DETAILED

SYLLABUS

for

M Tech Degree Course

(Semester System)

COMMUNICATION ENGINEERING & SIGNAL PROCESSING

w.e.f 2015-2016

COURSE STRUCTURE MTECH-15

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

VELAGAPUDI RAMAKRISHNA

SIDDHARTHA ENGINEERING COLLEGE

(AUTONOMOUS)

(An Autonomous, ISO 9001:2008 Certified Institution)

(Approved by AICTE, Accredited by NAAC with 'A' Grade, Affiliated to JNTUK, Kakinada)

(Sponsored by Siddhartha Academy of General & Technical Education)

Kanuru, Vijayawada

Andhra Pradesh - 520007, INDIA.

www.vrsiddhartha.ac.in

W.E.F. 2015-16 **MTECH-15**

ACADEMIC REGULATIONS

MASTER OF TECHNOLOGY

(MTECH-15) w. e. f: 2015-2016

(Common to all branches)

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Academic Regulations for M. Tech (M.TECH-15) w. e. f: 2015-2016

(Common to all branches)

1. INTRODUCTION

Academic Programmes of the College are governed by rules and regulations as approved by the Academic Council, which is the highest Academic Body of the Institute. These academic rules and regulations are effective from the academic year 2015-16, for students admitted into two year PG programme offered by the college leading to Master of Technology (M. Tech).

The regulations listed under this head are common for postgraduate programmes, leading to award of M. Tech degree, offered by the college with effect from the academic year 2015-16 and they are called as "M. TECH-15" regulations.

The regulations hereunder are subjected to amendments as may be made by the Academic Council of the college from time to time, keeping the recommendations of the Board of Studies in view. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the programme, as may be decided by the Academic Council.

2. DEFINITIONS

a) "Commission" means University Grants Commission (UGC)
b) "Council" means All India Council for Technical Education (AICTE)
c) "University" means Jawaharlal Nehru Technological University Kakinada, Kakinada (JNTUK)
d) "College" means Velagapudi Ramakrishna Siddhartha Engineering College (VRSEC)
e) "Programme" means any combination of courses and/or requirements leading to the award of a degree
f) "Course" means a subject either theory or practical identified by its course title and code number and which is normally studied in a semester.
g) "Degree" means an academic degree conferred by the university upon those who complete the postgraduate curriculum.

3. PROGRAMMES OFFERED

The nomenclature and its abbreviation given below shall continue to be used for the degree programmes under the University, as required by the Council and Commission.

Master of Technology (M. Tech) Besides, the name of the programme shall be indicated in brackets after the abbreviation. For example PG engineering degree in Computer Science and Engineering is abbreviated as M. Tech (Computer Science and Engineering).

Presently, the college is offering Post Graduate programme in Engineering with the following programmes:

Table 1: List of Programmes offered by college leading to M. Tech Degree

S. No	Programme	Department
1	Structural Engineering	Civil Engineering
2	Computer Science and Engineering	Computer Science and Engineering
3	Power Systems Engineering.	Electrical and Electronics Engineering
4	Communication Engineering and Signal Processing	Electronics and Communication Engineering
5	Telematics	
6	VLSI Design and Embedded Systems	
7	Computer Science & Technology	Information Technology
8	CADCAM	Mechanical Engineering
9	Thermal Engineering	

These Regulations shall be applicable to any new postgraduate programme (M. Tech) that may be introduced from time to time.

4. DURATION OF THE PROGRAMME

- The duration of the programme is two academic years consisting of four semesters.
- A student is permitted to complete the programme within a maximum duration of 4 years.

5. MINIMUM INSTRUCTION DAYS

- Each semester shall consist of a minimum of 90 instruction days with about 25 to 35 contact periods per week.

6. ELIGIBILITY CRITERIA FOR ADMISSION

- The eligibility criteria for admission into M.Tech programme are as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE).

6.1 CATEGORY –A Seats:

- These seats will be filled by the Convener, PGECET Admissions.

6.2 CATEGORY –B Seats :

- These seats will be filled by the College as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE).

7. PROGRAMME STRUCTURE

The programme structure is designed in such a way that it facilitates the courses required to attain the expected knowledge, skills and attitude by the time of their post-graduation as per the needs of the stakeholders. The curriculum structure consists of various course categories to cover the depth and breadth required for the programme and for the attainment of programme outcomes of the corresponding programme.

7.1 Programme Core:

The core consists of set of courses considered necessary for the students of the specific. The courses under this category should satisfy the programme specific criteria prescribed by the appropriate professional societies. The credits for programme core courses is 40.

7.2 Programme Electives:

The electives are set of courses offered in which covers depth and breadth to further strengthen their knowledge. The students may register for appropriate electives offered in the based on their area of interest. The credits for the programme electives are 12.

7.3 Independent Learning:

The students are expected to learn the courses offered under this category on their own. The courses offered under this category include:

7.3.1 Self-Learning Course:

The self-learning courses shall be taken from the list of approved MOOCs in the respective Board of Studies. The courses under this category shall carry two credits.

7.3.2 Seminar:

One seminar shall be delivered by the students as individual presentation. The seminar topics shall be related to the contemporary aspects of the programme. The seminar shall carry 2 credits.

- The self learning course and seminar shall be offered either in 1st year or in 2nd year of the programme depending upon this scheme approved by BOS & Academic Council.

7.3.3 Project:

The Project shall be offered in 2nd year of the programme. The project shall be carried out by the students, as individual project, for a minimum period of one academic year. The project shall be carried out in the major areas pertaining to the programme approved by Project Review Committee and may address the societal problems/issues related to the programme. The project shall consist of Part-A and Part-B with a weightage of 10 and 14 credits, respectively spreading over for one semester each. The project part B shall be the extension of project Part A.

- If a candidate wishes to change his/her topic of the project, he/she can do so with approval of the project review committee within one week from the completion of 1st review.

7.3.3.1 PROJECT IN COLLABORATION WITH INDUSTRY:

- A student may, with the approval of the Head of the Department/Centre, visit an industry or a Research Laboratory for data collection, discussion of the project, experimental work, survey, field studies, etc. during the project period. Projects sponsored by the industry or Research Laboratories will be encouraged and a close liaison with such organizations will be maintained.

- A student may, with the approval of Project Review Committee, do the project work in collaboration with an industry, a Research and Development Organization. A Joint Supervisor may be appointed from the Industry and Research Laboratory with the approval of the HOD. The student shall acknowledge the involvement and / or contribution of an industry, R&D organization in completing the project in his/her thesis and a certificate to this effect, issued by the supervisor from the industrial organization, will be included in the thesis. The Internal Supervisor may visit the industry or the research laboratory in connection with the project work of his / her student if felt necessary.

- It is mandatory for all the students (especially those who do their project in an Industry, R&D organization in India or abroad) to make full disclosure of all data on which they wish to base their project. They cannot claim confidentiality simply because it would come into conflict with the Industry's or R&D laboratory's own interests. Any tangible intellectual property other than copyright of the thesis may have to be assigned to the Institute. The copyright of the thesis itself would however lie with the student as per the IPR policy in force.

7.4 Course Code and Course Numbering Scheme

Course Code consists of Nine characters in which the one is the numeral and second to fourth are alphabets and the rest are numerals.

- The First character '15' indicates year of regulation.

- The second to fourth characters are described in Table 2 and 3.

Table 2: Second to Third Character description

Second & Third Characters	Name of the Department
CE	Civil Engineering Department
CS	Computer Science and Engineering Department
EC	Electronics & Communication Engineering Department
EE	Electrical & Electronics Engineering Department
IT	Information Technology Department
ME	Mechanical Engineering Department

The fourth and fifth characters represents specialization offering as mentioned in Table No. 3.

Table 3: Fourth and Fifth Character description

Fourth & Fifth Characters	Name of the Specialization
SE	Structural Engineering
CS	Computer Science and Engineering
SP	Communication Engineering and Signal Processing
VE	VLSI Design and Embedded Systems
TM	Telematics
PS	Power Systems Engineering
CT	Computer Science & Technology
CC	CADCAM
TE	Thermal Engineering

For all the Sixth and Seventh characters represent semester number and syllabus version number of the course offered.

Eighth character represents course type, as per Table No. 4

Table 4: Course type description

EIGHTH CHARACTER	DESCRIPTION
0	Theory course
5	Lab course

Nineth character represents course number as described in Figure 1 below.

For example, in **15 MECC 1051** course, the numeral **15** indicates year of regulation and the course is offered by Mechanical Engineering Department (**ME**) in CAD/CAM specialization offered in the first semester (**1**), the course syllabus version number (**0**), the course is of lab type (**5**) and the course number is (**1**), as given in figure.1 below.

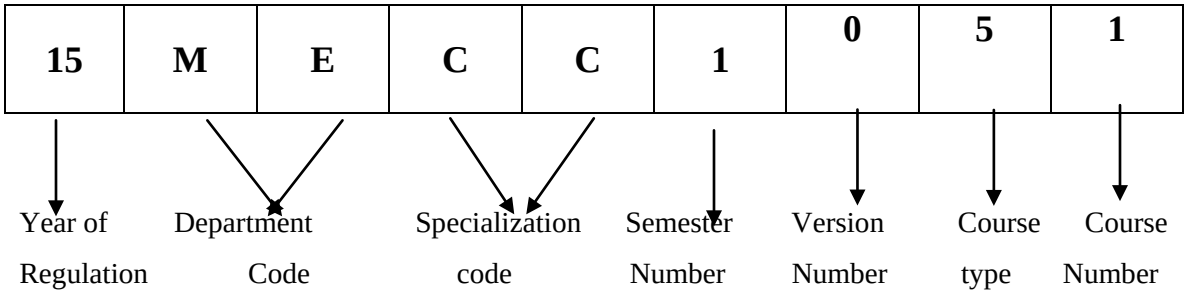

Figure 1: Course Code Description

7.5 Scheme of Instruction for 1st and 2nd Years

- The scheme of instruction and exact syllabi of all post graduate programmes are given separately.

7.6 Contact Hours and Credits

Credit means quantifying and recognizing learning. Credit is measured in terms of contact hours per week in a semester.

The Course Credits are broadly fixed based on the following norms:

- Lectures – One Lecture period per week is assigned one credit.
- Tutorials - Two tutorial periods per week are assigned one credit.
- Practical – 2 periods per week is assigned one credit
- Seminar/Mini Project shall have 2 credits.

- Major Project shall have 24 credits.
- However, some courses are prescribed with fixed number of credits depending on the subject complexity and importance.

7.7 Theory / Tutorial Classes

Each course is prescribed with fixed number of lecture periods per week. During lecture periods, the course instructor shall deal with the concepts of the course. For certain courses, tutorial periods are prescribed, to give exercises to the students and to closely monitor their learning ability.

7.8 Laboratory Courses

A minimum prescribed number of experiments have to be performed by the students, who shall complete these in all respects and get each experiment evaluated by teacher concerned and certified by the Head of the Department concerned at the end of the semester.

7.9 Programme Credits

Each specialization of M. Tech programme is designed to have a total of 80 credits, and the student shall have to earn all the credits for the award of degree.

8. MEDIUM OF INSTRUCTION

The medium of instruction and examination is English.

9. SYLLABUS

As approved by the concerned BOS and the Academic Council.

10. ELIGIBILITY REQUIREMENT FOR APPEARING SEMESTER END EXAMINATION AND CONDONATION

- A regular course of study means a minimum average attendance of 75% in all the courses computed by totaling the number of periods of lectures, tutorials,

practical courses and project as the case may be, held in every course as the denominator and the total number of periods attended by the student in all the courses put together as the numerator.

- Condonation of shortage in attendance may be recommended by the respective Heads of Departments on genuine medical grounds, provided the student puts in at least 65% attendance as calculated above and provided the Principal is satisfied with the genuineness of the reasons and the conduct of the student.
- Students, having shortage of attendance, shall have to pay the requisite fee towards condonation**.**
- Minimum of 50% aggregate marks must be secured by the candidates in the continuous evaluations conducted in that semester for courses such as theory, laboratory courses, seminar and project to be eligible to write semester end examinations. However, if the student is eligible for promotion based on the attendance, in case necessary, a shortage of internal marks up to a maximum of 10% may be condoned by the Principal based on the recommendations of the Heads of the Departments.
- Students having shortage of internal marks up to a maximum of 10% shall have to pay requisite fee towards condonation**.**
- A student, who does not satisfy the attendance and/or internal marks requirement, shall have to repeat that semester.
- Eligible candidates who failed to register for all courses for the semester-end examinations shall not be permitted to continue the subsequent semester and has to repeat the semester for which he/she has not registered for semester end examinations.

11. EXAMINATIONS AND SCHEME OF EVALUATION

11.1 Continuous Evaluation:

11.1.1 Theory Courses

Each course is evaluated for **40** marks (a+b)

a) The continuous evaluation shall be made based on the two midterm examinations each of 2**0** marks will be conducted in every theory course in a semester. The mid term marks shall be awarded giving a weightage of 2/3rd in the examination in which the student scores more marks and 1/3rd for the examination in which the student scores less marks. Each midterm examination shall be conducted for duration of 90 minutes without any choice**.**

b) The remaining 20 marks are awarded through continuous evaluation of assignments / mini project in each subject as notified by the teacher at the beginning of the semester.

Students shall be informed regarding the comprehensive assignment/ during the first week of the semester and they have to submit completed assignment on or before 12th week of semester.

11.1.2 Laboratory Courses: 40 marks

- For Laboratory courses there shall be continuous evaluation during the semester for 40 continuous evaluation marks. The distribution of continues evaluation marks is given below:

Table 5: Distribution of Marks

Sl. No.	Criteria	Marks
1	Day to Day work	10
2	Record	10
3	Continuous Evaluation	20

11.1.3 Seminar: 40 marks

The distribution of continues evaluation marks for the seminar is given below.

Table 6: Distribution of Marks

Sl. No.	Criteria	Marks
1	Report	15
2	Presentation	15
3	Viva-voce	10

The Seminar Review Committee (SRC) to be constituted by HOD with minimum two members related to programs specialization.

11.1.4 Project: (40 marks)

The continuous evaluation (Project Part A and Project Part B) for 40 marks shall be on the basis of two seminars by each student evaluated by a review committee and the day to day assessment by the supervisor in respective semester. The review committee consists of HOD, Programme coordinator, respective internal guide and two senior members of faculty of the department with expertise in the respective specialization nominated by HOD. The distribution of marks is as follows in Table 7.

Table 7: Continuous evaluation in each semester

S. No.	Criteria	Marks
1	Two reviews	15+15
2	Day to day assessment	10

Rubrics shall be prepared by review committee using appropriate performance indicators for each review separately and informed to the students well in advance.

11.1.5 Self-Learning Courses

For the courses under this category, there shall be continuous evaluation for 40 marks and semester end examination of 60 marks. The distribution of marks for continuous evaluation will be same as theory courses (Section 11.1.1).

11.2 SEMESTER END EXAMINATIONS

11.2.1 Theory Courses: 60 marks

The Semester end examinations shall be conducted for 3 hours duration at the end of the semester. The question paper shall be given in the following pattern: There shall be two questions from each unit with internal choice. Each question carries 15 marks. Each course shall consist of four units of the syllabus.

11.2.2 Lab Courses: 60 marks

40 marks are allotted for experiments/job works & **15** marks are allotted for viva-voce examination and **5** marks for the record.

11.2.3 Seminar: 60 marks

There shall be a seminar presentation. For Seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee. The Departmental Committee consists of Head of the Department, supervisor and two other senior faculty members of the department. For Seminar, the evaluation is done for 60 marks internally.

11.2.4 Self-Learning Courses: 60 marks

The semester end examinations for courses under this category are evaluated for 60 marks.

11.2.5 Project: 60 marks

The project (Project Part A and Part B) shall be evaluated for 60 marks in respective semesters. The semester end examination for project part – A shall be

evaluated by HOD, Programme coordinator and one of the senior Professors of the Department.

Project part – B shall be evaluated by a project evaluation committee consisting of the Head of the Department, project internal guide and an external examiner approved by the Principal from a panel submitted by the HOD.

The rubrics for evaluation of semester end examination shall be defined by the Project review committee separately for Part – A and Part B.

12. CONDITIONS FOR PASS AND AWARD OF CREDITS FOR A COURSE

12.1 Conditions for Pass and award of Grades & Credits:

a) A candidate shall be declared to have passed in individual Theory course if he/she secures a minimum of 50% aggregate marks (continues evaluation & semester end examination marks put together), subject to a minimum of 40% marks in the semester end examination.

b) A candidate shall be declared to have passed in individual labs/ seminar/ course if he/she secures a minimum of 50% aggregate marks (continues evaluation & semester end examination marks put together), subject to a minimum of 50% marks in the semester end examination.

c) If a candidate secures minimum of 40% marks in Theory Courses in the semester end examination and 40% - 49% of the total marks in the semester end examination and continues evaluation taken together in some theory courses and secures an overall aggregate of 50% in all theory courses in that semester he/she declared to be passed in the theory courses of that semester in semester end Examinations. This provision is applicable for Regular candidates only during Regular Semester – end Examinations.

d) The student has to pass the failed course by appearing the examination when conducted subsequently, as per the requirement for the award of degree.

e) A candidate shall be declared to have passed the Project part A/ **P**roject part B, if he/she secures minimum of 50 % aggregate marks (continuous evaluation and semester end examination marks put together), subject to a minimum of 50 % of marks in semester end examinations.

f) If any candidate does not fulfill the pass requirement as per 12.1.(e) in semester end examination of Project Part – A, he / she will be given two months additional time to re appear at the semester end examination after paying the requisite examination fee and also the candidate has to bear the expenditure for conducting examination. If the candidate does not fulfill the pass requirement again in Project Part – A as per 12.1(e), he/she has to repeat the semester in next academic year.

g) In a special case, if any student does not submit his / her thesis of Project Part – B, due to ill health or any other genuine reason, he / she will be given another chance to appear at Project Part - B examination conducted separately at a later date i.e. within two months from the completion of Project Part – B semester end examination of that particular academic year after paying the requisite examination fee, if the expenditure for conducting Project Part – B is completely borne by the candidate.

h) On passing a course of a programme, the student shall earn assigned credits in that

Course.

12.2 Method of Awarding Letter Grades and Grade Points for a Course.

A letter grade and grade points will be awarded to a student in each course based on his/her performance as per the grading system given below.

Table 8: Grading System for individual subjects/labs

Theory	Lab	Grade Points	Letter Grade
>= 90%	>= 90%	10	Ex
80-89%	80-89%	9	A+
70-79%	70-79%	8	A
60-69%	60-69%	7	B
50-59%	55-59%	6	C
45-49%	50-54%	5	D
40-44%	-	4	E
< 40%	< 50%	0	F (Fail)
ABSENT	ABSENT	0	AB

12.3 Calculation of Semester Grade Points Average (SGPA)* and award of division for the program.

The performance of each student at the end of the each semester is indicated interms of SGPA. The SGPA is calculated as below:

$$SGPA = \frac{\sum(CR \times GP)}{\sum CR}$$ (For all courses passed in semester)

Where CR= Credits of a course

GP = Grade points awarded for a course

*SGPA is calculated for the candidates who passed all the courses in that semester.

12.4 Calculation of Cumulative Grade Point Average (CGPA) for Entire Programme.

The CGPA is calculated as below:

$$CGPA = \frac{\sum(CR \times GP)}{\sum CR}$$ (For entire programme)

Where CR= Credits of a course

GP = Grade points awarded for a course

Table 9: Award of Divisions

CGPA	DIVISION
≥7.75	First Class with distinction
≥6.5 - <7.75	First Class
≥5.5 - <6.5	Second Class
≥4 - <5.5	Pass Class
<4	Fail

For the purpose of awarding first class with distinction, the candidate should complete the programme with in 2 years and should get required CGPA.

Detained, Break in study candidates, and the candidates who availed themselves of the opportunity of extension of project part – B for a further period of two months are not eligible for the award of first class with distinction.

For the purpose of awarding first/ second/ pass class, CGPA obtained in the examinations appeared within the maximum period allowed for the completion of course including extensions in project, if any shall be considered.

12.5 Transitory Regulations

A candidate, who is detained or discontinued in the semester, on readmission shall be required to pass all the courses in the curriculum prescribed for such batch of students in which the student joins subsequently and the academic regulations be applicable to him/her which have in force at the time of his/her admission. However, exemption will be given to those candidates who have already passed in such courses in the earlier semester(s) and additional subjects are to be studied as approved by Board of Studies and ratified by Academic Council.

12.6 Consolidated Grade Card

A consolidated grade card containing credits & grades obtained by the candidates will be issued after completion of the two years M. Tech Programme.

13.READMISSION CRITERIA

A candidate, who is detained in a semester due to lack of attendance/marks, has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling all the required norms stipulated by the college in addition to paying an administrative fee of Rs. 1,000/-.

Rules for Calculation of Attendance for Re- Admitted students.

a) No.of classes conducted will be counted from the day 1 of the semester concerned, irrespective of the date of payment of tuition fee.
b) They should submit a written request to the principal of the college, along with a challan paid towards tuition and other fee. for re – admission before the commencement of class work.
c) Student should come to know about the date of commencement of class – work of the semester in to which he / she wishes to get re – admission. The information regarding date of commencement of class – work for each semester is available in the college notice boards / website.

14. BREAK IN STUDY

Student, who discontinues the studies for whatsoever may be the reason, can get readmission into an appropriate semester of M. Tech program after a break-in study only with the prior permission of the Principal of the College provided such candidate shall follow the transitory regulations applicable to such batch in which he/she joins. An administrative fee of Rs. 2000/- per each year of break in study in addition to the prescribed tuition and special fee has to be paid by the candidate to condone his/her break in study.

15. ELIGIBILITY FOR AWARD OF M.TECH. DEGREE

The M. Tech., Degree shall be conferred on a candidate who satisfies the following requirement. A student should register himself for 80 Credits, and should obtain all the 80 credits in order to become eligible for the award of M.Tech Degree.

16. CONDUCT AND DISCIPLINE

- Students shall conduct themselves within and outside the premises of the Institute in a manner befitting the students of our Institute.
- As per the order of the Honorable Supreme Court of India, ragging in any form is considered a criminal offense and is banned. Any form of ragging will be severely dealt with.
- The following acts of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging.

i. Lack of courtesy and decorum; indecent behavior anywhere within or outside the campus.

ii. Willful damage or distribution of alcoholic drinks or any kind of narcotics to fellow students /citizens.

The following activities are not allowed within the campus

- Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.
- Mutilation or unauthorized possession of library books.
- Noisy and unseemly behavior, disturbing studies of fellow students.
- Hacking computer systems (such as entering into other person's areas without prior permission, manipulation and/or damage of computer hardware and software or any other cyber crime etc.
- Use of cell phones in the campus.
- Plagiarism of any nature.
- Any other act of gross indiscipline as decided by the college from time to time.

- Commensurate with the gravity of an offense, the punishment may be reprimanded, fine, expulsion from the institute / hostel, debarment from a examination, disallowing the use of certain facilities of the Institute, rustication for a specified period or even outright expulsion from the Institute, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.
- For an offense committed in (i) a hostel (ii) a department or in a classroom and (iii) elsewhere, the Chief Warden, the Head of the Department and the Principal, respectively, shall have the authority to reprimand or impose fine.
- Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Principal for taking appropriate action.
- Unauthorized collection of money in any form is strictly prohibited.
- Detained and Break-in-Study candidates are allowed into the campus for academic purposes only with permission from the authorities.
- Misconduct committed by a student outside the college campus, but having the effect of damaging, undermining & tarnishing the image & reputation of the institution will make the student concerned liable for disciplinary action commensurate with the nature & gravity of such misconduct.
- The Disciplinary Action Committee constituted by the Principal, shall be the authority to investigate the details of the offense, and recommend disciplinary action based on the nature and extent of the offense committed.
- "Grievance appeal Committee" (General) constituted by the Principal shall deal with all grievances pertaining to the academic / administrative /disciplinary matters.
- All the students must abide by the code and conduct rules of the college.

17. MALPRACTICES

- The Principal shall refer the cases of malpractices in internal assessment tests and Semester-End Examinations, to a Malpractice Enquiry Committee, constituted by him/her for the purpose. Such committee shall follow the approved scales of punishment. The Principal shall take necessary action, against the erring students based on the recommendations of the committee.
- Any action on the part of the candidate at an examination trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder. The

involvement of the Staff, who are in charge of conducting examinations, valuing examination papers and preparing/keeping records of documents relating to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

18. OTHER MATTERS

18.1 The physically challenged candidates who have availed additional examination time and a scribe during their B. Tech/PGECET/GATE examinations will be given similar concessions on production of relevant proof/documents.

18.2 Students who are suffering from contagious diseases are not allowed to appear either internal or semester end examinations.

18.3 The students who participated in coaching/tournaments held at the state / National /International levels through University / Indian Olympic Association during the end semester external examination period will be promoted to subsequent semesters till the entire course is completed as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated18-08-1994.

18.4 The Principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the Heads of the Departments in an appropriate manner, and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved in the Heads of the Departments Meetings, shall be reported to the academic council for ratification.

19. AMENDMENTS TO REGULATIONS

The Academic Council may, from time to time, revise, amend, or change the regulations, Schemes of examination and/or syllabi.

ELECTRONICS AND COMMUNICATION ENGINEERING
Curriculum, Scheme of Examination and Syllabi
for
M.Tech Degree Program
in
Communication Engineering & Signal Processing
being offered at
Velagapudi Ramakrishna Siddhartha Engineering College
w.e.f 2015-2016

FIRST SEMESTER

Code	Subject	L	P	C	I	E	T
15ECSP1001	Transform Techniques	4	0	4	40	60	100
15ECSP1002	Advanced Digital Communications	4	0	4	40	60	100
15ECSP1003	Discrete Spectral Analysis	4	0	4	40	60	100
15ECSP1004	Advanced Digital Signal Processing	4	0	4	40	60	100
	Elective – I						
15ECSP1005/1	Advanced Wireless Communications						
15ECSP1005/2	Random Sequences and Processes						
15ECSP1005/3	ANN and Fuzzy Logic	3	0	3	40	60	100
15ECSP1005/4	Optimization Techniques						
15ECSP1005/5	Remote Sensing and Image Analysis						
	Elective – II						
15ECSP1006/1	Antennas for Wireless Communication						
15ECSP1006/2	Image & Video Processing						
15ECSP1006/3	Statistical Signal Processing	3	0	3	40	60	100
15ECSP1006/4	VLSI Signal Processing						
15ECSP1051	Advanced DSP Lab	0	3	2	40	60	100
15ECSP1052	Advanced Communication Systems Lab	0	3	2	40	60	100
	Total Credits (6 Theory + 2 Labs)	22	06	26	320	480	800

L: Lecture **P**: Practicals **C**: Credits

I: Internal Assessment Marks **E**: End Examination Marks **T**: Total Marks

ELECTRONICS AND COMMUNICATION ENGINEERING
Curriculum, Scheme of Examination and Syllabi
for
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w.e.f 2015-2016

SECOND SEMESTER

Code	Subject	L	P	C	I	E	T
15ECSP2001	Fiber Optical Communication Systems	4	0	4	40	60	100
15ECSP2002	Coding Theory and Techniques	4	0	4	40	60	100
15ECSP2003	Radar Signal Processing	4	0	4	40	60	100
15ECSP2004	Communication Systems Modeling	4	0	4	40	60	100
15ECSP2005/1	**Elective – III** Microstrip Components and Antennas	3	0	3	40	60	100
15ECSP2005/2	Speech Processing						
15ECSP2005/3	Multimedia Communications						
15ECSP2005/4	Mobile Handset Design						
15ECSP2006/1	**Elective – IV** Software Defined Radio and Cognitive Radio	3	0	3	40	60	100
15ECSP2006/2	Biomedical Signal Processing						
15ECSP2006/3	ANN for RF & Microwave Design						
15ECSP2006/4	Adhoc Wireless and Sensor Networks						
15ECSP2006/5	Adaptive Signal Processing						
15ECSP 2051	Multimedia Lab	0	3	2	40	60	100
15ECSP2052	Communication Systems Modeling Lab	0	3	2	40	60	100
	Total Credits (6 Theory + 2 Labs)	22	06	26	320	480	800

L: Lecture **P**: Practicals **C**: Credits

I: Internal AssessmentMarks **E**: End Examination Marks **T**: Total Marks

ELECTRONICS AND COMMUNICATION ENGINEERING
Curriculum, Scheme of Examination and Syllabi
for
M.Tech Degree Program
in
Communication Engineering & Signal Processing
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w.e.f 2015-2016

THIRD SEMESTER

Code	Subject	L	P	C	I	E	T
15ECSP3001/1 15ECSP3001/2 15ECSP3001/3 15ECSP3001/4	**MOOCS** Advanced 3G and 4G Wireless Mobile Communications Linux Programming and Scripting Digital Voice & Picture Communication Digital Video Signal Processing	0	0	2	40	60	100
15ECSP3051	Project work – Part A	0	0	10	40	60	100
15ECSP3052	Seminar	0	0	2	40	60	100
	Total	0	0	14	120	180	300

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FOURTH SEMESTER

Code	Subject	L	P	C	I	E	T
15ECSP4051	Project work- Part B	0	0	14	40	60	100

15ECSP1001

TRANSFORM TECHNIQUES

Lecture :	4 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	4			**Final Examination:**	60

Course outcomes:

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

1. Implement the concepts of Integral Transforms in the analysis of different types of signals in frequency domain.
2. Evaluate and understand Hankel, Legendre and Short-Time-Fourier Transforms in frequency domain .
3. Analyse the concepts of wavelet transforms and apply them for the analysis of image signals.
4. Design various filter banks using wavelet transform for decomposition and reconstruction of signals used in communication systems.

UNIT – I

General Integral Transforms: Linear Integral Transformations, Kernel-product Convolution Properties and examples, Sturm-Liouville Transforms, Inverse Transforms, Further Properties, Transforms of Certain Functions, Example of Sturm-Liouville Transformations, Singular Cases.

UNIT - II

Hankel Transforms: Introduction, Finite Hankel Transformations, Inversion of $H_{nj,}$ Modified Finite Transformations $H_{nh,}$ Nonsingular Hankel Transformations, Hankel Transformations $H_{n\alpha}$ on the Half Line ($x > 0$), Further Properties of $H_{n\alpha,}$ Tables of Transforms $H_{n\alpha}\{F\}$

Legendre Transforms: The Legendre Transformation T_n on the Interval(-1,1), Further Properties of T_n, Legendre Transforms on the Interval (0,1), Laguerre Transforms, Mellin Transforms, Short-Time-Fourier Transforms(STFT), Properties of STFT.

UNIT – III

The origin of wavelets, Functions and Function Spaces, Orthogonal Basis Functions, Continuous Wavelet Transforms (CWT), The Uncertainty Principle and Time frequency Tiling, Properties of wavelets in CWT, Introduction to the Discrete Wavelet Transforms, Continuous versus Discrete Wavelet Transform(DWT),

Haar Scaling Functions and Function Space, Translation and scaling, Orthogonality of Translates, Function Space, Nested Spaces, Scaled Haar Wavelet Functions and Orthogonal Wavelets, Support of Wavelet System, Daubechies Wavelets.

UNIT- IV

Refinement Relation for Orthogonal Wavelet Systems, Restrictions on Filter Coefficients, Designing Daubechies orthogonal Wavelet system coefficients, Design of Coiflet wavelets, Signal Decomposition, Relationship with Filter Banks, Frequency Response, Signal

Reconstruction, Perfect Matching Filters, vanishing moments of wavelet function and filter coefficients, Multi-Resolution Analysis (MRA), Two Scale Relations, Their Relationship to Filter Banks, PR QMF Filter Banks.

TEXT BOOKS:

1. Ruel .V.Churchill , "Operational Mathematics" McGraw Hill, 3rd Edition, 1981 (Unit I and II)
2. K.P. Soman and K.I Ramachandran,N.G.Resmi "Insight into Wavelets from Theory to Practice",3rd edition, Eastern Economy Edition May 2011 (Unit III & IV)

REFERENCE BOOKS:

1. M.J.Roberts, Signals and Systems Analysis using Transform Method and MATLAB, Tata McGraw Hill, 2nd Edition, 2003.
2. Simon Haykin and Barry Van Veen, "Signals and Systems", John Wiley, 2nd Edition, 1999.
3. Jaideva C.Goswami, Andrew K. Chan, Fundamentals of Wavelets Theory, Algorithms and Applications, John Wiley & Sons, 2nd Edition, 2009.
4. Raghuveer M. Rao, Ahit S.Bopardikar, Wavelet Transforms - Introduction to Theory and Applications, Pearson Education Asia, 1999.

15ECSP1002

ADVANCED DIGITAL COMMUNICATIONS

Lecture :	4 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	4			**Final Examination:**	60

Course outcomes:

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

1. Analyze & discriminate the performance of various digital modulation techniques
2. Understand & analyze the various transmitter and receiver synchronization methods.
3. Select and evaluate an optimum spread spectrum technique for secure communications
4. Recognize the fundamental techniques to overcome the different fading effects and select the appropriate stochastic channel models for various environments.

UNIT- I

MODULATION AND CODING TRADE-OFFS

Defining, Designing, and Evaluating Digital Communication Systems- M-ary Signaling, Bandwidth-Limited Systems, Power-Limited Systems, Requirements for MPSK and MFSK Signaling. Bandwidth-Efficient Modulation- QPSK and Offset QPSK Signaling, Minimum Shift Keying, Quadrature Amplitude Modulation. Modulation and Coding for Band limited Channels- Commercial Telephone Modems, Signal Constellation Boundaries, Higher Dimensional Signal Constellations. Trellis-Coded Modulation: The Idea behind Trellis-Coded Modulation (TCM), TCM Encoding. TCM Decoding, Other Trellis Codes, Trellis-Coded Modulation Example.

UNIT - II

SYNCHRONIZATION

Introduction- Synchronization Defined, Costs versus Benefits, Approach and Assumptions- Receiver Synchronization- Frequency and Phase Synchronization, Symbol Synchronization—Discrete Symbol Modulations, Synchronization with Continuous-Phase Modulations (CPM), Frame Synchronization, Network Synchronization- Open-Loop Transmitter Synchronization, Closed-Loop Transmitter, Synchronization.

UNIT -III

SPREAD-SPECTRUM TECHNIQUES

Spread-Spectrum Overview-The Beneficial Attributes of Spread-Spectrum Systems, Model for Direct-Sequence Spread-Spectrum Interference Rejection. Pseudonoise Sequences- Randomness Properties, Shift Register Sequences, PN Autocorrelation Function. Direct-Sequence Spread-Spectrum Systems- Example of Direct Sequencing, Processing Gain and performance. Frequency Hopping Systems- Frequency Hopping Example, Fast Hopping versus Slow Hopping, FFH/MFSK Demodulator, Processing Gain. Synchronization- Acquisition, Tracking, Jamming Considerations- The Jamming Game, Broadband Noise Jamming, Partial-Band Noise Jamming, Multiple-Tone Jamming, Pulse Jamming.

UNIT - IV

FADING CHANNELS

The Challenge of Communicating over Fading Channels. Characterizing Mobile-Radio Propagation- Large-Scale Fading, Small-Scale Fading. Signal Time-Spreading- Signal Time-Spreading Viewed in the Time-Delay Domain, Signal Time-Spreading Viewed in the Frequency Domain, Examples of Flat Fading and Frequency-Selective Fading. Time Variance of the Channel Caused by Motion-Time Variance Viewed in the Time Domain, Time Variance Viewed in the Doppler-Shift Domain, Performance over a Slow-and Flat-Fading Rayleigh Channel, Mitigating the Degradation Effects of Fading-Mitigation to Combat Frequency-Selective Distortion, Mitigation to Combat Fast-Fading Distortion, Mitigation to Combat Loss in SNR, Diversity Techniques, Modulation Types for Fading Channels, The Role of an Interleaver. Applications: Mitigating the Effects of Frequency-Selective Fading- The Viterbi Equalizer as Applied to GSM, The Rake Receiver as Applied to Direct-Sequence Spread-Spectrum (DS/SS) Systems.

TEXT BOOK:

1. Bernard Sklar, "Digital Communications – Fundamentals and Applications", 2nd Edition, Pearson Education, 2001.

REFERENCE BOOKS :

1. Proakis, J. G, M. Salehi, "Digital Communications", 5th Edition, McGraw Hill Inc., NY, 2008.
2. Dassm J,Mullick S.K & Chatterjee P.K Principal of Digital Communication, Wiley Eastern Ltd.
3. Martin S.Roden: Digital and Data Communications System P.H.I London, Ed, 1998.
4. Viterbi, A.I and Qmura J.K Principles of Digital Communication, McGraw Hill Company, New York.

15ECSP1003

DISCRETE SPECTRAL ANALYSIS

Lecture :	4 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	4			**Final Examination:**	60

Course Outcomes

After successful completion of the course, the student will be able to

1. Translate a relevant real-world problem into a mathematical spectral estimation problem
2. Construct and solve non parametric spectral estimation problem
3. Formulate a parametric & non-parametric spectral estimation problems
4. Apply advanced spectral estimation methods for spatial filtering problems

UNIT -I

Introduction & Non parametric methods

Basic Concepts, Introduction, Energy Spectral Density of Deterministic Signals, Power Spectral Density of Random Signals, First Definition of Power Spectral Density, Second Definition of Power Spectral Density, Properties of Power Spectral Densities, The Spectral Estimation Problem

Nonparametric Methods Introduction, Periodogram and Correlogram Methods, Periodogram, Correlogram, Periodogram, Computation via FFT, Radix– FFT, Zero Padding, Properties of the Periodogram Method, Bias Analysis of the Periodogram, Variance Analysis of the Periodogram, The Blackman–Tukey Method, The Blackman–Tukey Spectral Estimate, Nonnegativeness of the Blackman–Tukey Spectral Estimate, Window Design Considerations.

UNIT- II

Parametric Methods for Rational Spectra Introduction, Signals with Rational Spectra, Covariance Structure of ARMA Processes, AR Signals, Yule–Walker Method, Least Squares Method, Order–Recursive Solutions to the Yule–Walker Equations, Levinson–Durbin Algorithm, Delsarte–Genin Algorithm, MA Signals, ARMA Signals, Modified Yule–Walker Method, Two–Stage Least Squares Method, Multivariate ARMA Signals, ARMA State–Space Equations, Subspace Parameter Estimation — Theoretical Aspects, Subspace Parameter Estimation — Implementation Aspects.

UNIT- III

Parametric Methods for Line Spectra Introduction, Models of Sinusoidal Signals in Noise, Nonlinear Regression Model, ARMA Model, Covariance Matrix Model, Nonlinear Least Squares Method, High–Order Yule–Walker Method, Pisarenko and MUSIC Methods.

Filter Bank Methods

Introduction, Filter Bank Interpretation of the Periodogram, Refined Filter Bank Method, Slepian Baseband Filters, RFB Method for High–Resolution Spectral Analysis, RFB Method for Statistically Stable Spectral Analysis, Capon Method, Derivation of the Capon Method.

UNIT- IV

Spatial Methods

Introduction, Array Model, The Modulation–Transmission–Demodulation Process, Derivation of the Model Equation, Nonparametric Methods, Beamforming, Capon Method, Parametric

Methods, Nonlinear Least Squares Method, Yule–Walker Method, Pisarenko and MUSIC Methods, Min–Norm Method, ESPRIT Method, On the Minimum Norm Constraint, NLS Direction-of-Arrival Estimation for a Constant-Modulus, Signal Capon Method: Further Insights and Derivations.

TEXT BOOK:

1. Peter Stoica and Randolph Moses, Spectral Analysis of Signals, Prentice Hall, Upper Saddle River, New Jersey, 2005, 447pp.

REFERENCE BOOK:

1. W. Gardner, Statistical spectral analysis a non probabilistic theory, Prentice Hall, Englewood Cliffs, New Jersey, 1998, 591pp

15ECSP1004

ADVANCED DIGITAL SIGNAL PROCESSING

Lecture :	4 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	4			**Final Examination:**	60

Course outcomes

After successful completion of the course, the student will be able to

1) Design a sample rate converter that reduces/increase by a given factor
2) a) Design a linear phase FIR filter for given specifications.
   b) Analyze and synthesize FIR filter for given multistructure filter bank
3) Evaluate the Optimum reflection coefficients for the Lattice Forward and Backward Predictors
4) Understand the concepts of LMS and RLS algorithms

UNIT – I

MULTIRATE DIGITAL SIGNAL PROCESSING

Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling Rate Conversion by a Rational Factor I/D, Implementation of Sampling Rate Conversion: Polyphase Filter Structures, Interchange of Filters and Downsamplers/Upsamplers, Sampling Rate Conversion with Cascaded Integrator Comb Filters, Polyphase Structures for Decimation and Interpolation Filters, Structures for Rational Sampling Rate Conversion.

UNIT – II

MULTISTAGE FIR FILTER DESIGN

Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing: Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrowband Lowpass Filters, Subband Coding of Speech Signals, Digital Filter Banks: Polyphase Structures of Uniform Filter Banks, Transmultiplexers, Two channel Quadrature Mirror Filter Bank: Elimination of aliasing, Condition for Perfect reconstruction, Polyphase form of the QMF Bank.

UNIT – III

LINEAR PREDICTION :

Forward and Backward Linear Prediction – Forward Linear Prediction, Backward Linear Prediction, Optimum reflection coefficients for the Lattice Forward and Backward Predictors. Solution of the Normal Equations: Levinson Durbin Algorithm, Schur Algorithm. Properties of Linear Prediction Filters.

UNIT –IV

ADAPTIVE FILTERS

Adaptive Direct Form FIR Filters – The LMs Algorithm: Minimum Mean Square Error Criterion, The LMS Algorithm, Related Stochastic Gradient Algorithms, Properties of the LMS Algorithm, Adaptive Direct Form Filters – RLS Algorithms: RLS Algorithm, The LDU Factorization and Square Root Algorithms, Fast RLS Algorithms, Properties of the Direct Form RLS Algorithms, Applications of Adaptive Filters: System Identification or System Modeling, Adaptive Channel Equalization, Echo Cancellation in Data Transmission over Telephone Channels, Suppression of Narrowband Interference in a Wideband Signal, Adaptive Noise Cancelling, Linear Predictive Coding of Speech Signals, Adaptive Arrays.

TEXT BOOK:

1. J.G.Proakis & D.G.Manolokis Digital Signal Processing: Principles, Algorithms & Applications , 4th ed., PHI.(Units-I,II,III & IV)

REFERENCE BOOKS:

1. P.P.Vaidyanathan Multirate Systems and Filter Banks — Pearson Education
2. S.Salivahanan, A.Vallavaraj, C.Gnanapriya Digital Signal Processing –, 2000,TMH

15ECSP1005/1

ADVANCED WIRELESS COMMUNICATIONS

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course outcomes

After successful completion of the course, the student will be able to

1. Acquire the knowledge about of technologies used in wireless communication for future needs and challenges
2. Understand the design considerations to effectively share spectrum through multiple access techniques
3. Gain insight as to how equalization and diversity afforded by radio propagation can be exploited to improve performance
4. Understand the basics of Wireless Communication Networks.

UNIT - I

Modern Wireless Communication Systems- Second Generation Wireless Systems, Third Generation Wireless Systems, Fourth Generation Wireless Systems, Wireless Local Loop, Wireless Local Area networks, Bluetooth and Personal Area Networks.

UNIT- II

Multiple Access Techniques for Wireless Communication: Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access (SSMA), Space Division Multiple Access (SDMA) Packet radio access-protocols, Carrier Sense Multiple Access (CSMA), Reservation Protocols ,Capture Effect in Packet Radio, Capacity of Cellular Systems

UNIT- III

Equalization – Fundamentals of Equalizer, Training A Generic Adaptive Equalizer, Equalizers in a Communications Receiver, Survey of Equalization Techniques, Linear and Non Linear Equalizers. **Diversity**- Diversity Techniques, RAKE receiver, Interleaving.

UNIT- IV

Wireless Networking: Introduction, Differences between Wireless and Fixed Telephone Networks, traffic routing in wireless networks, Wireless Data Services, common channel signaling, integrated services digital network.

TEXT BOOK:

1. Theodore S. Rappaport Wireless Communications, Principles, Practice –, Pearson, 2nd Edn., 2002.

REFERENCE BOOKS

1. Kamilo Feher Wireless Digital Communications –, PHI, 1999.
2. William Stallings Wireless Communication and Networking –, PHI, 2003.
3. Kaveh Pah Laven and P. Krishna Murthy Principles of Wireless Networks –, Pearson Education, 2002.

15ECSP1005/2

Random Sequences and Processes

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course outcomes

After successful completion of the course, the student will be able to

1. Formulate Probability Distribution and Density functions as well as functions ,properties of random sequences.
2. Formulate Probability Distribution and Density functions of vector random sequences and their convergence .
3. Apply Random processes as models for random or uncertain signals that arise in communication, control, signal processing.
4. Analyze Linear Time Invariant Systems excited by Wide sense stationary signals and to use low pass representation of Band pass signals.

Unit-I: **Random Sequences and Processes-I**

Basic concepts; Basic principles of discrete-time linear systems; Random sequences & linear systems; WSS random sequences; Markov Random sequences.

Unit-II: Random Sequences and Processes-II

Vector random sequences & state equations; Convergence of random sequences; Laws of large numbers; Basic definitions; Some important Random processes; Continuous time linear systems with random inputs ; Some useful classifications of random processes.

Unit-III: Random Processes and Noise

Wide-sense stationary processes and LSI systems; Periodic & cyclostationary processes; Vector Processes & State equations; Noise ; Narrow Band Noise; Representation of Narrow band noise in terms of Inphase & Quadrature components; Representation of Narrow band noise in terms of envelope & phase components; Sine wave plus Narrow Band Noise.

Unit-IV Advanced Topics in Random Processes

Mean Square(M.S) Calculus; M.S stochastic integrals; M.S stochastic differential equations; Ergodicity; Karhunen-Loeve Expansion; Representation of band limited & periodic processes.

Text Books:

1. Stark John and W. Woods, "Probability and Random Processes with Applications to Signal Processing", Prentice Hall, 3rd Edition, 2002.
2. Simon Haykin, "Communication Systems", John willey &Sons, 5th Edition,2009

Reference Books:

1. Peyton Z Peebles, "Probability, Random Variables and Random Signal Principles", TMH 4th Edition 2001
2. Athanasios Papoolis and S Unnikrishna Pillai, "Probability , Random Variables and Stochastic Processes", PHI 4th Edition, 2002

15ECSP1005/3

ANN AND FUZZY LOGIC

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes:

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

1. Identify the basic building blocks of artificial neural networks.
2. Develop the algorithms of supervised and unsupervised learning in neural networks.
3. Comprehend the concept of fuzziness involved in various systems.
4. Apply the knowledge of membership functions and fuzzy to crisp conversions.

UNIT-I

Introduction: Background and History, Biological neural network, Knowledge-based Information processing, Neural Information Processing, Hybrid Intelligence.

Basic Neural Computational Models: Basic concepts of Neural Nets (such as node properties, Network properties and Dynamics), Inference and learning (Data representation and functional classification), Classification models (single_layer Perceptrons, multi_layerperceptrons), Association models (Hop field Nets, Bi- directional associative memories), Self organizing models (Kohonen Networks, Competitive learning, Hebbian learning).

UNIT-II

Learning: Supervised and Unsupervised learning; Statistical learning, Neural Network learning (Back propagation, Radial basis Function Networks, ART Networks), Genetic Algorithms. Knowledge Based Neural Networks: Rule-based Neural networks, Network Training, Decision Tree Based NN's.

UNIT – III

Classical and fuzzy sets: Classical sets- operations, properties of classical sets, mapping of classical sets to the functions. Fuzzy sets-membership, uncertainty, fuzzy set operations, properties of fuzzy sets. Classical and fuzzy relations: Cartesian product, crisp relations-cardinality, operations and properties of crisp relations, Fuzzy relations-cardinality, operations and properties of fuzzy relations. Crisp equivalence and tolerance relations.

UNIT – IV

Membership functions: Futures of membership functions, fuzzification, membership value assignments-intuition, ranking ordering, neural nets, genetic algorithms, inductive reasoning,

Fuzzy-to-crisp conversions: Lambda-cuts for fuzzy sets, lambda-cuts for fuzzy relations, defuzzification methods. Fuzzy arithmetic, numbers and vectors and extension principle: fuzzy members, approximate methods of extension-vertex method, DSW algorithm, restricted DSW algorithm, fuzzy vectors.

Text Books:

1. Limin Fu Neural Networks in Computer Intelligence McGraw Hill Co., 1994.
2. Timothy J. Ross, Fuzzy logic with engineering applications, McGraw Hill, 1997.
3. Krishna Mehrotra, Chelkuri K. Mohan, Sanjav Ranka, "Elements of Artificial Neural Networks, Penram International.

15ECSP1005/4

OPTIMIZATION TECHNIQUES

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes

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

1. To mathematically formulate an optimization problem
2. To select the appropriate optimization algorithm suitable for a given problem
3. To implement convex and evolutionary optimization algorithms to solve engineering problems

Unit- I

Introduction

Mathematical optimization, least-squares and linear programming, convex optimization, nonlinear optimization, convex sets, affine and convex sets, some important examples, operations that preserve convexity, generalized inequalities, separating and supporting hyper-planes, dual cones and generalized inequalities, convex functions, basic properties and examples, operations that preserve convexity, the conjugate function, quasi-convex functions, log-concave and log-convex functions, convexity with respect to generalized inequalities.

Unit- II

Applications of Convex Optimization

Optimization problems, convex optimization, linear optimization problems, quadratic optimization problems, geometric programming, generalized inequality constraints, duality, the LaGrange dual function, the LaGrange dual problem , geometric interpretation, saddle-point interpretation, optimality conditions.

Introduction to Optimization Algorithms

Unconstrained minimization, unconstrained minimization problems, descent methods, gradient descent method, steepest descent method, Newton's method.

Unit- III

Advanced Optimization Methods

Interior-point methods, inequality constrained minimization problems, logarithmic barrier function and central path, the barrier method, feasibility and phase I methods, complexity analysis via self-concordance, problems with generalized inequalities, primal-dual interior-point method, implementation.

Unit- IV

Evolutionary Algorithms

Genetic algorithms, History, a simple binary genetic algorithm, mathematical models of genetic algorithm, Markov models and Dynamic system models. Ant colony optimization

Pheromone models, ant system, continuous optimization, other ant systems.

Particle swarm optimization (PSO) Basic PSO problem, velocity limiting, Global velocity updates, the fully informed particle swarm, learning from mistakes.

TEXT BOOKS:

1. Stephen Boyd, Lieven Vandenberghe, Convex Optimization, Cambridge University Press, Cambridge, UK, 2004, 727pp. https://web.stanford.edu/~boyd/cvxbook/bv_cvxbook.pdf
2. Dan Simon, Evolutionary Optimization Algorithms, Wiley, Hoboken, NJ, 2013.

REFERENCE BOOKS:

1. Dimitris Bertsimas, John N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, Belmont, MA, USA, 1997, 608pp.

15ECSP1005/5

Remote Sensing and Image Analysis

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes:

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

1. Understand and analyze the remotely sensed imagery
2. Carry out digital data interpretation and analysis of remotely sensed imagery
3. Appreciate various satellite images, both national and international, carrying out remote sensing jobs.

UNIT- I: Introductory Concepts

Introduction, Energy Sources and radiation, Energy interactions in Atmosphere and Earth Surface, Data acquisition and interpretation, Ideal remote sensing system, Characteristics of real remote sensing systems, Successful application of remote sensing data, Basic principles of aerial photography and photogrammetry. Remote sensing applications to Agriculture, Forestry, Oceans, Watershed, Urban areas.

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UNIT- II : Remote Sensing Platforms

Early history of space imaging, Landsat – 1-7, SPOT and IRS programmes, Other Earth resource satellites- Resource sat-1, Quick Bird, Cartosat and Materiological sats, Ocean monitoring systems and performance characteristics.

UNIT- III : Sensors Systems:

Earth Observing Sensors and systems- Sensors Carried on Terra and Aqua, MODIS, ASTER, MISR. Multi spectral, Thermal and Hyperspectral sensing – Across track scanning, Along track scanning, Operating principles of Across Track multispectral scanners, Example, Across track thermal scanning, Thermal radiation principle, Interpreting thermal imagery, Geometrical characteristics of across and along track scanner imagery, FLIR systems, Basics of Hyper-spectral, Microwave and Lidar sensing,

UNIT- IV : Visual Image Interpretation and Digital Image Processing

Process of Image interpretation, Basic Elements – Tone, Texture, Shape and others, key elements of Visual image interpretation.

Digital Image Processing – Introduction, Image rectification and restoration, Enhancement, contrast and spatial feature and multi-image manipulation, image classification - Supervised and unsupervised, classification of mixed pixels, output stage, post classification smoothing, classification accuracy assessment, Principles of GIS, Data merging and GIS integration, Hyperspectral image analysis, Scale effects.

TEXT BOOKS:

1. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, "Remote sensing and Image interpretation - Fifth Edition, Wiley 2004.

2. M.Anji Reddy,"Remote sensing and Gegraphical Information systems", 3rd Edition, B.S. Publications, 2006.

REFERENCE BOOKS :

1.K. Tempfli (editor), G.C. Huurneman (editor) et.al, "Principles of remote sensing: an introductory textbook" ITC Educational Text Book Series, 2009
2.Florence Tupin (Editor), Jordi Inglada (Editor), Jean-Marie Nicolas (Editor), "Remote sensing imagery" January 2014, Hardcover, Wiley-ISTE (E-book also available).
3.Rafael C. Gonzalez (Author), Richard E. Woods (Author)," Digital Image Processing (3rd Edition) [Kindle Edition] , Prentice Hall 2012.
4.Micheal N Demers, "Fundamentals of GIS", 3rd Edition, John Wiley &b Sons, 2008.
5.Robert Schowengerdt,"Remote sensing models and Methods" Academic Press, 3rd Edition. 2006.
6. B.C.Panda, Remote sensing: Principles and applications

15ECSP1006/1

ANTENNAS FOR WIRELESS COMMUNICATION

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course outcomes:

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

1. Analyze the concepts of smart antennas for various means of beam forming.
2. Evaluate the antennas required in different mobile communication and intelligent transportation systems such as on Cars, Trains and Buses
3. Demonstrate the different types Land Mobile Antenna Systems for Pagers and Portable Phones with safety aspects.
4. Analyze various types of antennas used in Aeronautical Mobile satellite and Aeronautical Mobile Communication systems.

UNIT - I: Introduction to Smart antennas: Spatial Processing for Wireless Systems: Key benefits of Smart Antenna Technology, Introduction to Smart antenna technology, The vector Channel Impulse Response and the Spectral Signature, Spectral Processing Receivers, Fixed Beamforming Networks, Switched beam Systems, Adaptive antenna Systems, Wideband Smart Antennas, spatial diversity-Diversity combining-Sectoring.

UNIT - II: Land Mobile Antenna Systems-Basic Techniques and Application: Antennas, Propagation Problems, Base station antenna Techniques, Mobile Station Antenna Techniques, Development in Mobile Phone Antenna Car Installations.
Land Mobile Antenna Systems for Cars, Trains, Buses: Antenna Systems for Broadcast Reception in Cars, Antenna Systems for TV Reception in Cars, Antenna Systems for Shinkansen (New Bullet Train), Antenna Systems for City Bus Operation.

UNIT - III: Land Mobile Antenna Systems for Pagers, Portable Phones and Safety: Practical Requirements and Constraints on Pager Antenna Design, Pager type and Performance, Design Techniques for Portable Phone Antennas, Portable Phone Antenna Systems, Safety Aspects of Portable and Mobile Communication Antenna Design.

UNIT - IV:
Antennas for Mobile satellite systems: Introduction, system requirements for vehicle antennas, Omnidirectional Antennas for mobile satellite communications, Directional antennas for mobile satellite communications, Antenna system for GPS, Antenna system for satellite broadcasting.

Antenna Systems for Aeronautical Mobile Communications: Propagation Problems, General Requirements and Remarks, Current Airborne Antennas, Advanced Circularly Polarized Antennas.

Text Books:

1. Joseph C.Liberti & Theodore S. Rappaport ―Smart Antennas for Wireless Communication, Prentice Hall Communication Engineering Series.1999.(Unit-I)
2. K.Fujimoto, J.R.James, ―Mobile Antenna Systems Handbook, IInd Edition, Artech House, 2001.(Unit-II,III,IV)

Reference Books:

1. KIN-LU WANG ―Planar Antenna for Wireless Communications, John-Wiley 2002.
2. Girish Kumar, K. P. Ray, Broadband Microstrip Antenna, Artech House, Boston, London, 2003
3. J. Bhal and P. Bhartia, Microstrip Antennas, Artech House, Dedham, 1980.
4. BALANIS.A ―Antenna Theory Analysis and Design, John Wiley and Sons, New York, 2000

15ECSP1006/2

IMAGE AND VIDEO PROCESSING

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course outcomes:

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

1. Apply basic operations and image transforms on a given image for manipulation and processing
2. Efficiently reduce the storage, band width using compression techniques , identify and recognize the objects in the given images using segmentation techniques
3. Apply basic operations on video.
4. Estimate the motion of two dimensional video.

UNIT- I

Introduction to Image processing system & Image transforms, Image sampling, Quantization, Resolution, Image file formats, Elements of image processing system, Applications of Digital image processing **Image Transforms**: Introduction. ,Need for image transforms, Fourier transform, 2 D Discrete Fourier transform and its properties, Walsh transform, Hadamard transform, Haar Transform, slant transform, Discrete cosine transform , Karhunen-loeve transform transform, singular value Decomposition, Radon transform, comparison of different image transforms. **Colour Image processing** :Introduction, Light and colour, colour formation, Human perception of colour, colour model the chromaticity diagram, colour image quantization, Histogram of colour image, colour image filtering, Gamma correction of a colour image, colour image segmentation.

UNIT - II

Image compression :Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standard, Wavelet-based image compression. **Image segmentation** :Introduction to image segmentation, Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform, Active contour segmentation.

UNIT- III

Video Processing: Video Formation, Perception and Representation, Video capture and display, Analog video raster, Analog color television systems, Digital video.

UNIT- V

Two Dimensional Motion Estimation : Optical flow, General methodologies, Pixel based motion estimation, Block Matching algorithm, Deformable block matching algorithms, Mesh

based motion estimation, Global motion estimation, Region Based motion estimation, Application of motion estimation in video coding.

Text Books:

1. S.Jayaraman, S.Esakkirajan and T.VeeraKumar, "Digital Image processing, Tata Mc Graw Hill publishers, 2009
2. Yao Wang,Jorn Ostermann and Ya Qin Zhang "Video processing and Communications" Prentice Hall Publishers, 2002, ISBN 0-13-017547-1

Reference Books:

1. R.Gonzalez, R.E.Woods, "Digital Image Processing", 3rd Edition, Pearson Education, India, 2009.
2. John W.Woods, "Multidimensional Signal, Image and Video Processing and Coding "Elsevier Academic Press Publications 2006, ISBN-13: 978-0-12– 088516-9 .

15ECSP1006/3

STATISTICAL SIGNAL PROCESSING

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes

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

1. Formulate a detection problem as a binary hypothesis test
2. Formulate a classical estimation problem
3. Formulate a Bayesian estimation problem
4. Evaluate the performance of a detector
5. Evaluate the performance of an maximum likelihood estimator

UNIT- I

Estimation Theory

Introduction, the mathematical estimation problem, minimum variance unbiased estimation (MVUE), unbiased estimators, minimum variance criterion, existence of the MVUE, finding MVUE.

Cramer-Rao Bound

Introduction, estimation accuracy considerations, Cramer Rao lower bound (CRLB), general CRLB for signals in white Gaussian noise, transformation of parameters.

Linear models

Definition and properties, linear model examples, general MVUE, sufficient statistics, finding sufficient statistics, using sufficiency to find MVUE.

UNIT- II

Detection Theory

Introduction, detection theory in signal processing, the detection problem, the mathematical detection problem, hierarchy of detection problems, summary of important pdfs.

Statistical Decision Theory I

Introduction, Neyman Pearson theorem, receiver operating characteristics, irrelevant data, minimum probability of error, Bayes risk, multiple hypothesis testing.

Statistical Decision Theory II

Composite hypothesis testing, Bayesian approach, Generalized likelihood ratio test (GLRT), performance of GLRT for large data records, Equivalent large record tests.

UNIT- III

Estimation Methods

Maximum likelihood estimation (MLE)

Introduction, an example, finding the MLE, MLE for transformed parameters, numerical determination of MLE.

Bayesian philosophy
Introduction, prior knowledge and estimation, choosing a prior pdf, properties of Gaussian probability density function (PDF), Bayesian linear model, nuisance parameters, Bayesian estimation for deterministic parameters.

UNIT- IV
Detection Methods
Detection of Deterministic signals
Matched filters, development of detector, performance analysis, Generalized matched filters (GMF), performance analysis of GMF, multiple signals, binary case, performance for binary case, linear model. Deterministic signals with unknown parameters, signal modeling and detection performance, unknown amplitude, GLRT, Bayesian approach.
Detection of Random Signals
Introduction, estimator correlator, linear model, estimator correlator for large data records, general Gaussian detection.

Textbooks
1. Steven M. Kay, Fundamentals of statistical signal processing volume I: Estimation theory, Pearson education, 1993. 625pp.
2. Steven M. Kay, Fundamentals of statistical signal processing volume II: Detection theory, Pearson education, 1993. 560pp.

Reference Books
1. L. Scharf, Statistical signal processing: detection, estimation, and Time Series Analysis, Pearson Education, 2010, 520pp.
2. R. Gray and L. Davisson, An introduction to Statistical Signal Processing, Cambridge University Press, 2010, 478pp.

15ECSP1006/4

VLSI SIGNAL PROCESSING

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes:

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

1. Apply the concepts of pipelining, parallel processing, Retiming, Folding and unfolding to optimize digital signal processing architectures
2. Analyze data flow in systolic architectures.
3. Minimize the computational complexity using fast convolution algorithms.
4. Analyze pipelining and parallel processing of IIR filters

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

UNIT- II

Retiming - Introduction – Definitions and Properties – Solving System of Inequalities – Retiming Techniques

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

Fast Convolution - Introduction – Cook-Toom Algorithm – Winogard algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection.

UNIT- IV

Pipelined and Parallel Recursive and Adaptive Filters – Introduction - Pipeline Interleaving in Digital Filters, Pipelining in 1st-Order IIR Digital Filters, Pipelining in Higher-Order IIR Digital Filters, Parallel processing for IIR Filters, Combined Pipelining and Parallel Processing for IIR Filters.

Text Book:

1. Keshab K. Parthi. (1998), "VLSI Digital Signal Processing- System Design and Implementation", Wiley Inter Science. (Unit:I - IV)

Reference Books:

1. Jose E. France, Yannis Tsividis.“Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing”, (1994) Prentice Hall.

Medisetti V. K ‘‘VLSI Digital Signal Processing”, . (1995), IEEE Press (NY), USA.

15ECSP1051

ADVANCED DIGITAL SIGNAL PROCESSING LAB

Lecture :		**Practical:**	-3 Hrs/ Week	**Internal Assessment:**	40
Credits :	2			**Final Examination:**	60

Note: -- Any **10** experiments out of the following **14** are to be completed in this course.

1. Implementation of Edge detection using various operators
2. Implementation of Line detection, Point detection& Global thresholding.
3. Implementation JPEG algorithm for image compression.
4. Implementation of image segmentation.
5. Program to verify Decimation and Interpolation of a given Sequences.
6. Program to Convert CD data into DVD data
7. Filter bank design
8. Estimation of Power Spectrum using Bartlett and Welch methods
9. Parametric methods of Yule-Walker and Burg of Power Spectrum Estimation
10. Estimation of data series using N^{th} order Forward Predictor and comparing to the Original Signal
11. Design of LPC filter using Levinson-Durbin Algorithm
12. Computation of Reflection Coefficients using Schur Algorithm
13. Implementation of FIR filter using LMS algorithm
14. Implementation of Adaptive filter using RLS algorithm

15ECSP1052

ADVANCED COMMUNICATION SYSTEMS LAB

Lecture :	-	**Practical:**	3 Hrs/ Week	**Internal Assessment:**	40
Credits :	2			**Final Examination:**	60

Note: -- Any **10** experiments out of the following **14** are to be completed in this course.

All experiments are to be simulated using MATLAB and to be verified using related training kits.

1. Estimation of power spectrum using AR models
2. Measurement of effect of Intersymbol Interference.
3. Measurement of Bit Error Rate using Binary Data.
4. Verification of DQAM Modulation and Demodulation techniques
5. Verification of DQPSK Modulation and Demodulation techniques
6. Design and Implementation of QSPK Modulator
7. Measure the Effect of Raised Cosine Filter, Roll off factor on the Constellation plot of I/Q (digital) Modulation (PSK, FSK).
8. Efficiency of FHSS & DSSS Spread- Spectrum Technique.
9. Verify the modulation and demodulation using FHSS & DSSS techniques using trainer.
10. Establish an audio & video satellite link between transmitter and receiver
11. PCM generation and detection using a CODEC Chip
12. Study basic configuration of ISDN system using Emulator, ISDN Telephones, terminal Adapter and Analog Telephones
13. Deduce Link Budget for Satellite Communication and evaluate Carrier to Noise Ratio.
14. Design optimum receiver for the AWGN channel.

15ECSP2001

FIBER OPTICAL COMMUNICATION SYSTEMS

Lecture :	4 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	4			**Final Examination:**	60

Pre-requisites: Knowledge of Optics

Course Outcomes:

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

1. Understand the design concepts of optical fiber systems.
2. Appreciate and evaluate transmission characteristics of cables
3. Acquire knowledge of optical devices such as detectors, sources, amplifiers.
4. Understand system aspects of OFC

UNIT- I

Concepts of Optical Propagation

Introduction: Block Diagram of OFC System, History, Advantages of OFC.

Optical Fiber principles: Introduction, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays, Problems. Concepts of Optical Propagation, Goos-Haenchen Shift, Cylindrical Fiber Modes,

Fibre types: Step Index Fibers - Problems, Graded Index Fibers - Problems . Single Mode Fibers – Problems, Cut Off Wavelength, Mode Fiber Diameter and Spot Size, Effective Refractive Index, The Gaussian Approximation- problems.

UNIT – II

Transmission Characteristics

Transmission Characteristics of Fibers – Attenuation, Absorption, Scattering Losses – Rayleigh, Mie, Nonlinear Scattering Losses, Stimulated Brillouin Scattering, Stimulated Raman Scattering, Fiber Bend Losses, Fiber Transmission at Various Frequencies, Dispersion Losses, Chromatic, Intermodal Losses, Multimode Fibers, Optical Link- Problems, Nonlinear Effects.

UNIT – III

Optical Tx & Rx - Devices

Optical Sources-Major Requirements, Semiconductor Injection Laser principles, Efficiency. Single Mode Operation, LED operation, LED Advantages, Power Efficiency, Comparison.

Optical Detectors- Requirements, Device Types, Optical Detection Principles, Absorption, Responsivity, Quantum Efficiency – Problems.

Optical Amplifiers: Semiconductor Types – Performance Characteristics, Fiber and Waveguide Amplifiers- Rare Earth Doped, Raman and Brillouin Types.

Optical Transmitter Circuit: Source Limitations, Digital, Analog Transmission.

Optical Receiver Circuit: Preamplifier, AGC, Equalization.

UNIT – IV

Optical Systems

System design considerations, Digital systems planning considerations, Optical transmitter and modulation formats,

Optical receiver: Channel losses, Temporal response, optical power budgeting (problems). Analog systems- Direct Intensity Modulation (D-IM), (problems), System planning.

Multiplexing Strategies: OTDM, Subcarrier Multiplexing, Orthogonal Frequency Division Multiplexing, Wavelength Division Multiplexing, Optical Code Division Multiplexing, Modulation formats and Demodulation Schemes.

Text book:

1. John M. Senior, "Optical fibre Communications – Principles and Practices" Third edition, 2010, LPE- Pearson Education Limited.

Reference Books:

1. Keiser Gerd, "Optical fiber Communication", 3rd Edition , 2003, Mc Graw Hill.
2. Kolimbiris, "Fiber Optics Communication", 1st Edition, 2003, McGraw Hill, Prentice Hall.
3. S.C. Guptha "Optical fiber communications and its applications" 2004 PHI
4. Djafar K Mynbaev and Lowell L. Scheiner, "Fiber Optic Communication Technology", 2006, Pearson Education.

15ECSP2002

CODING THEORY AND TECHNIQUES

Lecture :	4 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	4			**Final Examination:**	60

Course Outcomes:

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

1. Comprehend various error control code properties
2. Apply linear block codes for error detection and correction
3. Analyze and Apply convolution codes for performance analysis & cyclic codes for error detection and correction.
4. Design BCH & RS codes for Channel performance improvement against burst errors.

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.

UNIT- II

Cyclic codes:

Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding, Cyclic Hamming Codes, Error-trapping decoding

BCH – Codes:

Groups, Fields, Binary Field Arithmetic, Construction of Galois field $GF(2^m)$, Basic properties of Galois field $GF(2^m)$, Basic properties of Galois field $GF(2^m)$ arithmetic

BCH code- Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes- Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction

UNIT- III

Convolutional codes:

Encoding of Convolutional Codes, Structural and Distance Properties, Maximum likelihood decoding- Viterbi algorithm, Performance bounds for convolutional codes, construction of good convolutional codes, Sequential decoding- The Stack algorithm, The Fano algorithm, performance characteristics of Sequential decoding, code construction for Sequential decoding.

UNIT- IV

Burst –Error-Correcting codes:

Decoding of Signal-Burst error Correcting Cyclic codes, Single-Burst-Error-Correcting codes, Interleaved codes, Phase Burst-Error-Correcting codes, Burst- and –Random- Error-Correcting codes.

Bounds on Burst Error-Correcting Capability, Burst-Error-Correcting Convolutional Codes, Interleaved Convolutional Codes, Burst- and –Random- Error-Correcting Convolutional codes.

TEXT BOOKS:

1 Shu Lin, Daniel J.Costello,Jr, "Error Control Coding- Fundamentals and Applications", Prentice Hall, Inc.

2 Bernard Sklar "Digital Communications-Fundamental and Application", 2nd edition, PE.

REFERENCE BOOKS:

1. Man Young Rhee, "Error Correcting Coding Theory", 1989, TMH
2. John G. Proakis , "Digital Communications" , 5th ed., 2008, TMH.

15ECSP2003

Radar Signal Processing

Lecture :	4 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	4			**Final Examination:**	60

Course outcomes

After completing the course the students will be able to

1. formulate the models of radar signals including target component, clutter, and noise.
2. analyze basic problems and challenges in radar data acquisition.
3. formulate radar waveform design problem to achieve desired properties.
4. analyze Doppler aspects of the radar signals.

UNIT - I

Introduction, basic radar functions, elements of pulsed radar, review of selected signal processing concepts, preview of basic radar signal processing.

Signal Models

Components of a radar signal, amplitude models, simple point target radar range equation, distributed target forms of range equation, radar cross section (RCS), radar cross section for meteorological targets, statistical descriptions of RCS, Clutter, behavior of sigma_0, signal to clutter ratio, temporal and spatial correlation of clutter, compound models of RCS, noise model and Signal to Noise Ratio, jamming, frequency models: the Doppler shift, simplified approach to Doppler shift, the stop and hop assumption and spatial Doppler.

UNIT - II

Sampling and Quantization of Pulsed Radar Signals

Domains and Criteria for sampling radar signals, time and frequency samples, spatial samples sampling criteria, Sampling in the fast time dimension sampling in slow time, Sampling the Doppler spectrum, the Nyquist rate in Doppler, Straddle Loss, sampling in the spatial and angle domains, Phased array element spacing, Antenna beam spacing, Quantization.

UNIT - III

Radar Waveforms

Introduction, the waveform matched filter, the matched filter, matched filter for the simple pulse, all range matched filtering, range resolution of the matched filter, matched filtering of moving targets, the ambiguity function, definition and properties of the ambiguity function, ambiguity function of the simple pulse, the pulse burst waveform, matched filter for the pulse burst waveform, pulse by pulse processing, range ambiguity, Doppler response of the pulse burst waveform, ambiguity function for the pulse burst waveform, relation of the slow time spectrum to the ambiguity function, Frequency modulated (FM) pulse compression waveform, linear frequency modulation (LFM), the principle of stationary phase, ambiguity function of the LFM waveform, range-Doppler coupling.

UNIT - IV

Doppler Processing

Moving platform effects on the Doppler spectrum, moving target indication (MTI), pulse cancellers, vector formulation of the matched filter, matched filter for clutter suppression, blind speeds and staggered pulse repetition frequencies (PRFs), MTI figures of merit,

limitations of MTI, pulse Doppler processing, the discrete time Fourier transform of a moving target, sampling the DTFT: the discrete Fourier transform, matched filter and filter-bank interpretations of pulsed Doppler processing with the DFT, fine Doppler estimation, modern spectral estimation in pulse Doppler processing.

TEXT BOOK:

1. Mark Richards, Fundamentals of radar signal processing, McGraw-Hill education, 2005, 539pp.

REFERENCE BOOK :

1. Bassem R. Mahafza, Radar signal analysis and processing using Matlab, Chapman and Hall/CRC, 2008, 504pp.

15ECSP2004

COMMUNICATION SYSTEM MODELING

Lecture :	4 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	4			**Final Examination:**	60

Course Outcomes

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

1. Interpret, Analyse, model and Process the communication signals, systems using appropriate modeling techniques and simulation tools.
2. Analyse and evaluate a communication system and suggest enhancements to improve the system performance.
3. Apply suitable tools to design, simulate and demonstrate the working of communication systems and signal processing as per the application needs
4. Specify and design optimal modeling schemes for the given communication system problem to efficiently use the channel capacities and signal characteristics.

UNIT- I

Introduction: Identifying the role of simulation in Communication Systems ,Understanding analytically tractable and intractable systems, deterministic and stochastic simulations with examples, Mapping a problem into simulation model, system level modeling of timing recovery subsystem, linear vs nonlinear models, random process modeling and simulation, BER estimation.

UNIT- II

Quadrarure Models: Low pass and band pass sampling, Up sampling and down sampling, simulation sampling frequency, Low pass simulation model for band pass signals and systems, low pass complex envelope-time domain andfrequency domain representation, quadrature models for random band pass signals, Linear band pass systems, LTI systems, derivation of LPEQ components, Multi carrier signals, Nonlinear systems, time variant systems.

UNIT- III

Digital Filter models: Models and simulation techniques, CAD of IIR digital filters, PLL models, Nonlinear phase model, Simulating the PLL. Random Signal Models: Generating and Processing random signals, uniform random number generators, testing the random number generators, Mapping uniform RVs to an arbitrary pdf, generating uncorrelated Gaussian random numbers, generating correlated Gaussian random numbers, PN sequence generators, Post processing, Graphical techniques, Histogram estimation, PSD estimation, Gain, Delay, SNR.

UNIT- IV

Monte Carlo methods: Monte Carlo estimation, Application to communication systems, Monte Carlo simulation of PSK and QPSK systems, Semianalytic BER estimation for PSK and QPSK systems.

Advanced Models: Modeling and simulation of baseband and band pass non linearities, Multi carrier case, Modeling and simulation of time varying systems, time and frequency

descriptions of LTV systems, Modeling and simulation of waveform channels, multipath fading channel example, CASE STUDY –Modeling and Simulation of a cellular radio system, CCI and effects of sectoring, Generation of snapshots and SIR computation.

TEXT BOOKS:

1. WH TRANTER et.al, Principles of Communication Systems Simulation: Pearson Asia, 2010.
2. GB GIANNAKIS et. al, Signal Processing Advances in Wireless and Mobile communication, PHPTR, 2001
3. Michel C. Jeruchim, Philip Balaban and K.Sam Shanmugan, Simulation of Communication Systems Modeling ,Methodology &Techniques, 2nd Edition.

15ECSP2005/1

MICROSTRIP COMPONENTS AND ANTENNAS

Lecture :	3 Hrs/ Week	**Practical:** -	**Internal Assessment:**	40
Credits :	3		**Final Examination:**	60

Course Outcomes

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

1. Comprehend the properties of microstrip transmission lines and components.
2. Analyse the performance characteristics of low pass, high pass, band pass and Band stop filters .
3. Analyse various parameters of rectangular microstrip antennas.
4. Understand behavior of broadband and loaded microstrip antennas .

UNIT-I: MICROSTRIP TRANSMISSION LINES AND COMPONENTS

Microstrip Lines- Microstrip Structure, Waves in Microstrip, Quasi-TEM Approximation , Effective Dielectric Constant and Characteristic Impedance, Guided Wavelength, Propagation Constant, Phase , Velocity, and Electrical Length, Synthesis of W/h, Effect of Strip Thickness, Dispersion in Microstrip, Microstrip Losses, Effect of Enclosure, Surface Waves and Higher-Order Modes.

Coupled Lines - Even- and Odd-Mode Capacitances, Even- and Odd-Mode Characteristic Impedances and Effective Dielectric Constants, More Accurate Design Equations.

Discontinuities and Components - Microstrip Discontinuities, Microstrip Components, Loss Considerations for Microstrip Resonators, Other Types of Microstrip Lines.

UNIT-II:

LOW PASS AND BAND PASS FILTERS:

Low pass Filters- Stepped-Impedance L-C Ladder Type Low pass Filters, L-C Ladder Type of Low pass Filters using Open-Circuited Stubs,

Bandpass Filters- End-Coupled, Half-Wavelength Resonator Filters, Parallel-Coupled, Half-Wavelength Resonator Filters, Hairpin-Line Bandpass Filters, Interdigital Bandpass Filters,

HIGHPASS AND BANDSTOP FILTERS:

High pass Filters- Quasi lumped High pass Filters, Optimum Distributed High pass Filters.

Band stop Filters- Narrow-Band Band stop Filters; Band stop Filters with Open-Circuited Stubs, Optimum Bandstop Filters, Band stop Filters for RF Chokes.

UNIT-III:

MICROSTRIP RADIATORS

Review of various Microstrip antenna configurations, Feeding techniques and modeling, Radiation fields, Surface waves

ANALYTICAL MODELS FOR MICROSTRIP ANTENNAS

Introduction, Transmission line model, Cavity model, generalized cavity model, multiport network model.

RECTANGULAR MICROSTIP ANTENNAS

Introduction, Models for Rectangular patch antennas, Design considerations of rectangular patch antennas.

UNIT-IV:

BROADBANDING OF MICROSTIP ANTENNAS

Introduction, Effects of substrate parameters on bandwidth, Selection of suitable patch shape, Selection of suitable feeding technique.

LOADED MICROSTRIP ANTENNAS & APPLICATIONS

Introduction, Polarization diversity using microstrip antennas, Frequency agile microstrip antennas, Radiation pattern control of microstrip antennas, loading effect of a short, compact patch antennas.

TEXT BOOKS:

1. JIA- Sheng Hong, M.J.Lancaster "Microstrip Filters for RF / Microwave Applications", John Wiley & Sons. 2001. (Unit I and II)
2. Ramesh Garg, Prakash Bhartia,Inder Bahl, Apisak Ittipiboon "Microstrip Antenna Design Hand Book", Artech House,2001. (Unit III and IV)

REFERENCE BOOKS:

1. Prakash Bhartia and Inder Bahl " Microstrip Antennas" Artech House.
2. Girish Kumar, K.P.Ray "Broad Band Microstrip Antennas" , Artech House,2003.
3. Charles A. Lee & G.Conrod Delman "Microwave Devices Circuits and their Applications", John Wiley & Sons.
4. Kin-Lu Wong "Compact Broad Band Microstrip Antennas", John Wiley & Sons. 2002.

15ECSP2005/2

SPEECH PROCESSING

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes

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

1. Analyse different sound units from a given speech signal
2. Analyse and synthesize the speech signal from Linear Prediction Parameters for error reduction
3. Demonstrate advanced knowledge in Homomorphic Speech Models
4. Develop an end to end speech/speaker recognition system

UNIT -I

Fundamentals of Digital Speech Processing:

The process of Speech Production, The Acoustic Theory of Speech Production, Digital models for speech signals.

Time Domain Models for Speech Processing:

Introduction- Window considerations, Short time energy and average magnitude Short time 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, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

UNIT- II

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 Auto Correlation 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

UNIT -IV

Theory and Implementation of Hidden Markov Models

Introduction, Discrete Time Markov Processes Extensions of HMM, Three Basic problem sof HMMs, Types of HMMs, Autoregressive HMMs (Text Book 2)

Man Machine Communication: Recognition techniques, Features that distinguish speakers, Speaker Recognition Systems: Speaker Verification System, Speaker Identification System.

TEXT BOOKS:

1. L.R Rabiner and S.W. Schafer "Digital Processing of Speech Signals" Pearson Education, 4th edition, 2009
2. Lawrence Rabiner, Biing-Hwang Juang and B Yegnanarayana, "Fundamentals of Speech Recognition",1st edition, Pearson Education, 2009

REFERENCE BOOKS:

1. Thomas F Quateri Discrete Time Speech Signal Processing, Principles and Practice - Ist Ed., Pearson Education
2. Ben Gold & Nelson Morgan Speech & Audio Signal Processing-, 1 Edition., Wiley.
3. Douglas O'Shaughnessy Speech Communications: Human & Machine -, 2nd ed., IEEE Press.

15ECSP2005/3

MULTIMEDIA COMMUNICATIONS

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes

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

1. Develop the multimedia content using multimedia tools.
2. Understand various audio, video and joint coding techniques.
3. Identify the requirements of real time multimedia transfer on IP networks.
4. Study different types of multimedia processors.

UNIT- I

Introduction and tools used for MM content development , Media interaction, bimodality of human speech, Lip reading, speech driven talking heads, Lip synchronization, Lip tracking, Audio to visual mapping.

UNIT- II

Bimodal person verification, Joint AV coding, Multimedia processing, Digital media, Signal processing elements, Challenges in MM processing, Perceptual coding of Digital Audio Transform audio coders, Image coding, video coding, Water marking techniques, Organization, Storage and retrieval, ANNs for MMSP.

UNIT- III

Distributed MM systems, Multimedia processors, Multimedia OS, Multimedia communication standards, MPEG-1, MPEG-2, MPEG-4 and MPEG-7.

UNIT- IV

Real time multimedia across Internet, packet audio/video multimedia transport across IP/ATM Network, Wireless multimedia, mobile multimedia access for internet, multimedia PCS.

TEXT BOOK:

1. KR RAO et al “Multimedia Communication Systems: Techniques and Standards”, Pearson, 2002.

REFERENCE BOOKS:

1. D. BULL et al “Insight into Mobile Multimedia Communication , Academic Press, 1999
2. PK ANDLEIGH, K. THAKKAR Multimedia Systems Design , PHI,2002
3. TAY VAUGHAN Multimedia,5/e, TMH, 2001

15ECSP 2005/4

MOBILE HANDSET DESIGN

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Prerequisites:
Basic Electronics, Communication systems, Mobile Communication

Course outcomes:

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

1. Comprehend mobile handset RF transmitter and receiver.
2. Identify design solutions for mobile handset
3. Design GSM radio modems hardware and software
4. Design UMTS radio modems hardware

UNIT-I

Problem Analysis in Mobile Communication System- Introduction to Wireless Channels- Impact of Signal Propagation on Radio Channel- Signal Attenuation and Path Loss-Link Budget Analysis-Multipath Effect-Delay Spread-Doppler Spread-Fading-Signal Fading Statistics-Interference-Noise.

Mobile RF Transmitter and Receiver Design Solutions- Introduction to RF Transceiver, Mixer Implementations, Receiver Front-End Architecture, Receiver Performance Evaluation Parameters, Transmitter Front-End Architecture, Transmitter Architecture Design, Transmitter Performance Measures

UNIT-II

Design Solutions Analysis for Mobile Handsets- Introduction- Diversity- Channel Estimation and Equalization- Different Techniques for Interference Mitigation- Channel Coding- Automatic Repeat Request (ARQ) and Incremental Redundancy- Interleaving- Modulation- Bit Rate, Baud Rate, and Symbol Rate.

UNIT-III

GSM Radio Modem Design- Introduction- GSM Logical Channels- GSM Physical Channel- GSM Bursts- Burst RF Output Spectrum- Channel Allocation- GSM Frame Structure- Combination of Logical Channels- Design of Transmitter and Receiver Blocks for GSM- Radio Modem.

GSM Mobile Phone Software Design- Introduction to GSM Mobile Handset Software- Operating System Software- Device Driver Software- GSM System Protocol Software- Speech and Multimedia Application Software

UNIT-IV

UMTS Radio Modem Design- Introduction- Frequency Bands- Radio Link Frame Structure- Channel Structure- Spreading, Scrambling, and Modulation- Uplink Physical Channels-

Downlink Physical Channels- Timing Relationship between Physical Channels- Transmitter Characteristics- Different Channel Usage in Various Scenarios- Compressed Mode.

TEXT BOOKS:

1) Sajal K Das, Mobile Handset Design, John Wiley & Sons (Asia) Pvt. Ltd. 2010
2) Thomas H Lee: The Design of CMOS Radio Frequency Integrated Circuits, 2nd Edition, Cambridge University Press, 2009.

REFERENCE BOOKS:

1). 3GPP LTE Standards. http://www.3gpp.org/ftp/Specs/html-info/36-series.html
2). Abhi Naha, Peter Whale ,Essentials of Mobile Handsets Design, Cambridge Press,2012.

15ECSP 2006/1

SOFTWARE DEFINED RADIO AND COGNITIVE RADIO

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes:

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

1. Understand the software and hardware architecture of Software Defined Radio.
2. Understand the Essential Functionalities and requirements in development of Software Defined Radios and their usage for Cognitive Radio
3. Identify the Cognitive Radio Available Technologies and research fields.
4. Understand the concepts of Spectrum Sensing techniques for Cognitive Radio Applications

UNIT- I - Software Defined Radio

Basic SDR – Software and Hardware Architecture of an SDR – Spectrum Management – Managing unlicensed spectrum – Noise Aggregation

UNIT- II - SDR AS PLATFORM FOR COGNITIVE RADIO

Introduction – Hardware and Software architecture – SDR development process and Design – Application software – Component development – Waveform development – cognitive waveform development.

UNIT- III - Cognitive Radio Technology

Introduction – Radio flexibility and capability – Aware – Adaptive – Comparison of Radio capabilities and Properties – Available Technologies – Funding and Research in CRs.

UNIT- IV - Spectrum Sensing For Cognitive Radio Applications

Introduction - Challenges- Spectrum Sensing Methods for Cognitive Radio- Cooperative Sensing- External Sensing- Statistical Approaches and Prediction- Sensing Frequency- Hardware Requirements and Approaches- Multi-dimensional Spectrum Awareness- Spectrum Sensing in Current Wireless Standards.

TEXT BOOKS:

1. Bruce A Fette, “Cognitive Radio Technology”, 2nd edition Academic Press, 2009
2. Huseyin Arslan , “Cognitive Radio, Software Defined Radio and Adaptive wireless system, Springer, 2007.

REFERENCE BOOKS :

1. Mitola, J. and J. Maguire, G. Q., “Cognitive radio: making software radios more personal,” IEEE Personal Commun. Mag., Vol. 6, No. 4, pp. 13–18, Aug. 1999.
2. Tevfik Yucek and Huseyin Arslan, “A Survey of Spectrum Sensing Algorithms for Cognitive Radio Applications” , IEEE Communications Surveys & Tutorials, Vol. 11, No.1, First Quarter 2009, PP 116-130.

15ECSP2006/2

BIOMEDICAL SIGNAL PROCESSING

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course outcomes:

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

1. Understand the acquisition analysis and methods for processing of bioelectrical signals (ECG, EEG, EMG)
2. Modeling the EEG signal, analyze artifacts in the EEG, develop nonparametric and model based spectral analysis and joint time frequency analysis of EEG signals
3. Spectral analysis of the surface EMG, continuing with conduction velocity estimations, modeling of intramuscular EMG and intramuscular EMG signal decomposition
4. Identify and analyze the problem of baseline wander, powerline interference, interference from muscular activity, the detection of the QRS complex, the problem of wave delineation to compute wave durations, and data compression to handle large amounts of information.

Unit- I - Introduction: Biomedical signal Processing : Basics of Bioelectrical signals, signal Acquisition and analysis, Performance Evaluation.

Examples of Biomedical signals: The Electroencephalogram, The Electromyogram, The Electrocardiogram, The Electroneurogram, The Electrogastrogram, Event-related potentials (ERPs). Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer-aided Diagnosis.

UNIT -II - The Electroencephalogram (EEG):

The Electroencephalogram (EEG) – A brief background, The Nervous system, The EEG-electrical Activity measured on the scalp, Recording techniques, EEG applications.

EEG Signal Processing:

Modeling the EEG signal, Artifacts in the EEG, Nonparametric Spectral Analysis, Model-based Spectral Analysis, EEG Segmentation, Joint Time-Frequency analysis.

UNIT- III - The Electromyogram:

The Electrical Activity of Muscles, Amplitude Estimation in the surface EMG, Spectral analysis of the Surface EMG, Conduction Velocity Estimation, Modeling the Intramuscular EMG, Intramuscular EMG Signal Decomposition.

UNIT- IV - The Electrocardiogram:

The Electrocardiogram – A Brief Background : Electrical Activity of the Heart, Generation and Recording of an ECG, Heart Rythms, Heartbeat Morphologies, Noise and Artifacts, Clinical Applications.

ECG Signal Processing:
Baseline Wander, Power line interference (50/60 Hz), Muscle Noise Filtering, QRS detection, Wave delineation, Data Compression

ECG Signal Processing: Heart Rate Variability
Acquisition and RR interval condition, Time domain measures, Heart Rhythm representations, Spectral Analysis of Heart rate variability, Clustering of Beat Morphologies, Dealing with Ectopic Beats, Interaction with other Physiological signals.

TEXT BOOKS:

1. Leif Sornmo and Pablo Laguna, "Bioelectrical Signal Processing in Cardiac and Neurological Applications" Elsevier Academic Press. 2005.
2. Rangaraj M. Rangayan, "Biomedical Signal Analysis- A case study approach" IEEE Press series on Biomedical Engineering, 2002.

REFERENCE BOOKS:

1. Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley, 2001
2. D.C.Reddy, "Biomedical Signal Processing: Principles and Techniques", 2nd edition, Tata McGraw-Hill, New Delhi, 2005.
3. Metin Akay, "Biomedical Signal Processing", 1st edition, Academic Press Inc,1994.

15ECSP2006/3

ANN FOR RF AND MICROWAVE DESIGN

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Prerequisites: Basic course on ANN

Course outcomes:

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

1. Understand the anatomy of the overall design process.
2. Discuss various structures used for constructing Neural Networks.
3. Use various algorithms for training the ANNs.
4. Model different MW devices and circuits using ANN.

UNIT-I

INTRODUCTION AND OVERVIEW

RF and microwave design, Artificial Neural Networks (ANNs)

MODELING AND OPTIMIZATION FOR DESIGN

The design process, Anatomy of the design process, Conventional design procedures, CAD Approach, Knowledge-Aided Design (KAD) Approach, RF and Microwave circuit CAD, Modeling of circuit components, Computer Aided analysis Techniques, Circuit Optimization, CAD for printed RF and Microwave antennas, Modeling of printed Patches and slots, Analysis of printed patches and slots, Role of ANNs in RF and Microwave CAD, Modeling of RF and Microwave components, Efficient Optimization strategies, Implementation of Knowledge- Aided Design (KAD)

UNIT-II

NEURAL NETWORK STRUCTURES

Introduction, Generic notation, Highlights of Neural network modeling approach, Multilayer Perceptron (MLP), MLP structures, Information processing by a Neuron, Activation functions, Effects of Bias, Neural Network Feed Forward, Universal approximation Theorem, Number of Neurons, Number of layers, Back Propagation (BP), Training Process, Error Back Propagation, Radial Basis function networks (RBF), RBF network structure, Feed forward computation, Universal approximation Theorem, Two-Step training of RBF networks, Comparison of MLP and RBF neural networks, Wavelet Neural networks, Wavelet Transform, Wavelet networks and feed forward computation, Wavelet neural network with direct feed forward from input to output, Wavelet network training, Initialization of Wavelets, Arbitrary Structures, Clustering Algorithms and self-organizing maps, Basic concepts of Clustering Problems, K-Means algorithm, Self-Organizing Map (SOM), SOM training, Using a Trained SOM, Recurrent Neural Networks

UNIT-III

TRAINING OF NEURAL NETWORKS

Microwave neural modeling: Problem statement, Key issues in neural model development, Data generation, Range and distribution of samples in model input parameter space, Data splitting, Data scaling, Initialization of neural model weight parameters, Over learning and Under learning, Quality measurement for a neural model, Neural network training, Categorization of training techniques, Gradient-based methods, Line minimization, Local Minimum and Global Minimum, Back propagation Algorithm and its Variants, Training Algorithms Using Gradient-Based optimization techniques, Conjugate Gradient Training method, Quasi-Network Training Method, Levenberg-Marquardt and Gauss-Newton training Methods, Non Gradient-Based Training: Simplex Method, Training with Global Optimization Methods, Generic algorithms, Simulated Annealing (SA) algorithms, Training Algorithms Utilizing Decomposed Optimization, Comparisons of Different Training techniques, Feed forward Neural networks Training: Examples.

UNIT-IV

MODEL FOR RF AND MICROWAVE COMPONENETS

Modeling Procedure, Selection of model inputs and outputs, Training Data Generation, Error measures, Integration of EM-ANN Models with circuit simulators, Models for vias and Multilayer interconnects, Microstrip Transmission line model, Broadband GaAs One-Port Microstrip Via, Broadband GaAs Two-Port microstrip Via, Microstrip-to-Microstrip Multilayer interconnect, Integration of EM-ANN models with a network simulator, EM-ANN Models for CPW components, EM-ANN modeling of CPW transmission lines, Modeling of CPW Bends, EM-ANN Models for CPW opens and shorts, EM-ANN Modeling of CPW Step-in-Width, EM-ANN Modeling of CPW symmetric T-Junctions, Other passive component Models, Spiral Inductors, Multi conductor Transmission Lines, Micro Strip patch antennas, Waveguide Filter Components.

TEXT BOOK:

1. Q J Zhang and K C Gupta Neural Networks for RF and Microwave Design Artech House,2000

15ECSP2006/4

ADHOC WIRELESS AND SENSOR NETWORKS

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes:

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

1. Exemplify the unique issues in ad-hoc/sensor networks.
2. Familiar current technology trends for the implementation and deployment of wireless ad- hoc/sensor networks.
3. Confer the challenges in designing MAC, routing and transport protocols for wireless ad-hoc networks.
4. Comprehend the various sensor network Platforms, tools and applications..

UNIT- I:

Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet.

MAC Protocols: Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks – Classifications of MAC Protocol . MACAW – FAMA – BTMA – DPRMA – Real-Time MAC protocol – Multichannel protocols – Power aware MAC Routing Protocols for AD HOC Networks.

UNIT-II:

Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols -Table-driven protocols – DSDV – WRP – CGSR – On-Demand protocols – DSR – AODV – TORA – LAR – ABR – Zone Routing Protocol – Power Aware Routing protocols.

Multicast Routing: Introduction – Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols. Classifications of Multicast Routing Protocols -Tree-Based Multicast Routing Protocols BEMRP, MZRP, MCEDAR- Mesh–Based Multicast Routing Protocols - ODMRP, DCMP, FGMP, NSMP.

UNIT- III:

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 Protocols for Ad hoc Wireless Networks.

UNIT- IV:

Sensor Networks – Architecture : Single node architecture – Hardware components, energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design

principles, Development of wireless sensor networks , physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management.

TEXT BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, ―Ad Hoc Wireless Networks Architectures and Protocols, Pearson, 2004.
2. C. K. Toh, ―Ad Hoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall, 2001.

15ECSP2006/5

ADAPTIVE SIGNAL PROCESSING

Lecture :	3 Hrs/ Week	**Practical:**	-	**Internal Assessment:**	40
Credits :	3			**Final Examination:**	60

Course Outcomes:

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

1. Design an adaptive filter using an adaptive linear combiner for better performance.
2. Analyze the performance of the adaptive filter algorithm for minimum error.
3. Design LMS and RLS algorithms with minimum mean square error
4. Analyse interference cancelling methods in different environments

UNIT – I

Adaptive Systems : Definitions and Characteristics, Applications, General properties, open and closed loop adaptation, Applications of closed loop adaptation, Example of an Adaptive System.

The Adaptive Linear Combiner: Description, Input signal and Weight Vectors, Desired Response and Error, Performance Function, Gradient and Mean-Square Error, Examples of Performance Surface, Alternative Expression of the Gradient, De-correlation of Error and Input components.

UNIT – II

Properties of the Quadratic Performance Surface: Normal form of the input correlation matrix, Eigen values and Eigen vectors of the input correlation Matrix, Example with two weights, geometrical significance of Eigen vectors

Searching the Performance Surface: Methods of Searching the Performance Surface, Basic Ideas of Gradient Search Methods, Gradient Searching Algorithm and its Solution, Stability and Rate of Convergence, Learning Curves, Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Leaning Curves.

UNIT – III

Gradient Estimation and its effects on Adaptation: Gradient component estimation by derivative measurement, The performance penalty, derivative measurement and performance penalties with multiple weights, variance of the gradient estimate. Effects on the Weight-Vector solution, Excess Mean-square Error and Time constants, Misadjustment, Comparative Performance of Newton's and steepest-Descent Methods.

LMS Algorithms – Derivation of the LMS algorithm, Convergence of the Weight Vector, Example of convergence, Learning curve, Noise in the Weight Vector solution.

UNIT – IV

Adaptive interference cancelling: Early work in adaptive in interference cancelling, The concept of adaptive noise cancelling, Stationary noise cancelling solutions, Effects of signal concepts in the reference input, The adaptive interference canceller as a notch filter , The adaptive interference canceller as a high pass filter , Effects of finite length and causality , Multiple reference noise cancelling, Cancelling in echo's in long distance telephone circuits ,

Cancelling antenna side lobe interference, Cancelling periodic interference with an adaptive predictor ,The adaptive self tuning filter, The adaptive line enhancer

Introduction to adaptive arrays and adaptive beam forming: Side lobe cancellation, Beam forming with a pilot signal, spatial configurations, Adaptive algorithms, Narrow Band experiments, Broad band experiments

TEXT BOOKS:

1. Bernand Widrow, Samuel D.Stearns, Adaptive Signal Processing, PHI/Pearson Education, Asia 2nd edition,2002

REFERENCE BOOKS:

1. Simon Haykins, Adaptive filter Theory, PHI
2. Sophocles J. Orfamidis - Optimum Signal Processing – an Introduction, Tata McGraw Hill, 2nd edition
3. Thomas Alexander – Adaptive Signal Processing – Theory and Applications, Springer – Verlag
4. D. G. Manolokis, V. K. Ingle and S. M. Kogar, Statistical and Adaptive Signal Processing, Mc Graw Hill International Edition, 2000.

15ECSP2051

MULTIMEDIA COMMUNICATION LAB

Lecture :		**Practical:**	-3 Hrs/ Week	**Internal Assessment:**	40
Credits :	2			**Final Examination:**	60

Description: This course introduces basic techniques for multimedia signal processing, video processing and communications and discusses principles of real-world communication systems and standards. Topics include analog and digital video format, multiplexing of separate color components, video coding methods and standards, analog and digital TV systems, internet protocols for multimedia applications including streaming and interactive services, video watermarking and data hiding.

Prerequisites: Multimedia Communication Systems , Signals and Systems

Textbooks:

1) Y. Wang, J. Ostermann, and Y.-Q. Zhang, Video processing and communications, Prentice Hall, 2002.
2) K. R. Rao, Z. S. Bojkovic, D. A. Milovanovic, Multimedia Communication Systems: Techniques, Standards, and Networks, Prentice Hall PTR, 2002.
3) J. Kurose and K. Ross, Computer Networking: A Top Down Approach Featuring the Internet, 2nd edition. Addison-Wesley, July 2002.

Web References:

http://eeweb.poly.edu/~yao/EE4414/experiments.html

Experiment 1 --- Color TV transmission
Experiment 2 --- Motion estimation for video coding
Experiment 3 --- Video streaming over the Internet

During the lab course, each group of students will implement a complete hybrid video codec, concepts of the MPEG standards for the storage of moving images and analyze its properties.

Schedule:
(1) Introduction to MATLAB;
(2) Entropy Coding (1)
(3) Entropy Coding (2)
(4) Quantization
(5) Motion Estimation and Compensation
(6) Transform Coding and Intra-Coding Chain (1)
(7) Transform Coding and Intra-Coding Chain (2)
(8) Video Codec (1)
(9) Video Codec (2)
(10) Video Test

15ECSP2052

MODELING AND SIMULATION LAB

Lecture :		**Practical:**	-3 Hrs/ Week	**Internal Assessment:**	40
Credits :	2			**Final Examination:**	60

Note: -- Any **10** experiments out of the following **12** are to be completed in this course.

1. Estimation of Markov Model Parameters using MATLAB
2. Simulation of OFDM Spectrum using MATLAB
3. Simulation of Root Raised Cosine (RRC) Filters and Pulse Shaping in Communication Systems
4. Simulation BER estimation for PSK and QPSK
5. Simulation of BER performance of MSK modulator and 16-QAM modulator.
6. Simulation of TDM signal Transmission and reception.
7. Simulation of Histogram estimation of PDF, PSD estimation
8. Simulation of satellite link margin.
9. Simulation of direct sequence spread spectrum.
10. Simulation of BER for BPSK in OFDM with Rayleigh multipath fading channel
11. Simulation of Inter Carrier Interference (ICI) in OFDM due to frequency offset
12. Simulation for cancellation of Echo produced on the Telephone

Software:

1. MATLAB R2013b

THIRD SEMESTER

Code	Subject	L	P	C	I	E	T
15ECSP3051	Project work – Part A	0	0	10	40	60	100
15ECSP3052	MOOCS	0	0	2	40	60	100
15ECSP3053	Seminar	0	0	2	40	60	100
	Total	0	0	14	120	180	300

FOURTH SEMESTER

Code	Subject	L	P	C	I	E	T
15ECSP4051	Project work- Part B	0	0	14	40	60	100