need for wavelets, Wavelet Basis- Concept of Scale and its relation with frequency, Continuous time wavelet Transform Equation- Series Expansion using Wavelets- CWT- Tiling of time scale plane for CWT. Important Wavelets: Haar, Mexican Hat, Meyer, Shannon, Daubechies.

UNIT -IV:
Multi Rate Analysis and DWT:
Need for Scaling function – Multi Resolution Analysis, Two-Channel Filter Banks, Perfect Reconstruction Condition, Relationship between Filter Banks and Wavelet Basis, DWT, Structure of DWT Filter Banks, Daubechies Wavelet Function, Applications of DWT.

UNIT -V:
Special Topics: Wavelet Packet Transform, Multidimensional Wavelets, Bi-orthogonal basis- B-Splines, Lifting Scheme of Wavelet Generation, Multi Wavelets

TEXT BOOKS:
1. Wavelet Transforms-Introduction theory and applications -Raghuveer M.Rao and Ajit S. Bopardikar, Pearson Edu, Asia, New Delhi, 2003.

2. “Insight into Wavelets from Theory to practice “, Soman. K. P, Ramachandran. K.I, Printice Hall India, First Edition, 2004.

REFERENCE BOOKS:

1. “Fundamentals of Wavelets- Theory, Algorithms and Applications”, Jaideva C Goswami, Andrew K Chan, John Wiley & Sons, Inc, Singapore, 1999.
2. “Wavelets and sub-band coding”, Vetterli M. Kovacevic, PJI, 1995.
3. “Introduction to Wavelets and Wavelet Transforms”, C. Sydney Burrus, PHI, First Edition, 1997.
4. “A Wavelet Tour of Signal Processing”, Stephen G. Mallat,. Academic Press, Second Edition
5. Digital Image Processing – S.Jayaraman, S.Esakkirajan, T.Veera Kumar – TMH,2009

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Systems & Signal Processing)

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DIGITAL SYSTEM DESIGN WITH PLDs
(Elective – I)

Prerequisite: Switching Theory and Logic Design

Course Objectives:
1) To provide extended knowledge of digital logic circuits in the form of state model approach.
2) To provide an overview of system design approach using programmable logic devices.
3) To provide and understand of fault models and test methods.
4) To get exposed to the various architectural features of CPLDS and FPGAS.
5) To learn the methods and techniques of CPLD & FPGA design with EDA tools.
6) To expose software tools used for design process with the help of case studies.

Course Outcomes:
1) To understands the minimization of Finite state machine.
2) To exposes the design approaches using ROM's, PAL's and PLA's.
3) To provide in depth understanding of Fault models.
4) To understands test pattern generation techniques for fault detection.
5) To design fault diagnosis in sequential circuits.
6) To provide exposure to various CPLDS and FPGAS available in market.
7) To acquire knowledge in one hot state machine design applicable to FPGA.
8) To get exposure to EDA tools.
9) To provide understanding in the design of flow using case studies.

UNIT-I:
Programmable Logic Devices:
The concept of programmable Logic Devices, SPLDs, PAL devices, PLA devices, GAL devices, CPLD-Architecture, Xilinx CPLDs- Altera CPLDs, FPGAs-FPGA technology, architecture, virtex CLB and slice- Stratix LAB and ALM-RAM Blocks, DSP Blocks, Clock Management, I/O standards, Additional features. [TEXTBOOK-1]

UNIT-II:
Analysis and derivation of clocked sequential circuits with state graphs and tables:
A sequential parity checker, Analysis by signal tracing and timing charts-state tables and graphs-general models for sequential circuits, Design of a sequence detector, More Complex design problems, Guidelines for construction of state graphs, serial data conversion, Alphanumeric state graph notation. [TEXTBOOK-2]

UNIT-III:
Sequential circuit Design:
Design procedure for sequential circuits-design example, Code converter, Design of Iterative circuits, Design of a comparator, Design of sequential circuits using ROMs and PLAs, Sequential circuit design using CPLDs, Sequential circuit design using FPGAs, Simulation and testing of Sequential circuits, Overview of computer Aided Design. [TEXTBOOK-2]

UNIT-IV:

Fault Modeling and Test Pattern Generation:

Logic Fault Model, Fault detection & redundancy, Fault equivalence and fault location, Fault dominance, Single stuck at fault model, multiple Stuck at Fault models, Bridging Fault model. Fault diagnosis of combinational circuits by conventional methods, path sensitization techniques, Boolean difference method, KOHAVI algorithm, Test algorithms-D algorithm, Random testing, transition count testing, signature analysis and test bridging faults. [TEXTBOOK-3 & Ref.1]

UNIT-V:

Fault Diagnosis in sequential circuits:

Circuit Test Approach, Transition check Approach, State identification and fault detection experiment, Machine identification, Design of fault detection experiment. [Ref.1]

TEXTBOOKS:

1. Digital Electronics and design with VHDL- Volnei A. Pedroni, Elsevier publications.
2. Fundamentals of Logic Design-Charles H.Roth,Jr. -5th Ed.,Cengage Learning.
3. Logic Design Theory-N.N.Biswas,PHI

REFERENCES:

1. Digital Circuits and Logic Design-Samuel C.LEE,PHI 2008
2. Digital System Design using programmable logic devices- Parag K.Lala, BS publications.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Systems & Signal Processing)

L	T	P	C
4	0	0	4

ADVANCED DATA COMMUNICATIONS
(Elective – I)

Prerequisite: Digital Communication

Course Objectives:
1. To learn about basics of Data Communication networks, different protocols, standards and layering concepts.
2. To study about error detection and correction techniques.
3. Know about link layer protocol and point to point protocols.
4. To understand Medium Access Control sub layer protocols
5. To know about Switching circuits, Multiplexing and Spectrum Spreading techniques for data transmission.
6. To study Wired LANs different Ethernet standards

Course Outcomes:
At the end of the course, the student will be able to:
1. Understand the concepts of Data Communication networks, different protocols, standards and layering.
2. Acquire the knowledge of error detection, forward and reverse error correction techniques.
3. Analyze link layer protocol and point to point protocols
4. Explain and compare the performance of different MAC protocols like Aloha, CSMA, CSMA/CA, TDMA, FDMA & CDMA.
5. Understand the features and the significance of Switching circuits, Multiplexing and Spectrum Spreading for data transmission .
6. Understand the characteristics of Wired LANs and also the operation and applications of Connecting Devices
7. Understand the services and functions of Network layer protocols.

Unit I

Data Communications, Networks and Network Types, Internet History, Standards and Administration, Protocol Layering, TCP/IP protocol suite, OSI Model. Digital Data Transmission, DTE-DCE interface.

Data Link Layer

Introduction, Data Link Layer, Nodes and Links, Services, Categories of Links, sub layers, Link Layer Addressing, Address Resolution Protocol.

Unit II

Error Detection and Correction: Types of Errors, Redundancy, detection versus correction, Coding Block Coding: Error Detection, Vertical redundancy cheeks, longitudinal redundancy cheeks, Error Correction, Error correction single bit, Hamming code.

Cyclic Codes: Cyclic Redundancy Check, Polynomials, Cyclic Code Encoder Using Polynomials, Cyclic Code Analysis, Advantage of Cyclic Codes, Checksum

Data Link Control: DLC Services, Data Link Layer Protocols, HDLC, Point to Point Protocol

Unit III

Media Access Control (MAC) Sub Layer

Random Access, Aloha, Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Controlled Access- Reservation, Polling-Token Passing, Channelization - Frequency Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code - Division Multiple Access (CDMA).

Unit IV

Switching: Introduction to Switching, Circuit Switched Networks, Packet Switching, Structure of switch

Multiplexing and Spectrum Spreading: Multiplexing, Frequency Division Multiplexing, Time Division Multiplexing, Spread Spectrum -Frequency Hopping Spread Spectrum and Direct Sequence Spread Spectrum.

Unit V

Wired LANS: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Giga bit Ethernet

Connecting Devices: Hubs, Link Layer Switches, Routers

Networks Layer: Packetizing, Routing and Forwarding, Packet Switching, Network Layer Performance, IPv4 Address, Address Space, Classful Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Resolution(NATF), Forwarding of IP Packets, Forwarding based on Destination Address, Forwarding based on Label, Routing as Packet Switches.

TEXT BOOKS:

1. Data Communications and Networking - B. A. Forouzan, 5th , 2013,TMH.
2. Data and Computer Communications - William Stallings, 8th ed., 2007, PHI.

REFERENCE BOOKS:

1. Data Communications and Computer Networks - Prakash C. Gupta, 2006, PHI.
2. Data Communications and Networking - B. A. Forouzan, 2nd , 2013, TMH.
3. Data Communications and Computer Networks- Brijendra Singh, 2nd ed., 2005, PHI.

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year I-Sem (Systems & Signal Processing)

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SIGNAL PROCESSING LABORATORY

Note:

A. Minimum of 10 Experiments have to be conducted
B. All Experiments may be Simulated using MATLAB and to be verified theoretically.

1. Basic Operations on Signals, Generation of Various Signals and finding its FFT.
2. Program to verify Decimation and Interpolation of a given Sequences.
3. Program to Convert CD data into DVD data
4. Generation of Dual Tone Multiple Frequency (DTMF) Signals
5. Plot the Periodogram of a Noisy Signal and estimate PSD using Periodogram and Modified Periodogram methods
6. Estimation of Power Spectrum using Bartlett and Welch methods
7. Verification of Autocorrelation Theorem
8. Parametric methods (Yule-Walker and Burg) of Power Spectrum Estimation
9. Estimation of data series using Nth order Forward Predictor and comparing to the Original Signal
10. Design of LPC filter using Levinson-Durbin Algorithm
11. Computation of Reflection Coefficients using Schur Algorithm
12. To study Finite Length Effects using Simulink
13. ECG signal compression
14. Design and verification of Matched filter
15. Adaptive Noise Cancellation using Simulink
16. Design and Simulation of Notch Filter to remove 60Hz Hum/any unwanted frequency component of given Signal (Speech/ECG)

JNTUH COLLEGE OF ENGINEERING HYDERABAD

M.Tech. I Year II-Sem (Systems & Signal Processing)

L	T	P	C
4	0	0	4

WIRELESS COMMUNICATIONS AND NETWORKS

Prerequisite: Digital Communications

Course objectives:
The course objectives are:
1. To provide the students with the fundamental treatment about many practical and theoretical concepts that forms basic of wireless communications.
2. To equip the students with various kinds of wireless networks and its operations.
3. To prepare students to understand the concept of frequency reuse, and be able to apply it in the design of mobile cellular system.
4. To prepare students to understand various modulation schemes and multiple access techniques that are used in wireless communications,
5. To provide an analytical perspective on the design and analysis of the traditional and emerging wireless networks, and to discuss the nature of, and solution methods to, the fundamental problems in wireless networking.
6. To train students to understand the architecture and operation of various wireless wide area networks such as GSM, IS-95, GPRS and SMS.
7. To train students to understand wireless LAN architectures and operation.
8. To prepare students to understand the emerging technique OFDM and its importance in the wireless communications.

Course Outcomes:
Upon completion of the course, the student will be able to:
1. Understand the principles of wireless communications.
2. Understand fundamentals of wireless networking
3. Understand cellular system design concepts.
4. Analyze various multiple access schemes used in wireless communication.
5. Understand wireless wide area networks and their performance analysis.
6. Demonstrate wireless local area networks and their specifications.
7. Familiar with some of the existing and emerging wireless standards.
8. Understand the concept of orthogonal frequency division multiplexing.

UNIT -I:
The Cellular Concept-System Design Fundamentals
Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies-Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

UNIT –II:
Mobile Radio Propagation: Large-Scale Path Loss
Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley-Ryce Model,

Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

UNIT –III:

Mobile Radio Propagation: Small –Scale Fading and Multipath

Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

UNIT -IV:

Equalization and Diversity

Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT -V:

Wireless Networks

Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11,IEEE 802.11 Medium Access Control, Comparision of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

TEXT BOOKS:

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE
4. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.

REFERENCE BOOKS:

1. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
2. Wireless Communication and Networking – William Stallings, 2003, PHI.

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M.Tech. I Year II-Sem (Systems & Signal Processing)

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SPEECH AND AUDIO SIGNAL PROCESSING
(Elective-II)

Prerequisite: Advanced Digital Signal Processing

Course Objectives:

The objectives of this course are to make the student

1. Understand the anatomy and Physiology of Speech Production system and perception model and to design an electrical equivalent of Acoustic model for Speech Production.
2. To understand the articulatory and acoustic interpretation of various phonemes and their allophones.
3. To analyze the speech in time domain and extract various time domain parameters which can be used for various applications like pitch extraction, end point detection, Speech Compression, Speech Synthesis etc.,
4. To study the concept of Homomorphic system and its use in extracting the vocal tract information from speech using Cepstrum which is a bye product of Homomorphic processing of Speech.
5. To study various Speech Signal Processing applications viz: Speech Enhancement, Speech Recognition, Speaker Recognition.
6. To study various Audio coding techniques based on perceptual modeling of the human ear.

Course Outcomes:

On completion of this course student will be able to

1. Model an electrical equivalent of Speech Production system.
2. Extract the LPC coefficients that can be used to Synthesize or compress the speech.
3. Design a Homomorphic Vocoder for coding and decoding of speech.
4. Enhance the speech and can design an Isolated word recognition system using HMM.
5. Can extract the features for Automatic speaker recognition system which can used for classification.
6. Can design basic audio coding methods for coding the audio signal.

Unit – I :

Fundamentals of Digital Speech Processing:

Anatomy & Physiology of Speech Organs, The Process of Speech Production, The Acoustic theory of speech production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals.

Perception : Anatomical pathways from the Ear to the Perception of Sound, The Peripheral Auditory system, Hair Cell and Auditory Nerve Functions, Properties of the Auditory Nerve. Block schematics of the Peripheral Auditory system.

Unit – II :

Time Domain models for Speech Processing:

Introduction – Window considerations, Short time energy, average magnitude, average zero crossing rate, Speech vs Silence discrimination using energy and zero crossing, pitch period estimation using a parallel processing approach, the short time autocorrelation function, average magnitude difference function, pitch period estimation using the autocorrelation function.

Linear Predictive Coding (LPC) Analysis :
Basic principles of Linear Predictive Analysis : The Autocorrelation Method, The Covariance method, Solution of LPC Equations : Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, comparison between the methods of solution of the LPC Analysis Equations, Applications of LPC Parameters : Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

Unit – III :
Homomorphic Speech Processing:
Introduction , Homomorphic Systems for Convolution : Properties of the Complex Cepstrum, Computational Considerations , The Complex Cepstrum of Speech, Pitch Detection , Formant Estimation, The Homomorphic Vocoder.

Speech Enhancement:
Speech enhancement techniques : Single Microphone Approach, Spectral Subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi Microphone Approach.

Unit – IV:
Automatic Speech Recognition:
Basic pattern recognition approaches, parametric representation of Speech, Evaluating the similarity of Speech patterns, Isolated digit Recognition System, Continuous word Recognition system. Elements of HMM, Training & Testing of Speech using HMM.

Automatic Speaker Recognition:
Recognition techniques, Features that distinguish speakers, MFCC, delta MFCC, Speaker Recognition Systems: Speaker Verification System , Speaker Identification System, Performance Metrics.

Unit – V:
Audio Coding :
Lossless Audio Coding, Lossy Audio coding, Psychoacoustics , ISO-MPEG-1 Audio coding , MPEG - 2 Audio coding, MPEG - 2 Advanced Audio Coding, MPEG - 4 Audio Coding.

TEXT BOOKS:
1. Digital Processing of Speech Signals - L.R. Rabiner and S. W. Schafer. Pearson Education.
2. Digital Audio Signal Processing – Udo Zolzer, 2nd Edition, Wiley.
3. Speech & Audio Signal Processing- Ben Gold & Nelson Morgan, 1st Ed., Wiley

REFENCE BOOKS:
1. Discrete Time Speech Signal Processing: Principles and Practice - Thomas F. Quateri, 1st Ed., PE.
2. Digital Processing of Speech Signals. L.R Rabinar and R W Jhaung, 1978, PHI.
3. Speech Communications: Human & Machine - Douglas O'Shaughnessy, 2nd Ed., EEE Press.

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VLSI TECHNOLOGY AND DESIGN
(Elective – II)

Prerequisite: ICA / VLSI

Course Objectives:
1) Students from other engineering background to get familiarize with large scale integration technology.
2) To expose fabrication methods, layout and design rules.
3) Learn methods to improve Digital VLSI system's performance.
4) To know about VLSI Design constraints.
5) Visualize CMOS Digital Chip Design.

Course Outcomes:
1) Review of FET fundamentals for VLSI design.
2) To acquires knowledge about stick diagrams and layouts.
3) Enable to design the subsystems based on VLSI concepts.

UNIT –I: Review of Microelectronics and Introduction to MOS Technologies:
MOS, CMOS, BiCMOS Technology. Basic Electrical Properties of MOS, CMOS & BiCMOS Circuits: Ids – Vds relationships, Threshold Voltage VT, Gm, Gds and ωo, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.

UNIT –II: Layout Design and Tools:
Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools.
Logic Gates & Layouts:
Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

UNIT –III: Combinational Logic Networks:
Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing.

UNIT –IV: Sequential Systems:
Memory cells and Arrays, Clocking disciplines, Design, Power optimization, Design validation and testing.

UNIT –V: Floor Planning:
Floor planning methods, Global Interconnect, Floor Plan Design, Off-chip connections.

TEXT BOOKS:
1. Essentials of VLSI Circuits and Systems, K. Eshraghian Eshraghian. D, A. Pucknell, 2005, PHI.
2. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.

REFERENCE BOOKS:
1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
2. Principals of CMOS VLSI Design – N.H.E Weste, K. Eshraghian, 2nd Ed., Addison Wesley.

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SPREAD SPECTRUM COMMUNICATIONS
(Elective – II)

Prerequisite: Digital Communications

Course Objectives:
The objectives of this course are to make the student
1. Understand the concept of Spread Spectrum and study various types of Spread spectrum sequences and their generation.
2. Understand the principles of Code Division Multiple Access (CDMA) and use of Spread spectrum concept in CDMA
3. Understand various Code tracing loops for optimum tracking of wideband signals viz spread spectrum signals
4. Understand the procedure for synchronization of receiver for receiving the Spread spectrum signal.
5. Study the performance of spread spectrum systems in Jamming environment, systems with Forward Error Correction and Multiuser detection in CDMA cellular radio.

Course Outcomes:
On completion of this course student will be able to
1. Generate various types of Spread spectrum sequences and can simulate CDMA system (Both Transmitter & Receiver).
2. Analyze the performance of Spread spectrum systems in Jamming environment and systems with Forward Error Correction.
3. Can provide detection and cancellation schemes for Multiusers in CDMA cellular radio.

UNIT -I:
Introduction to Spread Spectrum Systems: Fundamental Concepts of Spread Spectrum Systems, Pseudo Noise Sequences, Direct Sequence Spread Spectrum, Frequency Hop Spread Spectrum, Hybrid Direct Sequence Frequency Hop Spread Spectrum, Code Division Multiple Access.
Binary Shift Register Sequences for Spread Spectrum Systems:
Introduction, Definitions, Mathematical Background and Sequence Generator Fundamentals, Maximal Length Sequences, Gold Codes.

UNIT -II:
Code Tracking Loops: Introduction, Optimum Tracking of Wideband Signals, Base Band Delay-Lock Tracking Loop, Tau-Dither Non- Coherent Tracking Loop, Double Dither Non-Coherent Tracking Loop.

UNIT -III:
Initial Synchronization of the Receiver Spreading Code: Introduction, Problem Definition and the Optimum Synchronizer, Serial Search Synchronization Techniques, Synchronization using a Matched Filter, Synchronization by Estimated the Received Spreading Code.

UNIT -IV:
Cellular Code Division Multiple Access (CDMA) Principles: Introduction, Wide Band Mobile

Channel, The Cellular CDMA System, Single User Receiver in a Multi User Channel, CDMA System Capacity,

Multi-User Detection in CDMA Cellular Radio: Optimal Multi-User Detection, Linear Suboptimal Detectors, Interference Combat Detection Schemes, Interference Cancellation Techniques.

UNIT -V:

Performance of Spread Spectrum Systems in Jamming Environments: Spread Spectrum

Communication System Model, Performance of Spread Spectrum Systems without Coding.

Performance of Spread Spectrum Systems with Forward Error Correction: Elementary Block Coding Concepts, Optimum Decoding Rule, Calculation of Error Probability, Elementary Convolution Coding Concepts, Viterbi Algorithm, Decoding and Bit-Error Rate.

TEXT BOOKS:

1. Rodger E Ziemer, Roger L. Peterson and David E Borth - “Introduction to Spread Spectrum Communication- Pearson, 1st Edition, 1995.
2. Mosa Ali Abu-Rgheff – “Introduction to CDMA Wireless Communications.” Elsevier Publications, 2008.

REFERENCE BOOKS:

1. George R. Cooper, Clare D. Mc Gillem - “Modern Communication and Spread Spectrum,” McGraw Hill, 1986.
2. Andrew j. Viterbi - “CDMA: Principles of spread spectrum communication,” Pearson Education, 1st Edition, 1995.
3. Kamilo Feher - “Wireless Digital Communications,” PHI, 2009.
4. Andrew Richardson - “WCDMA Design Handbook,” Cambridge University Press, 2005.
5. Steve Lee - Spread Spectrum CDMA, McGraw Hill, 2002.

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BIOMEDICAL SIGNAL PROCESSING
(Elective – III)

Prerequisite: Advanced Digital Signal Processing

Course Objectives:
The main objectives of the course are :
1. To use basic probability theory to model random signals in terms of Random Processes.
2. To derive the noise power Spectral Density of Random signals and its analysis.
3. To understand lossless and lossy compression techniques related to ECG data.
4. To understand various cardilogical signal processing techniques and noise cancellation techniques.
5. To understand estimation of signals using Prony's and least square and linear prediction methods.
6. To analyze evoked potentials.
7. To comprehend EEG signals, modeling and sleep stages.

Course Outcomes:
After studying the course , each student is expected to be able to :
1. Use probability theory to model random processes.
2. Analyze random signals using power spectral densities.
3. Compare various lossless and lossy techniques.
4. Compare various ECG processing and noise cancellation techniques.
5. Analyze evoked potentials.
6. Model and estimate EEG signals and various sleep stages.

UNIT -I:
Random Processes
Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth and noise figure of systems.

UNIT -II:
Data Compression Techniques: Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Huffman coding, vector quantisation, DICOM Standards

UNIT -III:
Cardiological Signal Processing: Pre-processing, QRS Detection Methods, Rhythm analysis, Arrhythmia Detection Algorithms, Automated ECG Analysis, ECG Pattern Recognition.
Adaptive Noise Cancelling: Principles of Adaptive Noise Cancelling, Adaptive Noise Cancelling with the LMS Adaptation Algorithm, Noise Cancelling Method to Enhance ECG Monitoring, Fetal ECG Monitoring.

UNIT -IV:
Signal Averaging, Polishing – Mean and trend removal, Prony's method, Prony's Method based on the Least Squares Estimate, Linear prediction, Yule – Walker (Y –W) equations, Analysis of Evoked Potentials.

UNIT -V:

Neurological Signal Processing: Modelling of EEG Signals, Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive (A.R.) modelling of seizure EEG. Sleep Stage analysis, Inverse Filtering, Least squares and polynomial modelling.

TEXT BOOKS:

1. Probability, Random Variables & Random Signal Principles – Peyton Z. Peebles, 4th Ed., 2009, TMH.
2. Biomedical Signal Processing- Principles and Techniques - D. C. Reddy, 2005, TMH.

REFERENCE BOOKS:

1. Digital Bio Dignal Processing - Weitkunat R, 1991, Elsevier.
2. Biomedical Signal Processing - Akay M , IEEE Press.
3. Biomedical Signal Processing -Vol. I Time & Frequency Analysis - Cohen.A, 1986, CRC Press.
4. Biomedical Digital Signal Processing: C-Language Experiments and Laboratory Experiments, Willis J.Tompkins, PHI.

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CMOS ANALOG INTEGRATED CIRCUIT DESIGN
(Elective – III)

Prerequisite: Analog Electronics

Course Objectives:

Analog circuits play a very crucial role in all electronic systems and due to continued miniaturization, many of the analog blocks are not getting realized in CMOS technology.

1. To understand most important building blocks of all CMOS analog ICs
2. To study the basic principle of operation, the circuit choices and the tradeoffs involved in the MOS transistor level design common to all analog CMOS ICs.
3. To understand specific design issues related to single and multistage voltage, current and differential amplifiers, their output and impedance issues, bandwidth, feedback and stability.
4. To understand the design of differential amplifiers, current amplifiers and OP AMPs.

Course Outcomes:

After studying the course, each student is expected to be able to:

1. Design basic building blocks of CMOS analog ICs.
2. Carry out the design of single and two stage operational amplifiers and voltage references.
3. Determine the device dimensions of each MOSFETs involved.
4. Design various amplifiers like differential, current and operational amplifiers.

UNIT -I:

MOS Devices and Modeling:

The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

UNIT -II:

Analog CMOS Sub-Circuits:

MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

UNIT -III:

CMOS Amplifiers:

Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

UNIT -IV:

CMOS Operational Amplifiers:

Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

UNIT -V:

Comparators:

Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

TEXT BOOKS:

1. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
2. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.

REFERENCE BOOKS:

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edn, 2013.
2. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition.
3. CMOS: Circuit Design, Layout and Simulation- Baker, Li and Boyce, PHI.

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DETECTION AND ESTIMATION THEORY
(Elective-III)

Prerequisite: Probability Theory and Stochastic Processes

Course Objectives:
1. The main objective of this course is to provide basic estimation and detection background for engineering applications.
2. This course provides the main concepts and algorithms for detection and estimation theory.
3. Students learn the statistics and estimating the parameters of Random Process from detection.

Course Outcomes:
1. Students will understand the basic detection methods.
2. Learn about basic estimation methods.
3. Gain ability to apply estimation method for real time engineering problems.

UNIT –I:
Random Processes: Discrete Linear Models, Markov Sequences and Processes, Point Processes, and Gaussian Processes.

UNIT –II:
Detection Theory: Basic Detection Problem, Maximum A posteriori Decision Rule, Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)- minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

UNIT –III:
Linear Minimum Mean-Square Error Filtering: Linear Minimum Mean Squared Error Estimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with Stored Data, Real-time Digital Wiener Filters, Kalman Filters.

UNIT –IV:
Statistics: Measurements, Nonparametric Estimators of Probability Distribution and Density Functions, Point Estimators of Parameters, Measures of the Quality of Estimators, Introduction to Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression, Multiple Linear Regression.

UNIT –V:
Estimating the Parameters of Random Processes from Data: Tests for Stationarity and Ergodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions.

TEXT BOOKS:
1. Random Signals: Detection, Estimation and Data Analysis – K. Sam Shanmugan & A.M. Breipohl, Wiley India Pvt. Ltd, 2011.
2. Random Processes: Filtering, Estimation and Detection – Lonnie C. Ludeman, Wiley India Pvt. Ltd., 2010.

REFERENCE BOOKS:

1. Fundamentals of Statistical Signal Processing: Volume I Estimation Theory– Steven.M.Kay, Prentice Hall, USA, 1998.
2. Fundamentals of Statistical Signal Processing: Volume I Detection Theory– Steven.M.Kay, Prentice Hall, USA, 1998.
3. Introduction to Statistical Signal Processing with Applications – Srinath, Rajasekaran, Viswanathan, 2003, PHI.
4. Statistical Signal Processing: Detection, Estimation and Time Series Analysis – Louis L.Scharf, 1991, Addison Wesley.
5. Detection, Estimation and Modulation Theory: Part – I – Harry L. Van Trees, 2001, John Wiley & Sons, USA.
6. Signal Processing: Discrete Spectral Analysis – Detection & Estimation – Mischa Schwartz, Leonard Shaw, 1975, Mc Graw Hill.

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ADVANCED COMMUNICATIONS AND NETWORKING LABORATORY

1. Simulation and analysis of MAC Layer protocols.
2. Simulation and analysis of various topologies.
3. Simulation and analysis of wired routing protocols.
4. Simulation and analysis of wireless routing protocols.
5. Simulation and analysis of various security attacks.
6. Analysis of log files and provide the intruder statistics.
7. Simulation of Queue Management Schemes.
8. Evaluation of DES, AES and Triple-DES.
9. Evaluation of Substitution and Transposition ciphers.
10. Error correcting coding in CDMA Mobile communication system.
11. Capturing and tracking of GOLD sequence in CDMA system.
12. Study of Satellite Azimuth & Elevation using sky Plot Window.
13. Study of Global Positioning System Applications.
14. Study of I2C and UART protocols.

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M.Tech. I Year III-Sem (Systems & Signal Processing)

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ADAPTIVE SIGNAL PROCESSING

Prerequisite: Digital Signal Processing

Course Objectives :
The main objectives of the course are:
1. This course focuses on problems algorithms and solutions for processing signals in an manner that is responsive to a changing environment.
2. To develop systems on recursive, model based estimation methods taking the advantage of the statistical properties of the received signals.
3. To analyze the performance of adaptive filters and considers the application of the theory to a variety of practical problems such as beam forming and echo cancellation signal.
4. To understand innovation process, Kalman filter theory and estimation of state using the innovation process , concept of Kalman Gain and Filtering.

Course Outcomes:
After studying the course, the student is expected to be able to :
1. Design and apply optimal minimum mean square estimators and in particular linear estimators.
2. Understand and compute their expected performance and verify it.
   Design , implement and apply Wiener Filters (FIR, non-casual, causal) and evaluate their performance.
1. To understand innovation process, Kalman filter theory and estimation of state using the Innovation Process, concept of Kalman Gain and Filtering.
2. Design , implement and apply LMS, RLS and Kalman filters to given applications.

UNIT –I:
Introduction to Adaptive Systems Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response Performance function - Gradient & Mean Square Error.

UNIT –II:
Development of Adaptive Filter Theory & Searching the Performance surface:
Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonally - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error, Estimation of phase shift between two narrow band signals using Orthogonal Decomposer.

UNIT –III:
Steepest Descent Algorithms: Searching the performance surface – Methods & Ideas of Gradient Search methods - Gradient Searching Algorithm & its Solution - Stability & Rate of convergence - Learning Curves Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.

UNIT –IV:
LMS Algorithm & Applications: Overview - LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms - Convergence of LMS algorithm. **Applications:** Adaptive BFSK, BPSK, ASK demodulators

and delay estimation. Adaptive Beam forming, concept of IQ channels, Adaptive filter implementation of Hilbert Transform. Introduction to MUSIC

UNIT –V:

State Estimators: Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Example estimation of state from observations of noisy observed narrow band signals. Target tracking using only DOA.

TEXT BOOKS:

1. Adaptive Signal Processing - Bernard Widrow, Samuel D.Strearns, 2005, PE.
2. Adaptive Filter Theory - Simon Haykin-, 4 ed., 2002,PE Asia.

REFERENCE BOOKS:

1. Digital Signal Processing: A Practitioner's Approach, Kaluri V. Rangarao, Ranjan K. Mallik ISBN: 978-0-470-01769-2, 210 pages, November 2006, John Weley (UK)
2. Optimum signal processing: An introduction - Sophocles.J.Orfamadis, 2 ed., 1988, McGraw-Hill, Newyork
3. Adaptive signal processing-Theory and Applications, S.Thomas Alexander, 1986, Springer –Verlag.
4. Siganl analysis – Candy, Mc Graw Hill Int. Student Edition
5. James V. Candy, Signal Processing: A Modern Approach, McGraw-Hill, International Edition, 1988.

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CODING THEORY AND TECHNIQUES
(Elective - IV)

Prerequisite: Digital Communications

Course Objectives:
1. To acquire the knowledge in measurement of information and errors.
2. T study the generation of various code methods.
3. To study the various application of codes.

Course Outcomes:
1. Learning the measurement of information and errors.
2. Obtain knowledge in designing various codes like block codes, cyclic codes, convolution codes, turbo codes and space codes

UNIT – I:
Coding for Reliable Digital Transmission and storage
Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies.
Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system

UNIT - II:
Cyclic Codes : Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding ,Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

UNIT – III:
Convolutional Codes : Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

UNIT – IV:
Turbo Codes
LDPC Codes- Codes based on sparse graphs, Decoding for binary erasure channel, Log-likelihood algebra, Brief propagation, Product codes, Iterative decoding of product codes, Concatenated convolutional codes- Parallel concatenation, The UMTS Turbo code, Serial concatenation, Parallel concatenation, Turbo decoding

UNIT - V:
Space-Time Codes
Introduction, Digital modulation schemes, Diversity, Orthogonal space- Time Block codes, Alamouti's schemes, Extension to more than Two Transmit Antennas, Simulation Results, Spatial Multiplexing : General Concept, Iterative APP Preprocessing and Per-layer

Decoding, Linear Multilayer Detection, Original BLAST Detection, QL Decomposition and Interface Cancellation, Performance of Multi – Layer Detection Schemes, Unified Description by Linear Dispersion Codes.

TEXT BOOKS:

1. Error Control Coding- Fundamentals and Applications –Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc.
2. Error Correcting Coding Theory-Man Young Rhee- 1989, McGraw-Hill

REFERENCE BOOKS:

1. Error Correcting Coding Theory-Man Young Rhee-1989,McGraw – Hill Publishing,19
2. Digital Communications-Fundamental and Application - Bernard Sklar, PE.
3. Digital Communications- John G. Proakis, 5th ed., 2008, TMH.
4. Introduction to Error Control Codes-Salvatore Gravano-oxford
5. Error Correction Coding – Mathematical Methods and Algorithms – Todd K.Moon, 2006, Wiley India.
6. Information Theory, Coding and Cryptography – Ranjan Bose, 2nd Edition, 2009, TMH.

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TCP/IP AND ATM NETWORKS
(Elective - IV)

Prerequisite: Computer Networks

Course Objectives:
1. To study Network Layer Protocols, Next Generation IP protocols
2. To learn about User Datagram Protocol, Transmission Control Protocol and stream control Transmission protocol.
3. To understand techniques to improve QoS
4. To learn about the features of ATM networks. .
5. To study the various Interconnection Networks

Course Outcomes:
At the end of the course, the student will be able to:
1. Get the concept of Network Layer Protocols and Transport Layer Protocols.
2. Understand and analyze about UDP, TCP AND SCTP protocols, flow and error control techniques.
3. Learn congestion control mechanisms and techniques to improve Quality of Service in switched networks
4. To understand features of Virtual circuit networks like ATM networks and their applications
5. Design and analyze various types of Inter connection Networks, understand the functioning of Folding , Benes, Lopping bit allocation algorithms and their significance.

Unit I
Network Layer Protocols: Internet Protocol (IP), ICMPv4, Mobile IP
Next Generation IP: IPv6, Addressing IPv6 Protocol, ICMPV6 Protocol, Transition from IPV4 to IPV6
Transport Layer: Introduction to Transport Layer, Transport Layer Protocols: Simple Protocols, Stop and Wait Protocols, Go Back N Protocol, Selective Repeat Protocol, Bidirectional Protocols: Piggybacking Transport layer protocols Services and Port Numbers.

Unit II
User Datagram Protocol: User Datagram, UDP Services, UDP Applications
Transmission Control Protocol: TCP Services, TCP Features, Segments, TCP Connection, State Transition Diagram, Windows in TCP, Flow and Error Control ,TCP Congestion Control, TCP Timers,
SCTP: SCTP Services, SCTP Features, Packet Format, An SCTP Association SCTP Flow and Error Control, TCP in Wireless Domain.

Unit III
Congestion Control and Quality of Service: Data Traffic, Congestion, Congestion Control, Quality of Service, Techniques to Improve QoS, Integrated Services, Differentiated Services, QoS in Switched Networks
Queue Management: Passive-Drop trial, Drop front, Random drop, Active- early Random drop, Random Early detection.

Unit IV

Virtual-Circuit Networks: Introduction, Frame relay Operation, Frame relay Layers, Congestion Control, Leaky Bucket algorithm.

ATM: Design Goals, ATM Architecture, Switching, Switch Fabric, ATM Layers, Service Classes, ATM Application.

SONET/SDH: Architecture, SONET Layers, SONET Frames, STS Multiplexing, SONET Networks

Unit V

Interconnection Networks

Introduction, Banyan Networks, Properties, Crossbar switch, Three stage Class networks, Rearrangeble Networks, Folding algorithm, Benes Networks, Lopping algorithm, Bit allocation algorithm.

TEXT BOOKS:

3. Data Communications and Networking - B. A.Forouzan, 5th edition, 2013, TMH.
4. High Performance TCP/IP Networking –Mahabub Hassan and Raj Jain ,PHI,2005

REFERENCE BOOKS:

1. ATM Fundamentals –N.N Biswas, Adventure Books,1998
2. Data Communications and Computer Networks - Prakash C. Gupta, 2006, PHI.
3. Data and Computer Communications - William Stallings, 8th ed., 2007, PHI.

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M.Tech. I Year III-Sem (Systems & Signal Processing)

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OPTIMIZATION TECHNIQUES
(Elective – IV)

Prerequisite: None

Course Objectives:

1. To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems.
2. To develop an interest in applying optimization techniques in problems of Engineering and Technology
3. To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems.

Course Outcomes:

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

1. Know basic theoretical principles in optimization
2. formulate optimization models and obtain solutions for optimization;
3. apply methods of sensitivity analysis and analyze post processing of results

UNIT – I: INTRODUCTION AND CLASSICAL OPTIMIZATION TECHNIQUES:

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

CLASSICAL OPTIMIZATION TECHNIQUES:

Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.

Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT – II: LINEAR PROGRAMMING:

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

UNIT – III: TRANSPORTATION PROBLEM:

Finding initial basic feasible solution by north – west corner rule- least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

UNIT – IV:UNCONSTRAINED OPTIMIZATION TECHNIQUES:

Univariate method-Powell's method and steepest descent method.

CONSTRAINED NONLINEAR PROGRAMMING:

Characteristics of a constrained problem – Classification - Basic approach of Penalty Function method- Basic approach of Penalty Function method-Basic approaches of Interior and Exterior penalty function methods-Introduction to convex Programming Problem.

UNCONSTRAINED NONLINEAR PROGRAMMING:

One – dimensional minimization methods: Classification-Fibonacci method and Quadratic interpolation method

UNIT – V: DYNAMIC PROGRAMMING:

Dynamic programming-multistage decision processes – types – concept of sub optimization and the principle of optimality–computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

TEXT BOOKS:

1. S. S. Rao,"Engineering optimization:Theory and practice"- New Age International (P) Limited, 3rd edition, 1998.
2. H.S.Kasene & K.D. Kumar, " Introductory Operations Research" - Springer(India), Pvt Ltd.

REFERENCE BOOKS:

1 K.V. Mital and C. Mohan,"Optimization Methods in Operations Research and systems Analysis"–New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Dr. S.D.Sharma,"Operations Research"
3. H.A. Taha "Operations Research : An Introduction" – PHI Pvt. Ltd., 6th edition

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M.Tech. II Year III-Sem (Systems & Signal Processing)

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DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES
(Elective – V)

Prerequisite: Digital Signal Processing

Course Objectives

The objectives of the course are:

1. To recall digital transform techniques.
2. To introduce architectural features of programmable DSP Processors of TI and Analog Devices.
3. To give practical examples of DSP Processor architectures for better understanding.
4. To develop the programming knowledge using Instruction set of DSP Processors.
5. To understand interfacing techniques to memory and I/O devices.

Course Outcomes

Upon completion of the course, the student

1. Be able to distinguish between the architectural features of General purpose processors and DSP processors.
2. Understand the architectures of TMS320054xx and ADSP 2100 DSP devices.
3. Be able to write simple assembly language programs using instruction set of TMS32OC54xx.
4. Can able to interfaceace various devices to DSP Processors.

UNIT –I

Introduction to Digital Signal Processing

Introduction, A Digital signal- processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FET), Linear time- invariant systems, Digital filters, Decimation and interpolation.

Computational Accuracy in DSP Implementations

Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, AID Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT —II

Architectures for Programmable DSP Devices

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT -III

Programmable Digital Signal Processors: Commercial Digital signal- processing Devices, Data Addressing modes of TMS32OC54XX DSPs, Data Addressing modes of TMS32OC54XX Processors, Memory space of TMS32OC54XX Processors, Program Control, TMS32OC54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS32OC54XX processors, Pipeline Operation of TMS32OC54XX Processors.

UNIT -IV

Analog Devices Family of DSP Devices

Analog Devices Family of DSP Devices —ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor.

Introduction to Blackfin Processor – The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

UNIT -V

Interfacing Memory and I/O Peripherals to Programmable DSP Devices

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TEXT BOOKS

1. Digital Signal Processing — Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach To Digital Signal Processing – K Padmanabhan, R Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

REFERENCE BOOKS

1. Digital Signal Processors, Architecture, Programming and Applications — B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing — Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features — Lapsleyet al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005.

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MOBILE COMPUTING
(Elective – V)

Prerequisites:
1. Computer Networks
2. Distributed Systems OR Distributed Operating Systems OR Advanced Operating Systems

Course Objectives:
1. To make the student understand the concept of mobile computing paradigm, its novel applications and limitations.
2. To understand the typical mobile networking infrastructure through a popular GSM protocol
3. To understand the issues and solutions of various layers of mobile networks, namely MAC layer, Network Layer & Transport Layer
4. To understand the database issues in mobile environments & data delivery models.
5. To understand the ad hoc networks and related concepts.
6. To understand the platforms and protocols used in mobile environment.

Course Outcomes:
1. Able to think and develop new mobile application.
2. Able to take any new technical issue related to this new paradigm and come up with a solution(s).
3. Able to develop new ad hoc network applications and/or algorithms/protocols.
4. Able to understand & develop any existing or new protocol related to mobile environment

UNIT –I:
Introduction to Mobile Computing Architecture: Mobile Computing – Dialog Control – Networks – Middleware and Gateways – Application and Services – Developing Mobile Computing Applications – Security in Mobile Computing – Architecture for Mobile Computing – Three Tier Architecture – Design considerations for Mobile Computing – Mobile Computing through Internet – Making existing Applications Mobile Enabled.

UNIT –II:
Cellular Technologies: GSM, GPS, GPRS, CDMA and 3G: Bluetooth – Radio Frequency Identification – Wireless Broadband – Mobile IP – Internet Protocol Version 6 (IPv6) – Java Card – GSM Architecture – GSM Entities – Call Routing in GSM – PLMN Interfaces – GSM addresses and Identifiers – Network aspects in GSM – Authentication and Security – Mobile computing over SMS – GPRS and Packet Data Network – GPRS Network Architecture – GPRS Network Operations – Data Services in GPRS – Applications for GPRS – Limitations of GPRS – Spread Spectrum technology – Is-95 – CDMA Versus GSM – Wireless Data – Third Generation Networks – Applications on 3G

UNIT –III:
Wireless Application Protocol (WAP) and Wireless LAN: WAP – MMS – Wireless LAN Advantages – IEEE 802.11 Standards – Wireless LAN Architecture – Mobility in wireless LAN

Intelligent Networks and Interworking: Introduction – Fundamentals of Call processing – Intelligence in the Networks – SS#7 Signaling – IN Conceptual Model (INCM) – soft switch – Programmable Networks – Technologies and Interfaces for IN

UNIT –IV:

Client Programming, Palm OS, Symbian OS, Win CE Architecture: Introduction – Moving beyond the Desktop – A Peek under the Hood: Hardware Overview – Mobile phones – PDA – Design Constraints in Applications for Handheld Devices – Palm OS architecture – Application Development – Multimedia – Symbian OS Architecture – Applications for Symbian, Different flavors of Windows CE -Windows CE Architecture

J2ME: JAVA in the Handset – The Three-prong approach to JAVA Everywhere – JAVA 2 Micro Edition (J2ME) technology – Programming for CLDC – GUI in MIDP – UI Design Issues – Multimedia – Record Management System – Communication in MIDP – Security considerations in MIDP – Optional Packages

UNIT –V:

Voice Over Internet Protocol and Convergence: Voice over IP- H.323 Framework for Voice over IP – Session Initiation Protocol – Comparision between H.323 and SIP – Real Time protocols – Convergence Technologies – Call Routing – Voice over IP Applications – IP multimedia subsystem (IMS) – Mobile VoIP

Security Issues in Mobile Computing: Introduction – Information Security – Security Techniques and Algorithms – Security Protocols – Public Key Infrastructure – Trust – Security Models – Security frameworks for Mobile Environment

TEXT BOOKS:

1. Mobile Computing – Technology, Applications and Service Creation – Asoke K Talukder, Roopa R Yavagal, 2009, TATA McGraw Hill
2. Mobile Communications – Jochen Schiller – 2nd Edition – Pearson Education

REFERENCE BOOKS:

1. The CDMA 2000 System for Mobile Communications – Vieri Vaughi, Alexander Damn Jaonvic – Pearson.
2. Adalestein - Fundamentals of Mobile & Parvasive Computing, 2008, TMH.

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AD-HOC WIRELESS AND SENSOR NETWORKS
(Elective - V)

Prerequisite: Wireless Sensor Networks

Course Objectives:
1. To study the fundamentals of wireless Ad-Hoc Networks.
2. To study the operation and performance of various Adhoc wireless network protocols.
3. To study the architecture and protocols of Wireless sensor networks.

Course Outcomes:
1. Students will be able to understand the basis of Ad-hoc wireless networks.
2. Students will be able to understand design, operation and the performance of MAC layer protocols of Adhoc wireless networks.
3. Students will be able to understand design, operation and the performance of routing protocol of Adhoc wireless network.
4. Students will be able to understand design, operation and the performance of transport layer protocol of Adhoc wireless networks.
5. Students will be able to understand sensor network Architecture and will be able to distinguish between protocols used in Adhoc wireless network and wireless sensor networks.

UNIT - I:
Wireless LANs and PANs
Introduction, Fundamentals of WLANS, IEEE 802.11 Standards, HIPERLAN Standard, Bluetooth, Home RF.
AD HOC WIRELESS NETWORKS
Introduction, Issues in Ad Hoc Wireless Networks.

UNIT - II:
MAC Protocols
Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

UNIT - III:
Routing Protocols
Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.

UNIT – IV:
Transport Layer Protocols
Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of

Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

UNIT – V:

Wireless Sensor Networks

Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

TEXT BOOKS:

1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI.
2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control - Jagannathan Sarangapani, CRC Press.

REFERENCE BOOKS:

1. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh , 1st Ed. Pearson Education.
2. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer

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SOFT SKILLS LAB
(Activity-based)

Course Objectives

- To improve the fluency of students in English
- To facilitate learning through interaction
- To illustrate the role of skills in real-life situations with case studies, role plays etc.
- To train students in group dynamics, body language and various other activities which boost their confidence levels and help in their overall personality development
- To encourage students develop behavioral skills and personal management skills
- To impart training for empowerment, thereby preparing students to become successful professionals

Learning Outcomes

- Developed critical acumen and creative ability besides making them industry- ready.
- Appropriate use of English language while clearly articulating ideas.
- Developing insights into Language and enrich the professional competence of the students.
- Enable students to meet challenges in job and career advancement.

INTRODUCTION

Definition and Introduction to Soft Skills – Hard Skills vs Soft Skills – Significance of Soft/Life/Self Skills – Self and SWOT Analysis ***and***

1. **Exercises on Productivity Development**
   - Effective/ Assertive Communication Skills (Activity based)
   - Time Management (Case Study)
   - Creativity & Critical Thinking (Case Study)
   - Decision Making and Problem Solving (Case Study)
   - Stress Management (Case Study)
2. **Exercises on Personality Development Skills**
   - Self-esteem (Case Study)
   - Positive Thinking (Case Study)
   - Emotional Intelligence (Case Study)
   - Team building and Leadership Skills (Case Study)
   - Conflict Management (Case Study)
3. **Exercises on Presentation Skills**
   - Netiquette
   - Importance of Oral Presentation – Defining Purpose- Analyzing the audience- Planning Outline and Preparing the Presentation- Individual & Group Presentation- Graphical Organizers- Tools and Multi-media Visuals
   - One Minute Presentations (Warming up)
   - PPT on Project Work- Understanding the Nuances of Delivery- Body Language – Closing and Handling Questions – Rubrics for Individual Evaluation (Practice Sessions)
4. **Exercises on Professional Etiquette and Communication**
   - Role-Play and Simulation- Introducing oneself and others, Greetings, Apologies, Requests, Agreement & Disagreement….etc.

- Telephone Etiquette
- Active Listening
- Group Discussions (Case study)- Group Discussion as a part of Selection Procedure- Checklist of GDs
- Analysis of Selected Interviews (Objectives of Interview)
- Mock-Interviews (Practice Sessions)
- Job Application and Preparing Resume
- Process Writing (Technical Vocabulary) – Writing a Project Report- Assignments

5. Exercises on Ethics and Values

Introduction –– Types of Values - Personal, Social and Cultural Values - Importance of Values in Various Contexts

- Significance of Modern and Professional Etiquette – Etiquette (Formal and Informal Situations with Examples)
- Attitude, Good Manners and Work Culture (Live Examples)
- Social Skills - Dealing with the Challenged (Live Examples)
- Professional Responsibility – Adaptability (Live Examples)
- Corporate Expectations

☞ Note: Hand-outs are to be prepared and given to students.

☞ Training plan will be integrated in the syllabus.

☞ Topics mentioned in the syllabus are activity-based.

SUGGESTED SOFTWARE:

☞ The following software from **'train2success.com'**

- Preparing for being Interviewed
- Positive Thinking
- Interviewing Skills
- Telephone Skills
- Time Management
- Team Building
- Decision making

SUGGESTED READING:

1. Alex, K. 2012. *Soft Skills.* S. Chand Publishers
2. *Management Shapers*. 2011. Collection of 28 Books by different Authors. Universities Press.
3. Sherfield, Robert M. *2005. et al Cornerstone: Developing Soft Skills*. Pearson
4. Suresh Kumar,E; Sreehari, P. & Savithri, J. 2011. *Communication Skills and Soft Skills- An Integrated Approach.* New Delhi: Pearson
5. The ACE of Soft Skills by Gopalaswamy Ramesh & Mahadevan Ramesh. 2013. Pearson Publishers. New Delhi.
6. Patnaik, P. 2011. *Group Discussion and Interview Skills.* New Delhi: Foundation
7. Sudhir Andrews. 2009. *How to Succeed at Interviews.* New Delhi: Tata McGraw Hill
8. **Sasikumar, V & Dhamija, P.V. 1993. *Spoken English - A Self-Learning Guide to Conversation Practice.* New Delhi: Tata McGraw-Hill**
9. *Dixson, Richard J. Everyday Dialogues in English. Prentice Hall India Pvt Ltd*
10. Mukhopadhyay. L *et al. 2012. Polyskills. New Delhi: CUP India Pvt Ltd*
11. Rizvi, M. A. 2005. *Effective Technical Communication.* New Delhi: Tata McGraw Hill
12. *The Hindu Speaks on Education* by the Hindu Newspaper
13. Naterop, B. Jean and Revell, Rod. 2004. *Telephoning in English*. Cambridge: CUP

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M.Tech. II Year IV-Sem (Systems & Signal Processing)

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IMAGE AND VIDEO PROCESSING
(Elective – VI)

Prerequisite: Digital Signal Processing

Course Objectives:
1. The student will be able to understand the quality improvement methods of Image.
2. To study the basic digital image and video filter operations.
3. Understand the fundamentals of Image Compression.
4. Understand the representation of video.
5. Understand the principles and methods of motion estimation.

Course Outcomes:
1. The students will learn image representation, filtering , compression.
2. Students will learn the basics of video processing , representation, motion estimation.

UNIT – I:
Fundamentals of Image Processing and Image Transforms
Basic steps of Image Processing System Sampling and Quantization of an image, Basic relationship between pixels.
Image Segmentation
Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region based segmentation.

UNIT – II:
Image Enhancement
Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.
Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

UNIT – III:
Image Compression
Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Huffman coding, , Bit plane coding, Transform coding, Predictive coding, Wavelet coding, Lossy Predictive coding, JPEG Standards.

UNIT - IV:
Basic Steps of Video Processing
Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT – V:
2-D Motion Estimation
Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

TEXT BOOKS:
1. Digital Image Processing – Gonzaleze and Woods, 3rd ed., Pearson.
2. Video Processing and Communication – Yao Wang, Joem Ostermann and Ya–quin Zhang. 1st Ed., PH Int.

REFRENCE BOOKS:

1. Digital Video Processing – M. Tekalp, Prentice Hall International
2. Digital Image Processing – S.Jayaraman, S.Esakkirajan, T.Veera Kumar –TMH, 2009

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4G TECHNOLOGIES
(Elective-VI)

Prerequisite: None

Course Objectives:
1. To know about Second Generation and Third Generation Cellular technologies
2. To study the Evolution Generation(2.5G) technology platforms,
3. To learn about OFDM modulation technique and their evaluation parameters.
4. To understand UWB wireless channels, data modulation and its features.
5. To study the 4G technology.

Course Outcomes:
At the end of the course, the student will be able to:
1. Explain and compare Second and Third Generation technologies and their architectures.
2. Understand improved version of 2G technology i.e., evolution Generation (2.5G) and data transmission using GPRS, EDGE, HSCSD.
3. Get the knowledge of Orthogonal Frequency Division Multiplexing and evaluate the performance using channel model and SNR, issues regarding OFDM.
4. Acquire the knowledge about UWB wireless channels, data modulation and their features.
5. Understand 4G Cellular technology and advantages of new technologies in cellular data networks.

UNIT I:
2G and 3G technology
Second Generation (2G) - Overview, Enhancements over 1G Systems, Integration with Existing 1G Systems, GSM, IS-136 System Description, IS-95 System Description, iDEN (Integrated Dispatch Enhanced Network), CDPD
Third Generation (3G)- Overview, Introduction, Universal Mobile Telecommunications Service (UMTS), UMTS Services, The UMTS Air Interface, Overview of the 3GPP Release 1999 Network Architecture, Overview of the 3GPP Release 4 Network Architecture, Overview of the 3GPP Release 5 All-IP Network Architecture, Overview CDMA2000, Commonality Between, DMA/CDMA2000/CDM

UNIT II:
The Evolution Generation (2.5G)
What Is 2.5G?,Enhancements over 2G, Technology Platforms, General Packet Radio Service, (GPRS), Enhanced Data Rates for Global Evolution (EDGE),High-Speed Circuit Switched Data (HSCSD), CDMA2000 (1XRTT), WAP, Migration Path from 2G to 2.5G to 3G,

UNIT III:
OFDM : Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, Channel model and SNR performance, OFDM Issues – PAPR, Frequency and Timing Offset Issues.

UNIT IV:
UWB: UWB Definition and Features, UWB Wireless Channels, UWB Data Modulation, Uniform Pulse Train.

UNIT V:

4G Cellular technology :

4G evolution, objectives of the projected 4G, advantages of 4G network technology over 3G, applications of 4G, 4G technologies, Smart antenna techniques, 4G software, New technologies in cellular data networks.

Text books:

1. 3G Wireless Networks, 2nd ed., Clint Smith, P.E , Daniel Collins
2. Mobile Cellular Communication , Gottapu Sasibhuhsana Rao, PEARSON, 2013

Reference Books:

1. 3G Networks Architecture, Protocols and Procedures, Sumith Kaseara, Nishit Narang

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VLSI SIGNAL PROCESSING
(Elective - VI)

Prerequisite: VLSI Technology , Digital Signal Processing

Course Objectives:
The objectives of this course are to:
1. Introduce techniques for the existing DSP structures to suit VLSI implementations.
2. Introduce efficient design of DSP architectures suitable for VLSI.
3. Understand various fast convolution techniques.
4. Understand low power processors for signal processing and wireless applications

Course Outcomes:
On successful completion of the module, students will have obtained an appreciation of:
1. Ability to modify the existing or new DSP architectures suitable for VLSI.
2. Ability to implement fast convolution algorithms.
5. Low power design aspects of processors for signal processing and wireless applications

UNIT -I:
Introduction to DSP
Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms
Pipelining and Parallel Processing
Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power
Retiming
Introduction – Definitions and Properties – Solving System of Inequalities – Retiming Techniques

UNIT –II:
Folding and Unfolding
Folding: Introduction -Folding Transform - Register minimization Techniques – Register minimization in folded architectures – folding of multirate systems
Unfolding: Introduction – An Algorithm for Unfolding – Properties of Unfolding – critical Path, Unfolding and Retiming – Applications of Unfolding

UNIT -III:
Systolic Architecture Design
Introduction – Systolic Array Design Methodology – FIR Systolic Arrays – Selection of Scheduling Vector – Matrix Multiplication and 2D Systolic Array Design – Systolic Design for Space Representations contain Delays

UNIT -IV:
Fast Convolution
Introduction – Cook-Toom Algorithm – Winograd algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection

UNIT -V:

Low Power Design

Scaling Vs Power Consumption –Power Analysis, Power Reduction techniques – Power Estimation Approaches

Programmable DSP: Evaluation of Programmable Digital Signal Processors, DSP Processors for Mobile and Wireless Communications, Processors for Multimedia Signal Processing

TEXT BOOKS:

1. VLSI Digital Signal Processing- System Design and Implementation – Keshab K. Parthi, 1998, Wiley Inter Science.
2. VLSI and Modern Signal processing – Kung S. Y, H. J. While House, T. Kailath, 1985, Prentice Hall.

REFERENCE BOOKS:

1. Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing – Jose E. France, Yannis Tsividis, 1994, Prentice Hall.
2. VLSI Digital Signal Processing – Medisetti V. K,1995, IEEE Press (NY), USA.

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SOFTWARE DEFINED RADIO
(Elective-VII)

Prerequisite: TCP/ IP , Digital Signal Processing

Course Objectives:
The objectives of this course is
1. To provide fundamentals and state of the art concepts in software defined radio.

Course Outcomes:
On completion of this course, the students:
1. Understand the design principles of software defined radio.
2. Understand the analog RF components as front end block in implementation of SDR.
3. Understand digital hardware architectures and development methods.
4. Understand the radio recourse management in heterogeneous networks.
5. Understand the object oriented representation of radio and network resources.

UNIT -I: Introduction: The Need for Software Radios, What is Software Radio, Characteristics and benefits of software radio- Design Principles of Software Radio, RF Implementation issues- The Purpose of RF Front – End, Dynamic Range- The Principal Challenge of Receiver Design – RF Receiver Front- End Topologies- Enhanced Flexibility of the RF Chain with Software Radios- Importance of the Components to Overall Performance- Transmitter Architectures and Their Issues- Noise and Distortion in the RF Chain, ADC and DAC Distortion.

UNIT -II: Profile and Radio Resource Management : Communication Profiles- Introduction, Communication Profiles, Terminal Profile, Service Profile , Network Profile, User Profile, Communication Profile Architecture, Profile Data Structure, XML Structure, Distribution of Profile Data, Access to Profile Data, Management of Communication Profiles, Communication Classmarks, Dynamic Classmarks for Reconfigurable Terminals, Compression and Coding, Meta Profile Data

UNIT -III: Radio Resource Management in Heterogeneous Networks : Introduction, Definition of Radio Resource Management, Radio Resource Units over RRM Phases, RRM Challenges and Approaches, RRM Modelling and Investigation Approaches, Investigations of JRRM in Heterogeneous Networks, Measuring Gain in the Upper Bound Due to JRRM, Circuit-Switched System, Packet-Switched System, Functions and Principles of JRRM, General Architecture of JRRM, Detailed RRM Functions in Sub-Networks and Overall Systems

UNIT -IV: Reconfiguration of the Network Elements : Introduction, Reconfiguration of Base Stations and Mobile Terminals, Abstract Modelling of Reconfigurable Devices, the Role of Local Intelligence in Reconfiguration, Performance Issues, Classification and Rating of Reconfigurable Hardware, Processing Elements, Connection Elements, Global Interconnect Networks, Hierarchical Interconnect Networks, Installing a New Configuration, Applying Reconfiguration Strategies, Reconfiguration Based on Comparison, Resource Recycling, Flexible Workload Management at the Physical Layer, Optimised Reconfiguration, Optimisation Parameters and Algorithms, Optimization Algorithms, Specific Reconfiguration Requirements, Reconfiguring Base Stations, Reconfiguring Mobile Terminals

UNIT -V: Object – Oriented Representation of Radios and Network Resources: Networks- Object Oriented Programming- Object Brokers- Mobile Application Environments- Joint Tactical Radio System.

Case Studies in Software Radio Design: Introduction and Historical Perspective, SPEAK easy- JTRS, Wireless Information Transfer System, SDR-3000 Digital Transceiver Subsystem, Spectrum Ware, CHARIOT.

TEXT BOOKS:

1. Software Defined Radio Architecture System and Functions- Markus Dillinger, Kambiz Madani, WILEY 2003
2. Software Defined Radio: Enabling Technologies- Walter Tuttle Bee, 2002, Wiley Publications.

REFERENCE BOOKS:

1. Software Radio: A Modern Approach to Radio Engineering - Jeffrey H. Reed, 2002, PEA Publication.
2. Software Defined Radio for 3G - Paul Burns, 2002, Artech House.
3. Software Defined Radio: Architectures, Systems and Functions - Markus Dillinger, Kambiz Madani, Nancy Alonistioti, 2003, Wiley.
4. Software Radio Architecture: Object Oriented Approaches to wireless System Enginering – Joseph Mitola, III, 2000, John Wiley & Sons.

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NETWORK SECURITY AND CRYPTOGRAPHY
(Elective - VII)

Prerequisite : None

Course Objectives:
1. Understand the basic concept of Cryptography and Network Security, their mathematical models
2. To provide deeper understanding of application to network security, threats/vulnerabilities to networks and countermeasures
3. To create an understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works
4. To provide familiarity in Intrusion detection and Firewall Design Principles

Course Outcomes:

After completion of this course, the student shall be able to:
1. Describe computer and network security fundamental concepts and principles
2. Identify and assess different types of threats, malware, spyware, viruses, vulnerabilities
3. Encrypt and decrypt messages using block ciphers
4. Describe the inner-workings of today's remote exploitation and penetration techniques
5. Describe the inner-workings of popular encryption algorithms, digital signatures, certificates, anti-cracking techniques, and copy-right protections
6. Demonstrate the ability to select among available network security technology and protocols such as IDS, IPS, firewalls, SSL, SSH, IPSec, TLS, VPNs, etc.
7. Analyze key agreement algorithms to identify their weaknesses

UNIT- I: Introduction : Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetwork security, Classical Techniques: Conventional Encryption model, Steganography, Classical Encryption Techniques.
Modern Techniques : Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Block Cipher Design Principles.

UNIT- II: Encryption : Triple DES, International Data Encryption algorithm, Blowfish, RC5, Characteristics of Advanced Symmetric block cifers.
Conventional Encryption
Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.

UNIT - III: Public Key Cryptography
Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptograpy.
Number Theory
Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.

UNIT- IV: Message Authentication and Hash Functions
Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash functions and MACs.
Hash and Mac Algorithms

MD File, Message digest Algorithm, Secure Hash Algorithm.
Digital signatures and Authentication protocols: Digital signatures, Authentication Protocols, Digital signature standards.
Authentication Applications
Kerberos, Electronic Mail Security: Pretty Good Privacy, S/MIME.

UNIT – V: IP Security
Overview, Architecture, Authentication, Encapsulating Security Payload, Key Management. Web Security: Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction.
Intruders, Viruses and Worms: Intruders, Viruses and Related threats.
Fire Walls: Fire wall Design Principles, Trusted systems.

TEXT BOOKS:
1. Cryptography and Network Security: Principles and Practice - William Stallings, Pearson Education.
2. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.

REFERENCE BOOKS:
1. Fundamentals of Network Security by Eric Maiwald (Dreamtech press)
2. Network Security - Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.
3. Principles of Information Security, Whitman, Thomson.
4. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
5. Introduction to Cryptography, Buchmann, Springer.

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RADAR SIGNAL PROCESSING
(Elective - VII)

Prerequisite: Radar Systems

Course Objectives:
1. This course emphasis on the principles of Radar Systems and Signal Processing techniques.
2. Ability to understand the various parameters of Radar like pdf , prf.
3. Acquire knowledge about pulse compression Radar.
4. To study the phase coding Techniques.

Course Outcomes:
Upon the completion of this course, the student will be able to
1. Understand the principles of Radar Systems.
2. Learn the appropriate model, calculate system performance parameters and assess the limitations of particular systems.
3. Understand the concepts of pulse compression Radar.

UNIT -I: Introduction
Radar, Radar Block Diagram, Radar Equation, Detection of Signals in Noise, Receiver Noise and the Signal to Ratio.

UNIT –II: Radar Equation
Probability Density Function, Probability of Detection and False Alarm, Radar Cross Section of Targets, Transmitter Power, PRF and Antenna Parameters, CFAR Receiver.

UNIT –III: Waveform Selection
Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse.

UNIT -IV: Pulse Compression in Radar Signals
Introduction, Significance, Types, Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Side lobes, Stretch Techniques, Generation and Decoding of FM Waveforms.

UNIT –V: Phase Coding Techniques
Principles, Binary Phase Coding, Barker Codes, Maximal Length Sequences (MLS/LRS/PN), Block Diagram of a Phase Coded CW Radar.

TEXT BOOKS:
1. Radar Handbook - M.I. Skolnik, 2nd Ed., 1991, McGraw Hill.
2. Radar Design Principles: Signal Processing and the Environment - Fred E. Nathanson, 2nd Ed.,1999, PHI.
3. Introduction to Radar Systems - M.I. Skolnik, 3rd Ed., 2001, TMH.

REFERENCE BOOKS:
1. Radar Principles - Peyton Z. Peebles, Jr., 2004, John Wiley.
2. Radar Signal Processing and Adaptive Systems - R. Nitzberg, 1999, Artech House.
3. Radar Design Principles - F.E. Nathanson, 1st Ed., 1969, McGraw Hill.

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MULTI-MEDIA AND SIGNAL CODING (ELECTIVE-VIII)

Prerequisite: Artificial Neural Networks and Fuzzy Systems.

Course Objectives:
This course makes the students to Understand
1. Various image & video processing algorithms.
2. Various video compression techniques.
3. Various audio compression techniques.

Course Outcomes:
On completion of this course the students will be able to
1. Represent and convert various colour models.
2. Simulate various video compression image techniques and can suggest the appropriate video compression techniques for specific application.
3. Simulate various audio compression techniques and can suggest the appropriate audio compression method for specific application.

UNIT -I:
Introduction to Multimedia: Multimedia, World Wide Web, Overview of Multimedia Tools, Multimedia Authoring, Graphics/ Image Data Types, and File Formats.
Color in Image and Video: Color Science – Image Formation, Camera Systems, Gamma Correction, Color Matching Functions, CIE Chromaticity Diagram, Color Monitor Specifications, Out-of-Gamut Colors, White Point Correction, XYZ to RGB Transform, Transform with Gamma Correction, L*A*B* Color Model. Color Models in Images – RGB Color Model for CRT Displays, Subtractive Color: CMY Color Model, Transformation from RGB to CMY, Under Color Removal: CMYK System, Printer Gamuts, Color Models in Video – Video Color Transforms, YUV Color Model, YIQ Color Model, Ycbcr Color Model.

UNIT -II:
Video Concepts: Types of Video Signals, Analog Video, Digital Video.
Audio Concepts: Digitization of Sound, Quantization and Transmission of Audio.

UNIT -III:
Compression Algorithms:
Lossless Compression Algorithms: Run Length Coding, Variable Length Coding, Arithmetic Coding, Lossless JPEG, Image Compression.
Lossy Image Compression Algorithms: Transform Coding: KLT And DCT Coding, Wavelet Based Coding.
Image Compression Standards: JPEG and JPEG2000.

UNIT -IV:
Video Compression Techniques: Introduction to Video Compression, Video Compression Based on Motion Compensation, Search for Motion Vectors, H.261- Intra-Frame and Inter-Frame Coding, Quantization, Encoder and Decoder, Overview of MPEG1 and MPEG2.

UNIT -V:

Audio Compression Techniques: ADPCM in Speech Coding, G.726 ADPCM, Vocoders – Phase Insensitivity, Channel Vocoder, Formant Vocoder, Linear Predictive Coding, CELP, Hybrid Excitation Vocoders, MPEG Audio – MPEG Layers, MPEG Audio Strategy, MPEG Audio Compression Algorithms, MPEG-2 AAC, MPEG-4 Audio.

TEXT BOOKS:

1. Fundamentals of Multimedia – Ze- Nian Li, Mark S. Drew, PHI, 2010.
2. Multimedia Signals & Systems – Mrinal Kr. Mandal Springer International Edition 1st Edition, 2009

REFERENCE BOOKS:

1. Multimedia Communication Systems – Techniques, Stds& Netwroks K.R. Rao, Zorans. Bojkoric, Dragorad A.Milovanovic, 1st Edition, 2002.
2. Fundamentals of Multimedia Ze- Nian Li, Mark S.Drew, Pearson Education (LPE), 1st Edition, 2009.
3. Multimedia Systems John F. Koegel Bufond Pearson Education (LPE), 1st Edition, 2003.
4. Digital Video Processing – A. Murat Tekalp, PHI, 1996.
5. Video Processing and Communications – Yaowang, Jorn Ostermann, Ya-QinZhang, Pearson, 2002.
6. Judith Jeffocate, "*Printmedia in practice (Theory and Applications)*", PHI, 1998.

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SOFT COMPUTING TECHNIQUES
(Elective - VIII)

UNIT – I: Fundamentals of Neural Networks & Feed Forward Networks
Basic Concept of Neural Networks, Human Brain, Models of an Artificial Neuron, Learning Methods, Neural Networks Architectures, Single Layer Feed Forward Neural Network :The Perceptron Model, Multilayer Feed Forward Neural Network :Architecture of a Back Propagation Network(BPN), The Solution, Backpropagation Learning, Selection of various Parameters in BPN. Application of Back propagation Networks in Pattern Recognition & Image Processing.

UNIT – II: Associative Memories & ART Neural Networks
Basic concepts of Linear Associator, Basic concepts of Dynamical systems, Mathematical Foundation of Discrete-Time Hop field Networks(HPF), Mathematical Foundation of Gradient-Type Hopfield Networks, Transient response of Continuous Time Networks, Applications of HPF in Solution of Optimization Problem: Minimization of the Traveling salesman tour length, Summing networks with digital outputs, Solving Simultaneous Linear Equations, Bidirectional Associative Memory Networks; Cluster Structure, Vector Quantization, Classical ART Networks, Simplified ART Architecture.

UNIT – III: Fuzzy Logic & Systems
Fuzzy sets, Crisp Relations, Fuzzy Relations, Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule based system, Defuzzification Methods, Applications: Greg Viot's Fuzzy Cruise Controller, Air Conditioner Controller.

UNIT – IV: Genetic Algorithms
Basic Concepts of Genetic Algorithms (GA), Biological background, Creation of Offsprings, Working Principle, Encoding, Fitness Function, Reproduction, Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator, Bit-wise Operators used in GA, Generational Cycle, Convergence of Genetic Algorithm.

UNIT – V: Hybrid Systems
Types of Hybrid Systems, Neural Networks, Fuzzy Logic, and Genetic Algorithms Hybrid, Genetic Algorithm based BPN: GA Based weight Determination, Fuzzy Back Propagation Networks: LR-type fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BPN, Inference by fuzzy BPN.

TEXT BOOKS:
1. Introduction to Artificial Neural Systems - J.M.Zurada, Jaico Publishers
2. Neural Networks, Fuzzy Logic & Genetic Algorithms: Synthesis & Applications - S.Rajasekaran, G.A. Vijayalakshmi Pai, July 2011, PHI, New Delhi.
3. Genetic Algorithms by David E. Gold Berg, Pearson Education India, 2006.
4. Neural Networks & Fuzzy Sytems- Kosko.B., PHI, Delhi,1994.

REFERENCE BOOKS:
1. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
2. An introduction to Genetic Algorithms - Mitchell Melanie, MIT Press, 1998
3. Fuzzy Sets, Uncertainty and Information- Klir G.J. & Folger. T. A., PHI, Delhi, 1993.

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ADVANCED COMPUTER NETWORKS
(Elective – VIII)

Prerequisite: Computer Networks

Course Objectives:
1. To study the WLAN and WPAN architecture and protocols
2. To know about WiMAX services, 802.16 standard, cellular telephony & satellite networks.
3. To study the techniques to improve QoS.in Networks
4. To learn about the basic concepts of Ad hoc wireless Networks
5. To know about various Routing Protocols in Ad hoc Networks.
6. To learn the concepts of Wireless Sensor Networks, architecture and various data dissemination and data gathering techniques

Course Outcomes:
At the end of the course, the student will be able to:
1. Acquire the knowledge about Wireless LANs, Bluetooth and WiMAX standards, architecture and their sub-layers.
2. Understand congestion control mechanisms and techniques to improve Quality of Service in switched networks
3. Get the basic concepts of Ad hoc wireless networks and its protocols and issues related to QoS, energy management, scalability and Security.
4. Explain about Wireless Sensor Network architecture, data dissemination & data gathering techniques and will be able to address the issues and challenges in designing Sensor Networks.

Unit I
Wireless LANs: Architectural Comparison, Characteristics, Access Control, IEEE 802.11 Project: Architecture, MAC Sub layer, Addressing Mechanism, Physical Layer
Bluetooth: Architecture, Bluetooth Layers
WiMAX: Services, IEEE Project 802.16, Cellular Telephony: operation,1G,2G,3G,4G, Satellite Networks, GEO, MEO and LEO Satellites

Unit II
Congestion Control and Quality of Service: Data Traffic, Congestion, Congestion Control, Quality of Service, Techniques to Improve QoS, Integrated Services, Differentiated Services, QoS in Switched Networks
Queue Management: Passive-Drop trial, Drop front, Random drop, Active- early Random drop, Random Early detection.

Unit III
AD HOC WIRELESS NETWORKS: Introduction, Cellular and Ad hoc Wireless Networks, Application of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks, Medium Access Scheme, Routing, Multicasting, Transport Layer Protocols, Pricing Scheme, Quality of Service Provisioning, Self-Organization, Security, Addressing and Service Discovery, Energy Management, Scalability, Deployment Considerations, Ad Hoc Wireless Internet

Unit IV

Quality of Service in Ad Hoc Wireless Networks:

Introduction, Real Time Traffic Support in Ad Hoc Wireless Networks, QoS Parameters in Ad Hoc Wireless Network, Issues and Challenges in providing QoS in Ad Hoc Wireless Networks, Classification of QoS Solutions: MAC Layer Solutions, Cluster TDMA, IEEE 802.11e, DBASE, Network Layer Solutions, QoS Routing Protocols, Ticket Based QoS Routing Protocol, Predictive Location Based QoS routing protocol, Trigger Based Distributed QoS Routing Protocol, QoS enabled AODV Routing Protocol, Bandwidth QoS Routing Protocol, On Demand QoS Routing Protocol, On Demand Link-State Multipath QoS Routing Protocol, Asynchronous Slot Allocation Strategies. QoS Frameworks for Ad Hoc Wireless Networks.

Unit V

Wireless Sensor Networks

Introduction, Application of Sensor Network , Comparison with Ad hoc Wireless Networks, Issues and challenges in Designing a Sensor Network, Sensor Network Architecture, Layer Architecture, Cluster Architecture, Data Dissemination Flooding, Gossiping, Rumor Routing, Sequential Assignment Routing, Direct Diffusion, Sensor Protocols for Information via Negotiation, Cost- Field Approach, Geography Hash Table, Small Minimum Energy Communication Network, Data Gathering, Direct Transmission, Power Efficient Gathering for Sensor Information Systems, Binary Scheme, Chain Based Three-Level Scheme.

TEXT BOOKS:

1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI
2. Data Communications and Networking - B. A.Forouzan, 5th , 2013, TMH.

REFERENCE BOOKS:

1. Data Communications and Computer Networks - Prakash C. Gupta, 2006, PHI.
2. Data and Computer Communications - William Stallings, 8th ed., 2007, PHI.