SREE VIDYANIKETHAN ENGINEERING COLLEGE
(AUTONOMOUS)
Sree Sainath Nagar, Tirupati

Department of Electronics and Communication Engineering

Supporting Document for 1.1.3

Courses having focus on

Employability/ Entrepreneurship/ skill Development

Program: M.Tech.- Communication Systems

Regulations : SVEC-16

The Courses (with course outcomes) under SVEC-16 Regulations which focus on ***employability/ entrepreneurship/ skill development*** are highlighted with the following colours.

Skill

Employability

Entrepreneurship

ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABI

For

MASTER OF TECHNOLOGY

In

Communication Systems (CMS)

(For the batches admitted from 2016-2017)

CHOICE BASED CREDIT SYSTEM

SREE VIDYANIKETHAN ENGINEERING COLLEGE

(AUTONOMOUS)

(Affiliated to JNTU Anantapur, Approved by AICTE
Programs Accredited by NBA; NAAC with 'A' grade)
Sree Sainath Nagar, A.Rangampet, Near Tirupati - 517 102.A.P.

VISION

To be one of the Nation's premier Engineering Colleges by achieving the highest order of excellence in Teaching and Research.

MISSION

- To foster intellectual curiosity, pursuit and dissemination of knowledge.
- To explore students' potential through academic freedom and integrity.
- To promote technical mastery and nurture skilled professionals to face competition in ever increasing complex world.

QUALITY POLICY

Sree Vidyanikethan Engineering College strives to establish a system of Quality Assurance to continuously address, monitor and evaluate the quality of education offered to students, thus promoting effective teaching processes for the benefit of students and making the College a Centre of Excellence for Engineering and Technological studies.

Department of Electronics and Communication Engineering

Vision

To be a center of excellence in Electronics and Communication Engineering through teaching and research producing high quality engineering professionals with values and ethics to meet local and global demands.

Mission

- The Department of Electronics and Communication Engineering is established with the cause of creating competent professionals to work in multicultural and multidisciplinary environments.

- Imparting knowledge through contemporary curriculum and striving for development of students with diverse background.

- Inspiring students and faculty members for innovative research through constant interaction with research organizations and industry to meet societal needs.

- Developing skills for enhancing employability of students through comprehensive training process.

- Imbibing ethics and values in students for effective engineering practice.

M. Tech. (Communication Systems)
Program Educational Objectives

After few years of graduation, the graduates of M. Tech. (Communication Systems) Program would have

PEO1. Enrolled or completed research studies in the core or allied areas of communication systems.

PEO2. Successful entrepreneurial or technical career in the core or allied areas of communication systems.

PEO3. Continued to learn and to adapt to the world of constantly evolving technologies in the core or allied areas of communication systems.

Program Outcomes

On successful completion of the Program, the graduates of M. Tech. (Communication Systems) Program will be able to

PO1. Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PO2. Analyze complex engineering problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

PO3. Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

PO4. Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

PO5. Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

PO6. Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as

others.

PO7. Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

PO8. Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

PO9: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PO10. Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PO11. Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

Programme Specific Outcomes

On successful completion of the Program, the graduates of M. Tech. (Communication Systems) Program will be able to

PSO1. Demonstrate in-depth knowledge of signal processing, communication systems and networks with global perspective and an ability to process and integrate the existing and new knowledge for enhancement of knowledge.

PSO2. Analyze complex engineering problems critically and synthesize information to make intellectual and creative advances in the domains of signal processing, communication systems and networks.

PSO3. Design and Develop solutions for real world problems in the domains of signal processing, communication systems and networks.

PSO4. Provide a wide range of feasible and optimal solutions for complex engineering problems in the domains of signal processing, communication systems and networks.

PSO5. Do research contributions individually or in groups to the development of scientific/ technological knowledge in the domains of signal processing, communication systems and networks.

PSO6. Apply appropriate techniques, resources, and modern tools to complex engineering activities in the domains of signal processing, communication systems and networks.

The Challenge of Change

"Mastery of change is in fact the challenge of moving human attention from an old state to a new state. Leaders can shift attention at the right time and to the right place. The real crisis of our times is the crisis of attention. Those who lead are the ones who can hold your attention and move it in a purposeful way. Transformation is nothing but a shift in attention from one form to another. The form of a beautiful butterfly breaks free from a crawling caterpillar. If you pay enough attention, you would be able to see how the butterfly hides within the caterpillar. The leader points out a butterfly when the follower sees only a caterpillar".

- Debashis Chatterjee

ACADEMIC REGULATIONS

CHOICE BASED CREDIT SYSTEM

M. Tech. Regular Two Year Degree Program

(for the batches admitted from the academic year 2016–17)

For pursuing Two year degree program of study in Master of Technology (M.Tech) offered by Sree Vidyanikethan Engineering College under Autonomous status and herein after referred to as SVEC (Autonomous):

1. Applicability : All the rules specified herein, approved by the Academic Council, shall be in force and applicable to students admitted from the academic year 2016-2017 onwards. Any reference to "College" in these rules and regulations stands for SVEC (Autonomous).

2. Extent: All the rules and regulations, specified hereinafter shall be read as a whole for the purpose of interpretation and as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. It shall be ratified by Academic Council in the forth coming meeting. As per the requirements of statutory bodies, Principal, SVEC (Autonomous) shall be the Chairman, Academic Council.

3. Admission :

3.1. Admission into the Two Year M. Tech. Degree Program of study in Engineering:

3.1.1. Eligibility:

- A candidate seeking admission into the two year M. Tech Degree Program should have

  (i) Passed B.Tech / B.E or equivalent Program recognized by JNTUA, Anantapuramu, for admission as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE).

  (ii) A minimum percentage of marks in the qualifying degree as prescribed by the AICTE / UGC or Government at the time of admission.

  (iii) Rank / score secured in the PGECET / GATE examination conducted by APSCHE/ MHRD for allotment of a seat by the convener PGECET, for admission.

3.1.2. Admission Procedure:

Admissions are made into the two year M.Tech. Degree Program as per the stipulations of APSCHE, Government of Andhra Pradesh:

(a) By the Convener, PGECET (for Category–A Seats)

(b) By the Management (for Category-B Seats).

4. Programs of study offered leading to the award of M.Tech. Degree and Eligibility:

Following are the two year postgraduate degree Programs of study offered in various branches at in SVEC (Autonomous) leading to the award of M.Tech. degree and eligibility to get admission into the Programs:

Name of the specialization	Offered by the Department	Name of the Degree / Branch eligible for Admission
Electrical Power Systems	EEE	BE/ B.Tech / AMIE in Electrical & Electronics Engineering / Electrical Engineering or equivalent
Digital Electronics and Communication Systems	ECE	BE / B.Tech in ECE / AMIE in ECE, AMIE (Electronics & Telecommunication Engineering) / AMIETE (Electronics & Telematics Engineering)/ Electronics & Computer Engineering/ Electronics/ Electronics & Telematics or equivalent
Communication Systems		
VLSI		BE / B.Tech / AMIE in ECE, / EEE / CSE / Electronics & Computer Engineering / ETE / IT / CSIT / Electronics and Control Engineering / Instrumentation Engineering / Instrumentation Technology / EIE / Electronics Engineering / Bio-Medical Engineering / AMIETE (Electronics & Telematics Engineering)/ Electronics or equivalent
Computer Science	CSE	BE / B.Tech / AMIE in CSE / CSIT / IT / CSSE , M. Sc. (Computer Science), M. Sc. (Information Systems), M. Sc. (Information Technology), MCA or equivalent.
Computer Networks and Information Security		
Software Engineering	IT	

5. Duration of the Program:

5.1 Minimum Duration: The program will extend over a period of two years leading to the Degree of Master of Technology (M.Tech) of the JNTUA, Ananthapuramu. The two academic years will be divided into four semesters with two semesters per year. In first year, each semester shall normally consist of 22 weeks (≥90 working days) having – 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. In second year, each semester shall consists of 18 weeks and the entire year is for project work. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as suggested by UGC, and Curriculum/ Course Structure as suggested by AICTE are followed.

5.2 Maximum Duration: The student shall complete all the passing requirements of the M.Tech degree program within a maximum duration of 4 years including Gap year, this duration reckoned from the commencement of the semester to which the student was first admitted to the program.

I SEMESTER (22 weeks)	**INSTRUCTION PERIOD**:	I Spell : 7 Weeks II Spell : 9 Weeks	16 Weeks
	Internal Examinations :	I Mid : 1 week II Mid : 1 week	2 Weeks
	Preparation & Practical Examinations		2 Week
	External Examinations		2 Weeks
	Semester Break		2 Weeks
II SEMESTER (22 weeks)	**INSTRUCTION PERIOD**:	I Spell : 7 Weeks II Spell : 9 Weeks	16 weeks
	Internal Examinations :	I Mid : 1 week II Mid : 1 week	2 Weeks
	Preparation & Practical Examinations		2 Week
	External Examinations		2 Weeks
	Summer Vacation		4 Weeks
III SEMESTER	Project Work Phase – I		19 Weeks
IV SEMESTER	Project Work Phase – II		19 Weeks
	Project Work Viva-Voce examinations		2 Weeks

6. Course Structure: Each Program of study shall consist of:

- Professional core courses:

  The list of professional core courses are chosen as per the suggestions of the experts, to impart knowledge and skills needed in the concerned specialization of study.

- Professional elective courses:

  Professional elective courses shall be offered to the students to diversify their spectrum of knowledge and skills. The elective courses can be chosen based on the interest of the student to broaden his individual knowledge and skills.

- Audit Courses: Audit courses shall be offered to the students to diversify their knowledge.

Contact periods: Depending on the complexity and volume of the course the number of contact periods per week shall be assigned.

7. Credit System: All Courses are to be registered by a student in a Semester to earn Credits. Credits are assigned based on the following norms given in Table 1.

Table 1

Course	Periods/Week	Credits
Theory	01	01
Practical	04	02
Seminar	--	02
Project Work Phase-I	--	--
Project Work Phase-II	--	28

i. As a norm, for the theory courses, **one credit** for one contact period per week is assigned.

ii. As a norm, for practical courses **two credits** will be assigned for four contact periods per week.

iii. For courses like Project/Seminar, where formal contact periods are not specified, credits are assigned based on the complexity of the work to be carried out.

iv. There are no credits for audit courses.

Other student activities like NCC, NSS, Sports, Study Tour, Guest Lecture etc. will not carry Credits.

The two year curriculum of any M. Tech Degree Program of study shall have total of **86** credits (28 credits in I Semester, 30 credits in II Semester and 28 credits in IV Semester).

8. Choice Based Credit System (CBCS):

Choice Based Credit System (CBCS) is introduced based on UGC guidelines in order to promote:

- Student centered learning

- Cafeteria approach
- Students to learn courses of their choice
- Learning at their own pace
- Interdisciplinary learning

- A student is introduced to "Choice Based Credit System (CBCS)"
- The total credits for the Programme is 86.
- A student has choice of registering for credits from the theory courses offered in the program ensuring the total credits in a semester are between 24 and 34.
- In I Semester, the student has the option of registering for one additional theory course from the latter semester or dropping one existing theory course from the current semester within the course structure of the program. In II Semester also, the student has the option of registering for one additional theory course from the previous semester if dropped earlier within the course structure of the program. However the maximum number of credits the student can register in a particular semester cannot exceed 33 credits.
- Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).
- All the registered credits will be considered for the calculation of final CGPA.

9. Course Enrollment and Registration

9.1 Each student, on admission shall be assigned to a Faculty Advisor (Mentor) who shall advice and counsel the student about the details of the academic programme and the choice of courses considering the student's academic background and career objectives.

9.2 The enrollment of courses in I Semester will commence on the day of admission. If the student wishes, the student may drop or add courses (vide clause 8) within **three** days before commencement of I semester class work and complete the registration process. The student shall enroll for the courses with the help of the student's Faculty Advisor (Mentor). The enrollment of courses in II Semester will commence 10 days prior to the last instructional day of the I semester and complete the registration process for all the remaining theory courses as per program course structure, duly authorized by the Chairman, Board of studies of concern department.

9.3 If any student fails to register the courses in a semester, he shall undergo the courses as per the program structure.

9.4 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the Semester-end Examinations.

9.5 No elective course shall be offered by a Department unless a minimum of 8 students register for the course.

10. Massive Open Online Course (MOOC)

A Massive Open Online Course (MOOC) is an online course aimed at unlimited participation and open access via the web. MOOC is a model for delivering learning content online to any person who takes a course, with no limit on attendance.

- A student shall undergo a "Massive Open Online Course (MOOC)" for award of the degree besides other requirements.
- A student is offered this Online Course at the beginning of his II Semester of study and the course has to be completed by the end of III Semester. If the student fails to complete the course by the end of III Semester, it shall be treated as a backlog and needs to be completed before completion of the program for the award of the degree.
- The student shall confirm registration by enrolling the course within 10 days prior to the last instructional day of the I semester like other courses.
- The courses will be approved by the Chairman, Academic Council, SVEC based on the recommendations of the Chairman, Board of Studies of concerned program considering current needs.
- A student has a choice of registering for only one MOOC with the recommendation of Chairman, Board of studies of concerned program and duly approved by the Chairman, Academic Council, SVEC.
- The student shall undergo MOOC without disturbing the normal schedule of regular class work.
- One faculty member assigned by the Head of the Department shall be responsible for the periodic monitoring of the course implementation.
- No formal lectures need be delivered by the faculty member assigned to the students.
- If any student wants to change the MOOC course already registered, he will be given choice to register a new MOOC course in M. Tech. II / III Semester only, with the recommendation of Chairman, Board of studies of concerned program and duly approved by the Chairman, Academic Council, SVEC.
- Finally, the performance of the student in the course will be evaluated as stipulated by the course provider. A certificate will be issued on successful completion of the course by the course provider.
- The performance in the MOOC will not be considered for the calculation of SGPA and CGPA of the student.
- The MOOC course will be listed in the grade sheets of the student.

11. Break of Study from a Programme (Gap Year)

11.1 A student is permitted to go on break of study for a maximum period of one year.

11.2 The student shall apply for break of study in advance, in any case, not later than the last date of the first assessment period in a semester. The application downloaded from website and duly filled by the student shall be submitted to the Head of the Department. In the case of start-up for incubation of idea only, the application for break of study shall be forwarded by the Head of the Department to the Principal, SVEC. A sub-committee appointed by the principal shall give recommendations for approval.

11.3 The students permitted to rejoin the programme after break of study shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new regulations shall apply to the Principal, SVEC in the prescribed format through Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

11.4 The total period for completion of the programme reckoned from the commencement of the I Semester to which the student was admitted shall not exceed the maximum period specified in clause 5.2 irrespective of the period of break of study in order that the student may be eligible for the award of the degree (vide clause 19).

11.5 If a student has not reported to the department after approved period of break of study without any intimation, the student is treated as detained in that semester. Such students are eligible for readmission for the semester when offered next.

12. Examination System: All components in any Program of study shall be evaluated through internal evaluation and / or an external evaluation conducted as semester-end examination.

12.1. Distribution of Marks:

<table>
<tr><th>Sl. No.</th><th>Course</th><th>Marks</th><th colspan="2">Examination and Evaluation</th><th>Scheme of examination</th></tr>
<tr><td rowspan="4">1.</td><td rowspan="4">Theory</td><td>60</td><td colspan="2">Semester-end examination of
3 hours duration
(External evaluation)</td><td>The examination question paper in theory courses shall be for a maximum of 60 marks. The question paper shall be of descriptive type with 5 questions, taken one from each unit of syllabus, having internal choice and all 5 questions shall be answered. All questions carry equal marks.</td></tr>
<tr><td rowspan="3">40</td><td rowspan="3" colspan="2">Mid-term Examination of
2 hours duration
(Internal evaluation).</td><td>The question paper shall be of descriptive type with 5 essay type questions out of which 4 are to be answered and evaluated for 40 marks.</td></tr>
<tr><td rowspan="2">Two mid-term examinations each for 40 marks are to be conducted. For a total of 40 marks, 75% of better one of the two and 25% of the other one are added and finalized.
Mid-I: After first spell of instruction (I to II Units).
Mid-II: After second spell of instruction (III to V Units).</td></tr>
<tr><td></td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Laboratory</td><td>50</td><td colspan="2">Semester-end Lab Examination for
3 hours duration
(External evaluation)</td><td>50 marks are allotted for laboratory examination during semester-end.</td></tr>
<tr><td>50</td><td>30</td><td>Day-to-Day</td><td>Two laboratory examinations, which</td></tr>
</table>

Sl. No.	Course	Marks	Examination and Evaluation		Scheme of examination
				evaluation for Performance in laboratory experiments and Record. (Internal evaluation).	includes Day-to-Day evaluation and Practical test, each for 50 marks are to be evaluated. For a total of 50 marks 75% of better one of the two and 25% of the other one are added and finalized. **Laboratory examination-I:** Shall be conducted just before I mid-term examinations. **Laboratory examination-II:** Shall be conducted just before II mid-term examinations.
			20	Practical test (Internal evaluation).	
3	Audit Course	-	-		Audit course will be conducted as given in 12.2.1
4	Seminar	100	Semester-end Examination		100 marks are allotted for Seminar during semester-end evaluation by the Departmental Committee (DC) as given in 12.2.2.
5	Project Work	400	200	External evaluation	Semester-end Project Viva-Voce Examination by Committee as detailed in 12.2.3.
			200	Internal evaluation	Continuous evaluation by the DC as detailed in 12.2.3.

12.2 Audit Course/ Seminar/Project Work Evaluation:

12.2.1. Audit Course: For audit course, attendance shall be maintained like in case of any regular course. Students may be encouraged to submit assignments and give presentations on the course topics. There won't be any examinations for audit courses. However, the courses shall be listed in the grade sheet of the student.

12.2.2. Seminar: For the seminar, the student shall collect information through literature survey on a specialized topic and prepare a technical report, showing his understanding over the topic, and submit to the Department a week before presentation. The report and the presentation shall be evaluated at the end of the semester during the period of preparation and practicals by the Departmental Committee (DC) consisting of two senior faculty members and concerned supervisor of the department. The DC is constituted by the Principal on the recommendations of the Head of the Department. The department shall have individual DCs for each M. Tech. Program with senior faculty members and the supervisor specialized in the program.

12.2.3. Project Work:

12.2.3.1. Student shall register for the Project work with the approval of DC in the III Semester and continue the work in the IV Semester too. The DC shall monitor the progress of the project work. In III Semester, Phase–I of the Project Work has to be completed. A Student has to identify the topic of work, collect relevant Literature, preliminary data, implementation tools/ methodologies etc., and perform a critical study and analysis of the problem identified. He shall submit status report in two different phases in addition to oral presentation before the DC for evaluation and award of internal marks

at the end of Phase –I. A candidate shall continue the Project Work in IV Semester (Phase – II) and submit a Project report at the end of Phase–II after approval of the DC. During Phase–II, the student shall submit status report in two different phases, in addition to oral presentation before the DC. The DC shall evaluate the project based on the progress, presentations and quality of work. A candidate shall be allowed to submit the dissertation only after passing all the courses from 1st to 3rd semesters and on recommendations of the DC. The Viva-Voce examination shall be conducted as per the IV Semester examinations schedule.

12.2.3.2 Three copies of the dissertation certified in the prescribed form by the concerned Supervisor and HOD shall be submitted to the Department. One copy is to be submitted to the Chief Controller of Examinations, SVEC (Autonomous) and one copy to be sent to the examiner. The examiner shall be nominated by the Chief Controller of the Examinations from the panel of three examiners submitted by the Department for a maximum of 5 students at a time for adjudication.

12.2.3.3 If the report of the examiner is favorable, Viva-Voce examination shall be conducted by a board consisting of the concerned Supervisor, Head of the Department and the examiner who adjudicated the dissertation. The board shall jointly evaluate the candidates project work. If the report of the examiner is not favorable, the candidate should revise and resubmit the project report followed by Viva-Voce examination.

12.2.3.4 The candidates who fail in Viva-Voce examination shall have to re-appear the Viva-Voce examination after three months. Extension of time within the total permissible limit for completing the project is to be obtained from the Chairman, Academic Council, SVEC (Autonomous).

12.2.3.5 If a candidate desires to change the topic of the project already chosen, during Phase–II, he has to re-register for Project work with the approval of the DC and repeat Phases–I & II. Marks already earned in Phase–I stand cancelled.

12.2.3.6 If a candidate unable to complete the project work after Phase–II and desires to change the topic of the project already chosen, he has to re-register for Project work with the approval of the DC and repeat Phases–I & II. Marks already earned in Phase–I & II stand cancelled.

12.3. Eligibility to appear for the semester-end examination:

12.3.1 A student shall be eligible to appear for semester-end examinations if he acquires a minimum of 75% of attendance in aggregate of all the courses in a semester.

12.3.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

12.3.3 Shortage of attendance below 65% in aggregate shall in no case be condoned.

12.3.4 Students whose shortage of attendance is not condoned in any semester shall not be eligible to take their semester-end examination and their registration shall stand cancelled.

12.3.5 A student shall not be promoted to the next semester unless he satisfies the attendance requirements of the semester, as applicable. The student may seek readmission for the semester when offered next. He will not be allowed to register for the courses of the semester while he is in detention.

12.3.6 A stipulated fee shall be payable to the college towards condonation of shortage of attendance.

12.4. **Evaluation**: Following procedure governs the evaluation.

12.4.1. Marks for components evaluated internally by the faculty should be submitted to the Controller of Examinations one week before the commencement of the semester-end examinations. The marks for the internal evaluation components shall be added to the external evaluation marks secured in the semester-end examinations, to arrive at total marks for any course in that semester.

12.4.2. Performance in all the courses is tabulated course-wise and shall be scrutinized by the Results Committee and moderation is applied if needed, and course-wise marks are finalized. Total marks obtained in each course are converted into letter grades.

12.4.3. Student-wise tabulation shall be done and individual grade sheet shall be generated and issued.

12.5. Personal verification / Revaluation / Recounting:

Students shall be permitted for personal verification/request for recounting/ revaluation of the semester-end examination answer scripts within a stipulated period after payment of prescribed fee. After recounting or revaluation, records shall be updated with changes if any and the student shall be issued a revised grade sheet. If there are no changes, the student shall be intimated the same through a notice.

12.6. Supplementary Examination:

In addition to the regular semester-end examinations conducted, the College may also schedule and conduct supplementary examinations for all the courses of other semesters when feasible for the benefit of students. Such of the candidates writing supplementary examinations may have to write more than one examination per day.

13. Re-Registration for Improvement of Internal Marks:

Following are the conditions to avail the benefit of improvement of internal evaluation marks.

13.1 The candidate should have completed the course work and obtained examinations results for I and II semesters.

13.2 Out of the courses the candidate has failed in the examinations due to internal evaluation marks secured being less than 50%, the candidate shall be given one chance for a maximum of 3 theory courses for improvement of internal evaluation marks.

13.3 He should have passed all the remaining courses for which the internal evaluation marks secured more than or equal to 50%.

13.4 The candidate has to register for the chosen courses and fulfill the academic requirements.

13.5 For each course, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D./ Challan in favour of the Principal, Sree Vidyanikethan Engineering College payable at Tirupati along with the requisition through the concerned Head of the Department.

13.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the semester-end examinations markssecured in the previous attempt(s) for the re-registered courses stand cancelled.

14. Academic Requirements for completion of M.Tech Program of study:

The following academic requirements have to be satisfied in addition to the attendance requirements for completion of M.Tech Program of study.

14.1 A student shall be deemed to have satisfied the minimum academic requirements for each theory, laboratory and project work, if he secures not less than 40% of marks in the semester-end examination and a minimum of 50% of marks in the sum total of the internal evaluation and semester-end examination taken together. For the seminar, he should secure not less than 50% of marks in the semester-end examination.

14.2 A student shall register for all the 86 credits and earn all the 86 credits. Marks obtained in the 86 credits shall be considered for the calculation of the DIVISION based on CGPA.

14.3 A student who fails to earn 86 credits as indicated in the curriculum within **four** academic years from the year of his admission shall forfeit his seat in M.Tech. Program and his admission stands cancelled.

15. Transitory Regulations:

Students who got detained for want of attendance (**or**) who have not fulfilled academic requirements (**or**) who have failed after having undergone the Program in earlier regulations (**or**) who have discontinued and wish to continue the Program are eligible for admission into the unfinished semester from the date of commencement of class work with the same (**or**) equivalent courses as and when courses are offered and they will be in the academic regulations into which they are presently readmitted.

A regular student has to satisfy all the eligibility requirements within the maximum stipulated period of **four years** for the award of M.Tech Degree.

16. Grades, Grade Point Average and Cumulative Grade Point Average:

16.1. Grade System: After all the components and sub-components of any course (including laboratory courses) are evaluated, the final total marks obtained shall be converted to letter grades on a "**10 point scale**" as described below.

Grades conversion and Grade points allotted

% of Marks obtained	Grade	Description of Grade	Grade Points (GP)
≥ 95	O	Outstanding	10
≥ 85 to < 95	S	Superior	9
≥ 75 to < 85	A	Excellent	8
≥ 65 to < 75	B	Very Good	7
≥ 55 to < 65	C	Good	6
≥ 50 to <55	D	Pass	5
< 50	F	Fail	0
Not Appeared	N	Absent	0

Pass Marks: A student shall be declared to have passed theory course, laboratory course and project work if he secures minimum of 40% marks in Semester-end examination, and a minimum of 50% marks in the sum total of internal evaluation and Semester-end examination taken together. For the seminar, he shall be declared to have passed if he secures minimum of 50% of marks in the semester-end examinations. Otherwise he shall be awarded fail grade - **F** in such a course irrespective of internal marks. **F** is considered as a fail grade indicating that the student has to pass the semester-end examination in that course in future and obtain a grade other than **F** and **N** for passing the course.

16.2. Semester Grade Point Average (SGPA):

Semester Grade Point Average (SGPA) shall be calculated as given below on a "10 point scale" as an index of the student's performance at the end of each semester:

$$\text{SGPA} = \frac{\sum(C\ X\ GP)}{\sum C}$$

where ***C*** denotes the credits assigned to the courses undertaken in that semester and ***GP*** denotes the grade points earned by the student in the respective courses.

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

16.3. Cumulative Grade Point Average (CGPA):

The CGPA for any student is awarded only when he completes the Program i.e., when the student passes in all the courses prescribed in the Program. The CGPA is computed on a 10 point scale as given below:

$$\text{CGPA} = \frac{\sum(C\ X\ GP)}{\sum C}$$

where ***C*** denotes the credits assigned to courses undertaken up to the end of the Program and *GP* denotes the grade points earned by the student in the respective courses.

17. Grade Sheet: A grade sheet (Marks Memorandum) shall be issued to each student indicating his performance in all courses registered in that semester indicating the SGPA.

18. Transcripts: After successful completion of the entire Program of study, a transcript containing performance in all academic years shall be issued as a final record. Duplicate transcripts will also be issued, if required, after payment of requisite fee. Partial transcript will also be issued upto any point of study to a student on request.

19. Award of Degree: The Degree shall be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Ananthapuramu on the recommendations of the Chairman, Academic Council, SVEC (Autonomous).

19.1. Eligibility: A student shall be eligible for the award of M.Tech Degree if he fulfills all the following conditions:

- Registered and successfully completed all the components prescribed in the Program of study to which he is admitted.
- Successfully acquired the minimum required credits as specified in the curriculum corresponding to the Program of study within the stipulated time.
- Obtained CGPA greater than or equal to 5.0 (Minimum requirement for declaring as passed).
- Has no dues to the College, Hostel, Library etc. and to any other amenities provided by the College.
- No disciplinary action is pending against him.

19.2. Award of Division: Declaration of division is based on CGPA.

Awarding of Division

CGPA	Division
> = 7.0	First Class with Distinction
> = 6.0 and < 7.0	First Class
> = 5.0 and < 6.0	Second Class

20. Additional academic regulations:

20.1 A student may appear for any number of supplementary examinations within the stipulated time to fulfill regulatory requirements for award of the degree.

20.2 In case of malpractice/improper conduct during the examinations, guidelines shall be followed as shown in the **Annexure-I**.

20.3 When a student is absent for any examination (Mid-term or Semester-end) he shall be awarded **zero** marks in that component (course) and grading will be done accordingly.

20.4 When a component is cancelled as a penalty, he shall be awarded zero marks in that component.

21. Withholding of Results:

If the candidate has not paid dues to the College/University (or) if any case of indiscipline is pending against him, the result of the candidate shall be withheld and he will not be allowed/promoted to the next higher semester

22. Amendments to regulations:

The Academic Council of SVEC (Autonomous) reserves the right to revise, amend, or change the Regulations, Scheme of Examinations, and / or Syllabi or any other policy relevant to the needs of the society or industrial requirements etc., with the recommendations of the concerned Board(s) of Studies.

23. General:

The words such as "he", "him", "his" and "himself" shall be understood to include all students irrespective of gender connotation.

Note: *Failure to read and understand the regulations is not an excuse.*

Annexure-I

GUIDE LINES FOR DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

Rule No.	Nature of Malpractices/ Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester. The Hall Ticket of the candidate is to be cancelled.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including labs and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester. The candidate is also debarred for four consecutive semesters from class work and all Semester-end examinations, if his involvement is established. Otherwise, The candidate is debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course only.
6.	Refuses to obey the orders of the Chief Controller of Examinations/Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already

	the examination hall or organizes a walk out or instigates others to walk out, or threatens the Controller of Examinations or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the Controller of Examinations, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester. If the candidate physically assaults the invigilator/Controller of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred and forfeits the seat.

Note: Whenever the performance of a student is cancelled in any course(s) due to Malpractice, he has to register for Semester-end Examinations in that course(s) consequently and has to fulfill all the norms required for the award of Degree.

SREE VIDYANIKETHAN ENGINEERING COLLEGE (Autonomous)

Sree Sainath Nagar, Tirupati – 517 102.

SVEC16
M. Tech. (Communication Systems)
Course Structure

I-Semester

S. No	Course Code	Course Title	Contact Periods per Week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Internal Marks	External Marks	Total Marks
1.	16MT15706	Advanced Digital Signal Processing	4	-	-	4	4	40	60	100
2.	16MT13802	Digital Communication Techniques	4	-	-	4	4	40	60	100
3.	16MT23803	Information Theory and Coding Techniques	4	-	-	4	4	40	60	100
4.	16MT23807	Optical Communications and Networks	4	-	-	4	4	40	60	100
5.	16MT16101	RF Circuit Design	4	-	-	4	4	40	60	100
6.	***Professional Elective-1***		4	-	-	4	4	40	60	100
	16MT13801	Computer Networks								
	16MT16102	Digital Satellite Communications								
	16MT16103	Software Defined Radio								
	16MT13807	Transform Techniques								
7.	16MT16131	Communications Lab - I	-	-	4	4	2	50	50	100
8.	16MT16132	RF Circuits & Optical Communications lab	-	-	4	4	2	50	50	100
		Total:	**24**	**-**	**8**	**32**	**28**	**340**	**460**	**800**
9.	16MT13808	Research Methodology (Audit Course)	-	2	-	2	-	-	-	-

II-Semester

S. No.	Course Code	Course Title	Contact Periods per Week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Internal Marks	External Marks	Total Marks
1.	16MT26101	Adaptive Signal Processing	4	-	-	4	4	40	60	100
2.	16MT23801	Detection and Estimation of Signals	4	-	-	4	4	40	60	100
3.	16MT13804	Image & Video Processing	4	-	-	4	4	40	60	100
4.	16MT26102	Smart Antennas	4	-	-	4	4	40	60	100
5.	16MT23805	Wireless Communications	4	-	-	4	4	40	60	100
6.	***Professional Elective-2***		4	-	-	4	4	40	60	100
	16MT26103	EMI/ EMC								
	16MT26104	Radar Signal Processing								
	16MT23809	Speech Processing								
	16MT25709	Wireless Sensor Networks								
7.	16MT26131	Communications Lab - II	-	-	4	4	2	50	50	100
8.	16MT13832	Image & Video Processing Lab	-	-	4	4	2	50	50	100
9.	16MT26133	Seminar	-	-	-	-	2	--	100	100
		Total:	**24**	**-**	**8**	**32**	**30**	**340**	**560**	**900**
10.	16MT23810	Intellectual Property Rights (Audit Course)	-	2	-	2	-	-	-	-

III-Semester

S. No.	Course Code	Course Title	Contact Periods per Week				Credits	Scheme of Examination Max. Marks		
			L	T	P*	Total		Internal Marks	External Marks	Total Marks
1.	16MT3MOOC	MOOC	-	-	-	-	-	-	-	-
2.	16MT36131	Project Work – Phase I	-	-	-	-	-	100	--	100
Total:			**-**	**-**	**-**	**-**	**-**	**100**	**--**	**100**

*Fulltime Project Work

IV-Semester

S. No.	Course Code	Course Title	Contact Periods per Week				Credits	Scheme of Examination Max. Marks		
			L	T	P*	Total		Internal Marks	External Marks	Total Marks
1.	16MT46131	Project Work – Phase II	-	-	-	-	28	100	200	300
Total:			**-**	**-**	**-**	**-**	**28**	**100**	**200**	**300**
Grand Total:							**86**	**880**	**1220**	**2100**

*Fulltime Project Work

I M. Tech.– I Semester
(16MT15706) ADVANCED DIGITAL SIGNAL PROCESSING
(Common to CMS & VLSI (PE – I))

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Courses on Digital Signal Processing at UG level

COURSE DESCRIPTION:
Digital filter banks; Parametric and Non-Parametric Power Spectrum Estimation methods; computationally efficient algorithms; Applications of DSP.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Gain in-depth knowledge in
   - Filter banks and Wavelets
   - Linear Prediction
   - Efficient power Spectral Estimation Techniques
   - Applications of Multirate signal processing
2. Analyze complex engineering problems critically in the field of Signal Processing.
3. Design optimum filters, multirate DSP systems and computationally efficient DSP algorithms for societal needs.
4. Solve engineering problems for feasible and optimal solutions in the field of digital signal processing.
5. Initiate research in advanced digital signal processing.
6. Learn and apply appropriate techniques, including prediction and modeling to complex engineering activities with an understanding of the limitations.
7. Contribute to scientific research in Radar signal processing ,Inter disciplinary areas like Speech and Image processing and Remote sensing with objectivity and rational analysis.

DETAILED SYLLABUS:

UNIT-I: MULTIRATE FILTER BANKS (Periods:12)
Decimation, Interpolation, Sampling rate conversion by a rational factor I/D, Multistage Implementation of sampling rate conversion. **Digital Filter Banks**: Two-Channel Quadrature-Mirror Filter Bank, Elimination of aliasing, condition for Perfect Reconstruction, Polyphase form of QMF bank, Linear phase FIR QMF bank, IIR QMF bank, Perfect Reconstruction Two-Channel FIR QMF Bank.

UNIT-II: POWER SPECTRAL ESTIMATIONS (Periods:12)
Estimation of spectra from finite duration observation of signals.

Non-Parametric Methods: Bartlett, Welch, Blackman & Tukey methods. Performance Characteristics of Non-parametric Power Spectrum Estimators, Computational Requirements of Non-parametric Power Spectrum Estimates.

Parametric Methods of Power Spectral Estimation:
Auto correlation & Its Properties, Relationship between auto correlation & model parameters, Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation.

UNIT-III: LINEAR PREDICTION (Periods:10)
Forward and Backward Linear Prediction – Forward Linear Prediction, Backward Linear Prediction, Optimum reflection coefficients for the Lattice Forward and Backward Predictors. Solution of the Normal Equations: Levinson Durbin Algorithm, Schur Algorithm. Properties of Linear Prediction Filters.

UNIT-IV: DSP ALGORITHMS (Periods:10)

Fast DFT algorithms based on Index mapping, Sliding Discrete Fourier Transform, DFT Computation Over a narrow Frequency Band, Split Radix FFT, Linear filtering approach to Computation of DFT using Chirp Z-Transform.

UNIT-V: APPLICATIONS OF DIGITAL SIGNAL PROCESSING (Periods:11)

Digital cellular mobile telephony, Adaptive telephone echo cancellation, High quality A/D conversion for digital Audio, Efficient D/A conversion in compact hi-fi systems, Acquisition of high quality data, Multirate narrow band digital filtering, High resolution narrow band spectral analysis.

Total periods: 55

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, *Digital signal processing, principles, Algorithms and applications,* Prentice Hall, 4th edition, 2007.
2. Sanjit K Mitra, "*Digital signal processing, A computer base approach",* McGraw-Hill Higher Education, 4th edition, 2011.

REFERENCE BOOKS:

1. Emmanuel C Ifeacher Barrie. W. Jervis, "*DSP-A Practical Approach*", Pearson Education, 2nd edition, 2002.
2. A.V. Oppenheim and R.W. Schaffer, "*Discrete Time Signal Processing",* PHI, 2nd edition, 2006.

I M. Tech. – I Semester
(16MT13802) DIGITAL COMMUNICATION TECHNIQUES
(Common to CMS & DECS)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES: --
Course on Digital Communications at UG Level**,** Review of random Variables and Processes

COURSE DESCRIPTION:
Characterization of Communication Signals and Systems; Digital Modulation Techniques; Optimum Receivers for the Additive Gaussian Noise Channel; Spread Spectrum Technique; Multichannel and Multicarrier Systems.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate in-depth knowledge in
   - Characterization of communication signals and systems.
   - Digital modulation techniques
   - Communication over AWGN channels
   - Optimum receivers
   - Spread spectrum techniques
   - Multi-carrier communication system
2. Analyze numerical and analytical problems critically for conducting research in the field of Digital Communication Systems.
3. Solve engineering problems and arrive at optimal solutions pertaining to digital communications.
4. Apply appropriate techniques to complex engineering activities in the field of signal processing and communications.

DETAILED SYLLABUS:

UNIT I– CHARACTERIZATION OF COMMUNICATION SIGNALS AND SYSTEMS (10 periods)

Representation of Band Pass Signals and Systems–Representation of Band Pass Signals, Representation of Linear Band-Pass System, Response of a Band-Pass System to a Band-Pass Signal. Signal Space Representations – Vector Space Concepts, Signal Space Concepts, Orthogonal Expansion of Signals. Representation of Digitally Modulated Signals – Memory Less Modulation Methods – PAM Signals, Phase Modulated Signals, QAM Signals, Multidimensional Signals, Orthogonal Multidimensional Signals. Spectral Characteristics of Digitally Modulated Signals – Power Spectra of Linearly Modulated Signals.

UNIT II – DIGITAL MODULATION TECHNIQUES (11 periods)

Digital Modulation – Factors that Influence the Choice of Digital Modulation, Bandwidth and Power Spectral Density of Digital Signals. Linear Modulation Techniques – BPSK, DPSK, QPSK, OQPSK, Π/4 QPSK. Constant Envelope Modulation Techniques – MSK, GMSK, Combined Linear and Constant Envelope Modulation Techniques – M-ary PSK, M-ary QAM.

UNIT III – OPTIMUM RECEIVERS FOR THE ADDITIVE GAUSSIAN NOISE CHANNEL (10 periods)

Optimum Receiver for Signals corrupted by AWGN –Correlation demodulator, Matched Filter Demodulator, Optimum Detector. Performance of the Optimum Receiver for Memory Less Modulation – Probability of Error for Binary Modulation, M-ary Orthogonal Signals, M-ary PAM, M-ary PSK, QAM. Optimum Receiver for Signals with Random Phase

in AWGN Channel – Optimum Receiver for Binary Signals, Optimum Receiver for M-ary Orthogonal Signals.

UNIT IV – SPREAD SPECTRUM TECHNIQUES (13 periods)

Introduction, Model of Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Signals – Introduction, The Processing Gain and Jamming Margin. Applications of Direct Sequence Spread Spectrum Signals – Anti jamming Application, Low-Detectability Signal Transmission, Code Division Multiple Access. Generation of PN-Sequences, Frequency-Hopped Spread Spectrum Signals, Other Types of Spread Spectrum Signals. Detection of spread spectrum signals- Matched filter receiver, RAKE Receiver.

UNIT V –MULTICHANNEL AND MULTICARRIER SYSTEMS (10periods)

Rayleigh and Rician channels, Multichannel Digital Communications in AWGN Channels; Binary Signals, M-ary Orthogonal Signals. Multicarrier Communications; Single Carrier verses Multicarrier Modulation, Capacity of a Non ideal Linear Filter Channel, OFDM, Modulation & Demodulation in an OFDM, An FFT Algorithm Implementation of an OFDM System. OFDMA.

Total Periods: 54

TEXT BOOKS:

1. John G. Proakis, "Digital Communications", McGraw-Hill, 4th edition, 2001.
2. Theodore S. Rappaport, "Wireless Communications", Pearson Education, 2nd edition, 2002.
3. George R. Cooper & Clare D. McGillem, "Modern Communication and Spread Spectrum", McGraw-Hill Book Company, 1986.

REFERENCE BOOKS:

1. Marvin K. Simon, Jim K Omura, Robert A. Scholtz& Barry K.Levit, "Spread Spectrum Communications", McGraw-Hill, 1st edition,1995.
2. J.Marvin, K.Simon, Sami. M.Hinedi and William C. Lindsey, "Digital Communication Techniques", PHI, 2009.

M. Tech. - I Semester

(16MT23803) INFORMATION THEORY AND CODING TECHNIQUES

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Digital Communications at UG Level

COURSE DESCRIPTION:
Information theory; Channel capacity; Channel coding techniques – Linear block codes, Cyclic codes, Convolutional codes; Reed-Solomon and Turbo codes.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate knowledge in
   - Various aspects of source and channel coding techniques
   - Channel capacity
   - Performance evaluation of various source coding techniques
2. Analyze complex engineering problems critically in the domain of information, source encoding.
3. Design encoder, Syndrome circuits to solve complex engineering problems.
4. Conceptualize and Solve engineering problems for feasible and optimal solutions in the core area of information theory and coding techniques.
5. Initiate research in information theory and coding techniques.
6. Contribute positively to multidisciplinary scientific research in communications with objectivity and rational analysis.

DETAILED SYLLABUS

UNIT I: INTRODUCTION (11 periods)
Entropy: Discrete stationary sources, Markov sources, Entropy of a discrete Random variable- Joint, conditional, relative entropy, Mutual Information and conditional mutual information. Chain rules for entropy, relative entropy and mutual information, Differential Entropy- Joint, relative, conditional differential entropy and Mutual information.
Loss less Source coding: Uniquely decodable codes, Instantaneous codes, Kraft's inequality, optimal codes, Huffman code, Shannon's Source Coding Theorem.

UNIT II: CHANNEL CAPACITY (10 periods)
Capacity computation for some simple channels, Channel Coding Theorem, Fano's inequality and the converse to the Coding Theorem, Equality in the converse to the coding theorem, The joint source Channel Coding Theorem, The Gaussian channels-Capacity calculation for Band limited Gaussian channels, Parallel Gaussian Channels, Capacity of channels with colored Gaussian noise.

UNIT III: CHANNEL CODING-1 (09 periods)
Linear Block Codes: Introduction to Linear block codes, Generator Matrix, Systematic Linear Block codes, , Parity Check Matrix, Syndrome testing, Error correction, Decoder Implementation of Linear Block Codes, Error Detecting and correcting capability of Linear Block codes.

UNIT IV: CHANNEL CODING-2 (13periods)
Cyclic Codes: Algebraic Structure of Cyclic Codes, Binary Cyclic Code Properties, Encoding in Systematic Form, Systematic Encoding with an (n - k)-Stage Shift Register, Error Detection with an (n - k)-Stage Shift Register, Well-Known Block Codes-Hamming Codes, Extended Golay Code, BCH Codes.

Convolutional Codes: Convolution Encoding, Convolutional Encoder Representation, Formulation of the Convolutional Decoding Problem, Properties of Convolutional Codes, Sequential Decoding,

UNIT V: CHANNEL CODING-3 (13periods)

Reed-Solomon Codes- Reed-Solomon Error Probability, Finite Fields, Reed-Solomon Encoding, Reed-Solomon Decoding, Interleaving and Concatenated Codes- Block Interleaving, Convolutional Interleaving, Concatenated Codes. Coding and Interleaving Applied to the Compact Disc Digital Audio System- CIRC Encoding, CIRC Decoding. Turbo Codes-Turbo Code Concepts, Encoding with Recursive Systematic Codes, Feedback Decoder, The MAP Decoding Algorithm.

Total periods:56

TEXT BOOKS:

1. Thomas M. Cover and Joy A. Thomas, Elements of Information Theory, John Wiley & Sons, 1st edition, 1999.
2. Bernard sklar, "Digital Communications – Fundamental and Application", Pearson Education, 2nd edition, 2009.

REFERENCE BOOKS:

1. Robert Gallager, Information Theory and Reliable Communication, John Wiley & Sons, 1st edition, 1968.
2. John G. Proakis, "Digital Communications", Mc. Graw Hill Publication, 5th edition, 2008.
3. Shulin and Daniel. Costello, Jr., "Error Control Coding–Fundamentals and Applications", Prentice Hall, 2nd edition, 2002.

M. Tech. - I Semester

(16MT23807) OPTICAL COMMUNICATIONS AND NETWORKS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: --

COURSE DESCRIPTION:

Non linear properties of fibers; characteristics of fiber materials; optical cable design and connectors; optical components; modulation and demodulation schemes; error detecting and correcting codes; optical network management and control.

COURSE OUTCOMES:

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

1. Demonstrate Knowledge in
   - Linear and Non-linear Characteristics of Optical fiber.
   - Fiber design considerations.
   - Minimization of Losses in Cable design.
   - Understanding the operation of advanced fiber optic components.
   - Modulation and demodulation techniques.
   - Access networks.
   - Network Control and Management.
2. Analyze complex engineering problems critically in the domain of optical communication for conducting research.
3. Design of optical cable and transmission layer in the field of optical Communications.
4. Solve engineering problems related to optical communication to meet societal and industrial needs.
5. Apply appropriate techniques to complex engineering activities in the field of optical communications.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION (Periods:11)

Evolution of fiber types, guiding properties of fibers, cross talk between fibers, coupled modes and mode mixing, dispersion properties of fibers, nonlinear effects of optical fibers- SRS, SBS, intensity dependent refractive index. Characterizations of materials for fibers, fiber preform preparation- Soot deposition, MCVD. Fiber drawing and control, roles of coating and jacketing.

UNIT II: OPTICAL CABLE DESIGN (Periods:10)

Fiber design considerations-Fiber diameter, Cladding thickness, Low and high bit rate systems. Design objectives and cable structures, Fiber splicing- fiber end preparation, single and array splices, measurement of splicing effects. Optical fiber connectors-The role of connectors, Connector alignment techniques.

UNIT-III: FIBER OPTIC COMPONENTS FOR COMMUNICATION AND NETWORKING (Periods:15)

Couplers, Isolators and Circulators, Multiplexers & filters- Bragg Gratings, Fabry-Perot Filters, Mach-Zehnder Interferometers, Arrayed Waveguide Grating, Acousto-Optic Tunable Filter, High Channel Count Multiplexer Architectures. Optical Amplifiers- Erbium Doped Fiber amplifiers, Raman amplifiers, Transmitters- LED, Lasers, Direct and External Modulation, Detectors- Photo detectors. Optical Switches – Large Optical Switches. Wavelength Converters – Optoelectronic Approach, Optical gating.

UNIT-IV: MODULATION AND DEMODULATION (Periods:8)

Signal formats for Modulation, Subcarrier Modulation and Multiplexing, Optical Modulations – Duo binary, Single Side Band and Multilevel Schemes, Demodulation- Ideal and Practical receivers, Bit Error Rates, Coherent Detection, Timing Recovery and Equalization, Reed-Solomon Codes for Error Detection and Correction.

UNIT-V: OPTICAL NETWORKS & MANAGEMENT (Periods:10)

Access Networks - architecture overview, Enhanced HFC, Fiber to the curb (FTTC). Photonic packet switching - OTDM, Synchronization. Deployment considerations - Designing the transmission layer using SDM, TDM, WDM, Unidirectional versus Bidirectional WDM Systems.

Control and Management- Network Management functions, Performance and fault management, Configuration Management, Optical Safety.

Total Periods: 54

TEXT BOOKS:

1. S. E. Miller, A. G. Chynoweth, "Optical Fiber Telecommunication", 1979.
2. Rajiv Ramaswamy, Kumar N. Sivaranjan and Galen H. Sasaki, "Optical Networks", Elsevier, 3rd edition, 2010.

REFERENCE BOOKS:

1. Govind P. Agarwal "Fiber–Optic Communication Systems", Wiley India, 3rd edition, 2002.
2. Gerd Kaiser, "Optical Fiber Communication", McGraw Hill, 4th edition, 2008.
3. John. M. Senior, "Optical fiber communications: Principles and Practice", Pearson, 3rd edition, 2010

M. Tech. - I Semester
(16MT16101) RF CIRCUIT DESIGN

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Concept of Basic Electronics and Wave Theory at UG level

COURSE DESCRIPTION:
Fundamental concepts of transmission line theory; RF Electronics; high frequency circuit behavior; design of tuning and matching networks; RF Passive and active components; RF Transistor amplifier design; Oscillators and RF Mixers.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate in-depth knowledge in
   - RF Electronics
   - Transmission line analysis
   - Matching and biasing networks
   - RF Passive and Active components
   - RF Transistor amplifier design
   - Oscillators and RF Mixers.
2. Analyze complex problems critically in the domains of RF field, RF Passive and Active components as well as a smart antenna techniques in the field of RF Circuits.
3. Design RF circuits for use in various systems as per societal needs.
4. Solve engineering problems to arrive at optimal solutions in compliance with public health and safety, societal and environmental factors in the core areas of RF Circuit design.
5. Apply appropriate techniques to complex engineering activities in the field of wireless communication systems and allied areas.
6. Understand ethical responsibility towards environment and society in the field of microwave and wireless systems.

DETAILED SYLLABUS

UNIT – I: INTRODUCTION TO RF ELECTRONICS (10 Periods)
The Electromagnetic Spectrum, units and Physical Constants, Microwave bands, RF behavior of Passive components: Tuned resonant circuits, Vectors, Inductors and Capacitors. Voltage and Current in capacitor circuits, Tuned RF / IF Transformers.

UNIT – II: TRANSMISSION LINE ANALYSIS (**14 Periods]**)
Examples of transmission lines, Transmission line equations and Biasing: Kirchoffs voltage and current law representation, Traveling voltage and current waves, General Impedance definition, lossless transmission line model. Micro Strip Transmission Lines, Special Termination Conditions, sourced and Loaded Transmission Lines.
Single And Multiport Networks: The Smith Chart, Interconnectivity networks, Network properties and Applications, Scattering Parameters.

UNIT -III: MATCHING AND BIASING NETWORKS (13 Periods)
Impedance matching using discrete components, Micro strip line matching networks, Amplifier classes of Operation and Biasing networks.
RF Passive & Active Components: Filter Basics, Lumped filter design, Distributed Filter Design, Diplexer Filters, Crystal and Saw filters, Active Filters, Tunable filters. Power Combiners / Dividers: Directional Couplers, Hybrid Couplers, Isolators. RF Diodes: BJTs, FETs, HEMTs and Models.

UNIT – IV: RF TRANSISTOR AMPLIFIER DESIGN (09 Periods)

Characteristics of Amplifiers, Amplifier Circuit Configurations, Amplifier Matching Basics, Distortion and noise products, Stability Considerations, Small Signal amplifier design, Power amplifier design, MMIC amplifiers, Broadband High Power multistage amplifiers, Low noise amplifiers, VGA Amplifiers.

UNIT – V: OSCILLATORS and Mixers (11 Periods)

Oscillator basics, Low phase noise oscillator design, High frequency Oscillator configuration, LC Oscillators, VCOs, Crystal Oscillators, PLL Synthesizer, and Direct Digital Synthesizer.

RF Mixers: Basic characteristics of a mixer, Active mixers, Image Reject and Harmonic mixers, Frequency domain considerations.

Total periods: 57

TEXT BOOKS:

1. Reinhold Ludwing, Pavel Bretchko, "*RF Circuit design: Theory and applications*", Pearson Education ,2000.
2. Joseph Carr, "*Secrets of RF Design*", Tata McGraw Hill Publications, 3rd edition, 2004.

REFERENCE BOOKS:

1. Devendra K. Misra, "*Radio Frequency and Microwave Communication Circuits Analysis and Design*", Wiley Student Edition, John Wiley & Sons, 2nd edition, July 2004.
2. Christopher Bowick, "*RF Circuit Design*", Newnes, 1982.
3. Mathew M.Radmanesh, "*Radio frequency and microwave electronics*", Prentice Hall PTR, 2001.

M. Tech. - I Semester
(16MT13801) COMPUTER NETWORKS
(Common to CMS (PE – I) & DECS)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES: --
A Course on Computer Networks and Wireless Communication and Networks at UG Level

COURSE DESCRIPTION:
Advanced computer networks and its architectures; Protocols & Network security; Mobile adhoc networks.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate in-depth knowledge on
   - Architectures and functioning of advanced computer networks like Ethernet, SONET/SDH, Wi-Fi, Frame Relay, ATM networks etc.
   - Protocols like IPv6, MPLS, RSVP, VoIP associated with advanced computer networks.
   - Security features associated with advanced computer networks.
2. Analyze various design issues for conducting research related to the Internet protocol (IP), Wireless LANs and ATM network technologies prominent in high performance scenario.
3. Design and develop techniques for solutions pertaining to the advanced networking technologies.
4. Formulate solutions for engineering problems pertaining to the advanced networking technologies.
5. Initiate research in advanced computer networks.
6. Apply appropriate techniques and tools to complex engineering activities in the field of advanced computer networks.
7. Contribute positively to multidisciplinary scientific research in design and development of Protocols for adhoc network architectures.

DETAILED SYLLABUS

UNIT- I: WIRED AND WIRELESS NETWORKS (10 Periods)
Introduction, Reference models- OSI, TCP/IP; Data Link Control Protocols - HDLC, Point to Point Protocol (PPP); Ethernet- Fast Ethernet, Gigabit Ethernet; Wireless LANS – Merits, topologies, Architecture – Physical Layer, MAC Layer, Frame structure, Applications; Virtual LANs.

UNIT- II: ADVANCED NETWORK ARCHITECTURES (13 Periods)
Circuit switching network - SONET/SDH; Virtual Circuit Networks – Frame Relay, ATM - Protocol Architecture, Logical Connections, ATM Cells, Transmission of ATM Cells, ATM Service Categories; Signaling Protocols - MPLS, RSVP; VPN architectures.

UNIT- III: INTERNET TRANSPORT AND APPLICATION PROTOCOLS (11 Periods)
Internet protocol - IPv6, Transport protocols – Connection Oriented protocol TCP, Connectionless protocol UDP; Congestion control in TCP, Domain Name System, Simple Mail Transfer Protocol, WWW and HTTP, Multimedia Applications – RTP, Voice Over IP.

UNIT- IV: SECURITY IN ADVANCED NETWORKS (10 Periods)
Network security, Cryptography - Symmetric Key Cryptography, Public Key Cryptography, Simple Network Management Protocol, Firewalls - Packet filtering, Digital Signature, IP Security.

UNIT- V: MOBILE AD-HOC NETWORKS (11 Periods)

Overview of Wireless Ad-Hoc Networks, Routing in Ad-Hoc Networks, Routing Protocols for Ad-Hoc Networks; Wireless Sensor Networks: Sensor Networks and Protocol Structures, Communication Energy Model, Clustering Protocols, Routing Protocols.

Total Periods: 55

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, New Delhi, 4th edition, 2006
2. Nader F. Mir, Computer and Communication Networks, Pearson Education, 4th edition, 2007.
3. William Stallings, "Data and Computer Communication", Prentice hall, 9th edition, 2010

REFERENCE BOOKS:

1. Jim Kurose, Keith Ross, "Computer Networking: A Top Down Approach", Addison Wesley, 4th edition, July 2007.
2. Andrew S. Tanenbaum "Computer Networks", Pearson Education, 4th edition, 2008.

M. Tech.-I Semester
(16MT16102) DIGITAL SATELLITE COMMUNICATIONS
(PE-I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PREREQUISITES: A Course on Satellite Communications at UG level

COURSE DESCRIPTION:
Orbital mechanics and satellite sub-systems; Non-geostationary satellite systems; Demand assignment multiple access techniques and packet communications; Spread spectrum communications; Satellite applications.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate advanced knowledge in
   - Satellite Orbits and Sub-Systems
   - NGSO Constellation Designs
   - DAMA Interfaces
   - Satellite Packet Communications and ALOHA systems
   - Spread spectrum Communications
   - Satellite Applications such as VSAT, MSAT, Direct Broadcast Satellite Television.
2. Investigate and analyze engineering problems critically in the field of satellite system design and communications.
3. Design efficient Digital Satellite Systems/ Subsystems and solve engineering problems in the area of satellite communications.
4. Solve engineering problems with feasible and economical solutions in digital satellite communications.
5. Apply appropriate techniques, resources and tools to engineering activities in the field of digital satellite communications.
6. Develop ethical attitude towards environment in the field of digital satellite communications.

DETAILED SYLLABUS

UNIT– I: SATELLITE ORBITS AND SUBSYSTEMS (Periods: 11)
Overview of Satellite Communications- Brief history, Orbital Mechanics, Look Angles determination, Orbital perturbations, Apogee- Perigee heights. Geo-stationary orbits- launching orbits, launch vehicles. Satellite Sub-Systems- Attitude and Orbit Control system, TT&C subsystem, Power systems, Communication subsystems, Satellite Antenna Equipment.

UNIT– II: LOW EARTH ORBIT AND NON-GEOSTATIONARY SATELLITE SYSTEMS (Periods:10)
Introduction-Orbit Considerations, Equatorial Orbits, Inclined Orbits, Elliptical Orbits, Molniya Orbit. Coverage and Frequency Considerations- General Aspects, Frequency band, Elevation Angle Considerations, Number of Beams Per Coverage, Off-Axis Scanning, Determination of Optimum Orbital Altitude, Projected NGSO System Customer Service Base. Delay and Throughput Considerations, System considerations- Incremental Growth, Interim Operations, Replenishment Options. Operational NGSO Constellation Designs- Ellipse, Global star, New ICO, Iridium, Orbcomn, Sky bridge, Teledesic.

UNIT –III: EFFICIENT TECHNIQUES & SATELLITE PACKET COMMUNICATIONS (Periods:11)

Demand Assignment Multiple Access and Digital Speech Interpolation: The ERLANG B Formula, Types of Demand Assignments, DAMA Characteristics, Real-Time Frame Reconfiguration- Frame and Burst Structures for DA-TDMA. DAMA Interfaces, SCPC-DAMA, SPADE, Digital Speech Interpolation.

Satellite Packet Communications: Preliminaries, Message Transmission by FDMA-The M/G/1 Queue, Message Transmission by TDMA, Pure ALOHA-Satellite Packet Switching, Slotted ALOHA, Packet Reservation, Tree Algorithm.

UNIT– IV: SATELLITE SPREAD SPECTRUM COMMUNICATIONS (Periods:12)

Direct Sequence Spread Spectrum Systems- PN Sequence, Error Rate Performance in Uniform Jamming, Error Rate Performance in Pulsed Jamming. Direct Sequence Code Division Multiple Access- Sequence Synchronous DS-CDMA, Sequence Asynchronous DS-CDMA, Random Access DS-CDMA. Frequency HOP Spread Spectrum Systems-Frequency HOP Code Division Multiple Access. DS Acquisition and Synchronization, FH Acquisition and Synchronization, Satellite on Board Processing.

UNIT –V: SATELLITE APPLICATIONS (Periods: 11)

Very Small Aperture Terminal Networks: VSAT Technologies, Network Configurations, Multi-access and Networking, Network Error Control.

Mobile Satellite Networks: Operating Environment, MSAT Network Concept, CDMA MSAT Network, Statistics of Mobile Propagation.

Direct Broadcast Satellite Television and Radio

C-Band and Ku-Band Home Satellite TV, Digital DBS TV, DBS-TV System Design, DBS-TV Link Budget, Error Control in Digital DBS-TV, Master Control Station and Uplink, Installation of DBS-TV Antennas, Satellite Radio Broadcasting.

Total periods: 55

TEXT BOOKS:

1. Timothy Pratt, Charles Bostian, Jeremy Allnutt, *"Satellite Communications",* John Wiley & Sons, 2nd edition, 2003.
2. Tri T. Ha, "*Digital Satellite Communications",* McGraw-Hill, 2nd edition, 1999.

REFERENCE BOOKS:

1. Dennis Roddy,"*Satellite Communications",* Tata McGraw-Hill Education Private Limited, 4th edition, 2009.
2. Wilbur L. Pritchard, H.G. Suyderhoud , Robert A.Nelson,"*Satellite Communication Systems Engineering*", Pearson Publications, 2nd edition, 2008.

M. Tech. -I Semester
(16MT16103) SOFTWARE DEFINED RADIO
(PE-I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PREREQUISITES:
A Course on Wireless Communication, Digital Signal Processing and Antennas at UG Level.

COURSE DESCRIPTION:
Principles of software defined radio; Multirate digital filter banks; Analysis and Synthesis of signals performance; Smart antennas with applications.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate advanced knowledge in the evolving paradigm of Software defined radio and technologies for its implementation.
2. Analyze complex problems critically in the domains of Radio frequency Implementation issues, multirate signal processing in SDR, as well as Smart antenna techniques for better spectrum exploitation for conducting research.
3. Design a Software defined Radio System/ Subsystem for public needs.
4. Initiate research in Software Defined Radio.
5. Apply appropriate techniques for the development of scientific and technological knowledge in designing software defined radios and their usage for cognitive radio.
6. Contribute to multidisciplinary scientific work in the fields of Satellite and Microwave Communications.
7. Understand ethical responsibility towards environment and society in the field of SDR.

DETAILED SYLLABUS

UNIT–I: INTRODUCTION TO SOFTWARE RADIO CONCEPTS (Periods:11)
The need for Software radios and its definition, Characteristics and benefits of Software radio, Design principles of a software radio.
Radio Frequency Implementation Issues: Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, ADC & DAC distortion, Pre-distortion, Flexible RF systems using micro-electromechanical systems.

UNIT – II: MULTIRATE SIGNAL PROCESSING IN SDR (Periods:11)
Sample rate conversion principles, Polyphase filters, Digital filter banks, Timing recovery in digital receivers using multirate digital filters.
Digital Frequency Up- and Down Converters- Introduction- Frequency Converter Fundamentals- Digital NCO- Digital Mixers- Digital Filters- Half band Filters- CIC Filters- Decimation, Interpolation, and Multirate Processing-DUCs - Cascading Digital Converters and Digital Frequency Converters.

UNIT -III: DIGITAL GENERATION OF SIGNALS (Periods:11)
Introduction, Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Spurious components due to periodic jitter, Band pass signal generation, Performance of direct digital synthesis systems, Hybrid DDS – PLL Systems, Applications of direct digital synthesis, Generation of random sequences, ROM compression techniques.

UNIT – IV: SMART ANTENNAS USING SOFTWARE RADIO (Periods:11)

Introduction, Vector channel modeling, Benefits of smart antennas, Structures for beam forming systems, Smart antenna algorithms, Diversity and Space time adaptive signal processing, Algorithms for transmit STAP, Hardware implementation of smart antennas, Array calibration, Digital Hardware Choices-Key hardware elements, DSP processors, FPGAs, Power management issues.Applying Software Radio Principles to Antenna Systems-Smart Antenna Architectures- Optimum Combining/ Adaptive Arrays- DOA Arrays- Beam Forming for CDMA- Downlink Beam Forming.

UNIT – V: OBJECT ORIENTED REPRESENTATION OF RADIOS AND NETWORK (Periods:11)

Networks, Object –oriented programming, Object brokers, Mobile application environments, Joint Tactical radio system.

Case Studies in Software Radio Design: SPEAKeasy, JTRS, WirelessInformation transfer system, SDR-3000 digital transceiver subsystem, Spectrum Ware, Brief introduction to Cognitive Networking.

Total periods: 55

TEXT BOOKS:

1. Jeffrey Hugh Reed, "*Software Radio: A Modern Approach to Radio Engineering*," Prentice Hall PTR, 2002.
2. Paul Burns, "*Software Defined Radio for 3G*," Artech House, 2003.

REFERENCE BOOKS:

1. Tony J Rouphael, "*RF and Digital Signal Processing for Software-Defined Radio*," Elsevier Newnes Press, 2009.
2. P. Kenington, "*RF and Baseband Techniques for Software Defined Radio*," Artech House, 2005.
3. Jouko Vankka,"*Digital Synthesizers and Transmitter for Software Radio*", Springer, 2005.

M. Tech. -I Semester
(16MT13807)TRANSFORM TECHNIQUES
(Common to CMS & DECS)
(PE-I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Course on Signal Processing at UG Level.

COURSE DESCRIPTION:
Continuous Wavelet Transforms; Discrete Wavelet Transforms; Multi Resolution Analysis; Wavelet packets; Applications of Wavelet Transforms.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Gain in-depth knowledge in
   - Multiresolution Analysis
   - Continuous wavelets
   - Discrete wavelets and Filter design.
   - Alternative Wavelets & Wavelet packets
2. Analyze complex engineering problems critically in the area of Signal Processing and communications.
3. Design, conduct experiments, analyze and interpret complex engineering problems and apply appropriate research methodologies for conducting research in Signal Processing.
4. Solve engineering problems with wide range of solutions in the areas of Biomedical Signal Processing, Image Processing, Radar Signal Processing and Communications and arrive at optimum solutions.
5. Initiate research in Transform Techniques.
6. Use appropriate techniques, resources and tools to engineering activities in the fields of Signal Processing and Communications.
7. Contribute to collaborative multidisciplinary scientific work/research by initiating research work on Data compression, Noise reduction, Communications, Image and signal Processing.

DETAILED SYLLABUS

UNIT –I: (14 Periods)
Review of Transforms:
Fourier series and Geometry- Vector space, functions and function spaces. Fourier transform, short-time Fourier transform, Walsh, Hadamard, Haar, Slant, KLT, Hilbert transforms.
Continuous Wavelet Transform:
Introduction, Continuous-Time Wavelets, Definition of the CWT, The CWT as a correlation, Constant Q-Factor Filtering Interpretation and Time-Frequency Resolution, The CWT as an operator, Inverse CWT.

UNIT –II: DISCRETE WAVELET TRANSFORM AND ORTHOGONAL WAVELET DECOMPOSITION (08 Periods)
Introduction, Approximations of vectors in nested linear vector spaces, Example of an MRA-Bases for the Approximation Subspaces and Harr Scaling Function, Bases for the Detail Subspaces and Harr Wavelet, Digital Filter Implementation of the Harr Wavelet Decomposition.

UNIT –III: MRA ORTHONORMAL WAVELETS, AND THEIR RELATIONSHIP TO FILTER BANKS (12 Periods)

Introduction, Formal Definition of an MRA, Construction of a General Orthonormal MRA, A Wavelet basis for MRA, Digital Filtering Interpretation, Examples of Orthogonal Basis Generating Wavelets, Interpreting Orthonormal MRAs for Discrete time signals, Miscellaneous issues Related to PRQMF Filter Banks, Generating Scaling Functions and Wavelets from Filter Coefficients.

UNIT-IV: ALTERNATIVE WAVELET REPRESENTATIONS (09 Periods)

Bi-orthogonal Wavelet Bases, Filtering Relationship for Bi-orthogonal Filters, Examples of Bi-orthogonal Scaling Functions and Wavelets, Two-Dimensional Wavelets, Non-separable Multidimensional Wavelets, Wavelet Packets.

UNIT–V: APPLICATIONS OF WAVELETS (11 Periods)

Wavelet De-noising, Speckle Removal, Edge Detection and Object Isolation, Image Fusion, Object Detection by Wavelet Transforms of Projections, Communication Applications-Scaling Functions as signaling pulses, Discrete Wavelet Multitone Modulation.

Total Periods: 54

TEXT BOOKS:

1. Raghuveer M.Rao and Ajit S.Bopardikar, "*Wavelet Transforms-Introduction theory and applications"*, Pearson Education, 1998.
2. Soman.K.P, Ramachandran.K.I, Resmi.N.G, "*Insight into Wavelets from theory to Practice"*, PHI, 3rd edition, 2010.

REFERENCE BOOKS:

1. R. C. Gonzalez, R. E. Woods, "*Digital Image Processing*," Pearson Education, 2nd edition, 1992.
2. Jaideva C Goswami, Andrew K.Chan, "*Fundamentals of Wavelets-Theory, Algorithms and Applications*", John Wiley and sons, 1999.
3. C.Sidney Burrus, Ramesh A Gopinath and Haitao Guo, "*Introduction to Wavelets and Wavelet Transforms",* Prentice Hall, 1998.

M. Tech. - I SEMESTER
(16MT16131) COMMUNICATIONS LAB-I

Int. Marks	Ext. Marks	Max. Marks	L	T	P	C
50	50	100	-	-	4	2

PRE-REQUISITES: Simulation Lab at UG Level

COURSE DESCRIPTION:
Design and simulation of communication systems - Baseband Communication Systems with Optimum terminal filters, QPSK communication system for AWGN channel, Baseband Direct Sequence Spread Spectrum (DS/SS) System; Generation of different density and distribution functions; Generation of maximal and Gold code sequences.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Gain advanced knowledge in
   - Generation of Maximal and Gold Sequences & verification of their properties.
   - Design of communication system for band limited channels for Zero ISI.
   - Evaluating the performance of QPSK over AWGN Channel, 16MPSK and 16QAM.
   - Simulation of Code matched filter in Spread Spectrum Communication System.
   - Design of Baseband Communication Systems with Optimum terminal filters.
   - Simulation of baseband Direct Sequence Spread Spectrum (DS/SS) System.
   - Equalization of Multipath Channel using LMS or RLS Algorithms.
2. Analyze complex and critical engineering problems in the field of communications.
3. Use MATLAB Toolbox to simulate complex engineering activities in the field of communication.
4. Demonstrate knowledge and understanding of engineering principles to execute the Projects effectively in the field of communications.
5. Understand ethical responsibility towards environment & society in the field of communications.
6. Communicate effectively in verbal & written forms.

LIST OF EXERCISES:

1. Generation of discrete time independent and identically distributed (IID) random processes with different distributions (Bernoulli, Binomial, Geometric, Poisson, Uniform, Gaussian, Exponential, Laplacian, Rayleigh, Rician). (2 time slots)
2. Communication system Design for Band limited Channels: System design for Zero ISI. (2 time slots)
3. Design of Baseband Communication Systems with Optimum terminal filters. (2 time slots)
4. Simulation of QPSK communication system and performance evaluation for AWGN channel. (1time slot)
5. Simulation of Maximal sequences of any length and verification of their properties. (1 time slot)
6. Generation of Gold codes, and verification of auto-correlation & cross correlation properties. (1 time slot)
7. Design and simulation of code matched filter in spread spectrum communication system. (2time slots)
8. Comparison of 16-MPSK and 16-QAM. (1time slot)
9. Design and simulation of baseband Direct Sequence Spread Spectrum (DS/SS) System. (2 time slots)
10. Equalization of Multipath Channel using LMS or RLS Algorithms. (1 time slot)

Total Time Slots: 14

Tools:

Numerical Computing Environments–GNU Octave or MATLAB

REFERENCE BOOKS:

1. W.H. Tranter, K. Sam Shanmugham, T.S. Rappaport, and K.L. Kosbar, "*Principles of Communication System Simulation with Wireless Applications",* Pearson,3 rd edition, 2004.
2. J.G. Proakis, and M. Salehi, "*Contemporary Communication Systems using MATLAB",* Bookware Companion Series,2 nd edition, 2006.
3. John G. Proakis, "*Digital Communications*", McGraw Hill, 4th edition, 2001.

M. Tech. - I SEMESTER

(16MT16132) RF CIRCUITS & OPTICAL COMMUNICATIONS LAB

Int. Marks	Ext. Marks	Max. Marks	L	T	P	C
50	50	100	-	-	4	2

PRE- REQUISITES:
Antennas, Microwaves and Optical Communication lab at UG level

COURSE DESCRIPTION:
Design and simulation of Various antennas; Measurement of various parameters; characteristics of couplers; non-ideal behaviour of lumped circuit components; characteristics of microwave passive components; Measurement of 4 channel CWDM using modulation; PC to PC communication; Characterization of Optial circulator and Bragg-grating.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate advanced knowledge required in
   - Measurement of Impedance, Coupling and cross talk in 3 wire pickup.
   - Design and simulation of different antennas.
   - Design and measurement of PC to PC communication.
   - Characterization of branch line directional copupler, capacitive coupling and inductive coupling.
   - Study of non ideal behaviour of lumped circuit components, 3 dB power divider and filters.
   - Designing WDM system and measurement of 4 channel CWDM by internal and external modulation.
   - Wavelength division multiplexing & de-multiplexing of analog/digital signals over 1310 nm and 1550 nm wavelengths.
2. Analyse of engineering problems for feasible and optimal solutions in the core area of RF, Microwave and Optical Communications.
3. Use RF Spice Pro Software to complex engineering activities in the domain of RF, Microwave and Optical communications.
4. Demonstrate Knowledge and understanding of Engineering Principles to execute the Projects effectively in the field of RF, Microwave and Optical communications.
5. Understand ethical responsibility towards environment & society in the field of communications.
6. Communicate effectively in verbal & written forms in the core area of RF, Microwave and Optical communications

LIST OF EXERCISES:

1. Measurement of Frequency, Wavelength and Impedance.
2. Characteristics of branch line directional coupler.
3. Measurement of coupling & cross talk in 3 wire pick up.
4. Characterization of current probe with capacitive coupling or inductive coupling.
5. Study of non-ideal behaviour of lumped circuit components.
6. Measure characteristics of passive components such as attenuator, isolator, coupler and WDM.
7. Characterization of Optial circulator and Bragg-grating.
8. Measurement of 4 channel CWDM by internal & external modulation.
9. Wavelength division multiplexing & de-multiplexing of analog/digital signals over 1310 nm and 1550 nm wavelengths.
10. Design and Simulate any patch antenna given by the faculty in the lab.

Total Time slots : 10

TOOLS REQUIRED:

RF Spice Pro simulation software, MIC System, Motorized microstrip transmission line trainer, advanced fiber optic lab with Fiber optic laser source, passive component, cable dispersion, DWDM and bragg grating modules.

REFERENCE BOOKS:

1. RF Circuit & Optical Communications lab-II manual of the department.
2. RF Spice Pro User Manual
3. Devendra K. Misra, "Radio Frequency and Microwave Communication Circuits Analysis and Design", Wiley Student Edition, John Wiley & Sons, 2nd edition, July 2004.
4. S.E.Miller, A.G.Chynoweth, *Optical Fiber Telecommunication,* 1979.

M. Tech. – I Semester
(16MT13808) RESEARCH METHODOLOGY
(Common to all M. Tech. Programs)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	-	2	-	-

PREREQUISITES: --

COURSE DESCRIPTION:

Overview of Research, research problem and design, various research designs, data collection methods, statistical methods for research, importance of research reports and its types.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Acquire in-depth knowledge on
   - Research design and conducting research
   - Various data collection methods
   - Statistical methods in research
   - Report writing techniques.
2. Analyze various research design issues for conducting research in core or allied areas.
3. Formulate solutions for engineering problems by conducting research effectively in the core or allied areas.
4. Carryout literature survey and apply research methodologies for the development of scientific/technological knowledge in one or more domains of engineering.
5. Select and Apply appropriate techniques and tools to complex engineering activities in their respective fields.
6. Write effective research reports.
7. Develop attitude for lifelong learning to do research.
8. Develop professional code of conduct and ethics of research.

DETAILED SYLLABUS:

Unit-I: Introduction to Research Methodology (Periods: 5)
Objectives and Motivation of Research, Types of Research, Research Approaches, Research Process, Criteria of good Research, Defining and Formulating the Research Problem, Problem Selection, Necessity of Defining the Problem, Techniques involved in Defining a Problem.

Unit-II: Research Problem Design and Data Collection Methods (Periods: 7)
Features of Good Design, Research Design Concepts, Different Research Designs, Different Methods of Data Collection, Data preparation: Processing Operations, Types of Analysis.

Unit-III: Statistics in Research (Periods: 6)
Review of Statistical Techniques - Mean, Median, Mode, Geometric and Harmonic Mean, Standard Deviation, Measure of Asymmetry, ANOVA, Regression analysis.

Unit-IV: Hypothesis Testing **(Periods: 7)**

Normal Distribution, Properties of Normal Distribution, Basic Concepts of Testing of Hypothesis, Hypothesis Testing Procedure, Hypothesis Testing: t-Distribution, Chi-Square Test as a Test of Goodness of Fit.

Unit-V: Interpretation and Report Writing **(Periods: 3)**

Interpretation – Techniques and Precautions, Report Writing – Significance, Stages, Layout, Types of reports, Precautions in Writing Reports.

Total Periods: 28

TEXT BOOK:

1. C.R. Kothari, "*Research Methodology: Methods and Techniques*," New Age International Publishers, New Delhi, 2nd Revised Edition, 2004.

REFERENCE BOOKS:

1. Ranjit Kumar, "*Research Methodology: A step-by-step guide for beginners*," Sage South Asia, 3rd ed., 2011.
2. R. Panneerselvam, "Research Methodology," PHI learning Pvt. Ltd., 2009

M. Tech. -II Semester

(16MT26101) ADAPTIVE SIGNAL PROCESSING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Signal Processing at UG Level

COURSE DESCRIPTION: Development of adaptive filter theory: Method of steepest descent, Least-Mean-Square Algorithm, recursive least square algorithm, Kalman filtering algorithm and order-recursive adaptive filters.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate in-depth knowledge in
   - Adaptive systems
   - Linear Optimum Filters
   - steepest descent
   - LMS,RLS Algorithms
   - Kalman filtering
   - Order-recursive adaptive filtering
   - Blind deconvolution
2. Analyze problems critically in the field of adaptive signal processing.
3. Design an Optimum adaptive filter for solving problems in the field of analog and digital communications.
4. Solve engineering problems and arrive at optimal solutions pertaining to communications.
5. Initiate research in adaptive signal processing.
6. Apply appropriate techniques to complex engineering activities in the field of signal processing and communications.
7. Contribute to multidisciplinary scientific work in the field of communications, Bio-Medical, Instrumentation, and control engineering.

DETAILED SYLLABUS

UNIT I: INTRODUCTION TO ADAPTIVE SYSTEMS & DEVELOPMENT OF ADAPTIVE FILTER THEORY (Periods: 10)

Eigen Value Problem, Properties of eigen values and eigen vectors(proof is not required), Eigen Filters, eigen Value computations. The Filtering problem,Linear Optimum Filters, Adaptive Filters, Linear Filter sturucters, Approaches to the development of linear adaptive filters. Linear Optimum Filtering: Statement of the problem, Principle of Orthogonality, Minimum Mean Square Error, Wiener- Hopf equations, Error- Performance Surface.

UNIT-II METHOD OF STEEPEST DESCENT (Periods: 7)

Basic Idea of Steepest-Descent Algorithm, Steepest-Descent Algorithm applied to the Wiener Filter, Stability of the Steepest-Descent Algorithm, Examination of the transient behavior of the Steepest-Descent Algorithm, the Steepest-Descent Algorithm as a deterministic search method, Virtue and limitation of the Steepest-Descent Algorithm.

UNIT III: LEAST-MEAN-SQUARE ADAPTIVE FILTERS AND RECURSIVE LEAST-SQUARES ADAPTIVE FILTERS (Periods: 12)

Overview of the structure and operation of the Least-Mean-Square Algorithm, Least-Mean-Square adaptation Algorithm, Applications-Adaptive Noise cancelling Applied to a Sinusoidal Interference and Adaptive Beam forming, Comparison of the LMS Algorithm with Steepest-Descent Algorithm.

Matrix Inversion lemma, exponentially weighted recursive least square algorithm, update recursion for the sum of weighted error squares, Single-Weight Adaptive Noise Canceller convergence analysis of RLS Algorithm.

UNIT IV: KALMAN FILTERING & NON LINEAR ADAPTIVE FILTERING

(Periods: 16)

Recursive Minimum Mean-Square Estimation for Scalar Random variables, Statement of Kalman filtering problem, The Innovations Process, estimation of the state using the Innovations Process, Filtering, Initial conditions.
An overview of the Blind Deconvolution problem, Buss Gang Algorithm for blind Equalization.

UNIT V: ORDER-RECURSIVE ADAPTIVE FILTERS (Periods: 10)

Gradient-Adaptive Lattice Filter, order-recursive adaptive filters using least square estimation, adaptive forward linear prediction, adaptive backward linear prediction, conversion factor, least-square lattice predictor, angle-normalized estimation errors, first order state space models for lattice filtering.

Total periods: 55

TEXT BOOK:

1. Simon Haykin, *"Adaptive Filter Theory",* Pearson Education, 4th edition, 2002.

REFERENCE BOOK:

1. Bernard Widrow, Samuel D. Strearns, *"Adaptive Signal Processing",* Pearson Education, 1985.

M. Tech.-II Semester
(16MT23801) DETECTION AND ESTIMATION OF SIGNALS
(Common to CMS & DECS)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Probability and Stochastic Processes at UG Level

COURSE DESCRIPTION:
Decision criteria for single and multiple observations; Estimation techniques; Properties of estimators; parameter Estimation.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate advanced knowledge in
   - Different decision criteria
   - Estimation techniques and their properties
   - Selection of a good estimator for the given specifications.
   - Kalman Filter
   - Statistical estimation of parameters
2. Analyze complex engineering problems critically for conducting research in the field of signal detection and estimation.
3. Design optimum filters for solving problems in the field of Communications.
4. Solve engineering problems to obtain solutions for the design of optimum receivers.
5. Initiate research in detection and estimation of signals.
6. Apply appropriate techniques, resources to complex engineering activities in the field of Communications.
7. Contribute to multidisciplinary scientific work in the field of Communications and Radar Systems.

DETAILED SYLLABUS

UNIT– I: Detection Theory (12 Periods)
Binary Decisions: Single observation–Maximum-likelihood decision criterion, Neyman-Pearson criterion, Receiver operating characteristics, Probability-of-error criterion, Bayes risk criterion, Min-max criterion.

UNIT – II: Binary Decisions: Multiple Observations (11 Periods)
Vector observations, the general Gaussian Problem, Waveform Observation in Additive Gaussian Noise, The Integrating Optimum Receiver, Matched Filter Receiver.

UNIT -III: Estimation Theory (12 Periods)
Maximum-likelihood estimation, Bayes estimation criterion - Mean Square Error Criterion, Uniform Cost Function, Absolute-Value Cost Function. Linear minimum-Variance and Least Squares Method, Estimation in the presence of Gaussian noise - Linear observation, Non-linear estimation.

UNIT – IV: Properties of Estimators (10 Periods)
Bias, Efficiency, Cramer-Rao bound, Asymptotic properties, Sensitivity and error analysis.

UNIT–V: State Estimation & Statistical Estimation of Parameters (10 periods)
State Estimation: Prediction, Kalman filter, Problem solving.

Statistical Estimation of Parameters: Concept of sufficient statistics, Exponential families of Distributions, Exponential families and Maximum likelihood estimation, uniformly minimum-variance unbiased estimation.

Total periods: 55

TEXT BOOKS:

1. James L.Melsa & David L.Cohn, "Decision and Estimation Theory", McGraw-Hill, 1978.
2. Steven M. Kay, "Statistical Signal Processing Vol. 1: Estimation Theory, Prentice Hall, 1993, Vol. 2: Detection Theory", Prentice Hall Inc., 1998.

REFERENCE BOOKS:

1. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part 1, John Wiley & Sons Inc. 1968.
2. Jerry M. Mendel, "Lessons in Estimation Theory for Signal Processing, Communication and Control", Prentice Hall Inc., 1995.
3. Sophocles J.Orfanidis, "Optimum Signal Processing", McGraw-Hill, 2nd edition, 1988.

M. Tech.-II Semester
(16MT13804) IMAGE & VIDEO PROCESSING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
A Course on Digital Communications & Digital Signal Processing at UG Level

COURSE DESCRIPTION:
Image Fundamentals and its transforms; image enhancement techniques; Image compression, Image Restoration & Image Segmentation; Video Processing basics like Representation, Sampling, Motion estimation, Filtering and Compression.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Gain in-depth knowledge in
   a. Image Transforms
   b. Image Enhancement & Restoration Techniques
   c. Image Segmentation & Compression Techniques
   d. Video Processing
2. Analyze complex engineering problems critically in the domain of Image Processing for conducting research.
3. Solve engineering problems for feasible and optimal solutions in the core area of Image Processing.
4. Initiate research in image and video processing.
5. Apply appropriate tools and techniques to complex engineering activities in the field of Image Processing.
6. Contribute positively to multidisciplinary scientific research in Image Processing.

DETAILED SYLLABUS

UNIT I: FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS: (10 Periods)
Fundamental steps in Image Processing, Gray scale and color Images, image sampling and quantization, **2-D Transforms:** DFT, Walsh, Hadamard, Haar, KLT, DCT.

UNIT II: IMAGE ENHANCEMENT & RESTORATION: (10 Periods)
Enhancement: Intensity transformation functions, Filters in spatial and frequency domains, histogram processing, homomorphic filtering.
Restoration: Image Degradation Model, Restoration in presence of noise only- spatial filtering, inverse filtering, Wiener filtering and Constrained least squares filtering.

UNIT III: IMAGE COMPRESSION & IMAGE SEGMENTATION: (13 Periods)
Image compression fundamentals -Redundancies, Compression models: Lossy & Lossless, Arithmetic coding, Bit plane coding, Run length coding, symbol based coding, Transform coding, fidelity criteria.
Segmentation: Fundamentals, Point, line and edge detection, Thresholding, Region based segmentation.

UNIT IV: VIDEO PROCESSING - I (11 Periods)
Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling for Analog and Digital Video, Two-Dimensional Rectangular Sampling, Two-Dimensional Periodic Sampling, Sampling on 3-D Structures, Reconstruction from Samples.

UNIT V: VIDEO PROCESSING -II (10 Periods)

Motion Estimation: 2-D Motion vs. Apparent Motion, 2-D Motion Estimation, Methods Using the Optical Flow Equation. Video filtering: motion compensated filtering, noise filtering, restoration, video compression standards.

Total periods: 54

TEXT BOOKS:

- Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education, 3rd edition, 2008.
- A. Murat Tekalp, Digital Video Processing, Prentice-Hall, 1995.

REFERENCE BOOKS:

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education, 2nd edition, 2002.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson Education, Inc., 2002.

M. Tech. - I Semester
(16MT26102) SMART ANTENNAS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES: --
A Course on Antennas and Wave Propagation at UG Level

COURSE DESCRIPTION:
Smart antenna configurations and architecture; Beam forming methods; Direction of Arrival (DOA) estimating methods, simulation of smart antennas and space time processing.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate in-depth knowledge on
   - Smart antenna architecture and configurations
   - Methods of estimating DOA
   - Beam forming techniques
   - Design and simulation of smart antennas
   - Space time processing
2. Analyze various design issues for conducting research related to smart antennas.
3. Design and develop smart antennas for wireless applications.
4. Formulate solutions for engineering problems pertaining to smart antennas in the field of communication.
5. Apply appropriate techniques to complex engineering activities in the field of Smart antennas.

DETAILED SYLLABUS

UNIT -I: SMART ANTENNAS (Periods: 10)
Introduction, Need for Smart Antennas, Overview, Smart Antenna Configurations- Switched Beam Antennas, Adaptive Antenna Approach. Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System- Receiver, Transmitter. Benefits and Drawbacks, Basic Principles, Mutual Coupling Effects.

UNIT -II: DOA ESTIMATION FUNDAMENTALS (Periods: 12)
Introduction, Array Response Vector, Received Signal Model, Subspace-Based Data Model, Signal Autocovariance matrices, Conventional DOA Estimation Methods- Conventional Beamforming Method, Capon's Minimum Variance Method. Subspace Approach to DOA Estimation- MUSIC Algorithm, ESPRIT Algorithm. Uniqueness of DOA Estimates.

UNIT -III: BEAM FORMING FUNDAMENTALS (Periods: 10)
Classical Beam former, Statistically Optimum Beamforming Weight Vectors- Maximum SNR Beam former, Multiple Sidelobe Canceller and Maximum, SINR Beam former, Minimum Mean Square Error (MMSE), Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV). Adaptive Algorithms for Beamforming

UNIT -IV: INTEGRATION AND SIMULATION OF SMART ANTENNAS (Periods: 11)
Overview, Antenna Design, Mutual Coupling, Adaptive Signal Processing Algorithms- DOA, Adaptive Beam forming, Beam forming and Diversity Combining for Rayleigh-Fading Channel. Trellis-Coded Modulation (TCM) for Adaptive Arrays, Smart Antenna Systems for Mobile Ad Hoc Networks (MANETs)- Protocol, Simulations. Discussion.

UNIT -V: SPACE–TIME PROCESSING (Periods: 12)

Introduction, Discrete Space–Time Channel and Signal Models, Space–Time Beamforming, Intersymbol and Co-Channel Suppression, Space–Time Processing for DS-CDMA, Capacity and Data Rates in MIMO Systems, Discussion.

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Total Periods: 55

TEXT BOOKS:

1. Constantine A. Balanis & Panayiotis I. Ioannides, "*Introduction to Smart Antennas*", Morgan & Claypool Publishers, 2007.
2. Joseph C. Liberti Jr., Theodore S Rappaport , "*Smart Antennas for Wireless Communications :IS-95 and Third Generation CDMA Applications*", Prentice Hall PTR, 1999

REFERENCE BOOKS:

1. T.S Rappaport ,"*Smart Antennas: Adaptive Arrays, Algorithms, & Wireless Position Locations*", IEEE press, 1998.
2. Lal Chand Godara, " *Smart Antennas*", CRC Press LLC, 2004.

M. Tech. - II Semester
(16MT23805) WIRELESS COMMUNICATIONS
(Common to CMS & DECS)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PREREQUISITES: A Course on Digital Communications at UG Level.

COURSE DESCRIPTION:
Introduction to cellular wireless communication; Radio propagation in mobile atmosphere; Equalization along with Diversity techniques; several access techniques; Introduction to wireless networking; Multicarrier modulation techniques.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate advanced knowledge in
   - Cellular systems and wireless standards
   - Radio wave propagation in wireless environment
   - Equalization and diversity techniques
   - Multiple access techniques and networking
   - Multicarrier modulation
2. Analyze complex engineering problems critically for conducting research in wireless systems.
3. Design a Digital Communication System/ Subsystem for societal needs.
4. Solve engineering problems with wide range of solutions in wireless communications.
5. Apply appropriate techniques to engineering activities in the field of wireless communications.

DETAILED SYLLABUS

UNIT-I: INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS AND CELLULAR CONCEPT (Periods:11)

Evolution of Mobile Radio Communication Systems, Examples of Wireless Communication Systems, 1G, 2G, 2.5G,3G and 4G Wireless Cellular Networks and Standards, Frequency Reuse Concept, Channel Assignment Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems-cell splitting and sectoring. Problem solving.

UNIT – II: MOBILE RADIO PROPAGATION (Periods:11)

Large Scale Path Loss: Introduction, Free Space Propagation Model, Relating Power to Electric field, Propagation Mechanisms – Reflection, Diffraction, and Scattering. Practical Budget Design using Path Loss Models, Outdoor and Indoor Propagation Models. Problem solving.

Small Scale Fading and Multipath: Small Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small Scale Multipath Measurements, Parameters of Mobile Channels, Types of Small Scale Fading (all variations) Statistical Models– Clarke's Model for Flat Fading, and Jake's Model. Problem solving.

UNIT -III: EQUALIZATION & DIVERSITY TECHNIQUES (Periods:11)

Equalization: Introduction, Survey of Equalization Techniques, Linear and Non-linear Equalizers – Linear Transversal Equalizer, Decision Feedback Equalizer (DFE). Algorithms for Adaptive Equalization – Zero Forcing, LMS, and RLS. Problem solving.

Diversity Techniques: Realization of Independent Fading Paths, Receiver Diversity – System Model, Selection Combining, Threshold Combining, Maximal Ratio Combining, and Equal Gain Combining, Rake receiver. Transmit Diversity–Channel known at Transmitter, Channel unknown at Transmitter – the Alamouti Scheme, analysis.

UNIT–IV: MULTIPLE ACCESS TECHNIQUES & NETWORKING (Periods:11)

Introduction to Multiple Access: FDMA, TDMA, CDMA, SDMA, Packet Radio- Pure ALOHA, Slotted ALOHA, CSMA, and Reservation protocols. Capacity of Cellular Systems-Cellular CDMA. Problem Solving.

Introduction to Wireless Networking: Introduction to Wireless Networks, Differences between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Traffic Routing in Wireless Networks, Wireless Data Services, Common Channel Signaling.

UNIT – V: MULTICARRIER MODULATION (Periods:11)

Data Transmission using Multiple Carriers, Multicarrier Modulation with Overlapping Sub channels, Discrete Implementation of Multicarrier Modulation –

DFT and its properties, The Cyclic Prefix, Orthogonal Frequency Division Multiplexing (OFDM), Matrix Representation of OFDM, Vector Coding. Challenges in Multicarrier Systems. Problem solving.

MIMO and multicarrier modulation: Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain –data transmission using multiple carriers multicarrier modulation with overlapping sub channels-mitigation of subcarrier fading.

Total periods: 55

TEXT BOOKS:

1. T. S. Rappaport, "Wireless Communications, Principles and Practice," Prentice Hall, 2nd edition, 2002.
2. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005.

REFERENCE BOOKS:

1. David Tse, Pramod Viswanath, "Fundamentals of Wireless Communications," Cambridge University Press, 2006.
2. Dr. KamiloFeher, "Wireless Digital Communications," Prentice Hall, 1995.
3. Raj Pandya, "Mobile and Personal Communication Systems and Services," Prentice Hall of India, 2002.
4. William C.Y. Lee, "Wireless and Cellular Telecommunications," McGraw-Hill, 3rd edition, 2006.

M. Tech. -II Semester
(16MT26103) EMI/EMC
(PE – II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Courses on Electromagnetic waves and Transmission lines, Antennas and wave propagation & Microwave engineering at UG Level.

COURSE DESCRIPTION:
Electromagnetic interference & compatibility; EMI/EMC Standards; Radiated Interference Measurement; Conducted Interference Measurement; Effects of Grounding, Shielding, Bonding; EMI Filters; EMI Cables; EMI Connectors; EMI Components.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate in-depth knowledge in
   - electromagnetic interference effects
   - standards of EMC
   - Radiated and conducted interference measurements
   - Effects of grounding at high frequencies
   - EMC Filters, Cables, Connectors, and Components
2. Analysis and design of electronic systems for real time applications.
3. Solve engineering problems and arrive at optimal solutions pertaining to EMI/EMC.
4. Initiate research in electromagnetic interference and compatibility.
5. Apply appropriate techniques to complex engineering activities in the field of electronic systems.
6. Ability to contribute multidisciplinary scientific research on radiated measurements.
7. Demonstrate knowledge and understanding of effects of Electromagnetic Interference and apply the same in practice, manage projects effectively in practical implementing issues.
8. Understand ethical responsibility towards environment and society in the field of communication applications.

DETAILED SYLLABUS

UNIT-I: Introduction and Sources of EMI and Non ideal Behavior of Components (12 periods)
Concepts and Definition of EMI and EMC, Natural and man-made EMI sources - Lighting Discharge, Electrostatic Discharge, Electromagnetic Pulse, Transient EMI, Time domain vs frequency domain EMI, Units of measurement parameters. Non-ideal behavior of components-Wires, printed circuit board (PCB) lands, effect of component leads, resistors, capacitors, inductors.

UNIT-II: EMI/EMC Standards and Open Area Test Sites (10 periods)
Introduction - Standards for EMI/EMC, MIL-STD 461 /462, IEEE/ANSI Standards, CISPR/IEC Standards, FCC regulations. Open area test sites- open area test site measurements, Measurement precautions, open area test site, Terrain Roughness, Normalized Site Attenuation, Measurement of test site imperfections, Antenna factor measurement, Measurement errors.

UNIT-III: Radiated Interference and Conducted Interference Measurements (11 periods)
Radiated Interference measurements-Anechoic chamber, Transverse Electromagnetic Cell, Reverberating chamber, Giga-Hertz TEM Cell, Comparison of test facilities.

Conducted Interference measurements-Characterization of conduction currents/voltages, Conducted EM noise on power supply lines, Conducted EMI from equipment, Immunity to conducted EMI, Detectors and measurement.

UNIT-IV: Grounding, Shielding and Bonding (12 periods)

Grounding - Principles and Practice of Earthing, Precautions in Earthing, Measurements of ground resistance, System grounding for EMC, Cable shield Grounding. Shielding- Shielding Theory and Effectiveness, Shielding Materials, Shielding Integrity at discontinuities, Conductive coatings, Cable shielding, Shielding Effectiveness measurements. Electrical Bonding.

UNIT-V: EMI Filters, Cables, Connectors and Components (10 periods)

Characteristics and Types of Filters - Impedance Mismatch Effects, Lumped Element Low Pass Filter, High Pass Filter, Band Pass Filter, Band Reject filter. Power Line filter Design- Common mode filter, Differential mode filter, Combined CM and DM filter. EMI suppression cables. EMC connectors.

EMC Gaskets - Knitted Wire-Mesh Gaskets, Wire Screen Gaskets, Oriented Wire mesh, Conductive Elastomer, Transparent Conductive windows, Conductive Adhesive, Conductive Grease. Conductive Coatings. Isolation transformers. Opto Isolators, Ferrite Components.

Total Periods: 55

TEXT BOOKS:

1. V. Prasad Kodali, "*Engineering Electromagnetic Compatibility*", S.Chand & company Ltd., 1st edition, 2000.
2. Clayton R. Paul, "*Introduction to Electromagnetic Compatibility*", John Wiley and Sons, 2nd edition, 2008.

REFERENCE BOOK:

1. Christos Christopoulos, "*Principles and Techniques of Electromagnetic Compatibility*", CRC Press (Taylor & Francis Group) 2nd edition, 2007.

M. Tech. -II Semester
(16MT26104) RADAR SIGNAL PROCESSING
(PE-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

Pre-requisite: A course on Radar systems at UG level.

Course Description: Radar range equation and matched filter; Detection of radar signals in the presence of noise; Wave form selection and radar clutter; Pulse compression and Phase coding techniques.

Course Outcomes:
After successful completion of the course, students will be able to:

1. Demonstrate knowledge in
   - Characteristics of matched filter
   - Detection criteria of radar signals in noise environment.
   - Radar waveform design requirements.
   - Pulse compression techniques
   - Different coding techniques.
2. Analyze complex engineering problems critically in the domain of information, source encoding.
3. Conceptualize and Solve engineering problems for feasible and optimal solutions in the core area of information theory and coding techniques.
4. Initiate research in radar signal processing.
5. Apply different detection techniques to extract the radar echo signals in the presence of Noise.
6. Contribute to multidisciplinary scientific work in the field of Communication and dynamics of environment.

DETAILED SYLLABUS

UNIT I: RANGE EQUATION AND MATCHED FILTER (Periods: 13)
Introduction– Radar Frequencies, Radar Block Diagram, Radar Equation, Information Available from Radar Echo. Review of Radar Range Performance– General Radar Range Equation, Radar Detection with Noise Jamming, Beacon and Repeater Equations, Bistatic Radar.
Matched Filter Receiver – Impulse Response, Frequency Response Characteristic and its Derivation. Matched Filter and Correlation Function, Correlation Detection and Cross-Correlation Receiver. Efficiency of Non-Matched Filters, Matched Filter for Non-White Noise.

UNIT II: DETECTION OF RADAR SIGNALS IN NOISE (Periods: 10)
Detection Criteria – Neyman-Pearson Observer, Likelihood-Ratio Receiver, Inverse Probability Receiver, Sequential Observer, Detectors –Envelope Detector, Logarithmic Detector, I/Q Detector. Automatic Detection – CFAR Receiver, Cell Averaging CFAR Receiver, CFAR Loss, CFAR Uses in Radar. Radar Signal Management –Schematics, Component Parts, Resources and Constraints.

UNIT III: WAVEFORM SELECTION (Periods: 09)
Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse, Noise like Waveforms. Waveform Design Requirements. Radar clutter-Introduction, surface clutter, Land clutter, Detection of targets in Clutter.

UNIT IV: PULSE COMPRESSION IN RADAR SIGNALS (Periods: 08)

Introduction, Significance, Types. Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Side lobes, Stretch Techniques, Generation and Decoding of FM Waveforms – Block Schematic and Characteristics of Passive System, Digital Compression, SAW Pulse Compression.

UNIT V: PHASE CODING TECHNIQUES (Periods: 13)

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

Poly Phase Codes : Frank Codes, Costas Codes, Non-Linear FM Pulse Compression, Doppler Tolerant PC Waveforms – Short Pulse, Linear Period Modulation (LPM/HFM), Side lobe Reduction for Phase Coded PC Signals, Complementary codes, Huffman codes, Limiting in Pulse Compression, Cross-Correlation Properties, compatibility.

Total Periods : 53

TEXT BOOKS:

1. M.I. Skolnik, "*Introduction to Radar Systems",* TMH, 3rd edition, 2001.
2. Fred E. Nathanson, "*Radar Design Principles – Signal Processing and The Environment",* McGraw Hill, Inc, 2nd edition, 1991.
3. M.I. Skolnik," *Radar Handbook",* McGraw Hill, 2nd edition, 1991.

REFERENCE BOOKS:

1. Peyton Z. Peebles Jr., "*Radar Principles",* Wiley India Pvt. Ltd., 1998.
2. R. Nitzberg,"*Radar Signal Processing and Adaptive Systems",* Artech House,2nd edition, 1999.
3. F.E. Nathanson, "*Radar Design Principles",* 1st edition, McGraw Hill, 1969.

M. Tech. - II Semester
(16MT23809) SPEECH PROCESSING
(Common to CMS & DECS)
(PE-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Courses on Signals & Systems and Digital Signal Processing in UG

COURSE DESCRIPTION:
Acoustic theory of speech production; Models for speech signals and speech processing systems; Mathematical analysis of speech signals - homomorphic and LPC models; Speech and speaker recognition systems.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate in-depth knowledge in
   - Digital model representation of speech signal
   - LPC analysis
   - Homomorphic models
2. Analyze complex engineering problems critically for conducting research in speech signal processing.
3. Solve engineering problems using efficient algorithms for feasible and optimal solutions in Speech signal processing field.
4. Initiate research in speech signal processing.
5. Apply speech and speaker verification techniques to complex engineering activities in the field of speech processing.
6. Contribute to scientific research in Speech and speaker identification and verification systems with objectivity and rational analysis.

DETAILED SYLLABUS:

UNIT-I: DIGITAL MODEL FOR THE SPEECH SIGNAL (Periods:13)
The process of speech production - the mechanism of speech production, acoustic phonetics. The Acoustic theory of speech production- sound propagation, uniform lossless tubes, Effect of losses in the vocal tract, Effect of radiation at the lips, Vocal tract transfer functions for vowels, the effect of nasal coupling, Excitation of sound in the vocal tract. Digital model for speech signals.

UNIT - II : TIME DOMAIN MODELS FOR SPEECH PROCESSING (Periods:10)
Introduction, Window considerations, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using Average energy and zero crossing, Pitch period estimation using parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.

UNIT-III: HOMOMORPHIC SPEECH PROCESSING (Periods:09)
Homomorphic systems for convolution – properties of the complex Cepstrum, computational considerations. The complex Cepstrum of speech, pitch detection, formant estimation, Homomorphic vocoder.

UNIT-IV : LINEAR PREDICTIVE CODING OF SPEECH (Periods:12)

Basic principles of linear predictive analysis – Auto correlation method, The covariance method. Computation of the gain for the model, solution of LPC Equations – Cholesky Decomposition solution for the covariance method. Durbin's Recursive solution for the autocorrelation equations. Comparison between methods of solutions of LPC analysis equations. Applications of LPC parameters – Pitch detection using LPC parameters, Formant analysis using LPC parameters.

UNIT-V: SPEECH AND SPEAKER RECOGNITION SYSTEMS (Periods:08)

Speaker recognition system-speaker verification system, speaker identification systems.

Speech recognition system- isolated digit recognition system, continuous digit recognition system, LPC distance measure.

Total periods: 52

TEXT BOOKS:

1. L R Rabiner and SW Schafer, "*Digital processing of speech signal*s", Pearson Education, 2006.
2. LR Rabiner, BH Juang, B Yegnanarayana, "*Fundamentals of Speech Recognition*", Pearson Education, 1993.

REFERENCE BOOKS:

1. Thomas F Quateri, "*Discrete time speech signal processing*", Pearson edition, 2006.
2. Ben Gold & Nelson Morgan, "*Speech & audio signal processing*", wiley, 2006.
3. Douglas O Shaughnessy, "*Speech Communications*", Oxford university press, 2nd edition, 2000.

M. Tech. -II Semester
(16MT25709) WIRELESS SENSOR NETWORKS
(Common to CMS & VLSI)
(PE-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES: --
A Course on Computer Networks and Wireless Communication and Networks at UG Level.

COURSE DESCRIPTION:
WSN architecture, types, Quality measures of wireless channels, various MAC protocols, Sensor deployment and routing related protocols, congestion control in WSNs.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Gain in-depth knowledge in
   - Wireless Sensor Networks
   - Physical layer
   - Data link layer
   - Network layer
   - Transport layer
2. Analyze various design issues for conducting research related to Datalink, network and transport protocols of wireless sensor network architecture.
3. Design and develop feasible and optimal solutions for societal use.
4. Solve complex engineering problems pertaining to the field of wireless sensor networks.

DETAILED SYLLABUS

UNIT – I: Introduction To Wireless Sensor Networks (10 Periods)
Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture - Hardware components, energy consumption of sensor nodes. Network architecture: Sensor network scenarios - types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources. Design principles for wireless sensor networks.

UNIT – II: Physical Layer (10 Periods)
Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement. Physical layer and transceiver design consideration in wireless sensor networks - Energy usage profile, choice of modulation, Power Management .

UNIT -III: Data Link Layer (16 Periods)
MAC protocols: fundamentals of wireless MAC protocols - Requirements and design constraints for wireless MAC protocols, Important classes of MAC protocols, MAC protocols for wireless sensor networks. Low duty cycle protocols and wakeup concepts - Sparse topology and energy management (STEM), S-MAC, Wakeup radio concepts. Contention-based protocols - CSMA protocols, PAMAS. Schedule-based protocols - SMAC, BMAC, Traffic-adaptive medium access protocol (TRAMA). Link Layer protocols – fundamentals task and requirements, error control - Causes and characteristics of transmission errors, ARQ techniques, FEC techniques, Hybrid schemes, Power control

UNIT – IV: Network Layer **(10 Periods)**

Gossiping and agent-based uni-cast forwarding - Basic idea, Randomized forwarding. Energy-efficient unicast, Broadcast and multicast - Source-based tree protocols, Shared, core-based tree protocols, Mesh-based protocols. geographic routing - Basics of position-based routing, Geocasting. Mobile nodes - Mobile sinks, Mobile data collectors, Mobile regions. Data centric and content-based networking - Introduction, Data-centric routing, Data aggregation.

UNIT – V: Transport Layer **(09 Periods)**

The transport layer and QoS in wireless sensor networks - Quality of service/reliabilitym, Transport protocols. Coverage and deployment - Sensing models, Coverage measures, Uniform random deployments: Poisson point processes, Coverage of random deployments: Boolean sensing model, general sensing model, Coverage determination, Coverage of grid deployments. Reliable data transport, Single packet delivery - Using a single path, Multiple paths, Multiple receivers. Congestion control and rate control - Congestion situations in sensor networks, Mechanisms for congestion detection and handling, Protocols with rate control, The CODA congestion-control framework.

Total periods: 55

TEXT BOOK:

1. Holger Karl, Andreas willig "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Oct 2007.

REFERENCE BOOKS:

1. Fengzhao, Leonidas, Guibas, "Wireless Sensor Networks: an information processing approach –publication, Elsevier,2004.
2. Edgar H .Callaway,"Wireless Sensor Networks: Architecture and protocol", 1st Edition, CRC press 2003.
3. C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, "Wireless Sensor Networks", Springer publication, 2006.

M. Tech. - II SEMESTER
(16MT26131) COMMUNICATIONS LAB-II

Int. Marks	Ext. Marks	Max. Marks	L	T	P	C
50	50	100	-	-	4	2

PRE- REQUISITES: Simulation lab at UG level

COURSE DESCRIPTION:

Simulation of communication systems over communication channels with and without line coding; Design and simulation of Bussgang Blind channel; Minimum Mean Square Error and zero force equalizer; Adaptive equalizers using LMS and RLS algorithms.

COURSE OUTCOMES:

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

1. Demonstarte in-depth knowledge in
   - Design of CDMA communication system and evluate its performance over a Gaussian and multipath Rayleigh fading channel.
   - Design and simulation of an adaptive equalizer using LMS and RLS algorithms.
   - Design and simulation of M-ary QAM system over an AWGN fading channel and evaluate its performance.
   - Simulating communication system using convolutional codes & Viterbi Decoding.
   - BER evaluation for BPSK modulation system with Minimum Mean Square Error (MMSE) equalization and Zero force Equalization in 3 tap ISI channel.
2. Analyze engineering problems for feasible and optimal solutions in the core area of advanced Communications.
3. Design of various components of communication systems.
4. Use MATLAB Toolboxes to solve complex engineering activities in the domain of advanced communications.
5. Understand ethical responsibility towards environment & society in the field of communications.
6. Communicate effectively in verbal & written forms.

LIST OF EXERCISES:

1. Design and simulation of M-ary QAM system with AWGN fading channel.
2. Simulation of Rayleigh fading channel in the mobile environment.
3. Design and performance evaluation of CDMA communication system over a Gaussian channel.
4. Design and performance evaluation of CDMA communication system over a multipath Rayleigh fading channel.
5. Simulation of communication system using convolutional codes & Viterbi Decoding.
6. Design and simulation of an adaptive equalizer using LMS algorithm.
7. Design and simulation of an adaptive equalizer using RLS algorithm.
8. Design and simulation of communication system using Bussgang Blind channel equalizer.
9. BER evaluation for BPSK modulation system with Minimum Mean Square Error (MMSE) equalization in 3 tap ISI channel.
10. BER evaluation for BPSK modulation system with Zero force Equalization in 3 tap ISI channel.

Total Time Slots : 10

TOOLS REQUIRED:
MATLAB with communication and Signal Processing tool boxes.

REFERENCE BOOKS:

1. Advanced communication lab-II manual of the department.
2. W.H. Tranter, K. Sam Shanmugham, T.S. Rappaport, and K.L. Kosbar, "*Principles of Communication System Simulation with Wireless Applications",* Prentice Hall Professional Technical Reference,2004.
3. J.G. Proakis, and M. Salehi, "*Contemporary Communication Systems using MATLAB",* cengage learning, *2nd edition,* 2004.

M.Tech – II Semester

(16MT13832) IMAGE & VIDEO PROCESSING LAB

Int. Marks	Ext. Marks	Max. Marks	L	T	P	C
50	50	100	-	-	4	2

PREREQUISITE:
A course on Image & Video Processing

COURSE DESCRIPTION: Fundamentals of images, image transforms, enhancement, restoration, image compression and coding and video processing.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate knowledge in
   - Image Transforms
   - Image Enhancement & Restoration Techniques
   - Image Segmentation & Compression Techniques
   - Video Processing
2. Understand various applications of image processing in industry, Medicine, and defense.
3. Solve engineering problems for feasible and optimal solutions in the core area of Image and video Processing.
4. Initiate research in image and video processing.
5. Acquire an appreciation for the Image and video processing issues and techniques and be able to apply these techniques to real world problems.
6. Contribute positively to multidisciplinary scientific research in Image and video Processing.
7. Communicate effectively in verbal and written forms.

List of Exercises

1. Point processing in spatial domain
   a. Negation of an image
   b. Thresholding of an image
   c. Contrast Stretching of an image
2. Geometric transformations.
   a. Image rotation
   b. Scaling
   c. Translation
3. Logical operations on Digital Image
   a. AND
   b. NAND
   c. OR
   d. NOR
   e. NOT
4. Histogram Equalization and Specification
5. Filtering in spatial domain
   a. smoothing
   b. sharpening
6. Filtering in frequency domain
   a. Low pass filter
   b. High pass filter
7. Edge Detection using derivative filter mask
   a. Prewitt
   b. Sobel
   c. Laplacian

8. Image compression using transform techniques.
9. Zooming and shrinking operations on images
10. Morphological operations on images
11. Representation of Digital video: Read, Write, View Videos and conversion of videos in different formats.
12. Video to frame and frame to Video conversion.

Total Time Slots: 12

Required Software Tools:

1. MATLAB with image processing and computer vision tool box

REFERENCE BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 3rd edition, Pearson Education, 2008.
2. A. Murat Tekalp, Digital Video Processing, Prentice-Hall, 1995.

M. Tech. -II Semester
(16MT26133) SEMINAR

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
--	100	100	--	--	--	2

PRE-REQUISITES:--

COURSE DESCRIPTION:
Identification of seminar topic; literature survey; preparation of technical report and presentation.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate capacity to identify an advanced topic for seminar in core and allied areas.
2. Extract information pertinent to the topic through literature survey.
3. Comprehend extracted information through analysis and synthesis critically on the topic.
4. Plan, organize, prepare and present effective written and oral technical report on the topic.
5. Adapt to independent and reflective learning for sustainable professional growth in communication systems.
6. Contribute to multidisciplinary scientific work in the field of Communication Systems.
7. Understand ethical responsibility towards environment and society in the field of Communication Systems.
8. Engage in lifelong learning for development of technical competence in the field of Communication Systems.

M. Tech. – II Semester
(16MT23810) INTELLECTUAL PROPERTY RIGHTS
(Common to all M. Tech. Programs)
(Audit Course)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	-	2	-	-

PRE-REQUISITES: --

COURSE DESCRIPTION:

Introduction to Intellectual Property; Trade Marks; Law of Copy Rights; Law of Patents; Trade Secrets; Unfair Competition; New Development of Intellectual Property.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate in-depth knowledge on
   - Intellectual Property
   - Trade Marks & Secrets
   - Law of Copy Rights, Patents
   - New development of Intellectual Property
2. Analyze the different forms of infringement of intellectual property rights.
3. Solve problems pertaining to Intellectual Property Rights.
4. Stimulate research zeal for patenting of an idea or product.
5. Write effective reports required for filing patents.
6. Develop life-long learning capabilities.
7. Develop awareness of the relevance and impact of IP Law on their academic and professional lives.
8. Develop attitude for reflective learning.

DETAILED SYLLABUS:

UNIT - I: Introduction to Intellectual property **(Periods:5)**
Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT - II: Trade Marks: **(Periods:5)**
Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

UNIT - III: Law of copy rights: **(Periods:6)**
Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT - IV: Trade Secrets: **(Periods:6)**
Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, False advertising.

UNIT - V: New development of intellectual property: (Periods:6)

New developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international - trade mark law, copy right law, international patent law, international development in trade secrets law.

Total Periods: 28

REFERENCE BOOKS:

1. Deborah, E. Bouchoux, *Intellectual property right*, Cengage learning.
2. Prabuddha ganguli, *Intellectual property right - Unleashing the knowledge economy*, Tata Mc Graw Hill Publishing Company Ltd.

M. Tech.-III & IV Semester
(16MT36131 & 16MT46131) PROJECT WORK

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
200	200	400	--	--	--	28

PRE-REQUISITES:--

COURSE DESCRIPTION:
Identification of topic for the project work; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the project work; Writing of thesis and presentation.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

1. Demonstrate capacity to identify an advanced topic for project work in core and allied areas.
2. Extract information pertinent to the topic through literature survey.
3. Comprehend extracted information through analysis and synthesis critically on the topic.
4. Solve engineering problems pertinent to the chosen topic for feasible solutions.
5. Use the techniques, skills and modern engineering tools necessary for project work.
6. Do time and cost analysis on the project.
7. Plan, prepare and present effective written and oral technical report on the topic.
8. Adapt to independent and reflective learning for sustainable professional growth.
9. Contribute to multidisciplinary scientific work in the field of Communication Systems.
10. Understand ethical responsibility towards environment and society in the field of Communication Systems.
11. Engage lifelong learning for development of technical competence in the field of Communication Systems.