KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE

(An Autonomous Institute under Kakatiya University, Warangal)
WARANGAL-506015, TELANGANA, INDIA

Post – Graduate Programme

M.TECH (DIGITAL COMMUNICATIONS)

Rules, Regulations, Scheme of Instruction & Evaluation and Syllabi

With effect from
2014 – 15

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

RULES AND REGULATIONS FOR POSTGRADUATE PROGRAMME – 2-YEAR M.TECH. DEGREE PROGRAMME (PRR-14)

(Applicable from the academic year 2014-15)

1. INTRODUCTION:

1.1 The provisions contained in these regulations given the conditions for imparting course of instructions, conducting examinations and evaluation of students performance leading to 2-year M.Tech. degree programme to be offered by Kakatiya Institute of Technology & Science, Warangal and awarded by Kakatiya University, Warangal

1.2 These regulations shall be called the ***"Kakatiya Institute of Technology & Science, Warangal (KITSW) regulations for the award of 2-year M.Tech. degree programme"*** *by Kakatiya University, Warangal*

1.3 They shall come into effect from the date of getting approval from the Academic Council of the Kakatiya Institute of Technology & Science, Warangal

1.4 They shall be applicable for all students enrolling for 2-year M.Tech. degree programme at the Kakatiya Institute of Technology & Science, Warangal from the academic year 2014-15.

2. DEFINITIONS:

2.1 ***"M.Tech."*** means Master of Technology, a Post-Graduate Degree awarded by Kakatiya University, Warangal

2.2 ***"University"*** means Kakatiya University, Warangal

2.3 ***"Institute"*** means Kakatiya Institute of Technology & Science, Warangal

2.4 ***"UGC"*** means University Grants Commission, New Delhi

2.5 ***"AICTE"*** means All India Council for Technical Education, New Delhi

2.6 ***"MHRD"*** means Ministry of Human Resource & Development, Govt. of India, New Delhi

2.7 ***"TSCHE"*** means Telangana State Council for Higher Education, Govt. of Telangana, Hyderabad

2.8 ***"GB"*** means Governing Body of the Institute

2.9 ***"AC"*** means Administrative Committee of the Institute

2.10 ***"FC"*** means Finance Committee of the Institute

2.11 ***"Council"*** means Academic Council of the Institute

2.12 ***"Principal"*** means Principal of the Institute

2.13 ***"Dean"*** means Dean of specific affairs of the Institute

2.14 ***"HoD"*** means Head of the Department of specific programme offered by the Institute

2.15 ***"BoS"*** means Board of Studies in the engineering of a specific programme offered by the Institute

2.16 ***"CoE"*** means Controller of Examinations of the Institute.

3. POST GRADUATE PROGRAMMES:

3.1 The Institute shall offer the following Post Graduate Programmes:

1. ***Structural & Construction Engineering (offered by the Dept. of Civil Engineering)***
2. ***Design Engineering (offered by the Dept. of Mechanical Engineering)***
3. ***Digital Communications (offered by the Dept. of Electronics & Communication Engineering)***
4. ***Software Engineering (offered by the Dept. of Computer Science & Engineering)***
5. ***VLSI & Embedded Systems (offered by the Dept. of Electronics & Instrumentation Engineering)***
6. ***Power Electronics (offered by the Dept. of Electrical & Electronics Engineering)***

3.2 The provisions of these regulations shall also be applicable to any new postgraduate programmes that are introduced from time to time with approval from appropriate bodies such as MHRD / AICTE / UGC, etc.

4. ADMISSION:

4.1

Course	Specialization	Eligibility		
		Qualifying Degree	GATE	PGECET
M.Tech.	Structural & Construction Engg.	B.E. / B.Tech. / AMIE in Civil Engineering / Construction Engineering or equivalent. They should have qualified at GATE/ PGECET	CE	CE
M.Tech.	Design Engineering	B.E. / B.Tech. / AMIE in Mechanical Engineering / Production Engineering / Industrial Engineering / Aeronautical Engineering / Marine Engineering or equivalent. They should have qualified at GATE / PGECET	ME	ME
M.Tech.	Digital Communications	B. E. / B.Tech. / AMIE in ECE, AMIE (Electronics & Telecommunication Engg. / B.E. / B.Tech. in Electrical or Electrical & Electronics Engg. EIE and Bio-medical Engg. or equivalent. They should have qualified at GATE / PGECET	EC / IN	EC
M.Tech.	Software Engineering	B.E. / B.Tech. / AMIE in any branch of Engg. / Tech. (Or) equivalent Master's Degree in Physics, Statistics, Mathematics, Applied Mathematics, Applied Statistics, Applied Physics, Geophysics, M.Sc. (Computer Science), M.Sc. (Information Systems), M.Sc. (Computer Applications & Electronics) and MCA or equivalent. They should have qualified at GATE / PGECET	CS	CS
M.Tech.	VLSI & Embedded Systems	B.E. / B.Tech. / AMIE in ECE, EIE, EEE, CSE, IT (Or) equivalent. They should have qualified at GATE / PGECET	CS / EC / IN / EE	EC
M.Tech.	Power Electronics	B.E. / B.Tech. / AMIE in Electrical & Electronics Engg. / Electrical Engg. or equivalent. They should have qualified at GATE / PGECET	EE	EE

4.2 **For GATE candidates**

The candidates should have passed B.E./B.Tech./AMIE in any branch of Engg./ Tech. (or) equivalent Master's Degree in Physics, Statistics, Mathematics or Applied Mathematics, Applied Statistics, Applied Physics, Geophysics, M.Sc. (Comp. Sc.), M.Sc. (Information Systems) (Computer Applications and Electronics) and MCA or equivalent. They should have qualified at the GATE and possess a valid GATE score. The seats will be assigned purely on the basis of merit in GATE.

For Sponsored candidates

The candidates should have passed BE/B.Tech./AMIE in any branch of Engg./ Tech. (or) equivalent Master's Degree in Physics, Statistics, Mathematics or Applied Mathematics, Applied Statistics, Applied Physics, Geophysics, M.Sc. (Comp. Sc.), M.Sc. (Information Systems) (Computer Applications and Electronics) and MCA or equivalent.

The criterion for selection of sponsored candidates shall be by their merit at the entrance examination to be conducted by the PGECET

Admission shall be made into sponsored category only with the candidates who are qualified either in GATE/ PGECET or as decided by the admission committee.

1. His/ Her application shall be duly recommended by the sponsoring agency for admission to the course and forwarded to the Convener, PGECET
2. He/ She must be permanent employee with the sponsoring agency for at least two years, after obtaining the qualifying degree.
3. The sponsoring agency must be a Government Establishment or a Public-Sector undertaking, or a reputed Private Engineering College
4. The sponsoring agency shall certify that the candidates will be granted leave for pursuing the M.E./ M.Tech. as regular course of study.
5. The candidates who are working in Research Projects approved by the competent authority are also required to fulfill the above conditions before they are sponsored for admission

4.3 The Admissions shall be made in accordance with the rules and guidelines issued by TSCHE

5 ACADEMIC YEAR:

5.1 Each academic year is divided into two semesters (odd and even), each of 15 weeks including two Mid Semester Examinations. Academic session of the first semester will be decided based on counseling schedule declared by the TSCHE / Convener, PGECET

5.2 The Institute shall announce the schedule for all the academic activities for both the semesters (odd & even semesters) well before the commencement of the academic year and take all the necessary steps to follow them scrupulously.

5.3 The academic activities in a semester normally include registration, course work, Continuous Internal Evaluation (CIE), End Semester Examination (ESE) and declaration of results.

6. REGISTRATION:

6.1 All the students are required to register in person at the beginning of each academic year on the dates specified in the academic calendar / almanac.

6.2 The sole responsibility for registration rests with the student concerned.

6.3 Registration of students will be centrally organized by the Academic Section of the Institute.

6.4 The Registration procedure involves:

a) Filling of the prescribed registration form
b) Payment of fees and clearance of outstanding dues (if any).
c) Submitting undertaking (undertaking for regular attendance, discipline and against ragging) along with the parents.

6.5 If for any compelling reasons like illness, etc., a student is unable to register on the announced day of registration, he/she can register within 12 working days from the beginning of the academic year on payment of an additional late fee as prescribed by the Institute.

6.6 **No late registration shall be permitted after 12th working day** from the scheduled date of commencement of class work for that academic year.

6.7 Only those students will be permitted to register who have

a) cleared all institute and hostel dues of previous semesters.
b) paid all required prescribed fees for the current academic year.
c) not been debarred / detained from registering for a specified period on disciplinary or any other grounds.
d) cleared the minimum academic requirement as detailed in Regulation No. 14.

7. CURRICULUM

7.1 The duration of the programme leading to 2-year M.Tech. degree will be 4 semesters (2 academic years).

7.2 The curricula for 2-year M.Tech. degree programme with specializations as proposed by the department concerned and recommended by its BoS shall have the approval of the Academic Council.

7.3 The curricula to be followed for all the M.Tech. programmes is as specified and approved by the BoS of the department concerned.

7.4 The courses offered would have a ***Lecture – Tutorial - Practical (L-T-P)*** component to indicate contact hours/ periods. Separate laboratory (practical) course may exist ***(0-0-P)*** in certain cases as decided.

7.5 The academic programmes of the Institute shall follow the credit system.

7.6 Each course shall have an integer number of credits(C), which reflects its weightage. The number of credits of a course in a semester shall ordinarily be calculated as under:

Number of credits of a course, C = L + (T+P)/2

- where L, T, P represent the No. of Lecture, Tutorial and Practical hours /periods per week.
- The fraction to be rounded off to next integer value.

7.7 **Course Code:** Each course offered in the Postgraduate (M.Tech.) curriculum at this institute shall be listed by using a total of 8 digits, as follows:

Ex: **P14SC101**

1. The first letter, to represent the **P**ost Graduate Programme
   Ex. **P** for Postgraduate Course
2. The next two numericals, to represent the year in which the syllabus is proposed / revised.
   Ex. **14** for the year 2014 from which syllabus is applicable for the batches admitted from academic year 2014-15.
3. The next two letters, to represent the post graduate specialization offered.
   Ex. **SC** for Structural & Construction Engineering
4. The last three numericals, to represent the course number and semester in which it is being offered.
   Ex. **XYZ**; X - Semester number ; YZ – Course number
   101 represents course number 01 offered in first semester

In general, a **course code** "**P14SC101**" represents a **Postgraduate Course number-01 offered for the batches admitted from the year 2014 in Structural & Construction Engineering in first semester.**

7.8 The syllabus of each course in the M.Tech. curriculum shall be divided into four units.

8. ATTENDANCE:

8.1 All the students are normally required to have full (100%) attendance.

8.2 However, the attendance in no case shall be less than 75% of the total classes held in all the courses offered in a semester for that academic year.

8.3 Students having attendance less than 75% in aggregate will be detained and are not allowed to appear for the end semester examination of that semester.

8.4 All such students who are detained have to repeat the entire semester when it is offered.

9. CONDUCT AND DISCIPLINE:

9.1 All students shall be required to conduct themselves in a manner befitting the reputation of the institution, within and outside the premises of the Institute; and are expected to complete their studies without any break.

9.2 As per the order of Hon'ble Supreme Court of India, ragging in any form is strictly banned. Involvement of a student in ragging will be considered as a gross indiscipline and may lead to his / her expulsion from the Institute.

9.3 Detailed rules regarding the conduct and discipline (code of conduct) are given in Appendix – I.

10 EVALUATION PROCEDURE:

10.1 The evaluation of students in a course for all 2-year M.Tech. programme (4 semesters) is a continuous process and is based on their performance in different examinations as mentioned below:

a) Sessional, involving **Continuous Internal Evaluation (CIE)** conducted all through the semester which includes **Mid-Semester Exams (MSE)** and **Teachers Assessment (TA)** through assignments.

b) Terminal, often designated as **End Semester Examination (ESE)** which includes a written examination for theory courses, practical, comprehensive viva-voce, dissertation examination with built-in oral part for laboratory / comprehensive viva-voce / dissertation courses.

10.2 A student's performance in a course (subject) shall be judged by taking into account the result of Continuous Internal Evaluation (CIE) and End Semester Examination (ESE) together.

10.3 Continuous Internal Evaluation (CIE) and End Semester Examination (ESE) shall have 40:60 weightage.

i.e. Continuous Internal Evaluation (CIE) carrying 40% weightage and End Semester Examination (ESE) carrying 60% weightage.

10.4 **Continuous Internal Evaluation (CIE) for Theory courses**:

10.4.1 The Continuous Internal Evaluation (CIE) throughout the semester shall consist of Teachers Assessment (TA) and Mid Semester Examination (MSE).

10.4.2 For assigning marks in Teachers Assessment (TA), performance in assignments is to be considered. Teacher shall give at least 2 assignments per each unit of syllabus covering the entire contents of that unit.

10.4.3 There shall be two mid semester examinations (MSE-I and MSE-II) of two hour duration for each course.

The average of the marks scored in MSE-I and MSE-II will be considered for evaluation under MSE. Hence, ***it is mandatory for the student to take both the mid semester examinations.***

10.4.4 The distribution given to each component of Continuous Internal Evaluation (CIE) for a theory course is given below:

S. No.	***Particulars***	***Weightage***
1.	*Teacher's Assessment (TA) (Assignments)*	*15%*
2.	*Mid Semester Examination (MSE) (MSE-I & MSE-II)*	*25%*
	Total Weightage::	***40%***

10.4.5 The marks obtained by the students in Mid Semester Examination (MSE) must be submitted to the Controller of Examination (CoE) by the teachers within 10 days from the date of conduct of the examination.

10.4.6 The dates for Mid Semester Examination (MSE) and End Semester Examination (ESE) will be declared by the CoE in consultation with the Dean, Academic Affairs.

10.5 **End Semester Examination (ESE) for Theory Course**:

There shall be an End Semester Examination (ESE) at the end of each semester for three hour duration for each course.

10.6 **Continuous Internal Evaluation (CIE) for Practical (Laboratory) Course:**

10.6.1 Continuous Internal Evaluation (CIE) for practical course shall carry 40% Weightage.

10.6.2 The Continuous Internal Evaluation (CIE) throughout the semester shall consist of the following:

Assessment	**Weightage**
Regular Experimentation / Job work	10%
Regular submission of record	10%
Quiz / Skill Test at the end of semester	10%
Viva-voce at the end of semester	10%
Total Weightage	**40%**

10.7 **End Semester Examination (ESE) for Practical (Laboratory) Course:**

10.7.1 There shall be an End Semester Examination (ESE) at the end of each semester for three hour duration for each practical course.

10.7.2 The End Semester Examination (ESE) for practical course shall carry 60% Weightage.

10.7.3 The marks distribution at End Semester Examination (ESE) shall be as follows:

Assessment	**Weightage**
Procedure / Experimentation / Tabulation / Result, as applicable …	40%
Viva-voce	20%
Total Weightage	**60%**

10.8 The **Department Post Graduate Review Committee (DPGRC)** shall be constituted with HoD as a Chairman, M.Tech. Coordinator as a Convener and Three to five other faculty members representing various specializations in that particular programme as members.

10.9 **Evaluation for Seminar :**

10.9.1 There shall be only Continuous Internal Evaluation (CIE) for Seminar, which includes Report Submission & Presentation

10.9.2 A teacher will be allotted to a student for guiding in

(i) selection of topic

(ii) report writing

(iii) presentation (PPT) before the DPGRC

10.10 **Evaluation for Comprehensive Viva-voce :**

There shall be only external oral examination for Comprehensive Viva-voce on a pre-notified date. The oral examination shall cover the entire content of courses covered in First and Second Semesters.

10.11 **Evaluation for Industrial Training:**

10.11.1 M.Tech. Coordinator in consultation with the Training & Placement Section has to procure training slots, for the students before the last day of instruction of 2nd semester.

10.11.2 The students shall confirm their training slots by the last day of 2nd semester

10.11.3 The students after 8 weeks Industrial Training shall submit a certificate, a report in the prescribed format before the last date specified by the Department Post Graduate Review Committee (DPGRC). The DPGRC shall evaluate their submitted reports and oral presentations.

10.12 **Continuous Internal Evaluation (CIE) for Dissertation:**

10.12.1 **Dissertation** shall be normally conducted in two stages, spread over two sequential semesters i.e. third and fourth semester.

10.12.2 **Registration Seminar** shall be arranged within four weeks after completion of the Industrial Training and Seminar in the 3rd semester. The Registration Seminar shall include a brief report and presentation focusing the identified topic, literature review, time schedule indicating the main tasks, and expected outcome.

10.12.3 **Progress Seminar-I:** At the end of first stage (third semester), student shall be required to submit a preliminary report of work done for evaluation to the project coordinator and present the same before the DPGRC. The Continuous Internal Evaluation (CIE) for the third semester is as follows:

Assessment	Weightage
Dissertation Supervisor Assessment	50%
DPGRC Assessment	50%
Total Weightage:	**100%**

10.12.4 **Progress Seminar-II** shall be arranged during the 6th week of IV semester.

10.12.5 **Progress Seminar-III** shall be arranged during the 15th week of IV semester.

10.12.6 **Synopsis Seminar** shall be arranged two weeks before the final thesis submission date. The student shall submit a synopsis report covering all the details of the works carried out duly signed by the Dissertation Supervisor.

10.12.7 At the end of second stage (fourth semester), student shall be required to submit two bound copies, one being for the department and other for the Dissertation Supervisor. The Dissertation report shall be evaluated by the DPGRC and external examination shall be conducted on a pre-notified date. The Dissertation evaluation for the fourth semester is as follows:

Assessment	Weightage
Dissertation Supervisor Assessment	20%
DPGRC Assessment	20%
ESE (Presentation & Viva-voce)	60%
Total Weightage:	**100%**

11 MINIMUM REQUIREMENT FOR PASSING A COURSE

11.1 **Theory Course**: A student is deemed to have passed in a theory course, if he / she secures

(a) 35 percent of marks assigned to End Semester Examination (ESE) and

(b) 35 percent of marks assigned to the Mid Semester Examination (MSE) and End Semester Examination (ESE) of the course taken together.

11.2 The average of the marks scored in both Mid Semester Examination (MSE) (as per the Regulation No. 10.4.4) will be considered for the evaluation under Mid Semester Examination (MSE).

11.3 **Laboratory Course**: A student is deemed to have passed in a laboratory course, if he / she secures

(a) 35 percent of marks assigned to End Semester Examination (ESE) and

(b) 35 percent of marks assigned to the Teachers Assessment (TA) and End Semester Examination (ESE) of the laboratory course taken together.

12 GRADING SYSTEM

12.1 At the end of the semester a student is awarded a letter grade in each of his / her courses taking into account his / her performance in Continuous Internal Evaluation (CIE) and End Semester Examination (ESE).

12.2 The typical grades and their numerical equivalents on 10-point scale (called Grade Points) are as follows:

Performance	Letter Grade	Grade Points (G_i)
Superior	S	10
Excellent	A	9
Very Good	B	8
Good	C	7
Average	D	6
Pass	P	4
Fail	F	0

12.3 F-Grade is a Fail Grade. The course in which the student has earned F-Grade will be termed as backlog Course.

12.4 In addition, there shall be a transitional M-grade.
M-Grade for "Debarred" due to malpractice / indiscipline during examination.

12.5 The Institute shall follow absolute grading system. The grades will be awarded as under:

Grade	Percentage Score (X)
S	$X \geq 90$
A	$80 \leq X < 90$
B	$70 \leq X < 80$
C	$60 \leq X < 70$
D	$45 \leq X < 60$
P	$35 \leq X < 45$
F	$X < 35$

12.6 For arriving at a grade obtained by a student in a particular course (subject), initially numeric marks obtained by the student out of 100 are to be determined. Once a numeric mark is obtained, the same is to be converted to a letter grade following the guidelines given in 12.5.

12.7 A Semester Grade Point Average (SGPA) will be computed for each semester. The SGPA will be calculated as follows:

$$\text{SGPA} = \sum_{i=1}^{n} C_i G_i \Big/ \sum_{i=1}^{n} C_i$$

where 'n' is the no. of courses (subjects) offered for the semester, 'C_i' is the credits allotted to a particular course, 'G_i' is the grade-points carried by the letter corresponding to the grade awarded to the student for the course as illustrated in 12.2.

12.8 The SGPA would indicate the performance of the student in the semester to which it refers. SGPA will be rounded off to the second place of decimal and recorded as such.

12.9 Starting from the second semester, at the end of each semester, a Cumulative Grade Point Average (CGPA) will be computed for every student as follows:

$$\text{CGPA} = \sum_{i=1}^{m} C_i G_i \Big/ \sum_{i=1}^{m} C_i$$

where 'm' is the total number of courses (subjects) the student has been offered from the first semester onwards upto and including the present semester, 'C_i 'and 'G_i' are as explained in 12.7.

12.10 The CGPA would indicate the cumulative performance of the student from the first semester up to the end of the semester to which it refers. CGPA will be rounded off to the second place of decimal and recorded as such.

12.11 SGPA and CGPA are calculated in consideration of only credits cleared, i.e. F-grade credits are not included for calculation.

13 SUPPLEMENTARY EXAMINATIONS

13.1 End Semester Examination (ESE) for each semester shall be conducted once in an academic year.

13.2 A student who obtained the F-grade in a course (theory or practical) can appear in a subsequent End Semester Examination (ESE) in the same course as supplementary candidate.

13.3 However the marks secured in Continuous Internal Evaluation (CIE) by the student in that course during the semester study shall remain unaltered.

13.4 The students those who have passed in the supplementary examination will be awarded grade with '*' marked on the courses passed in the supplementary.

13.5 Any candidate appearing for ESE in any course, after 2 years from his admission, shall be governed by the syllabus in force.

14 CONDITIONS FOR PROMOTION

14.1 A student shall have to satisfy the attendance requirements for the semester (as per the regulation No. 8) for promotion to the next higher semester.

15 GRADUATION REQUIREMENT

15.1 A student shall be declared to be eligible for award of the M.Tech. degree, if he / she has registered and completed all the courses with a minimum P-grade scored in every course

15.2 Normally a student should complete all the requirements consecutively in 4 semesters (2 academic years) for the award of M.Tech. degree. However, the students who fail to fulfill all the requirements for the award of M.Tech. degree within a period of 8 consecutive semesters (4 academic years from the registration in 1st semester) shall forfeit his / her enrolment to the program.

15.3 CGPA to Percentage (%) and Class Conversion is as follows:

S.No.	Division	Eligibility Criteria
1	First Division with Distinction	a) Student should secure CGPA≥8.0. b) Student should pass all the courses along with the batch of students admitted with him / her within 8 consecutive semesters. c) The failed candidate in any course shall not be awarded Distinction.
2	First Division	Student should secure CGPA, which is 6.5 ≤ CGPA < 8.0 within the time frame of the programme i.e. 8 semesters.
3	Second Division	Student should secure CGPA, which is 5.0 ≤ CGPA < 6.5 within the time frame of the programme i.e. 8 semesters.
4.	Pass Division	Student should secure CGPA, which is 4.0 ≤ CGPA < 5.0 within the time frame of the programme i.e. 8 semesters.

15.4 The University will award the post-graduate degrees to the students who are evaluated and recommended by the Institute.

16 MALPRACTICE IN EXAMINATION

16.1 Malpractice in examination is an illegal activity and is prohibited.

16.2 Mobile phones are strictly prohibited in the examination hall.

16.3 Exchange of question paper and material like pen, pencil, sharpener, eraser, scale, calculator, etc., during examination is strictly prohibited.

16.4 Malpractice in examination is viewed very seriously. Malpractice includes oral communication between candidates, possessing forbidden material, mobile phones (switched off/on) etc.

16.5 Any malpractice or engaging in any improper conduct and violation of the examination code by the student during examinations is liable for the punishment as given below:

S. No	Nature of Malpractice	S. No	Punishment
1.	Taking help from others, consulting and or helping other examinees during the examination period inside the examination hall or outside it, with or without their consent or helping other candidates to receive help from anyone else.	a)	Cancelling the examination of the paper in which he / she indulged in malpractices.

2	If the examinee attempts to disclose his / her identity to the valuer by writing his / her Hall-Ticket Number at a place other than the place prescribed for it or any coded message including his / her name or addressing the valuer in any manner in the answer book.		Cancelling the examination of the paper in which he / she indulged in malpractices.
3.	Candidate is found in possession of forbidden material; relevant or not relevant but not used.	b)	Cancellation of the result of all examinations taken or proposed to be taken during that session. However, he/ she shall be promoted to next semester/ year as per the promotion rules in vogue.
4.	Destroying the material found in his / her possession or acting in any other manner with a view to destroying evidence.	c)	Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting his/her admission to or continuation in any course of the Institute for a period of one year. The student will be eligible to appear for the next corresponding semester / year examination in the succeeding academic year.
5.	Smuggling main answer book / additional answer book / question paper / matter in to or out of the examination hall & Conspiring to interchange Hall Ticket Numbers.		-do-
6.	Candidate is found in possession of forbidden material, relevant or not relevant but used.		-do-
7.	In case of (i) impersonation, (ii) misbehavior with the invigilators/any person related to examination work, (iii) insertion of written sheets in different hand writing in the main/additional answer book, and (iv) creation of disturbance in and around the examination hall during or before the examination.	d)	Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting his/her admission in to or continuation in any course of the Institute for a period of two years. Further, the candidate shall not be allowed to appear for any examination during the period of punishment.

17 ROLL NUMBERS ALLOTMENT

The Roll Number given to the student shall have a total 8 digits as follows:

Ex: **M14SC007**

1. The first letter, to represent Masters (M.Tech.) degree programme.
   Ex: **M** for Masters programme
2. The next two numericals, to represent the year in which the student admitted into I semester.
   Ex: **14** for 2014
3. The next two letters, to represent the concerned specialization to which the student belongs.
   Ex: **SC** for Structural & Construction Engineering
4. The last three numericals, to represent the three digit roll number of the student.

In general, a **student with roll number** "**M14SC007**" represents a **Masters student with a specialization of Structural & Construction Engineering admitted in the year 2014 bearing a roll number of 007.**

18 AMENDMENTS

Notwithstanding anything contained in this manual, the Academic Council of the Institute reserves the right to modify / amend the curricula, requirements and rules & regulations pertaining to its postgraduate programmes, without any notice.

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE: WARANGAL
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Scheme of Instruction and Evaluation for Two Year Postgraduate Programme
M.TECH. (DIGITAL COMMUNICATIONS)

SEMESTER – I

Course code	Course Name	Periods/week			Credits	Evaluation Scheme				
						CIE			ESE	Total Marks
		L	T	P		TA	MSE	Total		
P14DC101	Detection & Estimation Theory	3	1	-	4	15	25	40	60	100
P14DC102	Modern Digital Communication Techniques	3	1	-	4	15	25	40	60	100
P14DC103	Advanced Digital Signal Processing	3	1	-	4	15	25	40	60	100
P14DC104	Microwave & Optical Fiber Communication Systems	3	1	-	4	15	25	40	60	100
P14DC105	Elective-I	3	1	-	4	15	25	40	60	100
P14DC106	Elective-II	3	1	-	4	15	25	40	60	100
P14DC107	Advanced Digital Signal Processing Lab	-	-	3	2	40	-	40	60	100
P14DC108	Microwave & Optical Fiber Communication Systems Lab		-	3	2	40	-	40	60	100
P14DC109	Seminar	-	-	-	2	100	-	100	-	100
	Total	**18**	**6**	**6**	**30**	**270**	**150**	**420**	**480**	**900**

Elective-I

P14DC105A	Advanced Digital Design
P14DC105B	Artificial Neural Networks
P14DC105C	Embedded System Design
P14DC105D	Low Power VLSI

Elective-II

P14DC106A	Data Compression Techniques
P14DC106B	Digital Design for Testability
P14DC106C	Data & Computer Communications
P14DC106D	Neuro-Fuzzy Modeling

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE: WARANGAL
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Scheme of Instruction and Evaluation for Two Year Postgraduate Programme
M.TECH. (DIGITAL COMMUNICATIONS)

SEMESTER – II

Course Code	Course Name	Periods/ week			Credits	Evaluation Scheme				
						CIE			ESE	Total Marks
		L	T	P		TA	MSE	Total		
P14DC201	Communication System Modeling	3	1	-	4	15	25	40	60	100
P14DC202	Coding Theory	3	1	-	4	15	25	40	60	100
P14DC203	Adaptive Signal Processing	3	1	-	4	15	25	40	60	100
P14DC204	Radar Signal Processing	3	1	-	4	15	25	40	60	100
P14DC205	Elective-III	3	1	-	4	15	25	40	60	100
P14DC206	Elective-IV	3	1	-	4	15	25	40	60	100
P14DC207	Communication System Modeling & Simulation Lab	-	-	3	2	40	-	40	60	100
P14DC208	Digital Communication Lab	-	-	3	2	40	-	40	60	100
P14DC209	Comprehensive Viva-voce	-	-	-	2	-	-	-	100	100
	Total	**18**	**6**	**6**	**30**	**170**	**150**	**320**	**580**	**900**

Elective – III

P14DC205A DSP Processors
P14DC205B Satellite Communications
P14DC205C Radio Navigational Aids
P14DC205D Multimedia Communications & System Design

Elective – IV

P14DC206A Statistical Signal Processing
P14DC206B Adhoc & Wireless Sensor networks
P14DC206C Digital Image Processing
P14DC206D Quantum Communications

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE: WARANGAL
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Scheme of Instruction and Evaluation for Two Year Postgraduate Programme
M.TECH. (DIGITAL COMMUNICATIONS)

SEMESTER – III

Course code	Course Name	Period	Credits	Evaluation Scheme				
				CIE			ESE	Total Marks
				TA	MSE	Total		
P14DC301	Industrial Training	08 Weeks	4	100	-	100	-	100
P14DC302	Dissertation	16 Weeks	8	100	-	100	-	100
	Total		**12**	**200**	**-**	**200**	**-**	**200**

SEMESTER – IV

Course code	Course Name	Period	Credits	Evaluation Scheme				
				CIE			ESE	Total Marks
				TA	MSE	Total		
P14DC401	Dissertation	24 Weeks	12	40	-	40	60	100
	Total		**12**	**40**	**-**	**40**	**60**	**100**

P14DC101 DETECTION & ESTIMATION THEORY

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

Course Learning Objectives:

- *To enable the students to acquire the fundamental concepts of Signal detection and estimation.*
- *To expose the conceptual basics of Hypotheses.*
- *To introduce the methods of Detection and estimation of signals in white and non-white Gaussian noise.*
- *To familiarize with the detection of random signals.*
- *To enable the students to understand the time varying waveform detection and its estimation.*

UNIT-I (9+3)

Classical Detection and Estimation Theory: Introduction, Detection and Estimation theory in signal processing, Bayes' Criterion-Binary Hypothesis Testing, Probability of making correct and error decisions, Minimum probability of error receivers , M-ary Hypothesis Testing, Minmax Criterion, Neymon-Peason Criterion, Composite Hypothesis Testing-Θ Random Variable with known density functions, Θ Non Random and unknown, Sequential detection, Vector Random Process, Illustrative problems on Hypothesis testing.

UNIT-II (9+3)

Representation of Random Processes: Representation of signals-Orthogonal functions-Generalized Fourier series, Gram-Schmidt Orthogonalization Procedure, Representation of random processes; General Gaussian problem-Binary detection, Same Covariance-Diagonal, Non diagonal Covariance Matrix, Same mean-Uncorrelated signal components equal and unequal Variances, Same mean Symmetric Hypothesis-Uncorrelated signal components equal and unequal Variances.

UNIT-III (9+3)

Signal Detection and Parameter Estimation: Maximum likely hood estimation, Criteria for good estimators, Bayes' Estimation-Minimum Mean-Square Error Estimate, Minimum Mean Absolute value of Error Estimate, Maximum A Posteriori Estimate. Cramer-Rao Inequality, Multiple parameter Estimation.

UNIT-IV (9+3)

Detection and Estimation of time varying waveforms: Simple Binary Detection, General Binary Detection. M-ary Detection. Linear Estimation- ML Estimation, MAP Estimation Non Linear Estimation- ML Estimation, MAP Estimation. General Binary Detection with unwanted parameters-Signals with random phase, Signals with random phase and amplitude, Signals with random parameters. Binary detection in colored noise-Karhunen-Loeve expansion approach, Whitening approach.

Text Books:

1. Signal Detection and Estimation-Mourad Barkat, ARTECH HOUSE, London.
2. Detection, Estimation and Modulation Theory: Part-1-Harry L.Van Trees, 2001, John Wiley & Sons, USA

Reference Books:

1. Fundamentals of Statistical signal processing: volume I Estimation Theory – Steven.M.Kay Prentice Hall, USA, 1998.
2. Fundamentals of Statistical Signal Processing: Volume I Detection Theory-Steven.M.Kay, Prentice Hall, USA, 1998.
3. Statistical Signal Processing: Detection, Estimation and Time Series Analysis – LouisL.Scharf, 1991, Addison Wesley.
4. Signals Processing: Discrete Spectral Analysis – Detection & Estimation – Mischa Schwartz, Leonard Shaw, 1975, McGrawHill.
5. Random Signals: Detection, Estimation and Data Analysis – K.SamShanmugam, Arthur M.Breiphol, 1998, John Wiley & Sons.

Course Learning Outcomes:

After completion of the course the student will be able to

- *Understand the basic concepts of Signal detection and estimation.*
- *Understand conceptual basics of Hypotheses.*
- *Understand the conceptual basics of Detection and estimation of signals in white and non-white Gaussian noise.*
- *Understand the detection of random signals.*
- *Understand the time varying waveform detection and its estimation.*

P14DC102 MODERN DIGITAL COMMUNICATION TECHNIQUES

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam:	60 marks

Course Learning Objectives:

- *To introduce various advanced digital communication concepts used as the building blocks for larger and more complex communication systems.*
- *To provide the basic theoretical elements and technological solutions suitable to design, implement and evaluate modern digital communication systems.*
- *To enable the student understand digital communication receivers like coherent and non-coherent receivers.*
- *To provide the properties and features of AWGN channels, Reed-Solomon codes, Viterbi algorithm and spread spectrum signals.*

UNIT-I (9+3)

Coherent and Non-Coherent Communication:

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Non-coherent receivers in random phase channels; M-FSK receivers – Partially coherent receivers – DPSK; M-PSK; M-DPSK--BER Performance Analysis.

UNIT-II (9+3)

Band-limited Channels and Digital Modulations:

Eye pattern; Demodulation in the presence of ISI and AWGN; Equalization techniques – IQ modulations; QPSK; QAM -BER Performance Analysis – Continuous phase modulation; CPFM, CPFSK, MSK-OFDM.

UNIT-III (9+3)

Space time propagation model , Rayleigh and Rician fading channels, MIMO and SISO modulation, MIMO BC signal model, Time varying fading Channel, Channel estimation using higher order statistical models.

UNIT-IV (9+3)

Spread Spectrum Signals for Digital Communication:

Model of spread Spectrum Digital Communication System-Direct Sequence Spread Spectrum Signals- Generation of PN Sequences and its properties - Frequency Hopped Spread Spectrum Signals- Performance of FH Spread Spectrum Signals in an AWGN Channel- Synchronization of Spread Spectrum Systems.

Text Books:

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, "Digital communication techniques; Signaling and detection"; Prentice Hall India, New Delhi, 1995.
2. Bernad Sklar, "Digital Communication – Fundamentals and Applications", Pearson Education, India, 2001.

Reference Books:

[1] Simon Haykin, "Digital communications", John Wiley and sons, 1998
[2] B.P.Lathi, "Modern digital and analog communication systems", 3rd Edition, Oxford University press, 1998.
[3] John G. Proakis, "Digital Communications" 4th Edition, McGraw-Hill, New York, 2003
[4] Introduction to space time wireless communications – A PAULRAJ et al, Cambridge Univ.Press 2003.

Course Learning Outcomes:

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

- *analyze all the M-ary modulation schemes.*
- *understand various types of block coding techniques for encoding and decoding.*
- *apply error control coding for reliable transmission over noisy channels.*
- *implement various equalization algorithms and understand their responses.*
- *understand the working principles of existing and advanced digital communication techniques.*
- *master the basic techniques suitable to understand, design and evaluate the main elements of a modern digital communication systems.*

P14DC103 ADVANCED DIGITAL SIGNAL PROCESSING

Class: M. Tech I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Examination:	60 marks

Course Learning Objectives :

- *To introduce the Advanced Signal Processing Techniques*
- *To understand the importance of spectral estimation techniques*
- *To design a multi-rate system*
- *To impart the concepts of Eigen value analysis techniques*

UNIT-I (9+3)

Multirate Digital Signal Processing: Decimation, Interpolation, time domain and frequency domain characterization of sampling rate alteration devices, Fractional sampling rate conversion, Direct-form FIR structures, poly phase filter structures, Time-variant filter structures, multistage implementation of sampling rate conversion, design of phase shifters**,.**

Interfacing of digital system: Interfacing with different sampling rates, Implementation of digital filter banks, sub band coding of speech signals, quadrature mirror filters, Trans multiplexers, oversampling ADCs and DACs.

UNIT-II (9+3)

Optimal Linear Filters: Representation of stationary random process, rational power spectra, filter parameters and auto correlation sequence. Forward and Backward Predictors: Reflection coefficients, AR process and Linear Prediction, Solution of normal Equations, Levinson & Durbin Algorithm, Properties of Linear Prediction error filters, AR and ARMA lattice Ladder structures.

UNIT-III (9+3)

Wavelet Transforms: Introduction to Short Time Fourier Transform (STFT), Definition of Wavelet Transform and its importance in multi-resolution analysis, Wavelet basis function, Mother Wavelet.

Power Spectrum Estimation: Cross correlation and Auto correlation of discrete time signals, power spectral density, periodogram, use of DFT in power spectrum estimation.

Non parametric methods for Power Spectrum Estimation: Bartlett method, Welch method, Blackman & Tukey method.

UNIT-IV (9+3)

Parametric methods for Power Spectrum Estimation: estimation Autoregressive (AR) moving average(MA) and Auto regressive – Moving average (ARMA) models, Yule-Walker method, Burg method Unconstrained least squares methods. Sequential Data algorithms for Power Spectrum Estimation: Capon's minimum variance, Pisarenko's harmonic decomposition method and Eigen decomposition method, MUSIC and ESPIRIT algorithms.

Text Books:

1. John G. Proakis D. G. Monolakis, *Digital Signal Processing: Principles, Algorithms & Applications*, PHI, New Delhi.
2. S. K. Mitra, Digital Signal processing: A computer based approach, Tata McGraw – Hill, New Delhi
3. Marple, Jr. SL., *Digital Spectral Analysis with Applications,* PHI, PPR,Englewood Cliffs, New Jersey.
4. P. Vaidyanatham, *Multirate filter banks*, PHI, New Delhi.
5. N.J. Fliege. "Multirate digital signal processing ." John Wiley.
6. M. Vetterli, J. Kovacevic, "Wavelets and subband coding" Prentice Hall Inc.

Course Learning Outcomes:

After completion of course the student will be able

- *To design a real time multi rate system*
- *To derive relation between wavelet transform, DFT and STFT*
- *To design and implement various systems like filter banks, implement different means of spectral estimation and apply Digital Signal Processing principles to process speech and Radar signals.*

P14DC104 MICROWAVE & OPTICAL FIBER COMMUNICATION SYSTEMS

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam	60 marks

Course Learning Objectives:

- *To introduce different O-type and M-type microwave tubes.*
- *To impart the concepts related to Microwave oscillators and amplifiers.*
- *To expose different microwave components and measurements.*
- *To introduce the concepts of optical fiber communications.*
- *To identify the significance of different Opto-Electric Integrated Circuits (OEICs).*

UNIT-I (9+3)

Microwave Tubes:

Introduction to Microwaves, Microwave region and bands, Applications. Classification of Microwave tubes – O type & M type. **O-type tubes:** Two cavity Klystron Amplifier – structure, velocity (Applegate) diagram, Small Signal Theory of Bunching, Principle of working and expressions for output power and efficiency. Reflex Klystron oscillator – structure, Applegate diagram, Mathematical Theory of bunching, Principle of working, electronic admittance and expressions for output power and efficiency. **Microwave cross field tubes (M type tubes)-** Magnetrons – 8 cavity cylindrical Magnetron – features, Mechanism of Oscillation, Hull cut-off condition.

UNIT-II (9+3)

Waveguide Components:

Microwave Hybrid Circuits: E-plane Tee, H-plane Tee and Magic Tee. Directional couplers, Ferrites – composition and characteristics, Faraday rotation. Ferrite components – Circulator, isolator and their applications. Scattering Matrix – Significance, formulation and properties, S-matrix of waveguide Tee junctions, Directional Coupler, Circulator and Isolator.

Microwave Measurements: Description of Microwave Bench – Different blocks and their features, Precautions, Attenuation Measurement, VSWR and Impedance measurement, Phase Shift Measurement.

UNIT-III (9+3)

Introduction to Fiber Optics:

Fiber Structures, Nature of light, basic optical laws and definitions, Modes and Configurations, Single, Multi mode step index and Graded Index fibers.

Optical sources and Detectors: Semiconductors as Optical Sources and their fabrication, LED and Laser Diodes, Linearity of Sources, Power launching and Coupling. Physical principles of PIN and APD, Photo Detector Noise, Detector Response time Avalanche Multiplication Noise and Photo Diode materials, Optical Amplifiers.

UNIT-IV (9+3)

Optical Fiber Communications: Basic Communication System fundamental receiver Operation, Fiber Links: Point to Point Links, Power budget, Time Budget, Line Coding, Eye Pattern, Dispersion compensation techniques, Limitations in High speed and WDM systems due to non-linearities in Fibers.

Opto-Electric Integrated Circuits (OEIC's): Basic Concepts of OEIC's, Optical planer and strip Wave guides, Principles of electro-Optic effect. Guided wave devices –Phase modulator, Machzehnder Inferometer modulator and switch, Optical directional coupler and Switches.

Text Books:

1. Microwave Devices and Circuits – by Samuel Y.Liao, PHI.
2. Microwave and Radar Engineering – by M.Kulkarni.
3. Senior John M. " Optical Fiber Communications Principles and practice", PHI 2/e 1996.
4. Keiser Gerd," Optical Fiber Communications", Mc GrawHill 2/e ,1991.
5. J. H Franz & V.K Jain." Optical Fiber Communication components & Systems" , Narosa Publishing House-2000.

Reference Text Books:

1. Microwave Engineering – by Annapurna Das and S.K.Das, Tata McGraw Hill.
2. Microwave Principles – by Herbert J.Reich, J.G.Skolnik, P.F.Ordung and H.L.Krauss, Affiliated East West Press Pvt.Ltd, New Delhi.
3. Gowar John ," Optical Fiber Communication Systems ", PHI 2/e, 2002.
4. Microwave Principles – by Herbert J.Reich, J.G.Skolnik, P.F.Ordung and H.L.Krauss, Affiliated East West Press Pvt.Ltd, New Delhi.
5. Electronic and Radio Engineering – by Frederic E.Terman, McGraw Hill Publ.

Course Learning Outcomes:

After completion of course the student will be able to

- *Understand the basic principles of O-type and M-type microwave tubes which can be used as an amplifier or oscillator*
- *Gain knowledge of different measuring techniques at Microwave frequencies*
- *Gain knowledge of different optical sources and detectors*
- *Understand the fundamental optical fiber receiver operation*
- *Apply the knowledge of Optical fiber Communication*
- *Gain the knowledge of Opto-Electric Integrated Circuits (OEIC's)*

P14DC105A ADVANCED DIGITAL DESIGN
(Elective - I)

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam:	60 marks

Course Learning Objectives:

- *To focus on detailed study of various building blocks of digital systems at transistor level.*
- *To focus on FSM and ASM based designs.*
- *To introduce Verilog hardware description language for developing and verifying designs of digital circuits.*
- *To elaborate on structure and applications of various PLDs.*

UNIT-I (9+3)

Digital Integrated System Building Blocks:
Multiplexors and Decoders, Barrel Shifters, Counters, Digital Adders, Digital Multipliers, Programmable Logic Arrays.

Latches, Flip-Flops, and Synchronous System Design:
CMOS Clocked Latches, Flip-flops, CMOS Flip-flops, Synchronous System Design Techniques, Synchronous System Examples.

UNIT-II (9+3)

Finite State Machines: Moore and Mealy machines, Case studies, sequence detector.
Algorithmic State machines: ASM Notations, multiplexer control method, one-hot method, ROM based method.
Design case studies: Binary multiplier, count number of ones, TLC.

UNIT-III (9+3)

Digital Design using Verilog HDL:
Introduction to HDL - language elements, Identifiers, operators, data types, types of model, Structural Gate-level, Behavioral, Dataflow and Switch-level.
Design using HDL- Adders, Multiplexers, decoders, Flip-flops, Counters, Shift registers.

UNIT-IV (9+3)

Programmable Logic Devices:
ROM: Internal ROM Structure, Applications of ROM, Static-RAM Structure, Dynamic-RAM Structure, CPLD, FPGA.

Text Books:

1. Ken Martin, "Digital Integrated Circuit Design", Oxford University Press 2000
2. "Digital Design Principles and Practices Fourth Edition", by John F. Wakerly, 2006, ISBN 0-13-186389-4.
3. "Digital Design" –M. Morris Mano, PHI.

Reference Books:

1. "Switching Theory and Logic Design" by Anand Kumar, PHI
2. Samir Palnitkar, "Verilog HDL- A Guide to Digital Design and Synthesis", Prentice Hall India, 2000.
3. "Fundamentals of Logic Design" – Charles H. Roth, 5th ed., Cengage Learning.

4. "Digital Circuits and Logic Design" – Samuel C. Lee, PHI.
5. A P Godse, "Digital System Design", Technical publication.

Course Learning Outcomes:

After completion of the course, the students will be able to

- *Get an in-depth knowledge of digital design.*
- *Design complex digital designs using contemporary design techniques, hardware description language (HDL) and professional CAD tools.*
- *Express a digital design in Verilog HDL and synthesize the design in programmable logic.*
- *Use standard digital memory devices as components in complex subsystems.*

P14DC105B ARTIFICIAL NEURAL NETWORKS
(Elective - I)

Class: M. Tech I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Examination:	60 marks

Course Learning Objectives :

- *To introduce the fundamental concepts of Artificial Neural Networks.*
- *To focus on learning rules of neural networks.*
- *To introduce Bidirectional Associate Memory and Hopfield Memory.*
- *To focus on stochastic networks and Simulated Annealing, working of Boltzman machine and its learning.*
- *To introduce the concepts of competitive learning network and adaptive resonance theory.*

UNIT-I (9+3)

Fundamental Concepts and Models of Artificial Neural Networks:
Biological Neuron and their Artificial Models, Models of Artificial Neural Network, Neural Network learning Rules: Hebbian rule, Perception learning rule its convergence theorem, Delta learning rule, Widrow-Hoff rule, Correlation learning rule, Winner-Take-All learning rule, Outstar learning rule.

UNIT-II (9+3)

Bidirectional associative memory and Hopfield memory:
Associative Memory definitions, Hamming distance, linear Associator, Bidirectional Associative Memory Architecture, Processing and Energy function.
Discrete Hopfield memory, Continuous Hopfield memory, traveling salesman problems.

UNIT-III (9+3)

Stochastic networks and simulated annealing:
Stochastic update, Equilibrium of Stochastic Networks, Stability in Stochastic Networks, Operation of a Stochastic Network, Simulated Annealing.
Boltzman Machine:
Architecture of a Boltzman Machine, Learning rule, issues in implementation of Boltzman Machine.

UNIT-IV (9+3)

Competitive learning network:
Components of Competitive learning network, basic learning rules, Description of Kohonen's neural network, Learning rule and parametric selection.
Adaptive resonance theory:
ART1, ART2 network description and learning rules.

Text Books:

1. Zurada, Artificial Neural Networks, TMH, NewDelhi
2. Freemann JA. And Skapura DM, Neural Networks Algorithm, Applications and Programming Techniques, Addison Wesley, 1991
3. Yegnanarayana. B,Artificial Neural Networks. PHI.

Reference Books:

1. Muller B.Rienhardt,J., Neural Networks and Introduction,Springer- Verlag,1991.
2. Simon Haykin. Neural Networks (A Comprehensive Foundations), McMillan College Pub. Company, New York, 1994.
3. S. Rajashekaran, G.A. Vijaya laxmi pai" Neural Networks .Fuzzy Logic & Genetic Algorithms", PHI.

Course Learning Outcomes:

After completion of the course, the student will be

- *Able to design and define the learning of Artificial Neural Networks in feed forward and feedback networks.*
- *Familiarized with the concepts of Bidirectional Associate Memory and Hopfield Memory.*
- *Able to learn about Stochastic networks and Simulated Annealing and working of Boltzman machine with machine learning.*
- *Able to learn the concepts of competitive learning network and adaptive resonance theory.*

P14DC105C EMBEDDED SYSTEM DESIGN
(Elective - I)

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam:	60 marks

Course Learning Objectives:

- *To emphasize on the basic concepts and building Blocks for Embedded Systems.*
- *To expose the students to the fundamentals of microcontroller based system design.*
- *To introduce I/O and RTOS role in microcontroller.*
- *To impart knowledge on PIC Microcontroller based system design.*
- *To introduce the architecture and programming of 16-bit RISC processor.*

UNIT-I (9+3)

EMBEDDED DESIGN WITH MICROCONTROLLERS:
Product specification - Hardware/software partitioning – Detailed hardware and software design – Integration – Product testing – Microprocessor Vs Microcontroller - Performance tools -Bench marking - RTOS Micro Controller - issues in selection of processors.

UNIT-II (9+3)

8051 PROGRAMMING:
Introduction to architecture. Assembly language programming – Arithmetic Instructions-Logical Instructions - Single bit Instructions - Timer Counter programming – Serial Communication Programming Interrupt Programming –RTOS for 8051 – RTOS Lite - Full RTOS - TASK creation and run – LCD digital clock/thermometer using full RTOS.

UNIT-III (9+3)

PIC MICROCONTROLLER:
Architecture-memory organization-addressing modes- Instruction set- PIC programming in Assembly & C – I/O port, Data Conversion, RAM&ROM Allocation ,Timer Programming ,Timers-Interrupts, I/O ports-I2C bus –A/D converter-UART-CCP modules-ADC,DAC and Sensor Interfacing –Flash and EEPROM memories.

UNIT-IV (9+3)

ARM ARCHITECTURE AND PROGRAMMING:
Acorn RISC Machine- Architectural Inheritance-Core & Architecture –The ARM Programmer's model –Registers-pipeline- Interrupts-ARM organization-ARM processor family-Co-processors. Instruction set-Thumb instruction set- Instruction cycle timings.

Text Books:

1. 1 James k.Peckol, "Embedded system Design", JohnWilley&Sons, 2010.
2. Muhammad Ali Mazidi, Janice G. Mazidi and D. McKinley, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2005.

Reference Books:

1. Muhammad Ali Mazidi, Rolin D.Mckinlay ,Danny Causey'PIC Microcontroller and Embedded systems using Assembly and C for PIC 18' Pearson Education 2008.
2. Andrew N.Sloss, Dominic Symes,Chris Wright , John Rayfiled "ARM system Developer's Guide Designing and Optimizing system Software' Elsevier 2007.
3. William Hohl,'ARM Assembly Language' Fundamentals and Techniques, CRC press.

Course Learning Outcomes:

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

- *understand the basics of an embedded system.*
- *learn efficient coding techniques for embedded systems.*
- *appreciate various considerations of embedded systems design like– specification; technological choice; the development process; technical, economic, environmental and manufacturing constraints; reliability, security and safety issues.*
- *learn the modern hardware/software tools for building prototypes of embedded systems.*
- *estimate if additional hardware can accelerate a system.*

P14DC105D LOW POWER VLSI
(Elective - I)

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam:	60 marks

Course Learning Objectives:

- *To introduce the concepts for low power design techniques.*
- *To introduce the concepts of power estimation and optimization techniques.*
- *To elaborate on various sources of power dissipation in CMOS circuits.*
- *To cover detailed analysis of power estimation including probabilistic and statistical techniques.*
- *To focus on circuit design techniques considering sub –micron and deep sub –micron design issues.*
- *To introduce power optimization techniques in SRAM cells.*

UNIT-I (9+3)

Simulation Power Analysis: Need For Low Power VLSI Chips- Charging And Discharging Capacitance- Short Circuit Current- Leakage Current- Static Current- Basic Principles of Low Power Design- Gate Level Logic Simulation- Architectural Level Analysis.

UNIT-II (9+3)

Circuit and logic level power Estimation: Transistor and Gate Sizing- Equivalent Pin Ordering- Network Reconstructing and Reorganization- Gate Reorganization- Signal Gating-Logic Encoding- State Machine Encoding- Pre-Computation Logic- Power Reduction in Clock Networks- CMOS Floating Node- Low Power Bus- Delay Balancing.

UNIT-III (9+3)

Power Estimation: Architecture and System- Power and Performance Management- Switching Activity Reduction- Parallel Architecture- Flow Graph Transformation. Modeling of Signals- Signal Probability Calculation- Probabilistic Techniques for Signal Activity Estimation- Statistical Techniques- Estimation of Glitching Power

UNIT-IV (9+3)

Circuit Design techniques and SRAM Architecture:
Circuit Design Style- Leakage Current in Deep Sub-Micrometer Transistors- Deep Sub-Micrometer Device Design Issues- Low Voltage Circuit Design Techniques- Multiple Supply Voltages- MOS Static RAM- Memory Cell- Banked SRAM- Reducing Voltage Swing on Bit Lines- Reducing Power in the Write Driver and Sense Amplifier Circuits

Text Books:

1. Gary Yeap, "Practical Low Power Digital VLSI Design", Kluwer academic publishers,2001.
2. Kaushik Roy, Sharat prasad, "Low Power CMOS VLSI Circuit Design", John Wiley &Sons Inc., 2000.

Reference Books:

1. Anantha Chadrasekaran and Robert Broderson, "Low Power CMOS Design", Standard Publishers, 2000.
2. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, "CMOS/BiCMOS ULSI Low Voltage, Low Power", Pearson edition, Second Indian reprint, 2003.

Course Learning Objectives:

After completion of the course, the students will be able to

- *understand the issues related to power consumption in ICs.*
- *use power analysis algorithms and computer-aided tools.*
- *acquire an ability to apply low power design methods to digital electronic circuits.*
- *understand circuit design techniques and SRAM Architectures.*

P14DC106A DATA COMPRESSION TECHNIQUES
(Elective - II)

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal evaluation:	40 marks
End semester Exam	60 marks

Course Learning Objectives:

- *To enable the students to acquire the fundamental knowledge about different compression techniques.*
- *To introduce the concept of optimal and adaptive waveform for speech and image.*
- *To emphasize the audio and video compression techniques for digital broadcasting.*
- *To acquire knowledge about digital signal compression standards for data, speech, image, audio and video.*

UNIT-I (9+3)

Data compression: Entropy coding-Huffman Run length, arithmetic and Ziv-Lemple coding. Speech & Image waveform characterization- Source models, Quantization Optimal & adaptive waveform coders for speech & images.

UNIT-II (9+3)

Private coding-DPCM, Linear prediction, prediction for video, Adaptive prediction, motion compensation for video

UNIT-III (9+3)

Transform coding: Orthogonal transforms- Fourier, Cosine, Wavelet based approaches to speech & image compression.

UNIT-IV (9+3)

Sub-band coding, VQ based compression, Fractal coding of images. High quality video & audio compression for digital broadcasting. Standards for digital signal compression-data,speech, audio,images & video.

Text books:

1. M.Nelson, "The data compression book"2nd edition, BPB publications, 1997.
2. Jananth & Noll, " Digital coding of waveforms-Principles and applications to speech & video", PHI,1984.
3. K.R.Rao 7 Hwang. JJ, "Techniques & standards for image, video & audio coding",PHI,1996.
4. Elliot, "Hand book of Digital Signal processing ",Academic press,1985.
5. Ning Lu, "Fractal Imagin",Academic press,1997.
6. C.S.Barrus, R.A.Gopinath & H.Guo, "Introduction to wavelets & wavelet transforms",PHI,1998.

Course Learning Outcomes:

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

- *Understand the speech and image waveform characterizations.*
- *Understand the basic compression techniques for speech and image.*
- *Know the standards of data, speech, audio, image and video signals for digital signal compression.*
- *Know the high quality audio and video compression for digital broadcasting.*

P14DC106B DIGITAL DESIGN FOR TESTABILITY
(Elective - II)

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam:	60 marks

Course Learning Objectives:

- *To focus on Programmable Logic, Finite state machine and Algorithmic state machine based designs to construct high level modules.*
- *To provide students with an understanding of fault tolerant concepts, including both the theory of how to design and evaluate them and the practical knowledge of real fault tolerant systems.*
- *To elaborate on design verification and testing issues.*
- *To introduce fault modelling techniques in digital system design.*
- *To introduce the concept of PLA Folding and Minimization*

UNIT-I (9+3)

Designing with Programmable Logic Devices:

Designing with Read only memories – Programmable Logic Arrays – Programmable Array logic – Sequential Programmable Logic Devices – Design with FPGA's– Using a One-hot state assignment, State transition table- State assignment for FPGA's - Problem of Initial state assignment for One –Hot encoding - State Machine charts – Derivation of SM Charts – Realization of SM charts – Design Examples –Serial adder with Accumulator - Binary Multiplier – Signed Binary number multiplier (2's Complement multiplier) – Binary Divider – Control logic for Sequence detector – Realization with Multiplexer – PLA – PAL.

UNIT-II (9+3)

Fault Modelling & Test Pattern Generation:

Logic Fault model – Fault detection & Redundancy- Fault equivalence and fault location –Fault dominance – Single stuck at fault model – Multiple stuck at fault models –Bridging fault model.
Fault diagnosis of combinational circuits by conventional methods – Path sensitization techniques, Boolean Difference method – Kohavi algorithm – Test algorithms – D algorithm, PODEM, Random testing, Transition count testing, Signature analysis and test bridging faults.

UNIT-III (9+3)

Fault Diagnosis in Sequential Circuits:

Circuit Test Approach, Transition Check Approach - State identification and fault detection experiment, Machine identification, Design of fault detection experiment.

UNIT-IV (9+3)

PLA Minimization and Testing:

PLA Minimization – PLA folding, Fault model in PLA, Test generation and Testable PLA Design.

Text Books:

1. Fundamentals of Logic Design – Charles H. Roth, 5th ed., Cengage Learning.
2. Digital Systems Testing and Testable Design – Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman- John Wiley & Sons Inc.
3. Logic Design Theory – N. N. Biswas, PHI

Reference Books:

1. Switching and Finite Automata Theory – Z. Kohavi , 2nd ed., 2001, TMH
2. Digital Design – Morris Mano, M.D.Ciletti, 4th Edition, PHI.
3. Digital Circuits and Logic Design – Samuel C. Lee , PHI

Course Learning Outcomes:

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

- *Construct high level modules using Programmable Logic, Finite State Machine and Algorithmic State Machine based designs.*
- *Get an in-depth knowledge of Advance digital System design.*
- *Design fault models for combinational and sequential circuits.*
- *Verify testability of a design based on given testability requirements.*
- *Minimize PLAs using PLA folding techniques.*

P14DC106C DATA & COMPUTER COMMUNICATIONS
(Elective - II)

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam :	60 marks

Course Learning Objectives:

- *To introduce baseband and M-ary modulation/demodulation, and Symbol error rate*
- *To expose Adaptive Equalization techniques*
- *To study Synchronization and Digital communications in fading channels.*
- *To study the basic concepts of communication networks, protocols and their performance.*
- *To solve the problems related to switching techniques.*
- *To study the satellite network architecture and protocols.*

UNIT-I (9+3)

Overview of Data Communications and Networking: Data Communication Networks- Physical structures, Protocols and standards, Layered tasks, Five layer Internet model, OSI model

Multiple Access: Random access,Multiple access, Aloha- Carrier Sense Multiple Access (CSMA), 1 and p-persistent CSMA- Carrier Sense Multiple Access with Collision Detection (CSMA/CD)- Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Controlled Access- Reservation- Polling- Token Passing.

UNIT-II (9+3)

Fading: Digital Signaling over multi path fading channels, characterization of time varying frequency selective channels, binary signaling over frequency non-selective fading channel.

UNIT-III (9+3)

Data Communication Networking: Computer communication architecture, Data link control line configuration, flow control, error control, Stop and wait ARQ, Go Back N ARQ, Selective Repeat ARQ, bit-oriented link control (HDLC).

Communication Networking Techniques: circuit, message and packet switching, broadcast networks, packet switching: Virtual circuits and datagrams, routing, Traffic control, error control.

UNIT-IV (9+3)

Satellite Networks: satellite network architecture, channel access protocols, local networks: technology Bus/Tree topology, ring topology, medium access control protocols and protocol performance.

Reference Text Books

1. John.G.Proakis, *Digital Communication*, MGH 4th edition, 2001
2. Sklar, *Digital Communication*, Pearson Education 2nd Edition, 2002
3. K.S.Shanmugan, *Digital and Analog Communication Systems*, Wiley, 1985
4. J.Das, SKMullick, PK Chatterjee, *Principles of Digital Communication*, Wiley eastern,1992
5. StallingsW, *Data and computer communications*,Maxwell Mac Mllan,Peasrosn Education,2002
6. Andrew S.Tanenbaum, *Computer Networks*, PHI, 4th Edition,
7. Green, *Computer Networks architectures and protocols*, Plenum, Pearson Education, 1983.

Course Learning Outcomes:

After completion of the course the student will be able to

- *learn the basic concepts of M-ary and Adaptive equalization techniques*
- *learn about the digital communications in fading channels*
- *get familiarized with the concept of LANs and switching techniques in network management*
- *learn about the satellite networks and protocols*

P14DC106D NEURO-FUZZY MODELING
(Elective - II)

Class: M. Tech I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Examination:	60 marks

Course Learning Objectives :

- *To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.*
- *To explain the concepts of neural networks with the help of examples and generalize to form appropriate rules for inference systems.*
- *To provide the mathematical background for carrying out the optimization associated with neural network learning.*
- *To introduce genetic algorithms and other random search procedures useful while seeking global optimization in self-learning situations.*

UNIT-I (9+3)

FUZZY SET THEORY:

Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT-II (9+3)

OPTIMIZATION:

Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search

UNIT-III (9+3)

NEURAL NETWORKS:

Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Mutilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning

UNIT-IV (9+3)

NEURO FUZZY MODELING:

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

Text Books:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.

Reference Books:

1. Elaine Rich & Kevin Knight, Artificial Intelligence, Second Edition, Tata Mcgraw Hill Publishing Comp., 2006, New Delhi.
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
3. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
5. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional, Boston, 1996.
6. Amit Konar, "Artificial Intelligence and Soft Computing Behaviour and Cognitive model of the human brain", CRC Press, 2008.

Course Learning Outcomes :

After completion of the course, the student will

- *get the concepts of fuzzy sets, fuzzy logic and use of heuristics based on human experience .*
- *be familiar with neural networks that can be learned from available examples and generalize to form appropriate rules for inferencing systems*
- *get the mathematical background for carrying out the optimization associated with neural network learning .*
- *get familiarized with genetic algorithms and other random search procedures useful while seeking global optimization in self-learning situations .*

P14DC107 ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam:	60 marks

Course learning objectives:

- *To develop students ability to solve problems on multi-rate signal processing using simulation software.*
- *To develop students ability to find autocorrelation, cross correlation & power spectrum estimation of different random processes with parametric & nonparametric methods using simulation software*

LIST OF EXPERIMENTS

MATLAB Program for:

S.No	Name of the Experiment
1	Plotting Interpolated version of a sinusoidal signal both in time domain & frequency domain
2	Plotting Decimated version of a sinusoidal signal both in time domain & frequency domain
3	Program To compute the order of the linear phase FIR filter using Kaiser's formulae
4	Program to compute the order of the linear phase FIR filter using Remezord function
5	Program to plot approximate and dedicated coefficients of a speech signal using DWT of 4 levels
6	Plot Periodogram Estimation of Additive White noise
7	Periodogram Estimation of noise corrupted signal using Bartlett method
8	Periodogram Estimation of noise corrupted signal using Welch Method
9	Periodogram estimation of noise corrupted signal using Blackman Tukey Method
10	Periodogram Estimation of noise corrupted signal using AR model
11	Periodogram Estimation of noise corrupted signal using MA model
12	Periodogram Estimation of noise corrupted signal using ARMA model
13	Plot Additive White Noise with a Variance of 1/12 and its Auto Correlation for 15 lags
14	Plot Periodogram Estimation of Additive White noise

Course Learning Outcomes:

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

- *Solve problems on multi rate signal processing.*
- *Find autocorrelation, cross correlation & power spectrum estimation of different random processes using parametric & nonparametric methods.*

P14DC108 MICROWAVE & OPTICAL FIBER COMMUNICATION SYSTEMS LAB

Class: M.Tech. I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation	40 marks
End semester Exam:	60 marks

Course Learning Objectives:

- *To verify the characteristics of Microwave oscillator.*
- *To measure VSWR and Reflection coefficient.*
- *To gain hands-on-experience of different waveguide components.*
- *To verify and compare the concepts of optical fiber communications.*

LIST OF EXPERIMENTS

1. Mode characteristics of Reflex Klystron
2. Study of Gunn Oscillator
3. Measurement of Frequency and Wave length
4. Measurement of VSWR and Reflection Coefficient
5. Measurement of Impedance
6. Study of Multi Hole Directional Coupler
7. Study of Magic Tee
8. Study of Isolator and Circulator
9. Study of Numerical Aperture in optical fiber
10. Study of Misalignments in optical fiber
11. Study of losses in optical fiber
12. Study of Eye Pattern for optical link
13. Measurement of Bit Error Rate for optical communication link

Course Learning Outcomes:

After completion of course the students will be able to

- *Understand the characteristics of reflex klystron and Gunn oscillator*
- *Gain knowledge of different measuring techniques at Microwave frequencies*
- *Understand measurement of different parameters of waveguide components*
- *Gain knowledge of misalignments and losses in optical fiber.*
- *Understand the fundamental optical fiber receiver operation*
- *Apply the knowledge of Optical fiber Communication*

P14DC109 SEMINAR

Class: M. Tech I Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
-	-	-	2

Examination Scheme:

Continuous Internal Evaluation:	100 marks
End Semester Examination:	-

There shall be only Continuous Internal Evaluation (CIE) for Seminar, which includes Report Submission & Presentation.

A teacher will be allotted to a student for guiding in

(i) Selection of topic

(ii) Report writing

(iii) Presentation (PPT) before the DPGRC

P14DC201 COMMUNICATION SYSTEM MODELING

Class: M.Tech. II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam	60 marks

Course Learning Objectives:

- *To interpret, analyze, model and Process the communication signals, systems using appropriate modeling techniques and simulation tools*
- *To analyze and evaluate a communication system and suggest enhancements to improve the system performance.*
- *To apply suitable tools to design, simulate and demonstrate the working of communication systems and signal processing as per the application needs.*
- *To specify and design optimal modeling schemes for the given communication system problem to efficiently use the channel capacities and signal characteristics*

UNIT-I (9+3)

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.

Quadrature 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 and frequency 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-II (9+3)

Digital Filter models: Models and simulation techniques, CAD of IIR digital filters, PLLmodels, 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-III (9+3)

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

UNIT-IV (9+3)

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. Principles of Communication Systems Simulation: **WH TRANTER** et al, Pearson Asia, 2010.
2. Signal Processing Advances in Wireless and Mobile communication **GBGIANNAKIS** et al, PHPTR, 2001

Course Learning Outcomes:

After competition of the course, the student will be able to

- *Understand the concepts Quadrature Models, Random Signal Models and Monte Carlo methods*
- *Interpret, Analyze, model and Process the communication signals, systems using appropriate modeling techniques and simulation tools*
- *Analyze and evaluate a communication system and suggest enhancements to improve the system performance.*
- *Apply suitable tools to design, simulate and demonstrate the working of communication systems and signal processing as per the application needs.*
- *Specify and design optimal modeling schemes for the given communication system problem to efficiently use the channel capacities and signal characteristics.*

P14DC202 CODING THEORY

Class: M.Tech. II Semester **Branch:** Digital communications

Teaching Scheme: **Examination Scheme:**

L	T	P	C
3	1	-	4

Continuous Internal evaluation:	40 marks
End semester Exam	60 marks

Course learning objectives:

- *To introduce the basic elements of digital communication with Galois fields using abstract algebra.*
- *To elaborate different encoding and decoding techniques like linear block codes, cyclic codes, convolutional codes and some channel coding theorems.*
- *To familiarize the students with BCH codes and some coding algorithms.*
- *To impart the convergence and distance properties of LDPC codes, Turbo codes and Reed-solomon codes.*
- *To study the importance of Reed muller and Golay codes.*
- *To acquire the knowledge of various coding theory techniques in applications like Digital video broadcasting, mobile communication and digital radio system.*

UNIT-I (9+3)

Introduction to abstract algebra: Fields, Galois Fields(GF), construction of external field, GF arithmetics, Polynomials, Linear block codes, syndrome decoding, Maximum likelihood decoding, Hard decision decoding and soft decision decoding.

Elements of Digital Communication System: Channel models, Shannon's noisy channel coding theorem, Weight enumerators and MacWilliam's theorem.

UNIT-II (9+3)

Introduction to cyclic codes, Encoding and Decoding of Cyclic codes, Encoding structural & distance properties of convolutional codes, sequential decoding of convolutional codes, Bose Chaudhury & Hocquenghem(BCH) codes, decoding of binary BCH codes, Berlekamp – Massey algorithm, Euclids algorithm.

UNIT-III (9+3)

Introduction to Reed solomon codes, decoding of Reed solomon codes, Low density parity-check(LDPC) codes, desirable properties, constructing LDPC codes, Decoding of LDPC codes, Turbo codes: Turbo algorithm, convergence properties of the turbo algorithm, Distance properties of turbo codes.

UNIT-IV (9+3)

Introduction to Reed muller and Golay codes, Application of Block codes in Digital Video Broadcasting(DVB),Mobile communication, Digital radio system, compact disc and Space probe communication.

Text books:

1. L.H.Charles Lee, "Error – control block codes for communication Engineers", Artech House, 2000
2. Shulln Danlel J.Costello. JR, "Error control coding, Fundamentals and applications", PHI, 1st Edition, 1982.
3. Ezio Biglieri – coding for wireless channels, springer International edition (SIE), 2005.

Course Learning Outcomes:

After successful completion of the course, the student will be

- *In a position to find solutions to the problems associated with Galois fields.*
- *Acquainted with basic block codes, cyclic codes, convolutional codes and BCH codes.*
- *Able to gain knowledge of hard decision, soft decision codes, Turbo codes and LDPC codes.*
- *Easily differentiate the specific application of specific code.*
- *Able to apply encoding techniques for Mobile applications and Space communication.*

P14DC203 ADAPTIVE SIGNAL PROCESSING

Class: M. Tech II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Examination:	60 marks

Course Learning Objectives :

- *To introduce Adaptive filters and their applications.*
- *To analyse the optimization techniques.*
- *To know the importance and characteristics of autocorrelation matrix and eigen value analysis.*
- *To use model-based signal processing methods in communications.*
- *To model systems like multipath communication channel.*

UNIT-I (9+3)

Fundamentals Adaptive Signal processing: General form of adaptive linear combiner, optimum Wiener filtering, performance surface, principle of orthogonality, gradient and minimum mean-square error, input correlation matrix, eigenvalues and eigenvectors of correlation matrix, Basic applications of adaptive filtering.

UNIT-II (9+3)

Gradient Search Algorithms: simple gradient search algorithm and its solution, learning curve, method of steepest descent; LMS Gradient Algorithm, Convergence analysis and misadjustment. Comparison of steepest descent and LMS algorithms, normalized LMS, sequential Regression (SER) algorithm and Linear Random Search (LRS).

UNIT-III (9+3)

Least Squares Algorithm: Recursive Least Squares (RLS) and exponentially weighted RLS.
Time domain Adaptive filtering: FIR and IIR adaptive filter. Frequency domain adaptive filter: Block LMS, Fast LMS and DFT-LMS. Computational complexity of time and frequency domain LMS algorithms.

UNIT-IV (9+3)

Kalman Filter Theory: Recursive minimum mean square estimation of scalar random variables, statement of the Kalman filtering problem, innovation process, estimation of state using the innovation process. Application of Kalman filters to target tracking and channel equalization.

Text Books:

1. Simon Haykin, *Adaptive Filter Theory*, PHI, New Delhi
2. Bernard Widrow, S. D. Stearns, *Adaptive signal processing*, Pearson Education.
3. D.G.Manolakis, Ingle & S.M.Kogon, Statistical and Adaptive Signal Processing,MGH.
4. Adaptive Signal Processing, L. Sibul, Ed., IEEE Press, 1987.
5. Adaptive Filters: Structures, Algorithms and Applications, M. Honig, D. Messerschmitt, Kluwer, 1984.

Course Learning Outcomes:

After completion of the course the student will be able to

- *implement the adaptive filter algorithms.*
- *implement the gradient based optimization techniques.*
- *apply adaptive techniques in real-time communication problems like channel estimation and channel equalization.*

P14DC204 RADAR SIGNAL PROCESSING

Class: M.Tech. II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End semester Exam	60 marks

Course Learning Objectives:

- *To introduce the concepts of radar signal processing.*
- *To represent different types of radar signals.*
- *To elaborate the concept of matched filter receiver and importance of Ambiguity function*
- *To make students understand different modulation techniques (LFM, Poly-phase coded signals).*
- *To study clutter models.*
- *To impart the knowledge regarding wide applications of Satellite technology*

UNIT-I (9+3)

Introduction: Classification of Radar based on functions, Principles of operation etc., performance measures and interplay between Radar parameters, Target parameters and Environment parameters. Classical Detection and Estimation Theory, Binary Hypotheses testing, Likely-hood Ratio Test, Neymon square, MAP, Maximum likely-hood estimation of parameters, cramer-rao bounds, Chernoff bounds.

UNIT-II (9+3)

Representation of Signals, K-L expansion, Equivalent Low-pass representation of Band pass signals and noise. Detection of slowly fluctuating point Targets in white noise and colored noise. Swerling Target models. Optimum receivers, correlator and Band pass Matched filter receiver. PD-PF performance; coherent and non-coherent integration sub-optimum reception. Radar power – Aperture product.

UNIT-III (9+3)

Range and Doppler resolution: Ambiguity function and its properties. Local and Global Accuracy. Signal Design. LFM. Polyphase coded signals detection of a Doppler shifted slowly fluctuating point target return in a discrete scatterer environment.

UNIT-IV (9+3)

Dolby dispersive fading Target and Clutter models – scattering function description. Land clutter-pulse length limited and beam width limited clutter. Sea clutter. Optimum/Sub optimum reception of Range Spread/Doppler Spread/Doubly Spread targets in the presence of noise and clutter. Introduction to adaptive detection and CFAR techniques.

Reference Books:

1) Di Franco.JV and Rubin, WI., "Radar Detection", Artech House, 1980.
2) Gaspare Galati (Ed), " Advanced Radar Techniques and systems", Peter Perigrinus Ltd. 1993
3) Ramon Nitzberg, " Radar Signal Processing and Adaptive Systems", Artech House, 1999
4) Lewis.BL and Frank, F.Krestchner, Jr and Wesley W.Sheldon," Aspect of Rada signal processing", Artech House, 1986.
5) (ED) simon Hay kin and Allan Steinhardt," Adaptive Radar Detection and Estimation', john Wiley, 1992.
6) Vantrees.H.L." Detection, Estimation and Modulation Theory", Wiley Part-I JohnWiley&Sons, 1968.

Course Learning Outcomes:

After completion of course the students will be able to

- *Understand the basic principles of radar, signal processing concepts.*
- *Gain knowledge of different subsystems of radar*
- *Design matched filters, non-coherent filter receivers.*
- *Apply the knowledge of Classical Detection and Estimation theory*
- *Gain the knowledge of fading Target and Clutter models.*

P14DC205A DSP PROCESSORS
(Elective - III)

Class: M. Tech II Semester

Branch: Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Examination:	60 marks

Course Learning Objectives :

- *To introduce the basic differences between conventional microprocessors and DSP processors.*
- *To elaborate the architectural features of DSP processors.*
- *To apply DSP theory to real-world situations.*

UNIT-I (9+3)

Introduction: Comparison between general purpose and Digital Signal Processors, need for specialized processors, RISC and CISC.

Data formats: Number formats for signal and coefficients in DSP systems. Dynamic range and precision, sources of error in DSP implementations: A/D conversion errors, DSP computational errors, and D/A conversion errors, Compensating filter.

UNIT-II (9+3)

Architecture for Programmable DSP devices: Basic architectural features, DSP computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation unit, programmability and program execution, speed issues, features for external interfacing.

Execution Control and Pipelining: Hardware looping, interrupts, stacks, relative branch support, pipelining and performance, pipeline depth, interlocking, branching effects, pipeline programming. Control-unit of DSP's, Pipelined instruction execution, specialized hardware for zero-overhead looping.

UNIT-III (9+3)

Programmable Digital Signal processors: Key features of TMS320C54X, Architecture and addressing modes, Instruction set, programming, pipelining, parallelism, on-chip peripherals and interrupts of 54x processor.

UNIT-IV (9+3)

DSP Tools: Assembler, Debugger, C-Compiler, Linker, Editor, Code Composer studio (CCS).

Implementation of DSP algorithms: FFT, FIR, IIR, Adaptive and multirate filters.

Applications of DSP algorithms: Case studies of signal processing in communication and multimedia.

Text Books:

1. Avtar Singh and S. Srinivasan, *Digital Signal Processing- Implementation using DSP Processors,* Thomson Brooks, 2004.
2. B. Venkatramani, M. Bhaskar, *Digital signal processors: Architecture, processing and applications,* Tata McGraw Hill, 2002.
3. Phil Lapsley,JeffBIER, Amit Shoham,E.A.Lee *DSP Processors Fundamentals- Architecture& Features* IEEE Press Signal Processing, Wiley Interscience, NY.

Course Learning Outcomes:

After completion of the course student will be able to

- *Describe the specific architecture of the DSP processor, and understand the architecture of similar commercially produced DSP processors.*
- *Discuss the various issues that need to be addressed when implementing DSP algorithms in real hardware with finite resources such as processing speed, memory and bit resolution.*
- *Write assembler code to implement basic DSP algorithms such as linear filtering with FIR and IIR filters.*

P14DC205B SATELLITE COMMUNCIATIONS
(Elective - III)

Class: M.Tech. II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End semester Exam	60 marks

Course Learning Objectives:

- *To introduce the concepts of satellite communications.*
- *To elaborate the concepts of orbital parameter.*
- *To enable the student understand different amplifiers and transponders.*
- *To make students understand different modulation techniques*
- *To study Link Analysis.*
- *To impart the knowledge regarding wide applications of Satellite technology*

UNIT-I (9+3)

The evaluation and growth of communication satellites; other satellite systems, kepler's laws of motion, Orbital Parameters, geostationary orbits, placing a satellite in stationary orbit, choice of frequency bands propagation characteristics, Effects of Doppler, Eclipse, Sun transit etc, Noise and attenuation.

UNIT-II (9+3)

Earth segment, Space segment, satellite transponders, Subsystems of a communication satellite.Satellite control, Solar cells and panels, antennas, Low noise amplifiers, High Power amplifiers.Earth station, G/T, C/N, link calculation, C/N for the complete link, and design of communication systems via satellites.

UNIT-III (9+3)

Modulation, Multiplexing and multiple access techniques; TDMA, FDMA,CDMA,SSMA Reliability, Redundancy; Quality assurance, Echo control and Echo suppression.

UNIT-IV (9+3)

Laser Satellite Communication, Link Analysis, Optical satellite link transmitter, Receiver, Satellite, Beam Acquision, Tracking and pointing, Deep space optical communication link.Introductory concepts of VSATS, GIS,GPS and Future trends.

Reference Books:

1. T.Partt&C.W.Bostian, " Satellite Communication Systems", PHI, 1st edition
2. Dr.D.C.Agarwal,"Satellite Communications," KhannaPublications, 5th Edition
3. Dennis Roddy, Satellite Communication Systems, McGraw Hill Publications, 1990
4. SpillkerJ.J.,"Digital Communication Satellite",Prentice Hall, 1977

Course Learning Outcomes:

After completion of course the students will be able to

- *Understand the basic principles of satellite communication, geostationary orbits and ionosphere properties.*
- *Gain knowledge of different subsystems of satellite.e*
- *Design of communication systems via satellites with high precision.*
- *compare TDMA, FDMA,CDMA,SSMA Reliability.*
- *Apply the knowledge of Laser Satellite Communication.*
- *Gain the knowledge of Laser Satellite Communication, VSATS, GIS and GPS.*

P14DC205C RADIO NAVIGATIONAL AIDS
(Elective - III)

Class: M. Tech. II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End semester Exam	60 marks

Course Learning Objectives:

- *To introduce the concept of radio navigation systems.*
- *To elaborate different approaches to navigational aids*
- *To study about the inertial navigation system and internal sensors.*
- *To impart the concepts and applications of GPS and errors.*
- *To study satellite navigation*
- *To study different applications of Radio navigational Aids and to study mapping and geographical information systems*

UNIT-I (9+3)

Review of Navigation Systems: Aircraft navigation system. Geometry of the earth .Navigation equation.Navigation errors.Radio navigation system types and performance parameters.Hyperbolic navigation systems, Loran, Omega, Decca Radio direction finding, DME, TACAN and VORTAC.

UNIT-II (9+3)

Intertial navigation: Interial navigation system, Sensing instruments: Accelerometer, Gyro-scopes, Analytic and Gimballed platform, Mechanization. Error analysis, Alignment

UNIT-III (9+3)

Global positioning system (GPS) for Navigation: Overview of GPS, Reference systems. Satellite orbits, Signal structure, Geometric dilution of precision (GDOP, or Precision dilution of precision (PDOP), Satellite ephemeris, Satellite clock, Ionospheric group delay.Tropospheric group delay, Multipath errors and Receiver measurement errors.

UNIT-IV (9+3)

Differential GPS and WAAS: Standard and precise positioning service local area DGPS and Wide area DGPS errors, wide area augmentation system (WAAS) architecture, Link budget and Data capacity, ranging function, precision approach and error estimates, GPS Navigational Applications.

Reference Books:

1. Myron Kavton and Walter Fried, R., Avionics Navigation systems, Wiley, 1997.
2. Parkinson, BW.Spilker, Global positioning system Theory and Applications, Progress in Astronautics, Vol. I and II, 1996.
3. Hoffman. B., Wellenhof. H., Lichtenegger and J.Collins. GPS Theory and Practice, Springer Verlangwiennew york, 1992.
4. Elliot D.Kaplan, understanding GPS Principles and Applications, Artech House. Inc., 1996.Lieck Alfred. GPS Satellite Surveying, John Wiely, 1990.

Course Learning Outcomes:

After completion of the course student will be able to

- *understand the different concepts of navigation.*
- *know about the Ground controlled approach system.*
- *know Gyroscopes, Laser gyro, fiber optic gyro and accelerometers.*
- *know the INS components, transfer function and errors.*
- *design satellite based navigational system with high accuracy.*
- *know Differential GPS and WAAS.*
- *know wide applications of navigational system like, Air andLand Navigation, Surveying, military & space.*

P14DC205D MULTIMEDIA COMMUNICATIONS & SYSTEM DESIGN
(Elective - III)

Class: M.Tech. II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 Marks
End Semester Exam :	60 Marks

Course Learning Objectives:

- *To provide the foundation knowledge of multimedia computing, e.g. media characteristics, Compression standards, multimedia representation, data formats, multimedia technology development.*
- *To describe the ways in which multimedia information is captured, processed and rendered.*
- *To study the technical issues and system solutions for providing multimedia Communications on the Internet.*
- *To introduce the concepts to differentiate text, image, video & audio*
- *To provide in-depth knowledge about Image and Video Compression*

UNIT-I (9+3)

Multimedia Communication: Introduction, Network requirements, multimedia terminals, multimedia requirement for ATM networks, Multimedia terminals, Audio Visual Integration, Audio to visual mapping, Multimedia File Formats.

UNIT-II (9+3)

Multimedia processing in Communications: Introduction, Digital Media, Signal Processing elements, Challenges in multimedia information processing, perceptual coding of Digital audio signals, Image coding, Video coding, MPEG-1, MPEG-2, MPEG-4 Audio/Video.

UNIT-III (9+3)

Distributed multimedia systems, Resource management of DMS, IP networking, Multimedia operating systems, distributed multimedia servers & applications. Multimedia communication standards.

UNIT-IV (9+3)

Multimedia communication across networks. Compression Techniques: JPEG, MPEG

Reference Text Books:

[1] Rao, Bojkovic, Milovanovic, " Multimedia Communication Systems", PHI
[2] Andleigh, Thakrar, " Multimedia System Design", PHI
[3] Sharda," Multimedia Information Networking", PHI
[4] Vaughan, " Multimedia making it work", Tata Mc Graw Hill

Course Learning Outcome:

After completion of the course the student will be able to

- *Understand the current state-of-the-art developments in Internet technologies for multimedia communications.*
- *Capable of applying the principles used in designing multimedia protocols, and so understand why standard protocols are designed the way that they are.*
- *Understand the system design principles of multimedia communications systems.*
- *Solve problems and design simple networked multimedia systems.*
- *understand and differentiate text, image, video & audio*
- *In the coding aspect, state-of-the-art compression technologies will be presented*

P14DC206A STATISTICAL SIGNAL PROCESSING
(Elective - IV)

Class: M. Tech II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Examination:	60 marks

Course Learning Objectives :

- *To introduce the probability theory of communication signals*
- *To design the key functionalities of a communication receiver and in particular its equalizer*
- *To analyze linear estimation, adaptive signal processing and multi-antenna signal processing.*

UNIT-I (9+3)

Review of random variables& Random process: Distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Schwarz Inequality Orthogonality principle in estimation, Central Limit theorem, Random process, stationary process, autocorrelation and auto-covariance functions, Spectral representation of random signals, Wiener Khinchin theorem, Properties of power spectral density, Gaussian Process and White noise process, Linear System with random input.

UNIT-II (9+3)

Linear Algebra Basics: Concepts of Vector Space, Linear Operators on finite dimensional vector spaces, Deionization of Auto- Covariance Matrix (Concept of positive definiteness, Eigen Vector Concept etc). Random signal modelling: MA(q), AR(p) , ARMA(p,q) models

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UNIT-III (9+3)

Optimum linear filtering: Overview of Non Parametric Spectral estimation Techniques Parametric Spectral Estimation with emphasis on AR process Modelling Yule Walker Equation and Levison Durbin Algorithm

UNIT-IV (9+3)

Array Signal Processing: Array Fundamental Spatial Signals Array Signal Model The Sensor Array : Spatial sampling, Conventional Spatial Filtering: Beam forming, Spatial matched filter
Tapered Beam forming, Optimum Array processing, Optimum Beam forming, Eigen analysis of the Optimum Beam former, Interference Cancellation Performance, Tapered Optimum Beam forming , he Generalised Side Beam lobe Canceller, Performance Consideration for Optimum Beam former, Effect of Signal Mismatch, Effect of Bandwidth

Text Books:

1. Bernard Widrow and Samuel D.stearns,"Adaptive Signal Processing", Person Education, 2005.
2. Simon Haykin, " Adaptive Filter Theory", Pearson Education, 2003.
3. John R. Treichler, C. Richard Johnson, Michael G. Larimore, "Theory and Design of Adaptive Filters",Prentice-Hall of India, 2002

Suggested References:

1. S.Thomas Alexander,"Adaptive Signal Processing-Theory and Application", Springer-Verlag.
2. D. G. Manolokis, V. K. Ingle and S. M. Kogar, "Statistical and Adaptive Signal Processing", Mc Graw Hill International Edition, 2000.

Course Learning Outcomes:

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

- *use the methodology of signal processing to design communication systems and their receivers.*
- *design and implement various equalizer algorithms.*
- *estimate the complexity of various equalizer algorithms.*

P14DC206B ADHOC & WIRELESS SENSOR NETWORKS
(Elective - IV)

Class: M.Tech. II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 Marks
End Semester Exam :	60 Marks

Course Learning Objectives:

- *To expose the students to the concepts of the 802.11 Wireless LAN (Wi-Fi) and Bluetooth standards. This includes their designs, operations, plus approaches to interoperability.*
- *To introduce the principles of ad hoc wireless networks, design and implementation issues, and available solutions.*
- *To enable the student to acquire fundamental knowledge of MAC protocols for Adhoc networks.*
- *To introduce the basic concepts of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid.*
- *To elaborate the concepts related to transport layer and security protocols of Adhoc wireless networks.*
- *To familiarize issues and challenges in providing QOS and QOS solutions for Adhoc wireless networks.*
- *To impart knowledge on energy management in Adhoc networks.*
- *To gain basic knowledge of sensor networks and their characteristics. This includes design of MAC layer protocols, location discovery and issues.*

UNIT-I (9+3)

Wireless LANS and PANS: Introduction, fundamentals of WLANS, IEEE 802.11 Standard, HIPERLAN Standard, Bluetooth, Home RF. **Wireless Internet:** Wireless Internet, Mobile IP, TCP in wireless Domain, WAP, Optimizing web over Wireless.

Adhoc Wireless Networks: Introduction, Issues in Ad hoc wireless networks, Adhoc wireless Internet. **MAC Protocols for AdHoc Wireless Networks:** Introduction, Issues in Designing a MAC Protocol for classifications of MAC Protocols, Contention – Based Protocols, Contention – Based Protocols with reservation Mechanisms, contention – Based MAC Protocols with scheduling mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

UNIT-II (9+3)

ROUTING PROTOCOLS: Introduction, Issues in Designing a Routing for Ad Hoc wireless Networks, Classification of Routing Protocols, Table – Driven routing Protocols, on-Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with efficient flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.

TRANSPORT LAYER AND SECURITY PROTOCOLS: Introduction, Issues in Designing a Transport Layer Protocol for Adhoc wireless Networks, Design Goals of a Transport Layer Protocol for Adhoc wireless networks, classification of Transport Layer solutions, TCP over Adhoc wireless networks, other transport layer protocol for Adhoc wireless networks, security in Adhoc wireless networks, Network security Requirements, Issues and challenges in security provisioning, Network security Attacks, Key Management, Secure Routing in Adhoc wireless networks.

UNIT-III (9+3)

Quality of Service: Introduction**,** Issues and challenges in providing QoS in Adhoc wireless Networks, Classification of QoS solutions, MAC Layer solutions, Network Layer solutions, QoS frameworks for Adhoc wireless networks.

ENERGY MANAGEMENT: Introduction, need for energy Management in Adhoc wireless networks, classification of Adhoc wireless networks, Battery Management schemes, Transmission power Management scheme, System power management schemes.

UNIT-IV (9+3)

WIRELESS SENSOR NETWORKS: Introduction, Sensor network Architecture, Data Dissemination, Data gathering, MAC protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving standards, Other Issues.

Reference Text Books:

1. Adhoc wireless networks: Architectures and Protocols – C.Siva Ram Murthy and B.S Manoj, 2004, PHI.
2. Wireless Adhoc and sensor Networks: Protocols, Performance and control – Jagannathansarangapani, CRC Press
3. Adhoc Mobile wireless Networks: Protocols & Systems, C.K.Toh, 1 ed.Pearson Education.
4. Wireless sensor Networks - C.S.Raghavendra, Krishna M.Sivalingam, 2004, Springer

Course Learning Outcomes:

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

- *know the layers of the Wi-Fi standard and its functions*
- *Understand the layers of the Bluetooth standard and its functions*
- *Understand the principles of ad hoc networks and what distinguishes them from infrastructure-based networks.*
- *Understand how proactive, reactive and hybrid routing protocols function and their implications on data transmission delay and bandwidth consumption.*
- *Understand MAC and transport layer protocols.*
- *know the mechanisms for implementing security mechanisms in adhoc networks.*
- *Understand QOS issues and solutions related to adhoc networks*
- *know the energy management in adhoc networks*
- *Understand the principles and characteristics of wireless sensor networks (WSNs).*
- *Understand the limitations of wireless sensor networks and the work needed to develop real-life applications.*
- *Understand the current topics in adhoc wireless and sensor networks both from an industry and research point of views. design their own wireless network.*

P14DC206C DIGITAL IMAGE PROCESSING
(Elective - IV)

Class: M. Tech II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Examination:	60 marks

Course Learning Objectives :

- *To provide the student with the fundamentals of digital image processing.*
- *To acquire a good knowledge in Digital image processing including the topics of filtering, transforms, morphology, image analysis and compression.*
- *To introduce the students about some advanced topics in digital image processing.*
- *To give the students a useful skill base that would allow them to carry out further study in the field of Digital Image Processing.*

UNIT-I (9+3)

Introduction: Elements of Digital Image Processing system, Digital Image representation, Image model, Sampling and Quantization, Neighbors of pixel, Connectivity, Distance measures, Arithmetic and Logical operations on images, Basic Transformations such as translation, Scaling, Rotation, Perspective Transformations

Image Transforms: Two dimensional DFT and its properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling (K-L) Transform

UNIT-II (9+3)

Image Enhancement: Brightness and contrast of an image, Simple intensity transformations – Image negatives, Linear mapping, logarithmic mapping, Gray level thresholding; Image histograms, histogram equalization, histogram specification, local enhancement; spatial filtering: smoothing filters – low pass, Rank filters, Median filters, min-max and range filters; sharpening filters – high pass, high boost and Derivative filters; Enhancement in frequency domain, Image restoration techniques.

UNIT-III (9+3)

Image Compression: Redundancy – Coding redundancy, interpixel redundancy, Psychovisual redundancy; Root mean square error, Image compression system model, noiseless and noisy coding, error free compression – Huffman coding, Bit-plane coding, constant area coding, lossless predictive coding; Lossy compression – Lossy predictive coding, Transform coding, JPEG coding standards.

UNIT-IV (9+3)

Image Segmentation: Detection of discontinuities – Point detection, line detection, Edge detection, pixel connectivity; Region – Oriented segmentation – Region similarity, Region growing, Limitations of region growing, Region splitting and Merging. Sigmentation with moving curves with PDE's. Morphological Image Processing – Fitting and Hitting, Dilation and Erosion, opening and closing, Hit or Miss Transform, Basic Morphological Algorithms, grey-scale morphology.

Text Books:

1. R.C.Gonzalez and R.E. Woods, ***Digital Image processing***, Pearson Education, New Delhi.
2. B.chanda, D.Dutta Majumder, *Digital image processing and analysis*, Prentice Hall of India, New Delhi.
3. Nick Efford, *Digital Image Processing Using Java* , Pearson Education, New Delhi.
4. Gregory Baxes, *Digital Image Processing: Principles and Applications,* John Wiley & Sons, New York.

Course Learning Outcomes:

After completion of the course, the student will

- *Understand the fundamentals of Digital image processing including the topics of filtering, transforms and morphology, and image analysis and compression.*
- *Be able to implement basic image processing algorithms in MATLAB.*
- *Have the skill base necessary to further explore advanced topics of Digital Image Processing.*
- *Be in a position to make a positive professional contribution in the field of Digial Image Processing.*

P14DC206D QUANTUM COMMUNICATIONS
(Elective - IV)

Class: M.Tech. II Semester **Branch:** Digital communications

Teaching Scheme:

L	T	P	C
3	1	-	4

Examination Scheme:

Continuous Internal evaluation:	40 marks
End semester Exam	60 marks

Course learning objectives:

- *To enable the students to acquire fundamental knowledge about open and closed quantum systems.*
- *To study the concept of quantum states*
- *To elaborate the concept of quantum communication over quantum channels.*
- *To introduce different theorems for representing channel capacities.*
- *To impart the concept of entanglement and quantum channel capacity.*
- *To introduce different theorems for quantum state compression.*

UNIT-I (9+3)

Quantum mechanics basics: Hilbert Space, density matrices, projective measurements, pure states and mixed states. Observables and commutivity, Heisenberg uncertainty principle, Quantum state preparation. Open and closed Quantum system Dynamics – Definition, unitary evolution of density matrices, requirements of closed and open system quantum maps, reduced density matrices, partial trace operator, open system measurements and positive operator valued Measurements, stinespringtheorem,Kraus Representation theorem for open system quantum evolution.

UNIT-II (9+3)

Quantum Communication Theory: Transmission of classical information over quantum channels. Classical bits encoded into the Z axis spin projection of an electron, quantum state encoding and decoding

Quantum Information Theory: Von Neumann entropy, Holevo's theorem on mutual information for ensembles of quantum states.

UNIT-III (9+3)

Quantum state Compression: Compressing ensembles of quantum states, relation of pure state ensemble compression with von Neumann entropy, relationship between mixed state compression and Holevo's theorem, connections between compression ideas and communication channel capacities.

Holevo-Schumacher-Westmoreland theorem for classical channel capacities of quantum channels, King Ruskai-Swarez-Werner Qubit Channel Representation Theorem, Kraus channel representation, channel capacities and their relation to the von Neumann entropy.

UNIT-IV (9+3)

Entanglement and Quantum Channel Capacity - entanglement, scaling issues in Hilbert space, notion of channel additivity and the role of entanglement in quantum channel capacity calculations

Quantum Communication over Quantum Channels- notion of quantum communication over quantum channels, Shor result on entanglement assisted channel capacities for the transmission of quantum states over quantum channels.

Text books:

1. Michael Nielsen and Issac Chuang: Quantum Computation and Quantum Information, Combridge University Press, 2000
2. JozefGruska; Quantum Computing, McGraw Hill, 1999.

Course Learning Outcomes:

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

- *Understand the basic concepts of quantum states, open and closed system quantum maps.*
- *Understand the transmission of classical information over quantum channels.*
- *Understand the quantum state encoding and decoding.*
- *Find the relation between mixed state and compression.*
- *Understand the role of entanglement in quantum channel capacity calculations.*

P14DC207 COMMUNICATION SYSTEM MODELING & SIMULATION LAB

Class: M.Tech. II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam:	60 marks

Course Learning Objectives:

- *To design and simulate a communication system.*
- *To interpret, analyze, model and process a communication signal.*
- *To implement different sampling techniques.*
- *To model non-linearity in the communication system.*
- *To evaluate different parameters of a communication system using Monte Carlo estimation.*

LIST OF EXPERIMENTS

I. MATLAB programs:

1. Up-sampling and Interpolation.
2. Signal-to-aliasing-Noise ratio for a given rectangular pulse shape.
3. Impulse response of a fourth-order Butterworth filter using both block and serial processing.
4. To produce sample functions for different random processes.
5. To generate QPSK signal.
6. PN sequence generator.
7. Uniformly distributed random points using Monte Carlo estimation.
8. Estimate of pi using Monte Carlo integration.
9. MCBPSK - delay, BER.
10. MCQPSK - delay, BER.
11. MCQPSK - phase sync, phase jitter, sym jitter.
12. Baseband non-linearity using general limiter model.

II. Trainer Kit Based Experiments:

Mobile trainer:

1. Study of the Tx IQ/Rx IQ signals
2. Study of the Signal Constellation of GMSK signal
3. Study of the GSM Data rate and Encoded GMSK Signal\
4. Constellation of GMSK signal(X-Y)
5. Study of audio signal
6. Study and Measure of PWM signal
7. Observation of PWM signal of Buzzer

Global Positioning System Trainer:

1. Understanding the Shape of Earth
2. Measurement of latitude, longitude

Course Learning Outcomes:

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

- *analyze Signal to Noise ratio for a given input.*
- *understand impulse responses of various types of digital filters.*
- *implement the PN sequence generator.*
- *estimate different parameters using Monte Carlo techniques.*
- *model the non-linearities in communication systems.*

P14DC208 DIGITAL COMMUNICATION LABORATORY

Class: M.Tech. II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
-	-	3	2

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam:	60 marks

Course Learning Objectives:

- *To simulate different discrete transform techniques.*
- *To interpret, analyze, model and process a Huffman coding technique.*
- *To simulate JPEG image compression.*
- *To simulate motion vector estimation.*
- *To generate a video signal using frames.*
- *To simulate various digital modulation techniques using MATLAB.*
- *To introduce ELANIX software for implementing various digital modulation techniques.*

LIST OF EXPERIMENTS

I. MATLAB programs:

Data Compression Techniques

S No.	Name of the Experiment
1.	1-Dimensional Discrete Fourier Transform (1-DFT)
2.	2-Dimensional Discrete Fourier Transform (2-DFT)
3.	1-Dimensional Discrete Cosine Transform (1-DCT)
4.	2-Dimensional Discrete Cosine Transform (2-DCT)
5.	Huffman Coding technique
6.	Joint Photographic Experts Group (JPEG) Compression
7.	Motion Vector Estimation
8.	Video generation Using frames

Data & Computer Communications:

1. Amplitude Shift keying(ASK) using MATLAB
2. Frequency Shift keying(FSK) using MATLAB
3. Phase Shift Keying (PSK) Using MATLAB

II.ELANIX software Experiments:

1. Amplitude Shift keying (ASK) Modulation and Demodulation.
2. Frequency Shift keying (FSK) Modulation and Demodulation.
3. Phase Shift Keying (PSK) Modulation and Demodulation.
4. Quadrature Phase Shift Keying (QPSK) Modulation and Demodulation.

Course Learning Outcomes:

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

- *Analyze different discrete transform techniques.*
- *Understand video signal generation using frames.*
- *Implement the various digital schemes.*
- *Understand the various digital modulation and demodulation schemes.*
- *Analyze different shift keying techniques.*

P14DC209 COMPREHENSIVE VIVA-VOCE

Class: M.Tech. II Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
-	-	-	2

Examination Scheme:

Continuous Internal Evaluation:	100 marks
End Semester Exam:	-

There shall be only external oral examination for Comprehensive Viva-voce on a pre-notified date. The oral examination shall cover the entire content of courses covered in First and Second Semesters.

P14DC301 INDUSTRIAL TRAINING

Class: M.Tech. III Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
-	-	-	4

Examination Scheme:

Continuous Internal Evaluation:	100 marks
End Semester Exam:	-

M.Tech. Coordinator in consultation with the Training & Placement Section has to procure training slots, for the students before the last day of instruction of 2nd semester.

The students shall confirm their training slots by the last day of 2nd semester.

The students after 8 weeks Industrial Training shall submit a certificate, a report in the prescribed format before the last date specified by the Department Post Graduate Review Committee (DPGRC). The DPGRC shall evaluate their submitted reports and oral presentations.

P14DC302 DISSERTATION

Class: M.Tech. III Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
-	-	-	8

Examination Scheme:

Continuous Internal Evaluation:	100 marks
End Semester Exam:	-

Registration Seminar shall be arranged within four weeks after completion of the Industrial Training and Seminar in the 3rd semester. The Registration Seminar shall include a brief report and presentation focusing the identified topic, literature review, time schedule indicating the main tasks, and expected outcome.

Progress Seminar-I: At the end of first stage (third semester), student shall be required to submit a preliminary report of work done for evaluation to the project coordinator and present the same before the DPGRC. The Continuous Internal Evaluation (CIE) for the third semester is as follows:

P14DC401 DISSERTATION

Class: M.Tech. IV Semester **Branch:** Digital Communications

Teaching Scheme:

L	T	P	C
-	-	-	12

Examination Scheme:

Continuous Internal Evaluation:	40 marks
End Semester Exam:	60 marks

Progress Seminar-II shall be arranged during the 6th week of IV semester.

Progress Seminar-III shall be arranged during the 15th week of IV semester.

Synopsis Seminar shall be arranged two weeks before the final thesis submission date. The student shall submit a synopsis report covering all the details of the works carried out duly signed by the Dissertation Supervisor.

At the end of second stage (fourth semester), student shall be required to submit two bound copies, one being for the department and other for the Dissertation Supervisor. The Dissertation report shall be evaluated by the DPGRC and external examination shall be conducted on a pre-notified date. The Dissertation evaluation for the fourth semester is as follows: