CURRICULUM AND SYLLABI
REGULATIONS – 2016

(WITH AMENDMENTS INCORPORATED TILL AUGUST 2018)

(As approved by the 12th Academic Council)

M.Tech.
COMMUNICATION SYSTEMS

SEPTEMBER 2018

B.S. Abdur Rahman
Crescent
Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956
GST Road, Vandalur, Chennai 600 048

UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science and Technology aspires to be a leader in Education, Training and Research in Engineering, Science, Technology and Management and to play a vital role in the Socio-Economic progress of the Country.

MISSION

- To blossom into an internationally renowned University
- To empower the youth through quality education and to provide professional leadership
- To achieve excellence in all its endeavors to face global challenges
- To provide excellent teaching and research ambience
- To network with global institutions of Excellence, Business, Industry and Research Organizations
- To contribute to the knowledge base through Scientific enquiry, Applied research and Innovation

VISION AND MISSION OF THE DEPARTMENT OFELECTRONICS AND COMMUNICATION ENGINEERING

VISION

The Department of Electronics and Communication Engineering envisions to be a leader in providing state of the art education through excellence in teaching, training, and research in contemporary areas of Electronics and Communication Engineering and aspires to meet the global and socio economic challenges of the country.

MISSION

- The Department of Electronics and Communication Engineering, endeavors to produce globally competent Engineers prepared to face challenges of the society.
- To enable the students to formulate, design and solve problems in applied science and engineering.
- To provide excellent teaching and research environment using state of the art facilities.
- To provide adequate practical training to meet the requirement of the Electronics & communication industry.
- To train the students to take up leadership roles in their career or to pursue higher education and research.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M.Tech.(COMMUNICATION SYSTEMS)

PROGRAMME EDUCATIONAL OBJECTIVES:

- To educate and train the graduates with knowledge and skills necessary to formulate, design and solve problems in communication systems, advanced radiation systems, signal processing, optical and computer networks.
- To provide knowledge in software and hardware tools for real time applications in RF system design, Wireless Communication, Signal Processing and Network design.
- To provide scope for Applied Research and innovation in the various domains of communication system, enabling the graduates to carry out research and development in Industry and Academia.
- To enhance communication and soft skills of students to make them work effectively as a team.

PROGRAMME OUTCOMES:

On completion of the program, the graduates will

- Have the ability to design and analyze different types of communication systems.
- Have the capability to develop real time applications in the area of RF system design, Wireless Communication, Signal Processing and Network design using software and hardware tools.
- Be able to undertake research projects and disseminate the knowledge to the society in the related domains of communication systems.
- Be able to communicate effectively and work as a team in their professional career.

REGULATIONS – 2016
FOR
M.Tech. / MCA / M.Sc. DEGREE PROGRAMMES

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

i. **"Programme"** means a Post Graduate Degree Programme (M.Tech./ MCA/ M.Sc.)

ii. **"Course"** means a theory or practical subject that is normally studied in asemester, like Applied Mathematics, Structural Dynamics, Computer Aided Design, etc.

iii. **"University"** means B.S.Abdur Rahman University, Chennai, 600048.

iv. **"Institution"** unless otherwise specifically mentioned as an autonomousor off campus institution means B.S.Abdur Rahman University.

v. **"Academic Council"** means the Academic Council, which is the apex body on all academic matters of this University

vi. **"Dean (Academic Affairs)"** means Dean (Academic Affairs) ofB.S.Abdur Rahman University, who administers the academic matters.

vii. **“Dean (P.G. Studies)”** meansDean (P.G. Studies) of B.S. Abdur Rahman University who administers all P.G Programmes of the University in coordination with Dean (Academic Affairs)

viii. **"Dean (Student Affairs)"** means Dean (Student Affairs) of B.S.Abdur Rahman University, who looks after the welfare and discipline of the students.

ix. **"Controller of Examinations"** means the Controller of Examinations ofB.S.Abdur Rahman University who is responsible for conduct of examinations and declaration of results.

2.0 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

2.1 P.G. Programmes Offered

The various P.G. Programmes and their modes of study are as follows:

Degree	Mode of Study
M. Tech. /M.C.A. / M.Sc.	Full Time & Part Time – Day / Evening / Weekends

2.2 Modes of Study

2.2.1 Full-time

Students admitted under "Full-Time" shall be available in the Institution during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

2.2.2 A full time student, who has completed all non-project courses desiring to do the Project work in part-time mode for valid reasons, shall apply to the Dean (Academic Affairs) through the Head of the Department. Permission may be granted based on merits of the case. Such conversion is not permitted in the middle of a semester.

2.2.3 Part-time

In this mode of study, the students are required to attend classes for the courses in the time slots selected by them, during the daytime (or) evenings (or) weekends.

2.3 Admission Requirements

2.3.1 Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination of this University as specified in the Table shown for eligible entry qualifications for admission to P.G. programmes or any other degree examination of any University or authority accepted by this University as equivalent thereto.

2.3.2 Eligibility conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by this Institution from time to time.

2.3.3 All part-time students should satisfy other conditions regarding experience, sponsorship etc., which may be prescribed by this Institution from time to time.

2.3.4 Student eligible for admission to M.C.A under lateral entry scheme shall be required to have passed three year degree in B.Sc (Computer Science) / B.C.A / B.Sc (Information Technology)

3.0 DURATION AND STRUCTURE OF THE P.G. PROGRAMME

3.1 The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech. (Full Time)	4	8
M.Tech. (Part Time)	6	12
M.C.A. (Full Time)	6	12
M.C.A. (Part Time)	9	18
M.C.A. (Full Time) – (Lateral Entry)	4	8
M.C.A. (Part Time) – (Lateral Entry)	6	12
M.Sc. (Full Time)	4	8
M. Sc. (Part Time)	6	12

3.2 The PG. programmes consist of the following components as prescribed in the respective curriculum

i. Core courses
ii. General Elective courses
iii. Professional Elective courses
iv. Project work / thesis / dissertation
v. Laboratory Courses
vi. Case studies
vii. Seminars
viii. Mini Project
ix. Industrial Internship

3.3 The curriculum and syllabi of all PG. programmes shall be approved by the Academic Council of this University.

3.4 The minimum number of credits to be earned for the successful completion of the programme shall be specified in the curriculum of the respective specialization of the P.G. programme.

3.5 Each academic semester shall normally comprise of 80 working days. Semester-end examinations will follow immediately after the last working day.

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
01	Civil Engineering	M.Tech. (Structural Engineering)	B.E / B. Tech. (Civil Engineering) / (Structural Engineering)
		M.Tech. (Construction Engineering and Project Management)	
02	Mechanical Engineering	M.Tech. (Manufacturing Engineering)	B.E. / B. Tech. (Mechanical / Auto / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace /Aeronautical / Material Science / Marine Engineering)
		M.Tech. (CAD/CAM)	
03	Polymer Engineering	M.Tech. (Polymer Technology)	B. E. / B. Tech. Mechanical / Production /Polymer Science or Engg or Tech / Rubber Tech / M.Sc (Polymer Sc./ Chemistry Appl. Chemistry)
04	Electrical and Electronics Engineering	M.Tech. (Power Systems Engg)	B.E / B.Tech (EEE / ECE / E&I / I&C / Electronics / Instrumentation)
		M.Tech. (Power Electronics & Drives)	B.E / B.Tech (EEE / ECE / E&I / I&C / Electronics / Instrumentation)
05	Electronics and Communication Engineering	M.Tech. (Communication Systems)	B.E / B.Tech (EEE/ ECE / E&I / I&C / Electronics / Instrumentation)
		M.Tech. (VLSI and Embedded Systems)	B.E. / B. Tech. (ECE / Electronics / E&I / I&C / EEE)
06	ECE Department jointly with Physics Dept.	M.Tech. (Optoelectronics and Laser Technology)	B.E. / B. Tech. (ECE / EEE / Electronics / EIE / ICE) M.Sc (Physics / Materials Science / Electronics / Photonics)
07	Electronics and Instrumentation Engineering	M.Tech. (Electronics and Instrumentation Engineering)	B.E. / B. Tech. (EIE / ICE / Electronics / ECE / EEE)

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
08	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA)
		M.Tech. (Software Engineering)	B.E. / B. Tech. (CSE / IT) MCA
		M.Tech. (Network Security)	B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA)
		M.Tech. (Computer Science and Engineering with specialization in Big Data Analytics)	B.E. / B. Tech. (CSE / IT / ECE / EEE / EIE / ICE / Electronics / MCA)
09	Information Technology	M.Tech. (Information Technology)	B.E / B. Tech. (IT / CSE / ECE / EEE / EIE / ICE / Electronics) MCA
		M.Tech. (Information Security & Digital Forensics)	B.E / B. Tech. (IT / CSE / ECE / EEE / EIE / ICE / Electronics) MCA
10	Computer Applications	M.C.A.	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level
		M.C.A. – (Lateral Entry)	B.Sc Computer Science / B.Sc Information Technology / B.C.A
		M.Tech. (Systems Engineering and Operations Research)	BE / B. Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A.
		M.Tech. (Data & Storage Management	BE / B. Tech. (Any Branch) or M.Sc., (Maths / Physics / Statistics / CS / IT / SE) or M.C.A.
11	Mathematics	M.Sc. (Actuarial Science)	Any Degree with Mathematics / Statistics as one of the subjects of study.
		M.Sc. Mathematics	B.Sc. (Mathematics)
12	Physics	M.Sc.(Physics)	B.Sc.(Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation)
		M.Sc. (Material Science)	B.Sc.(Physics / Applied Science / Electronics / Electronics

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
			Science / Electronics & Instrumentation)
13	Chemistry	M.Sc.(Chemistry)	B.Sc (Chemistry / Applied Science)
14	Life Sciences	M.Sc. Molecular Biology & Biochemistry	B.Sc. in any branch of Life Sciences
		M.Sc. Genetics	B.Sc. in any branch of Life Sciences
		M.Sc. Biotechnology	B.Sc. in any branch of Life Sciences
		M.Sc. Microbiology	B.Sc. in any branch of Life Sciences
		M.Sc. Bioscience	B.Sc. in any branch of Life Sciences
		M.Tech. Biotechnology	B. Tech. (Biotechnology / Chemical Engineering) / M.Sc. in any branch of Life Sciences

3.6 The curriculum of PG programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Minimum prescribed credits
M.Tech.	73
M.C.A.	120
M.Sc.	72

3.7 Credits will be assigned to the courses for all P.G. programmes as given below:

- One credit for one lecture period per week (or) 15 periods per semester
- One credit for one tutorial period per week
- One credit each for seminar/practical session/project of two or three periods per week
- One credit for two weeks of industrial internship
- One credit for 15 periods of lecture (can even be spread over a short span of time)

3.8 The number of credits registered by a student in non-project semester and project semester should be within the range specified below:

P.G. Programme	Full Time		Part Time	
	Non-project Semester	Project semester	Non-project Semester	Project semester
M.Tech.	9 to 28	12 to 28	6 to 12	12 to 28
M.C.A.	9 to 29	12 to 29	6 to 12	12 to 29
M.Sc.	9 to 25	12 to 20	6 to 12	12 to 20

3.9 The student may choose a course prescribed in the curriculum from any department depending on his /her convenient time slot. All attendance will be maintained course-wise only.

3.10 The electives from the curriculum are to be chosen with the approval of the Head of the Department.

3.11 A student may be permitted by the Head of the Department to choose electives from other PG programmes either within the Department or from other Departments up to a maximum of nine credits during the period of his/her study, with the approval of the Head of the Departments offering such courses.

3.12 To help the students to take up special research areas in their project work and to enable the department to introduce courses in latest/emerging areas in the curriculum, "Special Electives" may be offered. A student may be permitted to register for a "Special Elective" up to a maximum of three credits during the period of his/her study, provided the syllabus of this course is recommended by the Head of the Department and approved by the Chairman, Academic Council before the commencement of the semester, in which the special elective course is offered. Subsequently, such course shall be ratified by the Board of Studies and Academic Council.

3.13 The medium of instruction, examination, seminar and project/thesis/ dissertation reports will be English.

3.14 Industrial internship, if specified in the curriculum shall be of not less than two weeks duration and shall be organized by the Head of the Department.

3.15 Project Work / Thesis / Dissertation

3.15.1 Project work / Thesis / Dissertation shall be carried out under the supervision of a Faculty member in the concerned Department.

3.15.2 A student may however, in certain cases, be permitted to work for the project in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization and the student shall be instructed to meet the faculty periodically and to attend the review committee meetings for evaluating the progress.

3.15.3 Project work / Thesis / Dissertation (Phase - II in the case of M.Tech.) shall be pursued for a minimum of 16 weeks during the final semester, following the preliminary work carried out in Phase-1 during the previous semester.

3.15.4 The Project Report/Thesis / Dissertation report / Drawings prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

3.15.5 The deadline for submission of final Project Report / Thesis / Dissertation is within 30 calendar days from the last working day of the semester in which Project / Thesis / Dissertation is done.

3.15.6 If a student fails to submit the Project Report / Thesis / Dissertation on or before the specified deadline he / she is deemed to have not completed the Project Work / Thesis / dissertation and shall re-register the same in a subsequent semester.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 Class Advisor

A faculty member will be nominated by the HOD as Class Advisor for the whole class.

He/she is responsible for maintaining the academic, curricular and co-curricular records of all students throughout their period of study.

4.2 Faculty Advisor

To help the students in planning their courses of study and for general counseling on the academic programme, the Head of the Department of the students will attach a certain number of students to a faculty member of the department who shall function as Faculty Advisor for the students throughout their period of study. Such Faculty Advisor shall offer advice to the students on academic and personal matters and guide the students in taking up courses for registration and enrolment every semester.

5.0 CLASS COMMITTEE

5.1 Every class of the PG Programme will have a Class Committee constituted by the Head of the Department as follows:

i. Teachers of all courses of the programme

ii. One senior faculty preferably not offering courses for the class, as

Chairperson.

iii. Minimum two students of the class, nominated by the Head of the Department.

iv. Class Advisor / Faculty Advisor of the class - Ex-Officio Member

v. Professor in-charge of the PG Programme - Ex-Officio Member.

5.2 The Class Committee shall be constituted by the respective Head of the Department of the students.

5.3 The basic responsibilities of the Class Committee are to review periodically the progress of the classes to discuss problems concerning curriculum and syllabi and the conduct of classes. The type of assessment for the course will be decided by the teacher in consultation with the Class Committee and will be announced to the students at the beginning of the semester. Each Class Committee will communicate its recommendations to the Head of the Department and Dean (Academic Affairs). The class committee, **without the student members,** will also be responsible for finalization of the semester results and award of grades.

5.4 The Class Committee is required to meet at least thrice in a semester, first within a week of the commencement of the semester, second, after the first assessment and the third, after the semester-end examination to finalize the grades.

6.0 COURSE COMMITTEE

Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers teaching the common course with one of them nominated as Course coordinator. The nomination of the Course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

7.0 REGISTRATION AND ENROLMENT

7.1 For the first semester every student has to register for the courses within one week from the commencement of the semester

7.2 For the subsequent semesters registration for the courses will be done by the student one week before the last working day of the previous

semester. The curriculum gives details of the core and elective courses, project and seminar to be taken in different semester with the number of credits. The student should consult his/her Faculty Advisor for the choice of courses. The Registration form shall be filled in and signed by the student and the Faculty Advisor.

7.3 From the second semester onwards all students shall pay the prescribed fees and enroll on a specified day at the beginning of a semester.

7.4 A student will become eligible for enrolment only if he/she satisfies clause 9 and in addition he/she is not debarred from enrolment by a disciplinary action of the Institution. At the time of enrolment a student can drop a course registered earlier and also substitute it by another course for valid reasons with the consent of the Faculty Advisor. Late enrolment will be permitted on payment of a prescribed fine up to two weeks from the date of commencement of the semester.

7.5 Withdrawal from a course registered is permitted up to one week from the date of the completion of the first assessment test.

7.6 Change of a course within a period of 15 days from the commencement of the course, with the approval of Dean (Academic Affairs), on the recommendation of the HOD, is permitted.

7.7 Courses withdrawn will have to be taken when they are offered next if they belong to the list of core courses.

7.8 A student undergoing a full time PG Programme should have enrolled for all preceding semesters before registering for a particular semester

7.9 A student undergoing the P.G. programme in Part Time mode can choose not to register for any course in a particular semester with written approval from the head of the department. However the total duration for the completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1)

8.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. Such student has to rejoin only in the same semester from where he left. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / THESIS / DISSERTATION

9.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum No. of credits to be earned to enroll for project semester
M.Tech. (Full time / Part time)	18
M.C.A. (Full time / Part time)	45
M.C.A. (Full time / Part time) – (Lateral Entry)	22
M.Sc.(Full time / Part time)	18

9.2 If the student has not earned minimum number of creditsspecified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

10.0 DISCIPLINE

10.1 Every student is required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity, which will tend to bring down the prestige of the Institution.

10.2 Any act of indiscipline of a student reported to the Head of the Institution will be referred to a Discipline and Welfare Committee for taking appropriate action.

11.0 ATTENDANCE

11.1 Attendance rules for all Full Time Programme and Part time Programmes are given in the following sub-clause.

11.2 Ideally every student is expected to attend all classes and earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% for genuine reasons like on medical grounds, representing the University in approved events etc., to become eligible to appear for the semester-end examination in that course, failing which the student shall be awarded "I" grade in that course. If the course is a core course, the student should register for and repeat the course when it is offered next. If the course is an elective, either he/she can register and repeat the same elective or can register for a new elective.

11.3 The students of Full Time mode of study, who have not attended a single hour in all courses in a semester and awarded ‘I’ grade are not permitted

to write the examination and also not permitted move to next higher semester. Such students should repeat all the courses of the semester in the next Academic year.

12.0 SUMMER TERM COURSES

12.1 Summer term courses may be offered by a department on the recommendation of the Departmental Consultative Committee and approved by the Dean (Academic Affairs). No student should register for more than three courses during a summer term.

12.2 Summer term courses will be announced by the Head of the department at the end of the even semester before the commencement of the end semester examinations. A student will have to register within the time stipulated in the announcement. A student has to pay the fees as stipulated in the announcement.

12.3 The number of contact hours and the assessment procedure for any course during summer term will be the same as those during regular semesters.

Students with U grades will have the option either to write semester end arrears exam or to redo the courses during summer / regular semesters, if they wish to improve their continuous assessment marks subject to the approval of the Head of the department.

12.4 Withdrawal from a summer term course is not permitted. No substitute examination will be conducted for the summer term courses.

12.5 The summer term courses are not applicable for the students of Part Time mode.

13.0 ASSESSMENTS AND EXAMINATIONS

13.1 The following rule shall apply to all the PG programmes (M.Tech./ M.C.A. / M.Sc.)

For lecture-based courses, normally a minimum of two assessments will be made during the semester. The assessments may be combination of tests and assignments. The assessment procedure as decided in the Class Committee will be announced to the students right from the beginning of the semester by the course teacher.

13.2 There shall be one examination of three hours duration, at the end of the semester.

13.3 In one (or) two credit courses that are not spread over the entire semester, the evaluation will be conducted at the completion of the course itself. Anyhow approval for the same is to be obtained from the

HoD and the Dean of Academic Affairs.

13.4 The evaluation of the Project work will be based on the project report and a Viva-Voce Examination by a team consisting of the supervisor concerned, an Internal Examiner and External Examiner to be appointed by the Controller of Examinations.

13.5 At the end of industrial internship, the student shall submit a certificate from the organization and also a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a Departmental Committee constituted by the Head of the Department.

14.0 WEIGHTAGES

14.1 The following shall be the weightages for different courses:

i) Lecture based course

Two continuous assessments	50%
Semester-end examination	50%

ii) Laboratory based courses

Laboratory work assessment	75%
Semester-end examination	25%

iii) Project work

Periodic reviews	50%
Evaluation of Project Report by	
External Examiner	20%
Viva-Voce Examination	30%

14.2 Appearing for semester end examination for each course (Theory and Practical) is mandatory and a student should secure a minimum of 40% marks in semester end examination for the successful completion of the course.

14.3 The markings for all tests, tutorial, assignments (if any), laboratory work and examinations will be on absolute basis. The final percentage of marks is calculated in each course as per the weightages given in clause 13.1.

15.0 SUBSTITUTE EXAMINATION

15.1 A student who has missed for genuine reasons any one of the three assessments including semester-end examination of a course may be permitted to write a substitute examination. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accident or admissions to a hospital due to

illness, etc.

15.2 A student who misses any assessment in a course shall apply in a prescribed form to the Dean (Academic Affairs) through the Head of the department within a week from the date of missed assessment. However the substitute tests and examination for a course will be conducted within two weeks after the last day of the semester-end examinations.

16.0 COURSEWISE GRADING OF STUDENTS AND LETTER GRADES

16.1 Based on the semester performance, each student is awarded a final letter grade at the end of the semester in each course. The letter grades and the corresponding grade points are as follows, but grading has to be relative grading

Letter grade	Grade points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
W	-
I	-
AB	-

- Flexible range grading system will be adopted
- **“W”** denotes withdrawal from the course.
- **"I"** denotes inadequate attendance and hence prevention from semester-end examination
- **"U"** denotes unsuccessful performance in a course.
- **“AB”** denotes absent for the semester end examination

16.2 A student is considered to have completed a course successfully if he / she secure five grade points or higher. A letter grade ‘U’ in any course implies unsuccessful performance in that course.

16.3 A course successfully completed cannot be repeated for any reason.

17.0 AWARD OF LETTER GRADE

17.1 A final meeting of the Class Committee without the student member(s) will be convened within ten days after the last day of the semester end examination. The letter grades to be awarded to the students for different courses will be finalized at the meeting.

17.2 After finalization of the grades at the class committee meeting the Chairman will forward the results to the Controller of Examinations, with copies to Head of the Department and Dean (Academic Affairs).

18.0 DECLARATION OF RESULTS

18.1 After finalization by the Class Committee as per clause 16.1 the Letter grades awarded to the students in the each course shall be announced on the departmental notice board after duly approved by the Controller of Examinations.

18.2 In case any student feels aggrieved about the results, he/she can apply for revaluation after paying the prescribed fee for the purpose, within one week from the announcement of results.

A committee will be constituted by the concerned Head of the Department comprising of the Chairperson of the concerned Class Committee (Convener), the teacher concerned and a teacher of the department who is knowledgeable in the concerned course. If the Committee finds that the case is genuine, it may jointly revalue the answer script and forward the revised marks to the Controller of Examinations with full justification for the revision, if any.

18.3 The “U” and “AB” grade once awarded stays in the grade sheet of the students and is not deleted when he/she completes the course successfully later. The grade acquired by the student later will be indicated in the grade sheet of the appropriate semester.

19.0 COURSE REPETITION AND ARREARS EXAMINATION

19.1 A student should register to re-do a core course wherein"I" or "W" grade is awarded. If the student is awarded "I" or "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken.

19.2 A student who is awarded “U” or “AB” grade in a course shall write the semester-end examination as arrear examination, at the end of the next semester, along with the regular examinations of next semester courses.

19.3 A student who is awarded “U” or “AB” grade in a course will have the option of either to write semester end arrear examination at the end of the subsequent semesters, or to redo the course whenever the course is offered. Marks earned during the redo period in the continuous

assessment for the course, will be used for grading along with the marks earned in the end-semester (re-do) examination.

19.4 If any student obtained "U" or "AB" grade, the marks earned during the redo period for the continuous assessment for that course will be considered for further appearance as arrears.

19.5 If a student with "U" or "AB" grade prefers to redo any particular course fails to earn the minimum 75% attendance while doing that course, then he/she will not be permitted to write the semester end examination and his / her earlier 'U' grade and continuous assessment marks shall continue.

20.0 GRADE SHEET

20.1 The grade sheet issued at the end of the semester to each student will contain the following:

(i) the credits for each course registered for that semester.

(ii) the performance in each course by the letter grade obtained.

(iii) the total credits earned in that semester.

(iv) the Grade Point Average (GPA) of all the courses registered for that semester and the Cumulative Grade Point Average (CGPA) of all the courses taken up to that semester.

20.2 The GPA will be calculated according to the formula

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GP_i)}{\sum_{i=1}^{n}(C_i)}$$

where n = number of courses

where C_i is the number of credits assigned for i^{th} course

GP_i - Grade point obtained in the i^{th} course

for the cumulative grade point average (CGPA) a similar formula is used except that the sum is over all the courses taken in all the semesters completed up to the point of time.

'I' and 'W' grades will be excluded for GPA calculations.

'U', 'AB' 'I' and 'W' grades will be excluded for CGPA calculations.

20.3 Classification of the award of degree will be as follows:

20.3.1 For students under full time mode of study

CGPA	Classification
8.50 and above, having completed all courses in	First class with Distinction

first appearance	
6.50 and above, having completed within a period of 2 semesters beyond the programme period	First Class
All others	Second Class

However, to be eligible for First Class with Distinction, a student should not have obtained U or I grade in any course during his/her study and should have completed the PG Programme within a minimum period covered by the minimum duration (clause 3.1) plus authorized break of study, if any (clause 8). To be eligible for First Class, a student should have passed the examination in all courses within the specified minimum number of semesters reckoned from his/her commencement of study plus two semesters. For this purpose, the authorized break of study will not be counted. The students who do not satisfy the above two conditions will be classified as second class. For the purpose of classification, the CGPA will be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

20.3.2 For students under part timemode of study

CGPA	Classification
8.50 and above, having completed all courses in first appearance	First class with Distinction
6.50 and above	First Class
All others	Second Class

For the purpose of classification, the CGPA will be rounded to two decimal places.

21.0 ELIGIBILITY FOR THE AWARD OF THE MASTERS DEGREE

21.1 A student shall be declared to be eligible for the award of the Masters Degree, if he/she has:

i) successfully acquired the required credits as specified in the Curriculum corresponding to his/her programme within the stipulated time,

ii) no disciplinary action is pending against him/her.

21.2 The award of the degree must be approved by the University.

22.0 POWER TO MODIFY

Notwithstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

CURRICULUM & SYLLABI FOR M.TECH. (COMMUNICATION SYSTEMS) (FOUR SEMESTERS / FULL TIME)

CURRICULUM

Sl. No.	Course Code	Course Title	L	T	P	C
		SEMESTER I				
1	MAC6184	Probability Matrix Theory & Linear Programming	**3**	**1**	**0**	**4**
2	ECC6101	Mobile Communication Networks and Modeling	**3**	**0**	**2**	**4**
3	ECC6102	Satellite Communication	**3**	**0**	**0**	**3**
4	ECC6103	Advanced Digital Communication Techniques	**3**	**0**	**2**	**4**
5	ECC6104	Advanced Digital Signal Processing	**3**	**1**	**0**	**4**
6		Professional Elective – Minimum of ‘3’ credits to be earned				**3**
						22
		SEMESTER II				
1	ECC6201	Optical Networks	**3**	**0**	**0**	**3**
2	ECC6202	Advanced Radiation Systems and practice	**3**	**0**	**2**	**4**
3	ECC6203	Research Methodology for Engineers	**3**	**1**	**0**	**4**
4.		Professional Electives – Minimum of ‘9’ credits to be earned				**9**
						20
		SEMESTER III				
1	GEC	General Elective	**3**	**0**	**0**	**3**
2		Professional Electives – Minimum of ‘6’ credits to be earned				**6**
3	ECC7101	Project Work - Phase I*	**0**	**0**	**12**	**6***
4	ECC7102	Mini Project / Internship**	**0**	**0**	**3**	**1**
						10

Sl. No.	Course Code	Course Title	L	T	P	C
		SEMESTER IV				
1	ECC7101	Project Work - Phase II	**0**	**0**	**36**	**18***
						18 + 6 = 24
						Total Credits: 76

* Credits for Project Work Phase I to be accounted along with Project Work Phase II in IV Semester

** Internship has to be carried out at the end of second semester during summer vacation

PROFESSIONAL ELECTIVES

Sl. No.	Course Code	Course Title	L	T	P	C
1	ECCY001	Digital Image Processing	**3**	**0**	**0**	**3**
2	ECCY002	Advanced Microwave systems	**3**	**0**	**0**	**3**
3	ECCY003	Cognitive and Cooperative Radio Communications	**3**	**0**	**0**	**3**
4	ECCY004	Digital Communication Receivers	**3**	**0**	**0**	**3**
5	ECCY005	Electromagnetic Interference and Compatibility in System Design	**3**	**0**	**0**	**3**
6	ECCY006	Error Control Coding	**3**	**0**	**0**	**3**
7	ECCY007	Global Tracking and Positioning Systems	**3**	**0**	**0**	**3**
8	ECCY008	High Performance Communication Networks	**3**	**0**	**0**	**3**
9	ECCY009	Internet of Things	**3**	**0**	**0**	**3**
10	ECCY010	Internet Working Multimedia	**3**	**0**	**0**	**3**
11	ECCY011	Medical Image Processing	**3**	**0**	**0**	**3**
12	ECCY012	Microstrip Antennas	**3**	**0**	**0**	**3**
13	ECCY013	Microwave Integrated Circuits	**3**	**0**	**0**	**3**
14	ECCY014	MIMO systems	**3**	**0**	**0**	**3**
15	ECCY015	Multimedia Compression Techniques	**3**	**0**	**0**	**3**
16	ECCY016	Network Security	**3**	**0**	**0**	**3**
17	ECCY017	QoS in Ad Hoc Wireless Networks	**3**	**0**	**0**	**3**
18	ECCY018	Quantum Computing	**3**	**0**	**0**	**3**
19	ECCY019	RF System Design	**3**	**0**	**0**	**3**
20	ECCY020	RF Wireless Systems and Standards	**3**	**0**	**0**	**3**
21	ECCY021	Simulation of Communication Systems & Networks	**3**	**0**	**0**	**3**
22	ECCY022	Speech and Audio Signal Processing	**3**	**0**	**0**	**3**

Sl. No.	Course Code	Course Title	L	T	P	C
23	ECCY023	Statistical Signal Processing	**3**	**0**	**0**	**3**
24	ECCY024	Vehicular AD HOC Networks	**3**	**0**	**0**	**3**
25	ECCY025	Wireless Communication	**3**	**0**	**0**	**3**
26	ECCY026	Wireless sensor Networks	**3**	**0**	**0**	**3**
27	ECCY027	Communication System Design and Analysis	**2**	**0**	**2**	**3**
28	ECCY028	Adaptive Signal Processing	**2**	**0**	**0**	**2**
29	ECCY029	Classical and Advanced Techniques For Optimization	**2**	**0**	**0**	**2**
30	ECCY030	Network Routing Algorithms	**2**	**0**	**0**	**2**
31	ECCY031	Pattern Recognition Techniques and Applications	**2**	**0**	**0**	**2**
32	ECCY032	Radiation Systems for Personal area Network	**2**	**0**	**0**	**2**
33	ECCY033	Bio signal Processing	**1**	**0**	**0**	**1**
34	ECCY034	Ultrasonic Principles and Applications	**1**	**0**	**0**	**1**
35	ECCY035	Chaotronics	**3**	**0**	**0**	**3**
35	ECCY060	Software for Embedded Systems	**2**	**0**	**2**	**3**
36	MACY081	Signal Processing Techniques	**3**	**1**	**0**	**4**

GENERAL ELECTIVES FOR M.TECH PROGRAMMES

Sl. No.	Course Code	Course Title	L	T	P	C
1	GECY101	Project Management	**3**	**0**	**0**	**3**
2	GECY102	Society, Technology & Sustainability	**3**	**0**	**0**	**3**
3	GECY103	Artificial Intelligence	**3**	**0**	**0**	**3**
4	GECY104	Green Computing	**3**	**0**	**0**	**3**
5	GECY105	Gaming Design	**3**	**0**	**0**	**3**
6	GECY106	Social Computing	**3**	**0**	**0**	**3**
7	GECY107	Soft Computing	**3**	**0**	**0**	**3**
8	GECY108	Embedded System Programming	**3**	**0**	**0**	**3**
9	GECY109	Principles of Sustainable Development	**3**	**0**	**0**	**3**
10	GECY110	Quantitative Techniques in Management	**3**	**0**	**0**	**3**
11	GECY111	Programming using MATLAB& SIMULINK	**1**	**0**	**2**	**2**
12	GECY112	JAVA Programming	**1**	**0**	**2**	**2**
13	GECY113	PYTHON Programming	**1**	**0**	**2**	**2**
14	GECY114	Intellectual Property Rights	**1**	**0**	**0**	**1**

SEMESTER I

MAC 6184	PROBABILITY, MATRIX THEORY AND LINEAR PROGRAMMING	L	T	P	C
		3	1	0	4

OBJECTIVE:

The aim of this course is to

- provide a comprehensive introduction to the probability distributions used in engineering.
- familiarize students with advanced matrix theory and variational problems.
- expose the students to Operations Research using concepts of linear programming.

MODULE I PROBABILITY DISTRIBUTIONS 10+03

Axioms of probability – addition and multiplication theorem – conditional probability –total probability – random variables - moments – moments generating functions and their properties- Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

MODULE II TWO DIMENSIONAL RANDOM 08+03

Joint distributions - marginal and conditional distributions - functions of random variables - covariance - correlation and regression - Central limit theorem.

MODULE III ADVANCED MATRIX 09+03

Matrix norms - singular value decomposition - QR algorithm - pseudo inverse - least square approximations.

MODULE IV LINEAR PROGRAMMING 10+03

Formation - graphical method - simplex method - Big-M method - Two Phase method - transportation and assignment problems.

MODULE V CALCULUS OF VARIATIONS 08+03

Variation and its properties – Euler's equation – functional dependant on first and higher order derivatives – functional dependant on functions of several independent variables – variational problems with moving boundaries – isoperimetric problems – Ritz and Kantorovich methods.

L – 45; T – 15; Total – 60

TEXT BOOKS:

1. S.M.Ross, “A First Course in Probability”, 9th edition, Pearson Education, 2013.
2. Lewis.D.W., “Matrix Theory”, Allied Publishers, Chennai, 1995.
3. Taha, H.A., “Operations Research - An Introduction ", 10th edition, Pearson Prentice Hall, 2016.
4. A.S. Gupta, “Calculus of variations with applications”, PHI Pvt. Ltd, New Delhi, 2011.

REFERENCES:

1. H. Cramer., “Random Variables and Probability Distributions”, Cambridge University Press (2004).
2. Roger A. Horn, Charles R. Johnson, “Matrix Analysis”, Cambridge University Press; 2nd edition (2012).
3. Robert.J.Vanderbei., “Linear Programming: Foundations and Extensions”, Springer US(2014).
4. David. J. Rader., “Deterministic Operations Research”, Wiley (2010).
5. Elsgolts, “Differential Equations and Calculus of Variations", University Press of the Pacific (2003).

OUTCOMES:

At the end of the course students will be able to

- Solve problems using concept of standard, discrete and continuous distributions.
- Solve problems using one dimensional and two dimensional random variables.
- Find Eigen values and Eigen vectors of a higher order matrix.
- Solve problems of linear programming.
- Solve problems of calculus of variations by direct methods and using Euler’s formulae.

ECC6101 MOBILE COMMUNICATION NETWORKS AND MODELLING

L	T	P	C
3	0	2	4

OBJECTIVES:

- To define the principles used in the design of mobile communications networks.
- To learn the technical issues in the operation and management of mobile communications networks
- To discuss about various wireless local area networks
- To explain the security issues in wireless networks
- To introduce the propagation Models and Path Loss Estimation in Cellular Mobile Communication
- To analyze and evaluate the performance of mobile networks

MODULE I MOBILE COMMUNICATION NETWORKS 09

Review of 1G, 2G, 3G, 4G and 5G wireless networks, introduction to 3GPP cellular systems, medium access techniques, Mobile networks Elementary Principles of cellular Telephony Channel Division Techniques (TDMA, FDMA, CDMA), Cellular Coverage Methods, Network Planning and Resource Allocation, Network Dimensioning, Mobility Management Procedures.

Practical

Performance evaluation of CDMA System using simulation.

MODULE II PROPAGATION MODELS AND AIR PROTOCOL 09

Radio propagation models, error control techniques, handoff, power control, Soft handover, Forward link , Reverse link , common air protocols (AMPS, IS-95, IS-136, GSM, GPRS, EDGE, WCDMA, cdma2000, etc).

Practical

Simulation of Propagation Models and Path Loss. Estimation in Cellular Mobile Communication; Estimation of Received Bit Energy for Data Rates in Wireless Communication; Multipath Fading in Cellular Mobile Communication,

MODULE III MOBILE NETWORK ARCHITECTURE 09

General Architecture definition, Mobile Terminals (MT, SIM) Radio Section (BTS, BSC) Core Network (MSC, G-MSC, VLR, HLR, AuC) User and Control Plane Protocol Stack, MAP, Role of Signaling Interfaces, Network Entities Relation, The Physical Channel, The Logical Channels, Terminals, Call and Network Management Procedures.

Practical

Design of Cellular Mobile System

MODULE IV WIRELESS LOCAL AREA NETWORKS 09

Wireless Local Area Networks, General Characteristics of the Hyper LAN System, 802.11 Standard, Basic DCF access scheme DCF Access Scheme with Handshaking, PCF Access Scheme, The 802.11a Standard, Mobile Ad Hoc Networks, Wireless Sensor Networks, over view of Bluetooth technology.

MODULE V SECURITY ISSUES AND NETWORK SIMULATOR 09

Security in Wireless Networks, Secure routing, Key Pre-distribution and Management, Encryption and Authentication, Security in Group Communication, Trust Establishment and Management, Denial of Service Attacks, Energy-aware security mechanisms, Location verification, Security on Data fusion, Overview of Network Simulator.

Practical

Simulation of Security Algorithms;Simulator based performance analysis of wireless networks.

L – 45, P – 30; Total Hours:75

REFERENCES:

1. William Stallings, "Wireless Communications and Networks", Prentice Hall, 2002.
2. T.S. Rappaport, "Wireless Communications: Principles & Practice", Second Edition, Prentice Hall, 2002.
3. Leon-Garcia and I. Widjaja, "Communication Networks, Fundamental Concepts and Key Architectures", McGraw-Hill, 2000.
4. J.Schiller, “Mobile Communications", Addison Wesley, 2000.
5. Yi-Bang Lin, ImrichChlamtac, “Wireless and mobile network architectures”, Wiley India, 2011.
6. Holger Karl, Andreas Willing, “Protocols and Architectures for Wireless Sensor Networks” Wiley 2012.
7. William Stallings, “Cryptography and Network Security”, Pearson Education, 2004.

OUTCOMES:

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

- Describe the architectures of mobile networks

- Compare various network management techniques
- Explain radio propagation Model in mobile networks
- Use simulation tools to design and validate the propagation Models and Path Loss Estimation in Cellular Mobile Communication
- Describe and analyze the performance of CDMA
- Analyze the security issues in Wireless Networks.

ECC6102 SATELLITE COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES:

The aim of this course is

- To describe the concept of orbits and spacecraft subsystems
- To design uplinks and down links with various multiple access techniques
- To list and choose the services of satellites for different application
- To discuss the functional details of VSAT, GPS and DTH system

MODULE I SATELLITE SUBSYSTEMS 09

Review of satellite orbital mechanics - satellite subsystem - altitude and orbit control system - telemetry tracking command and monitoring - power system - communication subsystem, satellite antennas.

MODULE II SATELLITE LINK DESIGN AND ERROR CONTROL FOR DIGITAL SATELLITE LINKS 09

Basic transmission - system noise temperature and G/T ratio - design of down links - satellite system using small earth station- uplink design - design of specified C/N- system design examples. Error detection and correction for digital satellite links - channel capacity- error control coding- performance of block error correction codes- convolutional codes, implementation of error detection on satellite links- concatenated coding and interleaving-turbo codes

MODULE III MULTIPLE ACCESS SCHEMES FOR SATELLITE COMMUNICATION 11

Frame structures of FDMA, TDMA and CDMA in Satellite communication - onboard processing - packet radio systems and protocols

MODULE IV VSAT & GPS SYSTEM 10

Overview of VSAT systems - network architecture- access control protocols-basic techniques, VSAT earth station Engineering - GPS Introduction - position location principles - Receivers and codes - satellite signal acquisition - GPS Signal Message - signal levels - timing accuracy - GPS receiver operation, GPS C/A code accuracy - differential GPS

MODULE V DTH **06**

DTH system architecture – Satellite Architecture – Orbital Interference Limitation Difference among DTH systems- Current scenario in DTH

Total Hours: 45

References:

1. Timothy Pratt, Charles W Bostian, Jeremy E Allnut, “Satellite Communication” Wiley, Edition 2007.
2. Bruce R. Elbert, “The Satellite Communication Applications Hand Book”, Artech House Boston,1997.
3. Wilbur L. Pritchard, Hendri G. Suyderhood, Robert A.Nelson, “Satellite Communication Systems Engineering”, 2nd edition, Prentice Hall, New Jersey.1993.
4. Dennis Rody, “Satellite Communication”, 4th edition, Regents/Prentice Hall, Eaglewood Cliff, New Jersey, 2006.

OUTCOMES:

On completion of the course the student will be able to

- Define and discuss the orbital parameters, launching mechanism and various subsystems of spacecraft.
- Use the mathematical framework of satellite links to various types of satellites and its services
- Design and estimate the uplinks and down links with various multiple access techniques
- Analyze the services of satellites for various applications
- Estimate the performance measures of satellite link
- Assess the architecture of VSAT, GPS and DTH system to meet desired needs within realistic constraints.

ECC6103 ADVANCED DIGITAL COMMUNICATION TECHNIQUES

L	T	P	C
3	0	2	4

OBJECTIVES:

To make the student understand

- concepts of coherent and non-coherent communications.
- the effects of communication over band limited and fading channels
- the concepts of various coding and spread spectrum techniques.

Prerequisites :

- Digital Communication
- Probability and Random Process
- Discrete time signal Processing
- Programming skills in Matlab/ Labview software

MODULE I POWER SPECTRUM AND COMMUNICATION OVER MEMORYLESS CHANNEL 09

Complex base band signal representation, PSD of a Synchronous Data Pulse Stream, PSD of random binary signals, Scalar and Vector communication over Memoryless Channel .

Practical

- Spectral estimation of random binary signals
- Performance evaluation of digital base band communication

MODULE II COHERENT AND NON-COHERENT COMMUNICATION 09

Coherent receivers, Optimum receivers in AWGN, IQ Modulation & Demodulation. Non-coherent receivers in Random Phase and Random Amplitude Channels, M-FSK receivers, Rayleigh and Rician channels. Detector: Optimum rule for ML and MAPDetection; Performance: Bit-error-rate, symbol error rate for coherent and non-coherent schemes.

Practical

- Generation of digitally modulated signals and their constellations
- DPSK – BER Performance analysis

MODULE III COMMUNICATION OVER BANDLIMITED CHANNELS 09

Pulse shape design for channels with ISI: Nyquistpulse,Partial response signaling (duobinary and modified duobinary pulses), demodulation; Channel with distortion:

Design of transmitting and receiving filters for a known channel and for time varying channel (equalization);Performance: Symbol by symbol detection and BER,CPM : CPFM,CPFSK, MSK and GMSK

Practical

- Performance evaluation IQ modulations : QPSK, QAM

MODULE IV BLOCK CODED DIGITAL COMMUNICATION 09

Architecture and performance of Binary block codes: Orthogonal, Bi- orthogonal and Transorthogonal. Linear block codes, cyclic codes. Shannon's channel coding theorem: Channel capacity, Matched filter. Concepts of TDMA, CDMA, OFDMA,FDD, TDD.

Practical

- Simulation of LBC and Cyclic codes
- Generation and detection of CDMA using various spreading codes

MODULE V CONVOLUTIONAL CODED DIGITAL COMMUNICATION 09

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram .Decoding techniques using Maximum likelihood, Sequential and Threshold methods.Error probability performance for BPSK and Viterbi algorithm.TurboCoding.

Practical

- Simulation of coding and decoding of Convolutional codes
- Error probability performance

L – 45, P – 30; Total – 75

REFERENCES:

1. J. G. Proakis and M. Salehi, "Fundamentals of Communication Systems", Pearson Education, 2005.
2. S. Haykins, "Communication Systems", 5th ed., John wiley, 2008.
3. M. K. Simon, S. M. Hinedi and W. C. Lindsey," Digital Communication Techniques: Signaling and detection", Prentice Hall India, N. Delhi, 1995.
4. Andrew J. Viterbi, Jim K. Omura, "Principles of Digital Communication and Coding", McGraw-Hill Inc.1979.
5. M. K. Simon and M. S. Alouini," Digital Communication over Fading Channe"l, 2nd Ed., Wiley publications,2000
6. Ian Glover, Peter Grant, "Digital Communications", Prentice Hall, 2003 Edition

7. Bernard Sklar – “Modern Digital Communication Technique – Fundamental & Applications”, Prentice Hall, 2001 Edition

OUTCOMES:

On completion of the course the student will be able to

- Summarize the concepts of coherent and non-coherent communication techniques
- Perform simulation experiments on various base band digital communication systems
- Evaluate theoretically bit/ symbol error probability analysis
- Apply the concepts of digital modulation schemes
- Design and develop various coding schemes for digital communication systems
- Assess and justify performance of band limited and coded digital communication systems

ECC6104 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
3	1	0	4

OBJECTIVES:

Make the students to

- Describe the use of various transforms in digital signals & systems analysis.
- Estimate the spectrum of Discrete Random Signals.
- Model and design adaptive filters.
- Explain the concepts of multirate signal processing
- Choose the DSP processor for various applications

MODULE I TRANSFORMS AND THEIR APPLICATIONS 06

Review of Z Transform, Discrete Fourier Transform, Discrete Time Fourier Transform, Discrete Fourier series. Introduction to Discrete Wavelet Transform.Haarwavelet.Application of transforms to discrete signals.

MODULE II DISCRETE TIME RANDOM PROCESSES AND SPECTRUM ESTIMATION 09

Deterministic process – Stochastic (random) process – Auto correlation & auto covariance of random processes – Cross correlation of random variables – Ergodic random process – Gaussian random process – Stationary & WSS random process – Power spectrum – Parseval's theorem – Wiener-Khinchine theorem – Spectral factorization – Periodogram - Modified periodograms using Bartlett , Welch, Blackman &Tukey windows – AR, MA, ARMA model based spectral estimation – Yule-Walker Equations – Durbin's algorithm.

MODULE III SIGNAL MODELING AND OPTIMUM FILTERS 08

Least square method model – Prony's pole-zero model – Prony's all pole model – Levinson-Durbin's recursion – Lattice filters – Forward & backward linear prediction filters.

MODULE IV ADAPTIVE FILTERS 08

FIR adaptive filters – Steepest descent method - Widrow-Hoff LMS algorithm – Normalized LMS method – Adaptive channel equalization – Adaptive noise cancellation – IIR adaptive filters - RLS filters.

MODULE V MULTIRATE DIGITAL SIGNAL PROCESSING 08

Need for multirate sampling – Decimation – Interpolation - Poly-phase filters – Multistage implementation –Phase shifters – Sub-band coders – Trans multiplexers– Quadrature mirror filters.

MODULE VI DSP PROCESSORS 06

General and special purpose DSP Processors – Computer Architecture for signal processing – Havard Architecture – Pipelining – Hardware Multiply and Accumulate – Special Instructions – Replication – On-chip Memory Cache – Extended Parallelism – SIMD – VLIW and static super-scalar Processing – Brief study of TMS320C4X and ADSP 2106 processors.

Total Hours: 60

REFERENCES:

1. Monson H.Hayes , “Statistical digital signal processing and modeling” – JohnWiley& Sons – 2005.
2. John G.Proakis&DimitrisG.Maolakis –“ DSP principles, algorithms & applications” – 4th edition – Pearson Education – 2007.
3. A.V.Oppenheim and R.W Schafer, Englewood, “ Digital Signal Processing”, Prentice Hall, Inc. 2006.
4. B. Venkatramani&M.Bhaskar, “Digital Signal Procesors architecture”, “Programming and applications”, Tata McGraw Hill, 2002.
5. Andreas Antoniou, “Digital signal Processing Processing”, Tata McGraw Hill,second edition, 2008.
6. Stewen W. Smith, “Digital signal Processing Processing” –“ A practical guide for Engineers and scientist”, Elsevier Science, 2003

OUTCOMES:

The students will be able to,

- Apply various transforms in digital signals & systems analysis.
- Estimate the power spectrum of signals
- Design & analyze digital filters based on signal modeling
- Design & analyze the adaptive filters
- Implement multirate signal processing techniques.
- Summarize various DSP processorarchitectures.

SEMESTER II

GEC6201 RESEARCH METHODOLOGY FOR ENGINEERS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide a perspective on research to the scholars
- To educate on the research conceptions for designing the research
- To impart knowledge on statistical techniques for hypothesis construction
- To gain knowledge on methods of data analysis and interpretation
- To learn about the effective communication of research finding

MODULE I RESEARCH `PROBLEM FORMULATION 07

Research – objectives – types, Research process, Solving engineering problems, Identification of research topic, Formulation of research problem, Literature survey and review.

MODULE II HYPOTHESIS FORMULATION 08

Research design – meaning and need – basic concepts, Different research designs, Experimental design – principle – important experimental designs, Design of experimental setup, Mathematical modeling, Simulation – validation and experimentation, Dimensional analysis and similitude.

MODULE III STATISTICAL TECHNIQUES 12

Statistics in research – concept of probability – popular distributions – Hypothesis testing- sample design- Design of experiments – factorial designs - – orthogonal arrays- ANOM - ANOVA - Multivariate analysis - Use of optimization techniques – traditional methods – evolutionary optimization techniques –Transportation model.

MODULE IV STATISTICAL ANALYSIS OF DATA 10

Research Data analysis – interpretation of results – correlation with scientific facts-Accuracy and precision – error analysis, limitations - Curve fitting, Correlation and regression.

MODULE V RESEARCH REPORT 08

Purpose of written report – audience, synopsis writing, preparing papers for International journals, Thesis writing – organization of contents – style of writing

– graphs and charts – referencing, Oral presentation and defence, Ethics in research, Patenting, Intellectual Property Rights.

Total Hours: 45

REFERENCES:

1. Ganesan R., Research Methodology for Engineers, MJP Publishers, Chennai, 2011.
2. Ernest O., Doebelin, Engineering Experimentation: planning, execution, reporting, McGraw Hill International edition, 1995.
3. George E. Dieter., Engineering Design, McGraw Hill – International edition, 2000.
4. Madhav S. Phadke, Quality Engineering using Robust Design, Printice Hall, Englewood Cliffs, New Jersey, 1989.
5. Kothari C.R., Research Methodology – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2003.
6. Kalyanmoy Deb., “Genetic Algorithms for optimization”, KanGAL report, No.2001002.
7. Holeman, J.P., Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2007.
8. Govt. of India, Intellectual Property Laws; Acts, Rules & Regulations, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2010.
9. University of New South Wales, “How to write a Ph.D. Thesis” Sydney, Australia, Science @ Unsw.
10. Shannon. R.E., System Simulation: the art and science, Printice Hall Inc, Englewood Cliffs, N.J.1995.
11. Scheffer. R.L. and James T. Mc Clave, Probability and Statistics for Engineers, PWS – Kent Publishers Co., Boston, USA, 1990.

OUTCOMES:

Students should be able to

- Formulate the research problem
- Design and Analyse the research methodology
- Construct and optimize the research hypothesis
- Analyse and interpret the data
- Report the research findings

ECC6201 OPTICAL NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the evolution of optical network and their classification.
- To impart knowledge on optical components and network.
- Toexplain optical networks architecture and standards
- Discussthe issues in design and management of optical networks.

MODULE I INTRODUCTION TO OPTICAL NETWORKS 06

Telecommunication networks, First generation optical networks, Multiplexing techniques, Second generation optical networks, Optical layer, Transmission basics,Introduction to Li-Fi, VLC, optical wireless, optical attocell, Network evolution.

MODULE II OPTICAL COMPONENTS 12

Optical Components - Couplers, Isolators & Circulators, Multiplexers & Filters Optical Amplifiers, Switches, Wavelength Converters.

Transmission System Engineering- System model, Power penalty - transmitter, receiver, Opticalamplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations.

MODULE III OPTICAL NETWORK ARCHITECTURES 09

WDM networks, SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks- Topologies for Broadcast Networks, Media Access Control Protocols, Wavelength Routing Architecture.

MODULE IV WAVELENGTH ROUTING NETWORKS 09

WDM Network Elements; WDM Network Design - Cost tradeoffs, Virtual Topology Design, Routing and wavelength assignment, Statistical Dimensioning Models.

MODULE V NETWORK MANAGEMENT AND SURVIVABILITY 09

Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface; network Survivability- Protection in SONET / SDH and IP Networks, Optical layer Protection, Interworking between layers.

Total Hours:45

REFERENCES:

1. Rajiv Ramaswamy, Kumar N. Sivaranjan and Galen H. Sasaki, "Optical Networks – A practical perspective", 3rd edition, Elsevier, 2010.
2. C.Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, PHI, 1st Edition, 2002.
3. P.E.Green, jr., "Fiber Optical Networks", Prentice Hall, New Jersy, 1993.
4. John M. Senior, “Optical Fiber Communications –Principles and Practice”, Pearson Education, 2009.
5. Biswanath Mukherjee, “Optical Communication Networks”, McGraw-Hill, 1997.

OUTCOMES:

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

- Explain the operation of various optical components applied in optical networks.
- Define the fundamental concepts of optical networks and characteristics.
- Describe the optical network protocols.
- Distinguish between physical and logical topologies of WDM optical networks.
- Analyze the need and methods of efficient routing in optical networks.
- Analyze the main functions of the optical network management

ECC6202 ADVANCED RADIATION SYSTEMS AND PRACTICE

L	T	P	C
3	0	2	4

OBJECTIVES:

- To impart knowledge of antenna fundamentals.
- To design microstrip antenna with its feed network.
- To analyze different types of antenna synthesis method
- To discuss the concepts of different aperture antenna.
- To design the suitable antenna systems using antenna simulator
- To impart knowledge of antenna measurement.

MODULE I ANTENNA FUNDAMENTALS 15

Antenna parameters, Radiation from surface and line current distributions, Fields radiated by an alternating current element and half wave dipole, monopole, loop antenna: Total power radiated and radiation resistance. Mobile phone antenna, Broadband antennas and matching techniques: BALUN transformer, polarization states, Introduction to Simulation tool for antenna design.

MODULE II MICRO STRIP ANTENNA 12

Design and implementation: Microstrip dipole, Rectangular patch, Circular patch and Ring antenna. Radiation analysis from cavity model. Input impedance, Microstrip array and feed network, Design of microstrip and meander lineantennausing simulation tool.

MODULE III ARRAY ANTENNA 12

Linear arrays, Two dimensional uniform array: Phased array, beam scanning, grating lobe, feed network, Pattern multiplication, TheDolph-Tschebyscheff Antenna Synthesis,Design Procedures for a Tschebyscheff Synthesis, Genetic Algorithm for antenna synthesis, Simulation of Array antenna, Antenna synthesis.Design of array antenna for Baseband control.

MODULE IV RADIATION FROM APERTURES 09

Duality and the Equivalence Principle, Far-field Radiation from Electric and Magnetic Surface Currents, Tapered Field Distribution in Rectangular Aperture, The H-Sectoral Horn, Universal Radiation Patterns and Directivity for the H-Sectoral and E-Sectoral Horns, Circular Apertures, Paraboloidal Reflectors, Prime Focus Parabolic Reflector and Cassegrain Reflector, Spillover

,Efficiency,Aperture Blockage, and other effects in parabolic antenna.Simulation of slot antenna.

MODULE V ANTENNA MEASUREMENTS 12

Measurementsof Gain, Power, HPBW, Impedance and antenna factor.Experimentation of antenna parameters using Microwave test bench.

Total Hours 60

REFERENCES:

1. E.C. Jordan and Balmain, "Electro Magnetic Waves and Radiating Systems", PHI, 1968, Reprint 2003.
2. Constantine A. Ballanis, "Antenna Theory", John Wiley & Sons, second edition, 2003.
3. John D.Kraus and Ronald J. Marhefka, "Antennas for all applications", 3rd Edition Tata McGraw-Hill Book Company, 2006.
4. John D.Kraus, “Radio Astronomy” McGraw-Hill 1966

OUTCOMES:

Students will able to

- Describe and analyze the various antenna parameters and different impedance matching techniques.
- Compare the merits and demerits of various microwave patch antenna structures.
- Analyze the types of antenna arrays.
- Synthesize the antenna arrays
- Distinguish the apertures antennas.
- Design, fabricate the antenna and measure the various antenna measurements.

ECC6203 RESEARCH METHODOLOGY FOR ENGINEERS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To provide a perspective on research to the scholars
- To educate on the research conceptions for designing the research
- To be trained about research, design, information retrieval, problem formulation.
- To impart knowledge on statistical techniques for hypothesis construction
- To gain knowledge on methods of data analysis and interpretation
- To learn about the effective communications of research finding and writing of research reports, papers and ethics in research.

MODULE I : RESEARCH PROBLEM FORMULATION 9

Research - objectives - types, Research process, solving engineering problems- Identification of research topic - Formulation of research problem, literature survey and review.

MODULE II : RESEARCH DESIGN 10

Research design - meaning and need - basic concepts - Different research designs, Experimental design - principle - important experimental designs, Design of experimental setup, Mathematical modeling - Simulation, validation and experimentation - Dimensional analysis - similitude.

MODULE III : USE OF STATISTICAL TOOLS IN RESEARCH 12

Importance of statistics in research - Concept of probability - Popular distributions - Sample design. Hypothesis testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.

MODULE IV: DATA COLLECTION, ANALYSIS AND INTERPRETATION OF DATA 10

Sources of Data, Use of Internet in Research, Types of Data - Research Data Processing and analysis - Interpretation of results- Correlation with scientific facts - repeatability and reproducibility of results - Accuracy and precision – limitations, Application of Computer in Research- Spreadsheet tool, Presentation tool-Basic principles of Statistical Computation.

MODULE V: OPTIMIZATION TECHNIQUES 10

Use of optimization techniques - Traditional methods – Evolutionary Optimization Techniques. Multivariate analysis Techniques, Classifications, Characteristics, Applications -correlation and regression, Curve fitting.

MODULE VI: THE RESEARCH REPORT 9

Purpose of written report - Audience - Synopsis writing - preparing papers for International Journals, Software for paper formatting like LaTeX/MS Office, Reference Management Software, Software for detection of Plagiarism –Thesis writing, - Organization of contents - style of writing- graphs and charts - Referencing, Oral presentation and defense - Ethics in research - Patenting, Intellectual Property Rights.

Total = 60 Hrs

REFERENCES

1. Ganesan R., Research Methodology for Engineers, MJP Publishers, Chennai, 2011.
2. Ernest O., Doebelin, Engineering Experimentation: planning, execution, reporting, McGraw Hill International edition, 1995.
3. George E. Dieter., Engineering Design, McGraw Hill – International edition, 2000.
4. Madhav S. Phadke, Quality Engineering using Robust Design, Printice Hall, Englewood Cliffs, New Jersey, 1989.
5. Kothari C.R., Research Methodology – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2003.
6. Kalyanmoy Deb., “Genetic Algorithms for optimization”, KanGAL report, No.2001002.
7. Holeman, J.P., Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2007.
8. Govt. of India, Intellectual Property Laws; Acts, Rules & Regulations, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2010.
9. University of New South Wales, “How to write a Ph.D. Thesis” Sydney, Australia, Science @ Unsw.
10. Shannon. R.E., System Simulation: the art and science, Printice Hall Inc, Englewood Cliffs, N.J.1995.
11. Scheffer. R.L. and James T. Mc Clave, Probability and Statistics for Engineers, PWS – Kent Publishers Co., Boston, USA, 1990.

OUTCOME :

The graduates will have the capability to :

- Formulate the research problem
- Design and Analyze the research methodology
- Apply statistical techniques for hypothesis construction
- Construct and optimize the research hypothesis
- Analyze and interpret the data
- Report the research findings

SEMESTER III

ECC7101 PROJECT WORK – PHASE I

L	T	P	C
0	0	12	6

OBJECTIVES :

- To improve the professional competency and research aptitude
- Aims to develop the work practice of students to apply theoretical and practical tools/techniques
- To solve real life problems related to industry and current research
- To improve the skills towards report/documentation preparation

GUIDELINES:

Project work can be a design project/experimental project and/or computer simulation project on any of the topics of communication systems. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential (Industry oriented Projects), they may be permitted to continue their project outside the parent institute. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4thsemester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester. The Evaluation committee consists of at least four faculty members of which internal guide and other experts in the specified area of the project shall be two essential members.

OUTCOME

At the end of the project work phase I the student will be able to

- learn the tool required for the design, analysis of their preliminary work
- Select the specific devicesfor different application alongwith justification
- Apply the practical knowledge while solving real time problems
- Incorporate cost effective and efficient project models
- Conclude the subject knowledge through proto type models

- Prepare an appropriate documentation

ECC7102 MINI PROJECT

L	T	P	C
0	0	3	1

OBJECTIVES :

- To improve the professional competency and research aptitude of students

GUIDELINES:

1. This mini project will help the students to develop the work practice to apply the design skills for solving real life problems.
2. The project can be an experimental project on any of the topics in electronics and communication.
3. The project work is allotted individually on different topics.
4. The students shall be encouraged to do their project in the parent institute itself.
5. Department will constitute an Evaluation Committee to review the project periodically.

OUTCOMES:

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

- Design and analyze an electronic system
- Fabricate an electronic system/device in their area of interest
- Improve their presentation skills
- Improve the documentation skills

SEMESTER IV

ECC7101 PROJECT WORK – PHASE II

L	T	P	C
0	0	36	18

OBJECTIVES :

- To improve the professional competency and research aptitude
- Aims to develop the work practice of students to apply theoretical and practical tools/techniques
- To solve real life problems related to industry and current research
- To improve the skills towards report/documentation preparation

GUIDELINES:

Project work can be a design project/experimental project and/or computer simulation project on any of the topics of communication systems. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential (Industry oriented Projects), they may be permitted to continue their project outside the parent institute. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4thsemester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester. The Evaluation committee consists of at least four faculty members of which internal guide and other experts in the specified area of the project shall be two essential members.

OUTCOMES:

At the end of the project work phase I the student will be able to

- learn the tool required for the design, analysis of their preliminary work
- Select the specific devicesfor different application alongwith justification
- Apply the practical knowledge while solving real time problems
- Incorporate cost effective and efficient project models
- Conclude the subject knowledge through proto type models

- Prepare an appropriate documentation

PROFESSIONAL ELECTIVES

ECCY001 DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- Describe and explain basic principles of digital image processing;
- Design and implement algorithms that perform basic image processing
- Design and implement algorithms for advanced image analysis
- Assess the performance of image processing algorithms and systems.

MODULE I DIGITAL IMAGE FUNDAMENTALS 09

Elements of digital image processing systems, Basics of visual perception,Psycho, visual model, Color image fundamentals, Brightness, contrast, hue,saturation, GB,HSI models, Image sampling & quantization.

MODULE II IMAGE TRANSFORMS 09

2D discrete transforms, DFT, DCT, WHT, KLT, DWT, Simulation of 2D transformby 1D transform.

MODULE III IMAGE ENHANCEMENT, RESTORATION, SEGMENTATION &RECOGNITION 12

Histogram modification and specification techniques, Noise distributions, Low and High Pass filters, Color image enhancement, Image degradation model – Unconstrained and constrained restoration, Geometric transformations, Spatial transformations, Gray level interpolation, Image Segmentation & its types, Pattern and Pattern classes.

MODULE IV IMAGE COMPRESSION 08

Need for image compression, Vector Quantization, Run Length Encoding, Shiftcodes, Block Truncation Coding, DCT and Wavelet Transform coding, Simulation of basic concepts.

MODULE V IMAGE PROCESSING APPLICATIONS 07

Biometric identification, Satellite image processing, Industrial machine vision application, Neural Networks in image processing, Medical image processing and Motion Analysis, Augmented\Virtual reality.

Total Hours: 45

REFERENCES:

1. Rafael C. Gonzalez, Richard E.Woods, Digital Image Processing, PearsonEducation, Inc., Second Edition, 2004
2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India,2002.
3. David Salomon: Data Compression The Complete Reference, SpringerVerlag New York Inc., 2nd Edition, 2001
4. Rafael C. Gonzalez, Richard E.Woods, Steven Eddins, Digital ImageProcessing using MATLAB, Pearson Education, Inc., 2004.
5. William K.Pratt, Digital Image Processing, John Wiley, NewYork, 2002
6. G.W.Awcock&R.Thomas,Applied Image Processing,McGraw-Hill Inc,1996
7. Sonka,Hlavac,Boyle,Digital Image Processing and Computer Vision ,Cengage Learning,India Edition,2008
8. MadhuriA.Joshi, Digital Image Processing-An Algorithmic approach,Prentice Hall of India,2008

OUTCOMES:

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

- Acquire the knowledge of fundamental concepts of a digital image processingsystem
- Analyze 2D signals in the frequency domain through the various transforms.
- Describe various techniques for image enhancement and restoration.
- Recognize and apply suitable image segmentation techniques
- Identify and use of appropriate image compression techniques.
- Implement concepts of image processing using simulation technique.
- Apply suitable image processing techniques for various applications

ECCY002 ADVANCED MICROWAVE SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To describe the basic principles and advanced applications of Microwave Engineering.
- To introduce the concept of transmission lines and waveguides.
- To illustrate the concepts of microwave network analysis and impedance matching.
- To learn about various types of resonators.
- To describe the procedures to design different amplifiers, oscillators, filters and mixers.

MODULE I ELECTROMAGNETIC AND TRANSMISSION LINES THEORY 07

Introduction to microwave Engineering, Maxewell's Equations, Fields in media and boundary conditions, wave equations and basic plane wave solutions. Lumped element circuit model for a transmission line, field analysis of a transmission lines, terminated lossless transmission lines, smith chart, quarter wave transformers, generator and load mismatches, lossy transmission lines.

MODULE II TRANSMISSION LINES AND WAVEGUIDES 07

General solutions for TEM, TE and TM waves, Parallel plate, rectangular, circular waveguide, Coax line, surface waves on a grounded dielectric shield, strip line, microstrip line.

MODULE III MICROWAVE NETWORK ANALYSIS, IMPEDANCE MATCHINGAND TUNING 08

Impedance and equivalent voltages and currents, impedance and admittance matrices, scattering matrices, ABCD matrix, Signal flow graphs, discontinuities and modal analysis, excitation of waveguides-electric and magnetic currents, aperture coupling. Matching with lumped elements, single stub, double stub tuning, quarter wave transformer.

MODULE IV MICROWAVE RESONATORS 08

Series and parallel resonance circuits, transmission line resonators, rectangular waveguide cavity resonator, circular waveguide cavity resonator, dielectric resonator, excitation of resonator, cavity perturbation.

MODULE V MICROWAVE FILTERS 08

Periodic structures, filter design by: Image parameter method, insertion loss method, filter transformation, filter implementation, LPF, coupled line filters, filters using coupled resonators

MODULE VI MICROWAVE AMPLIFIER, OSCILLATOR AND MIXER DESIGN 07

Two port power gains, stability, single stage transistor amplifier design, broadband transistor amplifier design, power amplifier, RF oscillators, Microwave Oscillator, oscillator phase noise, frequency multipliers, mixers.

Total Hours: 45

REFERENCES:

1. R.E.Collin, “Foundations of Microwave Engineering”, McGraw-Hill, 1992.
2. Ramo, Whinnery and Van Duzer, “Fields and Waves in Communication Electronics”, 3rd Edition, Wiley, 1997
3. David .M Pozar “Microwave and RF System Design” Wiley 2001 Edition.
4. Wayne Tomasi, “Advanced Microwave Communication Systems” PHI 2002, 2nd Edition.

OUTCOMES:

On completion of this course the student will be able to

- Understand the underlying principles of microwave theory.
- Understand the concept and derive different characteristics of various transmission lines waveguides.
- Describe various parameters of microwave networks.
- Analyze and design microwave filters and resonators.
- Understand the concept of amplifier stability, gain and noise figure and also able to Design microwave small signal and power amplifiers.
- Design microwave oscillators and mixer

ECCY003 COGNITIVE AND CO-OPERATIVE RADIO COMMUNICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- • To acquire knowledge on cooperative communications
- • To learn cooperation protocols and networking
- • To acquire knowledge on broadband cooperative communications
- • To understand cognitive radio networks

MODULE I COOPERATIVE COMMUNICATIONS 09

Cooperation protocols- Hierarchical cooperation; Cooperative communications with single Relay – System model, DF Protocol, AF protocol; Multi-node cooperative communications – system model and protocol description; Distributed space–time coding (DSTC) – Distributed space–frequency coding (DSFC); Relay selection- protocol, criterion.

MODULE II DIFFERENTIAL MODULATION AND COOPERATIVE NETWORKING 09

Differential modulations for DF cooperative communications – Differential modulation for AF cooperative communications; Cognitive multiple access via cooperation – System model, CCMA protocol; Content-aware cooperative multiple access – system model, protocol; Distributed cooperative routing – network model and transmission models, cooperation based routing algorithm; Source–channel coding with cooperation- joint source channel coding bit rate allocation, joint source channel coding with user cooperation, source channel cooperation tradeoff problem.

MODULE III BROADBAND COOPERATIVE COMMUNICATIONS 09

System model - Cooperative protocol and relay assignment scheme – Network lifetime maximization - system model, via cooperation - System model – Lifetime maximization by employing a cooperative node - Deploying relays to improve device lifetime.

MODULE IV COGNITIVE RADIOS AND NETWORKS 09

Cognitive Radios and Dynamic Spectrum Access - Fundamental Limits of Cognitive Radios -Mathematical Models Toward Networking Cognitive Radios; Network Coding for Cognitive Radio Relay Networks - Cognitive Radio Networks Architecture; Overview of Spectrum Sensing concept.

Total Hours: 45

REFERENCES:

1. K.J. Rayliu, A.K. Sadek, Weifeng Su & Andres Kwasinski, “Cooperative Communications and Networking”, Cambridge University Press, 2009.
2. Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley & Sons, 2009.

OUTCOMES:

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

- List various protocols used in co-operative communications.
- Describe the network and transmission models of cooperative communications.
- Demonstrate the channel coding techniques for cooperative communications.
- Explain the concepts of broadband cooperative communications.
- Identify the applications of cooperative communications.
- Apply the concepts of cognitive radio and spectrum sensing for their research.

ECCY004 DIGITAL COMMUNICATION RECEIVERS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To analyze liner and non-linear modulation techniques
- Toexplain optimum receivers and functions
- To describe the fading channel characterization and diversity techniques
- To discuss the receiver synchronization concepts
- To explain adaptive Equalization concepts and algorithms

MODULE I REVIEW OF DIGITAL COMMUNICATION TECHNIQUES 09

Base band and band pass communication, signal space representation, linear and non- linear modulation techniques, and spectral characteristics of digital modulation.

MODULE II OPTIMUM RECEIVERS FOR AWGN CHANNEL 09

Correlation demodulator, matched filter, maximum likelihood sequence detector, Optimum receiver for CPM signals, M-ary orthogonal signals, envelope detectors for M-ary and correlated binary signals.

MODULE III RECEIVERS FOR FADING CHANNELS 09

Characterization of fading multiple channels, statistical models, slow fading, frequency selective fading, diversity technique, RAKE demodulator, coded waveform for fading channel.

MODULE IV SYNCHRONIZATION TECHNIQUES 09

Carrier and symbol synchronization, carrier phase estimation, PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation.

MODULE V ADAPTIVE EQUALIZATION 9

Zero forcing algorithm, LMS algorithm, Adaptive decision feedback equalizer, and equalization of Trellis-coded signals, Kalman algorithm, blind equalizers, and stochastic gradient algorithm.

Total Hours : 45

REFERENCES:

1. Heinrich Meyr, Mare Moeneclacy and Stefan.A. Fechtel, “Digital Communication Receivers”, Vol I & II, John Wiley, New York, 1997
2. John. G. Proakis, “Digital Communication”, 4th ed., McGraw Hill, New York, 2001
3. E.A. Lee and D.G. Messerschmitt, “Digital Communication”, 2nd edition, Allied Publishers, New Delhi, 1994
4. Simon Marvin, “Digital Communication Over Fading channel; An unified approach to performance Analysis”, John Wiley, New York, 2000
5. Bernard Sklar, “Digital Communication Fundamentals and Applications, Prentice Hall,1998

OUTCOMES:

On completion of this course, the students will be able to:

- Describe the various Digital communication techniques.
- Distinguish the performance of receivers for various channels.
- Construct optimum receivers for communication over AWGN channel and
- fading channels
- Analyze the various synchronization and estimation techniques for receivers.
- Categorize the equalization algorithms based on applications.
- Design a proper receiver for given application.

ECCY005 ELECTROMAGNETIC INTERFERENCE ANDCOMPATIBILITY SYSTEM DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know about EMI environment
- To introduce the concepts of electromagnetic interference coupling principles.
- To learn electromagnetic interference measurements and standards
- To learn about the techniques to control electromagnetic interferences
- To explain electromagnetic compatibility design of PCBS

MODULE I EMI ENVIRONMENT 07

EMI/EMC concepts and definitions, Sources of EMI, conducted and radiated EMI, Transient EMI, Time domain Vs Frequency domain EMI, Units of measurement parameters, Emission and immunity concepts, ESD.

MODULE II EMI COUPLING PRINCIPLES 08

Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near Field Cable to Cable Coupling, Power Mains and Power Supply coupling.

MODULE III EMI/EMC STANDARDS AND MEASUREMENTS 10

Civilian standards, FCC, CISPR, IEC, EN, Military standards : MIL STD 461D/ 462, EMI Test Instruments /Systems, EMI Shielded Chamber, Open Area Test Site, TEM Cell - Sensors/Injectors/Couplers, Test beds for ESD and EFT, Military Test Method

MODULE IV EMI CONTROL TECHNIQUES 10

Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

MODULE V EMC DESIGN OF PCBs 10

PCB Traces, Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models.

Total Hours: 45

REFERENCES:

1. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, NewYork. 1988.
2. C.R.Paul, “Introduction to Electromagnetic Compatibility”, John Wiley and Sons, Inc, 1992
3. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 1996.
4. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, 3rd Ed, 1986.
5. R.Paul, “Introduction to EMC” Wiley 2006 2nd edition.

OUTCOMES:

On completion of this course the student will be able to:

- Describe the EMI Coupling Principles.
- Identify and describe the EMI Specifications.
- Identify the Standards and Limits.
- Understand the test methods and usage of test beds
- Describe the EMI Measurements and Control Techniques.
- Design EMC based PCBs.

ECCY006 ERROR CONTROL CODING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce modern coding techniques and coding Algebra.
- To study the behavior of codes in AWGN channel.
- To introduce the recent advancements in codes
- To develop a new code based on an application

MODULE I CODING AND ALGEBRA 09

Linear Block Codes: Generator and parity-check matrices, Minimum Distance, Sydrome decoding, Bounds on minimum distance. Cyclic Codes: Algebra-Finite fields- Groups, Fermat's Little theorem, Finite fields, Polynomials over fields, Polynomial Division. Polynomial factorization over a field, Irreducible polynomials, Existence and construction of fields of a given size.Examples of finite field construction, Binary BCH codes, RS codes.

MODULE II CODING IN AWGN CHANNELS 09

AWGN channel: Coding gain, Encoding and decoding in AWGN channels. BPSK modulation, Capacity, Coding gain, ML and MAP decoding for Repetition codes, Probability of decoding error, Channel Capacity, Capacity for various schemes, Eb/No, Coding Gain. Soft-versus hard-decision decoding .Convolutional Codes: Encoders, Trellis, Viterbi decoding, Recursive convolutional encoders.

MODULE III MODERN ITERATIVE CODING 09

Turbo codes: Encoders, interleavers, Puncturing. turbodecoder.Low-density Parity-check Codes (LDPC): Ensembles of LDPC codes, Gallager decoding algorithm for LDPC codes, LDPC Threshold. Message-passing decoders, and density evolution for AWGN channels.

MODULE IV RECENT DEVELOPMENTS IN TURBO CODES 09

Various interleavers, Nonsystematic Turbo codes, Turbo codes in 3G, Effect of Fast Correlation, Low complexity turbo decoder design, turbo codes and ARQ scheme, 3D Turbo codes

MODULE V ERROR CONTROL CODING – APPLICATIONS 09

Wireless Sensor Networks(WSN), low power WSN using ECC, Energy efficient

WSN using ECC , Embedded WSN, ZIGBEE, WSN key Management. Embedded Systems, Impact on Embedded system design

Total Hours :45

REFERENCES:

1. Shu Lin and Daniel Costello, “Error Control Coding”, Pearson, II edition, 2004.
2. RudigerUrbanke and Thomas Richardson “Modern coding theory”, Cambridge 2008.
3. F. J. MacWilliams and N. J. A. Sloane, “The theory of error-correcting codes”, North-Holland publishers, 1983.
4. Richard Blahut “Algebraic codes for data transmission” Cambridge, 2003.
5. Thierry Lestable, Moshe Ran, “Error Control Coding for B3G/4G Wireless Systems”, John Wiley & Sons ltd, 2011.
6. DhouhaKbaier Ben Ismail, Catherine Douillard and Sylvie Kerouédan, “A survey of three-dimensional turbo codes and recent performance enhancements” Journal on Wireless Communications and Networking 2013, Vol. 2013:115.
7. Kbaier Ben Ismail, C. Douillard and S. Kerouédan “Analysis of 3-Dimensional Turbo Codes”, annals of telecommunications 2011,Vol. 67, Issue 5-6 ,pp 257-268.

OUTCOMES:

On completion of this course, the students will be able to:

- Describe the modern coding techniques and basics of coding algebra.
- Explain the behavior of modern codes in AWGN Channel
- Employ the concept of convolutional codes in constructing a turbo coder.
- Analyze the performance of Turbo codes and LDPC.
- Develop a new design of channel coding.
- Recommend a channel coder based on the application.

ECCY007 GLOBAL TRACKING AND POSITIONING SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know about history of GPS and various existing GPS Systems
- To learn about US based GPS System Segments
- To learn about various functionalities and techniques used in GPS
- To know about hindrances caused for GPS
- To acquire knowledge about various applications of GPS in various fields
- To learn about other constellations and augmentation systems

MODULE I INTRODUCTION TO TRACKING AND GPS SYSTEM 09

Basic concepts of GPS. Space segment, Control segment, user segment, History of GPS constellation, GPS measurement characteristics, selective availability(AS), ant spoofing (AS), GPS aided Geo-augmented navigation (GAGAN) architecture. Applications of Satellite and GPS for 3D position, Velocity, determination as function of time, Interdisciplinary application (eg,.Crystal dynamics, gravity field mapping, reference frame, atmospheric occultation)

MODULE II ORBITS AND REFERENCE SYSTEMS 09

Basics of satellite orbits and reference systems-Two-body problem, orbit elements, time system and time transfer using GPS, coordinate systems, GPS Orbit design, orbit determination problem, tracking networks, GPS force and measurement models for orbit determination, orbit broadcast ephemeris, precise GPS ephemeris, Tracking problems

MODULE III GPS MEASUREMENTS 09

GPS Observable-Measurement types (C/A Code, P-code, L1 and L2 frequencies for navigation, pseudo ranges), atmospheric delays(tropospheric and ionospheric), data format (RINEX), data combination (narrow/wide lane combinations, ionosphere-free combinations single, double, triple differences), undifferenced models, carrier phase Vs Integrated Doppler, integer biases, cycle slips, clock error.

MODULE IV PROCESSING TECHNIQUES 09

Pseudo range and carrier phase processing, ambiguity removal, Least square methods for state parameter determination, relation positioning, dilution of precision.

MODULE V OTHER CONSTELLATIONS AND AUGMENTATION SYSTEMS 09

Other satellite navigation constellations GLONASS and Galileo IRNS System.Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, GAGAN, EGNOS and MSAS.Local area augmentation system (LAAS) concept.

Total Hours: 45

REFERENCES:

1. B.HoffmanWellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice", 5th edition, Springer Wein, New york,2001
2. A.Leick, "GPS Satellites Surveying", 3rd edition, John Wiley & Sons, NewYork, 2003
3. A.Kleusberg and P.Teunisen(Eds), “GPS for Geodesy”, Springer-Verlag, Berlin,1996
4. G.S.Rao,”Global Navigation Satellite Systems”, McGraw-Hill Publications, New Delhi, 2010
5. Ahmed El-Rabbany, “Introduction to GPS,” Artech House, Boston, 2002.

OUTCOMES:

On completion of this course the student will be able to

- Understand the fundamental theory and concept of GPS
- Explain the satellite orbits and other navigational systems
- Explain various functionalities and techniques used in GPS
- Explain how a GPS receiver computes position and time from GPS signals.
- Describe the major error sources for GPS positioning projects.
- Analyze and compare different navigation systems

ECCY008 HIGH PERFORMANCE COMMUNICATION NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explore various high speed network architectures and protocols
- To discuss various advanced network architecture
- To explain the fundamentals and protocol architecture of WiMax and LTE networks
- To learn about Traffic management for congestion control in networks

MODULE I PACKET SWITCHED NETWORKS 09

OSI and IP models, Ethernet (IEEE 802.3), Token ring (IEEE 802.5), Wireless LAN (IEEE 802.11) FDDI, DQDB, SMDS: Internetworking with SMDS

MODULE II ISDN AND BROADBAND ISDN` 09

ISDN, Overview, Interfaces and functions, Layers and services, Signaling System 7, Broadband ISDN architecture and Protocols.

MODULE III ATM AND FRAME RELAY 09

ATM: Main features-Addressing, Signaling and Routing, ATM header structure-Adaptation layer, management and control, ATM switching and transmission.
Frame Relay: Protocols and services, Congestion control, Internetworking with ATM, Internet and ATM, Frame relay via ATM.

MODULE IV ADVANCED NETWORK ARCHITECTURE 09

IP forwarding architectures overlay model, Multi Protocol Label Switching, Integrated services in the Internet, Resource Reservation Protocol, Differentiated services

MODULE V HIGH PERFORMANCE NETWORKS 09

WiMAX overview –WiMAX Physical Layer – MAC layer overview – Advanced Features for Performance Enhancement – LTE – Technologies for LTE – Network Architecture – Protocol Architecture

Total Hours: 45

REFERENCES:

1. William Stallings, “ISDN and Broadband ISDN with Frame Relay and ATM”, 4th edition, Pearson education Asia, 2002.
2. Leon Gracia, Widjaja, “Communication networks”, Tata McGraw-Hill, New Delhi, 2000.
3. SumitKasera, PankajSethi, “ATM Networks”, Tata McGraw-Hill, New Delhi, 2000.
4. Jean Walrand and PravinVaraiya, “High Performance Communication Networks”, 2nd edition, Harcourt and Morgan Kauffman, London, 2000.
5. William Stallings, “High-speed Networks and Internets”, 2nd edition, Pearson education Asia, 2003.
6. Jeffrey G. Andrews, ArunabhaGhosh and RiasMuhamed, “Fundamentals of WiMAX Understanding Broadband Wireless Networking”, Prentice Hall of India, 2008.
7. StefaniaSesia, IssamToufik, Matthew Baker, “LTE – The UMTS Long Term Evolution”, Wiley, 2011.

OUTCOMES:

At the end of the course student will be able to

- Describe the fundamental concepts of packet switched networks.
- Distinguish various high speed network architectures and protocols
- Compare various advanced network architecture
- Describe the technologies used in wiMax and LTE
- Analyze the resource management techniques in advanced network architecture
- Asses various protocol architecture and services.

ECCY009 INTERNET OF THINGS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce emerging technological options and platforms
- To explain the architecture of IoT
- To explore application development for mobile Platforms
- To Provide the appropriate IoT solutions and recommendations according to the applications used.

MODULE I THE IoT NETWORKING CORE 10

History of IoT, Review of Technologies involved in IoT Development, Internet/Web and Networking Basics -OSI Model, Data transfer referred with OSI Model, IP Addressing, Point to Point Data transfer, Point to Multi Point Data transfer & Network Topologies, Sub-netting, Network Topologies referred with Web, Introduction to Web Servers, Introduction to Cloud Computing. Basics of Big Data, Data Science.

MODULE II IoT ARCHITECTURE AND APPLICATIONS 09

Architecture: M2M – Machine to Machine, Web of Things, IoT protocol, Introduction to wireless and mobile networks, ZigBee, BLE mesh, WiFi, MQTT, LoRa-Machine Applications: Remote Monitoring & Sensing, Remote Controlling, Performance Analysis

MODULE III IoT PLATFORM OVERVIEW 09

Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards. Network Fundamentals: Overview and working principle of Wired Networking equipment's – Router, Switches, Overview and working principle of Wireless Networking equipment's – Access Points, Hubs etc. Linux Network configuration Concepts: Networking configurations in Linux Accessing Hardware & Device Files interactions.

MODULE IV IoT APPLICATION DEVELOPMENT 09

Application Protocols-MQTT, REST/HTTP, CoAP, MySQL -Back-end Application -Design Apache for handling HTTP Requests, PHP & MySQL for data processing, MongoDB Object type Database, HTML, CSS &jQuery for UI Designing, JSON lib for data processing, Security & Privacy during development, Application Development for mobile Platforms: Overview of Android / IOS 10 25 47 /97 App Development tools

MODULE V CASE STUDY & ADVANCED IOT APPLICATIONS 08

IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards

L:45, T:15, Total Hours: 60

REFERENCES

1. Jean-Philippe Vasseur, Adam Dunkels, " Interconnecting Smart Objects with IP: The Next Internet," Morgan Kuffmann-2010
2. Vijay Madisetti," Internet of Things (A Hands-on-Approach), "Arshdeep Bahga-2014
3. Adrian McEwen (Author), "Designing the Internet of Things , "Hakim Cassimally-2013
4. Dr. Peter Friess, Dr. OvidiuVermesan," Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems," River Publishers -2013
5. Barrie Sosinsky ,"Cloud Computing Bible," Wiley-India, 2010 10. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010
6. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
7. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009

OUTCOMES:

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

- Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art Internet of things
- Identify the architecture and infrastructure of IoT.
- Explain the core issues of IoT such as security, privacy, and interoperability
- Choose the appropriate technologies, algorithms, and approaches for the related issues.
- Identify problems, and explain, analyze, and evaluate various IoT solutions

- Attempt to generate new ideas and innovations in IoT.

ECCY010 INTERNET WORKING MULTIMEDIA

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain Internet service models.
- To describe multimedia broadband networks.
- To describe different coding and compression techniques.
- To discuss multimedia standards.

MODULE I MULTIMEDIA NETWORKING 09

Digital sound, video and graphics, basic multimedia networking, multimedia characteristics, evolution of Internet services model, network requirements for audio/ video transform, multimedia coding and compression for text, image, audio and video.

MODULE II BROADBAND NETWORK TECHNOLOGY 09

Broadband services, ATM and IP, IPV6, High speed switching, resource reservation, Buffe management, traffic shaping, caching, scheduling, and policing, throughput, delay and jitter performance. Storage and media services, voice and video over IP, MPEG-2 over ATM/IP, indexing synchronization of requests, recording and remote control.

MODULE III RELIABLE TRANSPORT PROTOCOL AND APPLICATIONS 09

Multicast over shared media network, multicast routing and addressing, scaling multicast and NBMA networks, Reliable transport protocols, TCP adaptation algorithm, RTP, RTCP. MIME, Peer- to-Peer computing, shared application, video conferencing, centralized and distributed conference control, distributed virtual reality, light weight session philosophy.

MODULE IV MULTIMEDIA COMMUNICATION STANDARDS 09

Objective of MPEG- 7 standard, Functionalities and systems of MPEG-7, MPEG-21 MultimediaFramework Architecture - Content representation, Content Management and usage, Intellectualproperty management, Audio visual system- H322: Guaranteed QOS LAN systems; MPEG - 4 video Transport across internet.

MODULE V MULTIMEDIA COMMUNICATION ACROSS NETWORKS 09

Packet Audio/video in the network environment, video transport across Generic network Layered video coding, error Resilient video coding techniques, Scalable Rate Control, Streaming video across Internet, Multimedia transport across ATM networks and IP network, Multimedia across wireless networks.

Total Hours: 45

REFERENCES:

1. Jon Crowcroft, Mark Handley, Ian Wakeman, “Internetworking Multimedia”, Harcourt Asia Pvt. Ltd. Singapore, 1998.
2. B.O. Szuprowicz, “Multimedia Networking”, McGraw Hill, Newyork. 1995.
3. Tay Vaughan, “Multimedia - Making it to work”, 4th edition, Tata McGraw Hill, NewDelhi, 2000.
4. K.R.Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, “Multimedia Communication systems”, PHI 2003.

OUTCOMES:

On completion of this course the student will be

- Describe the evolution of Internet service models.
- Analyze Multimedia broadband networks.
- Design Multimedia broadband networks.
- Differentiate various multimedia communication standards
- Apply different coding and compression techniques
- Analyze Multimedia communication across networks

ECCY011 MEDICAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain fundamental concepts of digital image processing
- Design and implement algorithms that perform basic image pre-processing
- To interpret medical images through various multimodal imaging sources
- To describe idea on image representation,analysis, classification, reconstruction, registration and visualization of medical images.

MODULE I IMAGE FUNDAMENTALS 09

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – 2D-DFT and other transforms.

MODULE II IMAGE PREPROCESSING 09

Image enhancement, point operation, Histogram modeling, spatial operations, Transform operations, Image restoration, Image degradation model, Inverse and Weiner filtering. Image Compression, Spatial and Transform methods.

MODULE III MEDICAL IMAGE RECONSTRUCTION 09

Mathematical preliminaries and basic reconstruction methods, Imagereconstruction in CT scanners, MRI, functional MRI, Ultra sound imaging, 3DUltra sound imaging Nuclear Medicine Imaging Modalities-SPECT, PET,Molecular Imaging.

MODULE IV IMAGE ANALYSIS AND CLASSIFICATION 09

Image segmentation: pixel based, edge based, region based, segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification: Statistical, Rulebased, Neural Network approaches.

MODULE V IMAGE REGISTRATIONS AND VISUALIZATION 09

Rigid body visualization: Principal axis registration, Interactive principal axisregistration, Feature based registration, Elastic deformation based registration,Image visualization: 2D display methods, 3D display methods, virtual realitybased interactive visualization.

Total Hours: 45

REFERENCES:

1. AtamP.Dhawan, “Medical Image Analysis”, Wiley InterscicencePublication,NJ, USA 2003.
2. R.C.Gonzalez and R.E.Woods, “Digital Image Processing”, Second Edition,Pearson Education, 2002.
3. Anil. K. Jain, “Fundamentals of Digital Image Processing”, Pearson education,Indian Reprint 2003.
4. Alfred Horowitz, “MRI Physics for Radiologists – A Visual Approach”, Secondedition Springer Verlag Network, 1991.
5. KavyanNajarian and Robert Splerstor, “Biomedical signals and Imageprocessing”, CRC, Taylor and Francis, New York, 2006.
6. John L.Semmlow, “Biosignal and Biomedical Image Processing MatlabBasedapplications”, Marcel Dekker Inc., New York, 2004.
7. Jerry L. Prince and Jonathan M.Links, “Medical Imaging Signals and Systems”, Pearson Education Inc. 2006.

OUTCOMES:

On completion of the course the student will be able to

- Explain the fundamental concepts of digital image processing
- Recognize & apply suitable image enhancement,compression and restoration techniques.
- Compare various imaging sources(i.e.,MRI,CT,SPECTetc)
- Solve Mathematical Preliminaries for image Reconstruction
- Describe various techniques for image analysis and classification
- Use appropriate image registration technique for various applications

ECCY012 MICROSTRIP ANTENNAS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To distinguish the properties and parameters of antenna such as radiation pattern, intensity, directivity, radiation pattern.
- To describe the response characterization of microstrip transmission lines, losses and substrate materials.
- To illustrate the basic concept of radiation mechanism and feeding techniques of microstrip patch antennas.
- To analyse and design of rectangular and circular microstrip antennas.

MODULE I BASIC ANTENNA CONCEPTS 09

Introduction- Definitions- Basic antenna Parameters - Radiation Intensity- Directivity- Directivity and Gain.Friis Transmission Formula- Duality of Antennas- Sources of Radiation.Antenna characteristics: Radiation pattern, Beam solid angle, Input impedance, Polarization, Bandwidth.

MODULE IIMICROSTRIP TRANSMISSION LINES 09

Introduction - Microstrip Capacitance Evaluation - Characteristic Impedance - The Microstrip Line in free Space - Effective Relative Permittivity - Practical Microstrip Lines - Losses, Shielding, Substratematerials, Dispersion - Modes of Propagation.

MODULE IIIINTRODUCTION TO MICROSTRIP ANTENNA 09

Introduction – Definition - advantages, disadvantages of microstrip antenna - Radiation mechanism and radiated fields – Various configurations – Feeding techniques – Applicatios.

MODULE IV RECTANGULAR MICROSTRIP ANTENNAS 09

Models – Transmission Line Model Analysis – Design Considerations – Substrate Selection – Element width & Length – Radiation patterns and Radiation Resistance – losses & Q Factor – Bandwidth – Radiation efficiency– Polarisation- Antenna Ranges-Radiation Patterns

MODULE V CIRCULAR MICROSTRIP ANTENNAS 09

Analysis methods, Cavity model with feed, Model expansion model, Procedure to determine radius, Input impedance, Radiation pattern, Band width, Directivity,

Gain, Radiation resistance, Applications, Gain Measurements, Absolute Gain Measurement, Gain Transfer (Gain-Comparison).

Total Hours: 45

REFERENCES:

1. Constantine A. Balanis, “Antenna Theory Analysis and Design”, John Wiley, 2nd Edition, 2007.
2. E.C.Jordan and Balmain, “Electromagnetic waves and Radiating Systems”, Pearson Education / PHI, 2006.
3. S.W Lee, Y.T. Lo, “Antenna Handbook”, Morgan Kaufmann Publishers, Van Nostrand Reinhold, 1994.
4. John D.Kraus, Ronald J Marhefka and Ahmad S Khan, “Antennas for all Applications”, Tata McGraw-Hill Book Company, 3rded, 2007.
5. I.J. Bahl and P. Bhartia,” Microstrip Antennas”, Artech House, Inc.,1980

OUTCOMES:

On completion of this course the student will

- Describe the basic concepts of antenna properties and parameters.
- Analyze the radiation mechanism using transmission line.
- Design microstrip patch antenna with feed line technique.
- Analyze and design of various rectangular& circular microstrip antennas.
- Measure microstrip antenna parameters
- Estimate its performance measure

ECCY013 MICROWAVE INTEGRATED CIRCUITS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the different technologies of microwave integrated circuits.
- To design and analyze micro strip lines.
- To describe and analyze coupled microstrip
- To learn about active and passive microwave devices.

MODULE I TECHNOLOGY OF MICs **08**

MIC Technology – Thick film and Thin film technology, Hybrid MIC's - Monolithic MIC technology, Characteristics of Materials in MIC.

MODULE II ANALYSIS OF MICROSTRIP LINES **09**

Characteristics of planar transmission lines: strip line, micro strip, suspended and inverted micro strip lines, slot line and coplanar lines. Comparison of various MIC transmission media, coupled line and discontinuities.

MODULE III ANALYSIS OF COUPLED MICROSTRIP **10**

Basic properties of dividers and couplers: T junction power dividers, even and odd mode analysis, waveguide directional couplers, Bethe hole coupler, design of multihole couplers, quadrature hybrid, design of coupled line directional couplers and 180 degree hybrid.

MODULE IV PASSIVE DEVICES **09**

Design of lumped elements: inductors, capacitors and resistors. Ferromagnetic substrate for non-reciprocal devices: microstrip and latching circulators, Isolators and phase shifters, dielectric resonators, Introduction to RF MEMS.

MODULE V ACTIVE DEVICES **09**

BJT, HBT, GaAs FET, HEMT, gunn diode, varactor diodes, PIN diodes & their application in oscillator, mixer and amplifiers.

Total Hours: 45

REFERENCES:

1. I.J.Bhal and P.Bhartia, "Microwave solid state circuit design", John Wiley & sons, 2003.

2. David M.Pozar, “Microwave Engineering”, John Wiley & sons, 4th Edition, 2011.
3. Mike Golio, Janet Golio, “The RF and Microwave Handbook”, CRC Press, 2008.
4. MIIC Design: GaAs FETs and HEMTs- Peter Ladbrooke ,Artech House, 1989.
5. Hoffman, R.K- “Handbook of Microwave Integrated Circuits”- Artech House, 1987
6. S.Y.Liao, “Microwave Circuit Analysis and Amplifier Design”, Prentice Hall, 1987.
7. Gupta.K.C and Amarjit Singh, “Microwave Integrated Circuits”- John Wiley & sons-Wiley Eastern Reprint, 1978.

OUTCOMES:

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

- Understand the concepts of different technologies of MICs
- Design and analyze different types of micro strip line.
- Design and analyze coupled micro strip line.
- Design passive devices
- Design active devices
- Identify the microwave device for specific applications

ECCY014 MIMO SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce MIMO wireless communications
- To describe MIMO Architecture and physical modeling of MIMO channels
- To analyze MIMO channel capacity and information rates
- To Discuss Space time coding techniques
- To explain about MIMO receiver design

MODULE I INTRODUCTION TO MIMO SYSTEMS AND CHANNELS 09

Need for MIMO systems, MIMO wireless communications, MIMO channel and signal model, MIMO transceiver design.

MODULE II SPATIAL MULTIPLEXING AND CHANNEL MODELING 09

Multiplexing capability : Capacity via singular value decomposition – Physical modeling of MIMO channels: LOS - SIMO and MISO model, MIMO multipath channel model, degrees of freedom and diversity.

MODULE III CAPACITY AND INFORMATION RATES OF MIMO CHANNELS 09

Capacity of MIMO Channels, MIMO frequency selective channels, Single user MIMO, Multiuser MIMO

MODULE IV SPACE TIME CODING AND MIMO – OFDM 09

Space time coding principles,Alamouti scheme, optimal receiver for Alamouti and multiple receiver antennas, orthogonal STBC, Interpretation of MIMO FS channel,MIMO-OFDM,Space-Frequency coding.

MODULE V MULTI USER MIMO RECEIVER DESIGN 09

MIMO receivers for uncoded signals and coded signals, Multiple access MIMO systems, Multiuser detection in space time coded systems

Total Hours: 45

REFERENCES :

1. Andrea Goldsmith, “MIMO Wireless communications”, Cambrige university Press, 2005

2. Tolga M. Duman and Ali Ghrayeb, “Coding for MIMO communication systems”, John Wiley & sons, 2007
3. Davi Se, PramodViswanath, “Fundamentals of wireless communications”, Cambridge University press,2005
4. Theodore S.Rappaport, “Wireless communications: Principles and practice, Pearson Education”, 2002

OUTCOMES:

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

- Explain MMO wireless communications need and advantages
- Discuss MIMO channels and characteristics
- Assess Channel capacity and information rates
- Explain MIMO coding techniques
- Justify and design multiuser MIMO receivers
- Estimate capacity and information rates of MIMO channels

ECCY015 MULTIMEDIA COMPRESSION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To discuss the different categories of multimedia data and the need for their compression.
- To learn the various techniques for multimedia data compression.

MODULE I INTRODUCTION 09

Basics of multimedia data types - Text, audio, image & video – Digital representation of multimedia data -Storage memory requirements for multimedia data –Meaning of data compression –Need for data compression – Lossy compression-Lossless compression-Data compression by source coding and line coding- Mid-tread and Mid-rise quantization-Quantization Error- Scalar and vector quantization –Evaluation of Compression Factor, RMSE &PSNR values.

MODULE II TEXT COMPRESSION 09

Need for lossless compression of text data –Source codes for text compression-Uniquely decodable codes - Kraft-McMillaninequivality- Code trees- Shannon-Fano code - Huffman code – Adaptive Huffman Code – Arithmetic code – Dictionary- based LZW code.

MODULE III AUDIO COMPRESSION 09

Lossy and lossless compression of audio data - μ-law and A-law compression-Differential coder –Jayantquantizer- Differential linear predictive coder- Adaptive differential linear predictive coder-Frequency domain filtering – Sub-band coder – MPEG perceptual audio coder.

MODULE IV IMAGE COMPRESSION 12

Lossless compression of image data – Differential coder - Differential linear predictive coder- Optimal Predictors- Optimal Quantizers – Context based compression – Lossy compression of image data- DCT based compression - Sub-band coding for image compression- Zigzag scanning of transform coefficients - JPEG- JPEG 2000 – JBIG -JBIG 2- Haar wavelet based compression- EZW & SPIHT coders -Fractal compression.

MODULE V VIDEO COMPRESSION 06

Video compression techniques and standards – MPEG Video Coding – Motion estimation and compensation techniques – H.261 Standard – DVI technology.

Total Hours : 45

REFERENCES:

1. Khalid Sayood: “Introduction to Data Compression”, Morgan Kauffman Harcourt, 4th Edition, 2012.
2. David Salomon: “Data Compression - The Complete Reference”, Springer Verlag New York Inc., 3rd Edition,2004.
3. FredHalsall:“Multimedia communications - Applications, Networks, Protocols& Standards”, Pearson Education, 2001.

OUTCOMES:

On completion of this course the graduates will be able to:

- Distinguish and describe the basic of multimedia compression techniques.
- Describe various compression techniques and apply them for text compression.
- Describe various compression techniques and apply them for audio compression.
- Describe various compression techniques and apply them for image compression.
- Describe various compression techniques and apply them for video compression.
- Estimate the compression factor, RMSE & PSNR parameters.

ECCY016 NETWORK SECURITY

L	T	P	C
3	0	0	3

OBJECTIVES:

The student will be able to,

- Understand security concepts, Ethics in Network Security.
- Understand security threats, and the security services and mechanisms to counter them.
- Ability to analyze performance of various cryptographic and cryptanalytic algorithms.
- Gain knowledge about the role of Firewalls and Intrusion Detection Systems.

MODULE I SYMMETRIC CIPHERS (TECHNIQUES AND STANDARDS) –I 09

Introduction – Services, Mechanisms and Attacks, OSI security Architecture, Model for network Security; Classical Encryption Techniques- Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Stegnography; Block Ciphers and Data Encryption Standard Simplified DES, Block Cipher Principles, Data Encryption Standard, Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles, Block Cipher Modes of Operation.

MODULE II SYMMETRIC CIPHERS (TECHNIQUES AND STANDARDS) – II 09

Advanced Encryption Standard- Evaluation Criteria for AES, AES Cipher; Contemporary Symmetric Ciphers- Triple DES, Blowfish, RC5, Characteristics of Advanced Symmetric Block Ciphers, RC4 Stream Cipher; Confidentiality using Symmetric Encryption- Placement of Encryption Function, Traffic Confidentiality, Key Distribution, and Random Number Generation.

MODULE III PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS 09

Public Key Cryptography and RSA- Principles of Public Key Cryptosystems, RSA Algorithm; Key Management and other public key cryptosystems- Key Management, Diffie-Hellman Key Exchange, Elliptic Curve arithmetic, Elliptic Curve Cryptography; Message Authentication and Hash Functions Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions and MACs; Hash Algorithms- MD5 Message Digest Algorithm; Secure Hash Algorithm, RIPEMD 160, HMAC;

Digital Signatures and Authentication Protocols - Digital Signatures, Authentication Protocols, Digital Signature Standards.

MODULE IV NETWORK SECURITY PRACTICE 09

Authentication Applications- Kerberos, X.509 Authentication Service; Electronic Mail Security- Pretty Good Privacy, S/MIME; IP Security- IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations; Web Security- Web Security Considerations, Secure Sockets Layer and Transport Layer Security, Secure Electronic Transaction.

MODULE V SYSTEM SECURITY 09

Intruders- Intruder Detection, Password Management; Malicious Software-Virus and Related Threats, Virus Counter Measures; Firewalls- Firewall Design Principles, Trusted Systems.

Total Hours: 45

REFERENCES:

1. William Stallings, “Cryptography and Network Security”, 3rd edition.Prentice Hall of India, New Delhi, 2004.
2. William Stallings, “Network Security Essentials”, 2rd edition.Prentice Hall of India, New Delhi, 2004.
3. Charlie Kaufman , “Network Security: Private Communication in Public World”, 2nd edition. Prentice Hall of India, New Delhi, 2004.

OUTCOMES:

On completion of the course the student will be able ,

- To identify common network security vulnerabilities/attacks; explain the foundations of network security;
- To identify the appropriate procedures required to secure networks;
- To evaluate the risks and threats to networked computers;
- To demonstrate detailed knowledge of the role of encryption to protect data;
- Get knowledge on development of security policies, standards and practices.
- To determine firewall requirements, and configure a firewall.

ECCY017 QoS IN ADHOC WIRELESS NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the concepts of Ad-hoc networks.
- To discuss the Medium access protocol, network protocols, and QoS support protocols.
- To describe the issues, challenges and solution of QOS in Ad-hoc networks.

MODULE I INTRODUCTION 09

Introduction to Adhoc networks, definition, characteristics features, applications. Characteristics of wireless channel, Adhoc Mobility Models: Indoor and Outdoor models.

MODULE II MEDIUM ACCESS PROTOCOLS 09

MAC Protocols: design issues, goals and classification. Contention based Protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards:-802.11a, 802.11g, 802.15. HIPERLAN.

MODULE III NETWORK PROTOCOLS 09

Routing Protocols: Design issues, goals and classification. Proactive vs. reactive routing, Unicast routing algorithms, Multicast routing algorithms, energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

MODULE IV PROTOCOLS FOR QOS SUPPORT 09

RSVP Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms, Multiprotocol Label Switching, Operations, Label Stacking, Protocol details, RTP: Protocol Architecture, Data transfer Protocol, RTCP.

MODULE V QOS IN AD-HOC NETWORKS 09

Issues and challenges, Classification of QoSsolution : MAC layer solutions, Network layer solutions, QoS frameworks for Ad-Hoc Wireless networks, Energy management in Ad-hoc wireless networks, Need for energy management in Ad-hoc wireless networks.

Total Hours: 45

REFERENCES:

1. C. Siva Ram Murthy and B.S.Manoj "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall PTR,2004
2. C.K. Toh, Ad Hoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR ,2001
3. William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition, 2002. [Chapter- 4-6,8, 10, 12, 13, 17,18]

OUTCOMES:

On completion of the course the students will

- Describe the general concept of Ad-hoc networks.
- List various protocols of ad hoc wireless networks.
- Explain Medium Access Protocols and Routing Protocols
- Analyze the issues, challenges involved forQoS in Ad-hoc networks
- Provide solution of QoS in Ad-hoc networks
- Describe Issues and challenges in Ad-hoc networks

ECCY018 QUANTUM COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the basics of quantum mechanics.
- To develop the knowledge of quantum computation and quantum information.
- To introduce the quantum algorithms.
- To describe the quantum error correction techniques.

MODULE I INTRODUCTIONTO QUANTUM MECHANICS 10

Introduction to quantum computing- Power of quantum computing- Quantum information-Quantum Computers.The Superposition probability rule- A Photon coincidence experiment-Quantum mechanics-Hilbert space- linear operators tensor and outer products- Quantum states- Quantum operators- spectral decomposition of a quantum operators.

MODULE II QUBITS AND QUANTUM GATES 10

Qubits, blocks sphere representation- Rotation operation-the measurement of a single qubits- A pair of qubits-Qubits-physical implementation-Measurement of the spin-Qubit as polarized photon- Entanglement, Exchange of information-single qubit gates- two, three and multiple qubit gates- The Toffoli gates- Matrix representation of quantum gates and circuits.

MODULE III QUANTUM CIRCUITS 09

The No-Cloning theorem- Full adder circuits- Single and multiple qubit controlled operations-Universal quantum gate-State transformation-Quantum circuit for the Walsh-Hadamard transform- Mathematical models of quantum computer.

MODULE IV QUANTUM ALGORITHM 10

Introduction to quantum algorithms.Deutsch-Jozsa algorithm, Grover's quantum search algorithm, Simon's algorithm.Shor's quantum factorization algorithm.

MODULE V ERROR CORRECTION 06

Errors and correction for errors.Simple examples of error correcting codes in classical computation.Linearcodes.Quantum error correction and simple examples.Shor code.

Total Hours: 45

REFERENCES:

1. Dan C.Marinescu, Gabriela M.Marinescu ,“Approaching Quantum Computing”, , Pearson Education, 2008-09.
2. Vishal SahniLov K Grover ,“Quantum Computing”, , Tata McGraw-Hill Publishing Company Limited,2007.ISBN: 9780070657007
3. Nielsen, Michael A and Isaac L. Chuang. Cambridge,UK “Quantum Computation and Quantum Information”,:Cambridge University Press, September 2000. ISBN: 9780521635035.
4. Eleanor G. Rieffel and Wolfgang H. Polak, “Quantum Computing: A Gentle Introduction”, The MIT Press Cambridge, Massachusetts London, England,2011.

OUTCOMES:

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

- Define the basics of Quantum mechanics.
- Use the mathematical framework of quantum computing to solve computational problems.
- Apply Quantum bit representation for quantum machines.
- Design and write simple algorithms for quantum machines.
- Analyze the quantum algorithms of quantum circuit and measurement-based quantum computing models.
- Describe simple error correction techniques.

ECCY019 RF SYSTEM DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To discuss the importance and issues involved in RF design.
- To introduce admittance transformation smith chart.
- To explain RF components and design techniques of filters, amplifiers and oscillators.
- To describe RF system module.
- To learn the design of RF amplifiers using transistors.

MODULE I RF ISSUES **09**

Importance of RF design, Electromagnetic Spectrum, RF behavior of passive Components-resistors, capacitors and inductors, Chip components and Circuit .Board considerations, transmission line analysis.

MODULE II SMITH CHART AND SINGLE AND MULTI PORT NETWORKS **09**

Reflection coefficient to load impedance, impedance transformation, admittance transformation, parallel and series connection.interconnecting networks, network properties and applications, scattering parameters-transformation on Z- and S-parameters, measurements of S-parameters.

MODULE III RF FILTER DESIGN **09**

Reqiurement of filter, Basic resonator and filter configuration, types of filters, their realization and implementation, Coupled filter.Modeling of special filters.

MODULE IV ACTIVE RF COMPONENTS AND MATCHING NETWORKS **09**

RF diodes, BJTs and FETs, Matching and Biasing Networks, discrete components based Impedance matching, Micro stripline based impedance matching networks, Operation of RF Amplifiers and biasing networks.

MODULE V RF AMPLIFIER DESIGNS USING SMITH CHART **09**

Characteristics, Amplifier power relations, Stability considerations, Constant gain circles, noise figure circles, Constant VSWR circles, Low Noise circuits, modeling of amplifier circuits.

MODULE VI OSCILLATORS, MIXERS AND RF SYSTEMS 09

High frequency oscillator configuration, Basic characteristics of Mixers-types of mixers, Detector and demodulator circuits.Integrated model of RF systems.

Total Hours: 45

REFERENCES:

1. Reinhold Ludwig and Powel Bretchko, “RF Circuit Design - Theory and Applications”, Pearson Education Asia, First Edition, 2001.
2. Joseph . J. Carr, “Secrets of RF Circuit Design” , McGraw Hill Publishers, 3rd Edition, 2000.
3. Mathew M. Radmanesh, “Radio Frequency & Microwave Electronics”, Pearson Education Asia, Second Edition, 2002.
4. Ulrich L. Rohde and David P. NewKirk, “RF/ Microwave Circuit Design”, John Wiley & Sons, USA 2000.
5. Roland E. Best, “Phase - Locked Loops: Design, Simulation and Applications”, McGraw Hill Publishers, 5th edition 2003.
6. http://ece.wpi.edu/books/EM_RF_lab/book.htm

OUTCOMES:

On completion of this course the student will be able to

- Understand the importance of RF design.
- Understand the concept of networks, their interconnections and applications
- Analyze the characteristics of amplifier circuits.
- Solve impedance matching for RF circuits.
- Design RF filters, Oscillators and mixers
- Design RF system module.

ECCY020 RF WIRELESS SYSTEMS AND STANDARDS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn and acquire knowledge on Wireless and RF standards
- To introduce 2G, 3G and 4G technologies and its spectrum
- To introduce the concepts of WLAN standards
- To know about the concepts of WIMAX and their standards
- To learn about UWB technology

MODULE I INTRODUCTION TO CELLULAR STANDARDS 09

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

MODULE II WIRELESS SYSTEMS 09

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

MODULE III THE IEEE 802.11 WLAN STANDARD 09

Introduction to IEEE 802.11 – General Description – Medium Access Control (MAC) – Physical Layer for IEEE 802.11 Wireless LANs; Radio systems – IR Systems Applications.

MODULE IV THE IEEE 802.16 WIMAX STANDARD 09

Introduction to IEEE 802.16 – General Description – Medium Access Co0ntrol (MAC) –Radio systems – Physical Layer- Evolution to 802.16m-Bluetooth, Zigbee, RFID

MODULE V RECENT ADVANCES 09

Introduction, Ultra Wide Band (UWB) Technology, Characteristics, Signal Propagation, Current Status and Applications, Advantages, Disadvantages, Challenges and Future Directions.

Total Hours: 45

REFERENCES:

1. AssuncionSantamaria, Francisco Lopez-Hernandez, “Wireless LAN Standards and Applications”, Artech House, 2001.
2. Dharma PrakashAgarwal and Qing- Anzeng, “Introduction to Wireless and Mobile Systems”, Vikas publishing House, New Delhi, 2004.
3. Neeli Prasad and Anand Prasad, “WLAN System & Wireless IP for Next Generation Communications”, Artec House, 2002.
4. Moray Rumney :” LTE and the Evolution to 4G Wireless”, Wiley, 2009

OUTCOMES:

On completion of this course the students will be able to:

- Understand the concepts of wireless systems
- Describe about various cellular standards
- Identify various IEEE wireless standards and their layers
- Gain knowledge on various modulation techniques used.
- Explain the latest technologies introduced in wireless systems
- Describe the 3G, 4G and UWB standards

ECCY021 SIMULATION OF COMMUNICATION SYSTEMS ANDNETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To describe modeling of signals and channels in communication system
- To estimate performance of communication system
- To define the concept of communication networks in terms of modeling
- To analyze the routing model for any communication network

MODULE I MODELLING OF COMMUNICATION SYSTEM 09

Model of speech and picture signals, Pseudo noise sequences, Non-linearsequences, Analog channel model, Noise and fading, Digital channel model-Gilbert model of bursty channels, HF, Troposcatter and satellite channels,Switched telephone channels, Analog and Digital communication systemmodels, Light wave system models.

MODULE II SIMULATION OF RANDOM VARIABLES AND RANDOMPROCESS 09

Univariate and multivariate models, Transformation of randomvariables,Bounds and approximation, Random process models-Markov andARMA Sequences, Sampling rate for simulation, Computer generation andtesting of random numbers.

MODULE III ESTIMATION OF PERFORMANCE MEASURES 09

Quality of an estimator, estimator for SNR, Probability density functions ofanalog communication system, BER of digital communication systems, MonteCarlo method and Importance of sampling method, Estimation of powerspectral density.

MODULE IV COMMUNICATION NETWORKS 09

Queuing models, M/M/1 and M/M/m queues, Little formula, Burke's theorem,M/G/1 queue, Embedded Markov chain analysis of TDM systems, Polling,Random access systems.

MODULE V NETWORK OF QUEUES 09

Queues in tandem, Store and forward communication networks, Capacityallocation, Congestion and flow chart, Routing model, Network layout andReliability.

Total Hours: 45

REFERENCES:

1. M.C.Jeruchim, Philip Balaban and K.SamShanmugam, "Simulation ofcommunication systems", Plenum Press, New York,1992
2. A.M.Law and W.DavidKelton, "Simulation Modelling and analysis", McGrawHill Inc., New York ,1991
3. J.F.Hayes, “Modelling and Analysis of Computer Communication networks”,Plenum Press, New York,1984
4. Jerry Banks and John S.Carson, “Discrete-event System Simulation”, PrenticeHall Inc., New Jersey, 1984
5. MC. Jeruchim, P.Balaban, S.Shanmugam, “Simulation of Communicationsystems- Modelling methodology and techniques”, Plenum publication, 2000.

OUTCOMES:

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

- Analyze different modeling methods of communication channel
- Implement concepts of random models using simulation techniques
- Estimate communication channels by different performance measures
- Explain the concepts of communication networks
- Use appropriately the routing mechanism for different communication network
- Summarize the concepts of wide range of communication systems and networks

ECCY022 SPEECH AND AUDIO SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the speech and audio signal processing
- To discuss the speech mechanics, various analysis and synthesis methods
- To characterize speech , audio signals and hearing system.
- To introduce various algorithms for different applications.

MODULE I INTRODUCTION 05

Sources, propagation and environmental characteristics, audio sources, sampling, quantizing and compression. Human speech and hearing: speech generation, speech signal characteristics, the hearing system, hearing characteristics.

MODULE II MECHANICS OF SPEECH 07

Speech production mechanism, Nature of Speech signal, Discrete time modelling of Speech production, Representation of Speech signals, Classification of Speech Sounds, Phones, Phonemes, Phonetic and Phonemic alphabets, Articulatory features. Music production, Auditory perception, Anatomical pathways from the ear to the perception of sound, Peripheral auditory system, Psycho acoustics.

MODULE III TIME DOMAIN METHODS FOR SPEECH PROCESSING 07

Time domain parameters of Speech signal, Methods for extracting the parameters Energy, Average Magnitude, Zero crossing Rate, Silence Discrimination using ZCR and energy, Short Time Auto Correlation Function, Pitch period estimation using Auto Correlation Function.

MODULE IV FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING 08

Short Time Fourier analysis, Filter bank analysis, Formant extraction, Pitch Extraction, Analysis by Synthesis, Analysis synthesis systems, Phase vocoder, Channel Vocoder.omomorphic Speech Analysis: Cepstral analysis of Speech, Formant and Pitch Estimation – HomomorphicVocoders.

MODULE V LINEAR PREDICTIVE ANALYSIS OF SPEECH 09

Formulation of Linear Prediction problem in Time Domain, Basic Principle, Autocorrelation method, Covariance method, Solution of LPC equations,

Cholesky method, Durbin's Recursive algorithm, lattice formation and solutions, Comparison of different methods, Application of LPC parameters, Pitch detection using LPC parameters, Formant analysis, VELP, CELP.

MODULE VI APPLICATION OF SPEECH & AUDIO SIGNAL PROCESSING 09

Algorithms: Dynamic time warping, K-means clustering and Vector quantization, Gaussian mixture modeling, hidden Markov modeling - Automatic Speech Recognition: Feature Extraction for ASR, Deterministic sequence recognition, Statistical Sequence recognition, Language models - Speaker identification and verification, Voice response system, Speech synthesis: basics of articulatory, source-filter, and concatenative synthesis, VOIP.

Total Hours : 45

REFERENCES:

1. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing", John Wiley and Sons Inc., 2004.
2. L.R.Rabiner and R.W.Schaffer, "Digital Processing of Speech signals", Prentice Hall 1978.
3. Quatieri, "Discrete-time Speech Signal Processing", Prentice Hall , 2001.
4. J.L.Flanagan, "Speech analysis: Synthesis and Perception", Springer-Verlag, Berlin.
5. I.H.Witten, "Principles of Computer Speech", Academic Press, 1982.

OUTCOMES:

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

- Explain speech signal, audio signal and hearing characteristics , mechanics and their generation
- Manipulate, visualize and analyze speech signals and use various processing methods
- Apply various decomposition techniques and modifiy the speech signals.
- Analyze speech and audio signals in time domain and frequency domain.
- Apply various algorithms for speech and audio processing and synthesizing.
- Characterize and justify various speech processing techniques for various applications

ECCY023 STATISTICAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the statistical signal processing techniques
- To study signal estimation parameters and methods
- To introduce various algorithms for signal analysis
- To discuss on spectral analysis of statisticl signals.

MODULE I REVIEW OF RANDOM VARIABLES 09

Vector-space representation of Random variables, Schwarz Inequality Orthogonality principle in estimation, Central Limit theorem, Random processes, wide-sense stationary processes, autocorrelation and autocovariance functions, Spectral representation of random signals, Wiener Khinchin theorem Properties of power spectral density, Gaussian Process and White noise process, Linear System with random input, Spectral factorization theorem and its importance, innovation process and whitening filter, .Random signal modelling: MA(q), AR(p) , ARMA(p,q) models.

MODULE II PARAMETER ESTIMATION THEORY 09

Principle of estimation and applications, non linear estimation, Properties of estimates, unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE), Cramer Rao bound, Efficient estimators; Criteria of estimation: the methods of maximum likelihood and its properties ;Baysean estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation.

MODULE III ESTIMATION OF SIGNAL IN PRESENCE OF WHITE GAUSSIAN NOISE 09

Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Noncausal IIR Wiener filter, Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters.

MODULE IV ADAPTIVE FILTERING 09

Principle and Application, Steepest Descent Algorithm Convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS algorithm;Application of Adaptive filters ; RLS algorithm, derivation.

KalmanFiltering : State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.

MODULE V SPECTRAL ANALYSIS 09

Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.

Total Hours: 45

REFERENCES :

1. M. Hays: “Statistical Digital Signal Processing and Modelling”, John Willey and Sons, 1996.
2. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan: “Statistical Signal Processing with Applications”, PHI, 1996.
3. Simon Haykin: “Adaptive Filter Theory”,Prentice Hall, 1996.
4. D.G. Manolakis, V.K. Ingle and S.M. Kogon: “Statistical and Adaptive Signal Processing”, McGraw Hill, 2000.
5. S. M. Kay: “Modern Spectral Estimation”, Prentice Hall, 1987

OUTCOMES :

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

- Describe and summarize the techniques and concepts of Statistical signal processing
- Describe the criteria of estimation and applications
- Apply various estimation algorithms on statistical signals
- Analyse statistical signals using various filtering methods
- Carry out spectral analysis by different methods
- Justify and characterize the statistical signals.

ECCY024 VEHICULAR AD HOC NETWORKS (VANETs)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student recognizes information, idea and principles of

- Vehicular networking and characteristics
- Congestion control mechanisms in Vehicular Ad hocNetworks
- Cluster based Routing Protocol for Vehicular Networks

MODULE I INTRODUCTION TO VANET 09

VANET characteristics and challenges, Layered architecture for VANETs-concepts and challenges, wireless technology- The IEEE 802 family, The IEEE 802.11 MAC foundations, IEEE 802.11 security, MAC in VANET, Physical layer of VANETs.

MODULE II CONGESTION CONTROL FOR SAFETY VANETs 09

Introduction to congestion control- Aspects of Congestion Control – The need for congestion control – Congestion control by means of transmit power control- Congestion control by means of rate control- Beaconing frequency, Data rate, Transmission power, Minimum contention window, physical carrier sense,Performance evaluation and modeling.

MODULE III CONVOY: CLUSTER-BASED ROUTING PROTOCOL FORVEHICULARNETWORKS 09

Introduction to clustering or network partitioning, mobility based clustering in ad hoc networks, Clustering of VANETs for MAC and transport applications, CONVOY: a vehicle convoy formation protocol, Assessment of the convoy formation protocol.

MODULE IV GATEWAY SELECTION AND DATA SECURITY IN VEHICULAR NETWORKS 09

Clustering and gateway selection in VANET networks, Gateway selection in clustered VANET-LTE advanced hybrid network-Problem statement, LTE advanced standard, Challenges of Data Security in Vehicular Networks-Cryptographic Protocols- Privacy Protection Mechanisms- Implementation aspects.

MODULE V TRAFFIC SIGNAL CONTROL SYSTEMS AND CAR-TO-CAR COMMUNICATIONS 09

Classification of traffic signal control systems, static systems, Dynamic systems, traffic signal control and car-to-car communication, vehicular mobility modeling for VANET- Random Models- Traffic Models, Integration with Network Simulators.

Total Hours: 45

REFERENCES:

1. Andre-Luc Beylo, HoudaLabiod,“vehicular networks models and algorithms” wiley publications,2013.
2. Claudia campolo, antanellomolinaro, Riccardo scopigno, “VANET-standards solutions and research”, springer, 2015.
3. Al- sakibkhanpathan, “Security of self organizing networks MANET WSN WMN VANET”,Auerbach Publications, 2014.
4. Hannes Hartenstein, Kenneth Laberteaux, “VANET Vehicular Applications and Inter-Networking Technologies”, John Wiley & Sons, 2010.

OUTCOMES:

On completion of the course students will be able to

- Develop VANET algorithms that can be designed and applied on VANET.
- Implement congestion control in VANET
- Examine the vulnerabilities of vehicular ad-hoc networks and the salient challenges.
- Design vehicular mobility modeling for VANET
- Implement security in Vehicular Networks
- Develop routing protocols for VANET

ECCY025 WIRELESS COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce current wireless systems and spectrum allocation
- To explain general ray tracing models and path loss models
- To impart knowledge on wireless channels and capacity
- To introduce MIMO systems, multiuser system, OFDM and broadband modulation
- To impart knowledge on multiuser systems .

MODULE I INTRODUCTION 09

Current wireless systems, Wireless spectrum and allocation to existing systems, radio propagation models, path loss calculation, ray tracing methods, empirical path loss models, discrete time and space time statistical channel models.

MODULE II CAPACITY AND DIVERSITYOF WIRELESS CHANNELS 09

Capacity in AWGN, capacity of flat fading channels, capacity of frequency selective fading channels. Receiver Diversity& Transmitter Diversity techniques.

MODULE III MULTIPLE ANTENNA SYSTEMS 09

Narrow band MIMO model, MIMO channel capacity, MIMO Diversity and beam forming, diversity multiplexing tradeoff, space time modulation and coding, Smart antennas.

MODULE IV MULTI CARRIER MODULATION 09

Data transmission using multiple carriers, Multi carrier modulation with overlapping subchannels. Mitigation of subcarrier fading, Discrete implementation of multicarrier systems, OFDM, PAPR.

MODULE V SPREAD SPECTRUM AND MULTI USER SYSTEMS 09

Spread spectrum principle – DSSS – FHSS , multiuser DSSS – spreading codes, downlink and uplink channels , multicarrier CDMA system and multi user FHSS systems. Multiuser channels - uplink and downlink channel capacity – Multiuser detection .

Total Hours: 45

REFERENCES

1. Andrea Goldsmith, “Wireless Communication”, Cambridge Univ. Press, 2006.
2. Andreas F.Molisch, “Wireless Communications” 2nd Edition, Wiley publications, 2014
3. Theodore S.Rappaport., “Wireless Communications”, 2nd Edition, Pearson Education, 2002.
4. Yong SooCho , “MIMO – OFDM wireless communications with MATLAB”, IEEE press, John Wiley publications, 2010.

OUTCOMES:

On completion of this course, student will be able to

- Describe ray tracing models and path loss models
- Characterize wireless channels and describe channel models
- Discuss MIMO narrow band model and transmission techniques with multiple antennas.
- Explain multi carrier modulation schemes
- Explore on broadband modulation and multiuser systems
- Discuss on wireless communication techniques

ECCY026 WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To make the students list the Wireless Sensor Network Architecture and its Applications
- To explain the physical layer design,
- To describe the MAC protocols and time synchronization algorithms
- To discuss various routing protocols, localization algorithms used for sensor network.
- To explain basics of sensor network programming and Internet of Things

MODULE I NODE ARCHITECTURE 07

Introduction to sensor network – Application – Difference between Adhoc and Sensor Network - Node architecture - Hardware components overview - Energy consumption of Sensor nodes - Operating Systems and Execution Environment - some examples of Sensor nodes.

MODULE II NETWORK ARCHITECTURE 07

Sensor Network Scenarios – Optimization goals- Design Principles –Gateway Concepts–Wireless Channel fundamentals - Physical layer and transceiver design considerations in Wireless Sensor Network

MODULE III MAC PROTOCOLS & TIME SYNCHRONIZATION 10

Fundamentals of MAC Protocols – Low duty cycle protocols – Contention based Protocols – schedule based protocols – IEEE 802.15.4 MAC – Address and name management in wireless sensor network. Need for time synchronization

MODULE IV LOCALIZATION & ROUTING PROTOCOLS 12

Properties of localization and positioning procedures – Range based Localization – Range free Localization Routing Metrics – Data Centric Routing– Proactive Routing - On Demand Routing – Hierarchical Routing – QoS based Routing Protocols

MODULE V SENSOR NETWORK PROGRAMMING and IoT 09

Challenges in sensor network programming – Node Centric programming – Dynamic programming – Sensor Network Simulators - Internet of Things (IoT): overview, Applications, potential & challenges, and architecture.

Total Hours: 45

REFERENCES:

1. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley and Sons, 2012.
2. WaltenegusDargie and Christian Poellabauer, “Fundamentals of Wireless Sensor Networks – Theory and Practice”, John Wiley and Sons, First edition, 2010.
3. G.Anastasi, Marco Conti, Mario Di Francesco and Andrea Passarella, “Energy Conservation in Wireless Sensor Networks: A Survey”, Adhoc Networks, Vol.7, No.3 May 2009, Elsevier Publications, pp.537-568.
4. “Adrian McEWen and Hakim Cassimalli, “Designing the Internet of Things” Wiley publications, November 2013.

OUTCOMES:

At the end of the course students will be able to

- Describe Wireless Sensor Network Architecture and its Applications
- Explain the physical layer design
- Compare the various MAC protocols and illustrate time synchronization algorithms
- Distinguish various routing protocols, localization algorithms used for sensor network.
- To describe the basics of sensor network programming and Internet of Things
- Analyze various Sensor Network Simulators

ECCY027 COMMUNICATION SYSTEM DESIGN AND ANALYSIS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To introduce the concepts of software radio
- To discuss the design issues in software radio
- To address the practical issues in Signal generation and processing and RF design

MODULE I INTRODUCTION TO SOFTWARE RADIO 07

The need for Software Radios.Characteristics and benefits of a software Radio – Design principles of a Software Radio.

MODULE II RADIO FREQUENCY IMPLEMENTATION ISSUES 08

The Purpose of the RF Front-End. Dynamic Range-The Principal Challenge of Receiver Design-RF Receiver Front-End Topologies- Enhanced Flexibility of the RF Chain with Software Radios-Importance of the Components to Overall Performance- Transmitter Architectures - Noise and Distortion in the RF Chain. ADCand DAC Distortion.

MODULE III DIGITAL GENERATION OF SIGNALS 08

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.

MODULE IV RADIO FREQUENCY DESIGN 07

Baseband Signal Processing, Radios with intelligence, ADC and DAC architectures- Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antenna systems, Smart antenna architectures

LIST OF LABORATORY EXPERIMENTS 15

1. Software Defined Radio Architecture
2. Pulse Shaping Filter and Matched filter
3. Channel detection, Estimation and Equalization
4. Frame Synchronization and Channel Synchronization
5. IQ Modulation and Complex FFT

6. Error Vector Magnitude and Modulation Error Ratio
7. RF Power and Power gain
8. Intermodulation Distortion
9. Adjacent Channel Power Ratio (ACPR)
10. Dynamic Range and Spurious Free Dynamic Range
11. BER Measurement and Calculation of E_b/N_0
12. Real-Time record and playback of Data Streams.

Total Hours: 60

REFERENCES:

1. Jeffrey H Reed, “Software Radio: A Modern Approach to Radio Engineering”, Prentice Hall Publication, 2002.
2. Walter H.W. Tuttlebee, “Software Defined Radio: Enabling Technologies”, John Wiley Publications, 2007.
3. Paul Burns, "Software Defined Radio for 3G”, Artech House Publication, 2002.
4. Markus Dillinger, KambizMadani, Nancy Alonistioti, “Software Defined Radio: Architectures, Systems and Functions”, John Wiley, 2007
5. Bard,Kovarik,”Software Defined Radio, The Software Communications Architecture”, Wiley 2007
6. John Bard, Vincent J. Kovarik Jr. "Software Defined Radio: The Software Communications Architecture", John Wiley 2007.
7. Peter Kenington, “RF And Baseband Techniques for Software Defined Radio”. Artech House Publishers, 2005

OUTCOMES:

On completion of the course the student will be able to

- Discuss the concept and benefits of SDR
- Explain the issues in RF implementation of SDR
- Use the SDR with Analog and Digital Front End
- Analyze the various antenna structures to accommodate the needs of a SDR
- Choose SDR based on the application
- Evaluate the performance of SDR based communication system

ECCY028 ADAPTIVE SIGNAL PROCESSING

L	T	P	C
2	0	0	2

OBJECTIVES:

- To introduce the concept of adaptive signal processing
- To explore the basics of adaptive filters
- To develop various adaptation algorithms
- To assess the adaptation algorithms in terms of convergence rate,computational complexity, robustness against noisy data.

MODULE I INTRODUCTION TO ADAPTIVE FILTERS 06

Adaptive filter structures, issues and examples.Applications of adaptive filters: Channel equalization, active noise control. Echo cancellation, beamforming.

MODULE II WIENER FILTER, SEARCH METHODS AND THE LMS ALGORITHM 06

Wiener FIR filter (real case), Steepest descent search and the kernel LMS algorithm,Extension of optimal filtering to complex valued input, Complex LMS algorithm.

MODULE III CONVERGENCE AND STABILITY ANALYSES 06

Convergence analysis of the kernel LMS algorithm,Learning curve and mean square error behavior, Weight error correlation matrix.,Dynamics of the steady state mean square error (SSMSE), Misadjustment and stability of excess MSE.

MODULE IV VARIANTS OF THE LMS ALGORITHM 06

The sign-LMS and the normalized LMS algorithm.,BlockLMS,Review of circular convolution: Overlap and save method, circular correlation. FFT based implementation of the block LMS Algorithm.

MODULE V CASE STUDY AND APPLICATION 06

Survey and comparison of various adaptive filtering methods with its significance.Application of adaptive algorithms applied to signals using simulation tool.

Total Hours: 30

REFERENCES

1. S. Haykin, Prentice Hall, Englewood Cliffs,“Adaptive Filter Theory”, NJ, Fourth Edition
2. B. Farhang-Boroujeny, “Adaptive Filters ,Theory and Applications”, John Wiley and Sons, 2013.

OUTCOMES:

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

- Summarize the concept of adaptive signal processing
- Train the filter coefficients to track the target signal
- Assess various adaptation algorithms in signal processing
- Analyze the adaptation algorithms in terms of computational complexity, hardware complexity, numerical stability etc.
- Apply mathematical tools like random variables, stochastic processes and correlation structure -in signal processing.
- To apply particular adaptive algorithm based on the signal constrains

ECCY029 CLASSICAL AND ADVANCED TECHNIQUES FOR OPTIMIZATION

L	T	P	C
2	0	0	2

OBJECTIVES:

- To introduce the concepts of Linear and Non-Linear programming
- To familiarize modern optimization methods.

MODULE I LINEAR PROGRAMMING 05

Introduction to Linear Programming - Simplex method, Duality theory, Linear programming Algorithms. Transportation and Assignment Models.

MODULE II NONLINEAR PROGRAMMING 05

One-variable unconstrained and multivariable unconstrained optimization, Quadratic Programming

MODULE III DYNAMIC PROGRAMING 07

Dynamic programming, Network Optimization Models, Integer programming, Metaheuristics, Game Theory, Queueing Theory, Inventory Theory, Markov Decision Process.

MODULE IV MODERN METHODS OF OPTIMIZATION 07

Genetic algorithms, Simulated annealing, Particle swarm and ant-colony optimization, Fuzzy and Neural networks based methods.

MODULE V PRACTICAL ASPECTS OF OPTIMIZATION. 06

Reduction of size, sensitivity of optimum solution to problem parameters, multi-level optimization, multi-objective optimization.

Total Hours: 30

REFERENCES:

1. Singiresu S. Rao "Engineering Optimization Theory and Practice", 4th Edition, John Wiley 2009.
2. Frederick S. Hillier & Gerald J. Lieberman, "Introduction to Operations Research", 10th Edition McGraw Hill Education, 2015.
3. Hamdy A. Taha, "Operations Research - An Introduction", 8th Edition, Pearson Education Inc., 2007.
4. G. Hadley, “Linear Programming”, 1st Edition, Addison-Wesley, 1962.

5. David G. Luenberger, “Optimization by Vector Space Methods”, John Wiley & Sons, 1969.

OUTCOMES:

On completion of the course the student will be able to

- Recognize problems and associate it with suitable optimization methods
- Solve practical optimization problems using both linear and non-linear methods
- Analyze the engineering issues for optimization using classical methods like Queueing theory, inventory theory, Markov chain, and Metaheuristics.
- Apply modern optimization methods to engineering designs
- Develop new models using Fuzzy and Neural networks.
- Evaluate the optimization methods for various practical applications.

ECCY030 NETWORK ROUTING ALGORITHMS

L	T	P	C
2	0	0	2

OBJECTIVES:

- To understand the basics of Network Routing concepts.
- To create in-depth awareness of routing algorithms and protocols.
- To provide comprehensive details of routing in IP networks and in Ad-hoc networks.

MODULE I NETWORK ROUTING – AN INTRODUCTION 06

Network Routing: An Overview, Protocol Stack Architecture, Router Architecture, Network Topology Architecture, Public Switched Telephone Network, Communication Technologies.

MODULE II ROUTING ALGORITHMS - SHORTEST PATH AND WIDEST PATH 06

Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra's Algorithm, Comparison of the Bellman–Ford Algorithm and Dijkstra's Algorithm, Shortest Path Computation with Candidate Path Caching, Widest Path Computation with Candidate Path Caching, Widest Path Algorithm, kShortest Paths Algorithm.

MODULEIII ROUTING PROTOCOLS - FRAMEWORK AND PRINCIPLES 06

Routing Protocol and Algorithm, Routing Information Representation and Protocol Messages, Distance Vector Routing Protocol, Link State Routing Protocol, Path Vector Routing Protocol.

MODULE IV ROUTING IN IP NETWORKS 06

Routers, Networks, and Routing Information: Some Basics, Routing Information Protocol (RIP), Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP), OSPF: Protocol Features, Integrated IS-IS - Key Features, BGP: A Brief Overview.

MODULE V ROUTING IN AD HOC NETWORK 06

Introduction to Ad hoc Networks – Features/ Characteristics, Types and Applications, Limitations, Advantages and Disadvantages, Classification of Routing Protocols in Ad hoc Networks – Proactive Routing Protocols (DSDV,

OLSR), Reactive Routing Protocols (DSR, AODV), Hybrid Routing Protocols (ZRP).

Total Hours: 30

TEXT BOOK:

1. DeepankarMedhi and KarthikeyanRamasamy, “Network Routing:Algorithms, Protocols, and Architectures”, Elsevier, 2007.

REFERENCES:

1. William Stallings, "Data and Computer Communications", Pearson Education, 2006.
2. Martha SteenStrup, "Routing in Communication Networks", Prentice Hall, 1995.
3. Subir Kumar Sarkar, T G Basavaraju and C Puttamadappa, “Ad Hoc Mobile Wireless Networks – Principles, Protocols and Applications”, Auerbach publications.
4. Dharma PrakashAgrawal and Carlos De MoraisCordeiro, “Adhoc and Sensor Networks – Theory and Applications”, World Scientific publication.

OUTCOMES:

At the completion of this course the students will be able to

- Define the fundamentals of Network Routing.
- Decide the routing protocol for any level of complex network design.
- Select the routing algorithm suitable for the network considered.
- Relate the routing algorithms for different types of network.
- Explain the feature of various routing protocols.
- Recommend the routing protocol for a given network.
- Perform the research in the routing platform.

ECCY031 PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS

L	T	P	C
2	0	0	2

OBJECTIVES:

- To familiarize with classical and modern techniques for pattern recognition
- To compare various classifiers

COURSE PREREQUISITES:

- Familiarity with concepts digital image processing
- Fundamental knowledge in mathematics and numerical methods.

MODULE I REPRESENTATION OF PATTERNS 08

Data structures, representation of cluster, proximity measures and size, Feature extraction.

MODULE II CLASSIFIERS 08

Nearest neighbor Based Classifiers, Bayes Classifiers, Hidden Markov Models, Decision trees Supprot Vector Machines.

MODULE III COMBINATION OF CLASSIFIERS 07

Ensembles of Classifiers, Methods for combining Classifiers.

MODULE IV CLUSTERING 07

Hierarchical algorithms, Partitiona, Clustering, Clusteringlarge Data sets.

Total Hours: 30

REFERENCES:

1. M. NarasimhaMurty& V. Susheela Devi, "Pattern Recognition - An Algorithmic Approach", Springer 2011.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer 2013.
3. J. P. Marques de Sa, "Pattern Recoanition - Concepts, Methods and Applications", Springer 2001

OUTCOMES:

On completion of the course the student will be able to

- Discuss the representation of cluster

- Apply the techniques for proximity measures
- Classify the pattern recognition methods for various applications.
- Summarize the methods used for representation of patterns
- Compare various classifiers for different applications
- Design pattern recognition methods using combination of classifiers.

ECCY032 RADIATION SYSTEMS FOR PERSONAL AREA NETWORK

L	T	P	C
2	0	0	2

OBJECTIVES:

- To List the various types of Printed Antennas
- To understand about Wearable Antennas
- To gain the knowledge about Active Integrated Antennas
- To apply the Reconfigurability function in Antenna Design
- To study about different array techniques

MODULE I INTRODUCTION TO WIRELESSS PAN AND PRINTED ANTENNAS 06

Introduction to IEEE 802.15, 15.1Bluetooth, IEEE 802.15.3A Ultra Wideband Wireless Pan, 15.4 Zigbee.Concepts of Printed Antennas, Broadband Microstrip Patch Antennas, Patch Antennas for Multiband Applications.

MODULE II WEARABLE ANTENNAS 06

Overview of Wearable Systems and its Characteristics, Antennas for Wearable Devices, DesignRequirements, Modeling and Characterization of Wearable Antennas, Domains of Operation, Compact Wearable Antenna for Healthcare Sensors.

MODULE III ACTIVE INTEGRATED ANTENNAS 06

Active Wearable Antenna Modules-Features, Electromagnetic Characterization of Fabrics and Flexible Foam Materials, Small-Band Inverse Planar Antenna,Resonator Method, Active Antenna Modules for Wearable Textile Systems.

MODULE IV RECONFIGURABLE ANTENNAS 06

Reconfigurable methodologies, Design Considerations for Reconfigurable systems, Reconfigurable Planar/printed antenna configurations, Active reconfigurable systems.

MODULE V ARRAY ANTENNAS 06

Linear and planar array fundamentals, Mutual Coupling in Arrays, Multidimensional Arrays, Switched beam and Phased Arrays, Array Feeding Techniques, Array optimization techniques.

Total Hours: 30

REFERENCES

1. DebatoshGuha, Yahia M.M. Antar, “Microstrip and Printed Antennas”, 1st Edition, JohnWiley& Sons, 2011.
2. Taming the Borg, “Moving Wearables into the Mainstream”, Springer, 2008.
3. Eng Hock Lim , Kwok Wa Leung, “Compact Multifunctional Antennas for WirelessSystems”, John Wiley & Sons, 2012.
4. ZhiNing Chen, “Antennas for Portable Devices”, John Wiley & Sons, 2007.
5. ApostolosGeorgiadis, HendrikRogier, Luca Roselli, Paolo Arcioni, “Microwave &Millimeter Wave Circuits & Systems”, First Edition, John Wiley & Sons, 2013.
6. Warren L Stutzman, Gary A.Thiele, “ Antenna Theory and Design”, 3rd edition, John Wiley & Sons, 2013.

OUTCOMES:

The students will be able

- To discuss the basics of PAN network
- To classify various types of Printed Antennas.
- To describe about Wearable Antennas
- To analyze different materials for Antennas
- To apply the reconfigurability function in any Antenna Design
- To optimize different array configurations.

ECCY033 BIO SIGNAL PROCESSING

L	T	P	C
1	0	0	1

OBJECTIVES:

- The basics of bio-signal and characteristics.
- The processing techniques of biomedical signals and parameter detection.
- Noise reduction in Bio signals.
- To expose the students with Simulation tools for bio signal processing.

MODULE I INTRODUCTION TO BIOMEDICAL SIGNALS 03

The origin of Bio signal - Typical waveforms -need of analyzing and classification.

MODULE II ANALYSIS OF PCG 03

PCG-Characteristics and analysis using NILABVIEW.

MODULE III ANALYSIS OF ECG 03

ECGsignalanalysis: parameters estimation-compression technique-MATLAB Simulation of analyzing ECG.

MODULE IV ANALYSIS OF EEG 03

EEG - artifacts in EEG & their characteristics and processing - EEG segmentation - MATLAB Simulation of analyzing ECG.

MODULE V ANALYSIS OF EMG 03

EMG - characteristics and analysis using NILABVIEW.

Total Hours:15

REFERENCES:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, NewDelhi, 2007.
2. D.C.Reddy, "Biomedical Signal Processing: Principles and techniques", Tata McGraw Hill, New Delhi, 2005
3. Myer Kutz, “Standard Handbook of Biomedical Engineering and Design”, McGraw HillPublisher, 2003.
4. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.

5. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley andsons, New York, 2004.
6. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.

OUTCOMES:

On completion of the course the students will

- Explain the bio signal characteristics.
- Simulate & analyze of PCG.
- Simulate & analyze of ECG.
- Simulate & analyze of EEG.
- Simulate & analyze of EMG.
- To program with simulation tools.

ECCY034 ULTRASONIC PRINCIPLES AND APPLICATIONS

L	T	P	C
1	0	0	1

OBJECTIVES:

Make the students to

- state the basics of ultrasonics signals and types.
- Infer the ultrasonic wave propagation techniques and parameter detection.
- Manipulate the measurement technique in ultrasonic signals..
- expose with Simulation tools for ultrasonic signal processing.

MODULE I ULTRASONIC TECHNOLOGIES AND APPLICATIONS 08

Ultrasonic – Inroduction-Types of ultrsonics – Ultrsonics in electronics - Ultrasonic Systems: Transmitters and Receivers. Elastic Wave Propagation, Velocity of Sound - Transmission through Thin Plates. Attenuation of an ultrasonic wave. Fundamental equations employed in Ultrasonic design-wave equation: plane wave general wave and plate wave. Design of Ultrasonic Transducers

MODULE II SATTERING OF SOUND AND ADVANCED TECHNIQUES 07

Comparition of electromagnetic and Acoustic Propagation – Scattering theory: Description of weak scattering, Plane wave incident by single particle, Sattering by many particles-numerical calculation. Sattering from bubbles, Particle sizing, Propagation in viscoelastic materials.Automation and computer tools.

Total Hours:15

REFERENCES:

1 Dale Ensminger and Leonard J. Bond, “Ultrasonic Fundamentals Technologies and Applications, CRC Press third edition.
2 Malcolm J.W.Povey, “Ultrasonic Techniques for Fluids Characterisation”, Academic Press, Claifornia.
3 J. David N. Cheeke, "Fundamentals and Applications of Ultrasonic Waves", CRC Press LLC, 2002
4 E. G. Richardson, **“**Ultrasonic Physics”, ELSEVIER Publishing Company

OUTCOMES:

On completion of the course the students will be able to

- Identify the type of ultrasonic signal.

- Describe the ultrasonic wave propagation and attenuation through transmission media.
- Interpret the fundamental wave equations of ultrasonic signal.
- Design ultrasonic transducers for palne wave and plate wave.
- Synthesize the electromagnetic, acoustic propagation and scattering of ultrasonic waves.
- Program with simulation tools.

ECCY035 **CHAOTRONICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To prepare the students to understand the concepts of chaos in electronic circuits

MODULE I **LINEAR AND NONLINEAR CIRCUITS** **9**

Linear circuit elements-nonlinear circuit elements- circuits with linear elements-circuits with non linear elements-LC, RLC and forced RLC circuits-importance of non linearity-low and higher order electronic circuits with non linearity-Opamp: Mathematical operations.

MODULE II **BIFURCATION AND CHAOS** **9**

Introduction-periodic, quasi-periodic and chaotic behaviors-types of bifurcation-routes to chaos-discrete and continuous dynamical systems-characterization of periodic and chaotic motions.

MODULE III **DISCRETE MAP BASED CHAOTIC CIRCUITS** **9**

Introduction-Logistic map dynamics-circuit realization of logistic map-cob-web diagrams-Poincare-map construction-bifurcation diagram circuits-Henon map circuit-phase-portrait.

MODULE IV **CONTINUOUS TYPE CHAOTIC CIRCUITS** **9**

Introduction-autonomous chaotic circuits: Chau's circuit, Chau's canonical circuit-Wein bridge oscillator based chaotic circuit-Colpitts chaotic oscillator-negative resistance based chaotic circuits-LC oscillator based chaotic circuits, Non-autonomous chaotic circuits:RL-diode circuit, driven Chaus's circuit-Murali-Lakshmanan-Chua (MLC) circuit, Lindberg-Murali-Tamasevicius (LMT) oscillator-stochastic resonance circuit. Analog simulation circuits: Duffing oscillator, van-der Pol oscillator-Lorenz system-Rossler system-Threshold-controller based circuits.

MODULE V **HIGHER-ORDER CHAOTIC CIRCUITS** **9**

Introduction-simple hyper-chaotic circuits with LCR elements-negative resistance based hyper-chaotic circuits-delay-chaotic circuits: autonomous and non-autonomous versions. Power-electronics circuits-CNN base chaotic circuits.

Total Hours –45

TEXT BOOKS:

1. Lakshmanan M, Rajasekar S, "Nonlinear Dynamics Integrability Chaos and patterns, Springer International Edition, 2009
2. F C M Lau and C K Tse, "Chaos-Based Digital Communication Systems,

Springer-Verlag Berlin Heidelberg 2003.

3. Branislav Jovic, “Synchronization Techniques for Chaotic Communication Systems”, Springer-Verlag Berlin Heidelberg, 2011

REFERENCES:

1. Steven H. Strogatz, “Nonlinear Dynamics and Chaos”, Sarat Impressions, 2007
2. Marcio Eisencraft (Editor), Romis Attux • Ricardo Suyama “Chaotic signals in digital communications”, CRC press, 2014.

OUTCOMES:

On completion of the course the students will be able to

- Distinguish and describe linear and nonlinear system and its characteristics
- Describe various periodic, quasi-periodic and chaotic behaviors and apply them for wireless communication.
- Explain various Nonlinear Dynamics and Chaos techniques and apply them for RF Communication.
- Describe various autonomous chaotic circuits and non autonomous chaotic circuits for signal processing.
- Analyze the performance issues of dynamic circuits.
- Apply higher order chaotic circuits for secured network.

ECCY060 SOFTWARE FOR EMBEDDED SYSTEMS

L	T	P	C
2	0	2	3

OBJECTIVES:

The objective of the course is to

- To know the basic conepts of C Programming.
- To Introduce the GNU C Programming Tool Chain in Linux.
- To understand embedded C and Embedded OS
- To introduce the phython language

MODULE I C PROGRAMMING CONCEPTS 09

Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization.

Laboratory Practice:

Practice C language programs illustrating the language constructs in the module I using C compiler

MODULE II C PROGRAMMING TOOLCHAIN IN LINUX 09

Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof - Memory Leak Detection with valgrind - Introduction to GNU C Library .

Laboratory Practice:

Practice C language programs using GCC compiler in Linux environment

MODULE III EMBEDDED C USING 8051 MICROCONTROLLER 09

Adding Structure to ‘C’ Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

Laboratory Practice:

Practice Embedded C language programs illustrating the language construct in the module III using C Keil µvision IDE

MODULE IV EMBEDDED OS 09

Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS.

Laboratory Practice:

Practice Embedded C language programs illustrating the language construct in the module IV using C Keil µvision IDE

MODULE V PYTHON PROGRAMMING 09

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution Environment.

Laboratory Practice:

Practice basic Python language programs illustrating the language construct in the module V using Python interactive shell software

Total Hours:45

REFERENCES:

1. Stephen Kochan, “Programming in C”, 3rd Edition, Sams Publishing, 2009.
2. Steve Oualline, “Practical C Programming 3rd Edition”, O’Reilly Media, Inc, 2006.
3. Michael J Pont, “Embedded C”, Pearson Education, 2007.
4. Mark Lutz, “Learning Python Powerful OOPs”,O’reilly,2011.

OUTCOMES:

At the end of the course students will be able to

- Write, compile and debug programs in C language.
- compile the program in linux operating system
- Develop program using embedded C
- Describe operating system in embedded system
- Program using phython language
- Design projects using embedded C and python language

MACY081 SIGNAL PROCESSING TECHNIQUES

L	T	P	C
3	1	0	4

OBJECTIVES:

- To impart knowledge on various mathematical transforms for signal processing applications.

MODULE I LAPLACE TRANSFORM FOR CONTINUOUS TIME SIGNALS 06+03

Analog and digital signals - Periodic and aperiodic signals – Spectrum estimation for bandwidth requirement – Laplace Transform – Spectrum estimation – Frequency filtering for spectrum modification – Inverse Laplace Transform – Modified spectrum to get filtered signal.

MODULE II Z -TRANSFORM FOR DISCRETE TIME SIGNALS 12+03

Sampling of continuous time signals for discrete time signals – Nyquist sampling rate - Need for discrete signals – Quantization for digital signal – Z-Transform – Spectrum estimation of discrete signals – Digital filters for spectrum modification – Inverse Z-Transform – Modified spectrum to get filtered signal – Impulse response of digital systems - Bilinear Transform for analog to digital conversion.

MODULE III DISCRETE FOURIER TRANSFORM FOR DISCRETE TIME SIGNALS 09+03

Discrete Fourier Transform – Comparison with Z-Transform – Discrete signals for spectrum estimation – Digital filters for spectrum modification – Inverse Discrete Fourier Transform to get filtered signals – Fast Fourier Transform with decimation in either time or frequency

MODULE IV DISCRETE COSINE TRANSFORM FOR DISCRETE TIME SIGNALS 09+03

One dimensional and two dimensional discrete Cosine transforms – comparison with discrete Fourier transform – image processing applications like filtering & compression – two dimensional transform implementation using successive one dimensional transform – application in JPEG standards – zig zag scanning of transform coefficients – inverse discrete Cosine transform – expansion of compressed images – calculation of compression parameters of CF,RMSE,PSNR &CQ.

MODULE V DISCRETE WAVELET TRANSFORM FOR DISCRETE TIME SIGNALS

(09+03

Wavelet – Haar wavelet – one dimensional forward discrete wavelet transform – comparison with discrete Cosine transform - two dimensional transform implementation using successive one dimensional transform – Image processing applications like filtering & compression - application in JPEG 2000 standards – zig zag scanning of transform coefficients – inverse discrete wavelet transform – expansion of compressed images – calculation of compression parameters of CF, RMSE, PSNR & CQ.

L – 45; T – 15; Total Hours– 60

REFERENCES:

1. Joel L.Schiff ,“The Laplace Transform: Theory and Applications” – Springer – 1999.
2. Alexander D. Poularikas, “The Transforms and Applications Handbook” Chapter 6 on Z- Transforms - Boca Raton : CRC Press LLC - 2000.
3. D.Sundararajan, “The Discrete Fourier Transform: Theory”, Algorithm and Applications – World Scientific Publishers – 2001.
4. K.Rao and P.Yip, “Discrete Cosine Transform – Elsevier”, – 1990.
5. D.Sundararajan, “Discrete Wavelet Transform: A Signal Processing Approach”, Wiley – 2015.

OUTCOMES:

On completion of the course, the student will be able to apply

- Laplace transform for analog signal analysis.
- Z Transform for discrete signal analysis.
- Discrete Fourier Transform for discrete signal analysis.
- Discrete Cosine Transform for discrete signal analysis.
- Discrete Wavelet Transform for discrete signal analysis.
- The methods to calculate compression parameters.

GENERAL ELECTIVES

GECY101 PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

The objectives of the course would be to make the students

- Learn to e valuate and choose an optimal project and build a project profile.
- Attain knowledge on risk identification and risk analysis
- Gain insight into a project plan and components
- Familiar with various gamut of technical analysis for effective project implementation
- Learn to apply project management techniques to manage resources.

MODULE I INTRODUCTION & PROJECT INITIATION 09

Introduction to project and project management - projects in contemporary organization – The project life cycle - project initiation - project evaluation methods & techniques - project selection criteria - project profile.

MODULE II RISK ANALYSIS 09

Sources of risk: project specific - competitive - industry specific - market and international risk – perspectives of risk – risk analysis: sensitivity analysis - scenario analysis - breakeven analysis - simulation analysis - decision tree analysis – managing/mitigating risk – project selection under risk.

MODULE III PROJECT PLANNING & IMPLEMENTATION 09

Project planning – importance – functions - areas of planning - project objectives and policies - steps in planning process - WBS – capital requirements - budgeting and cost estimation - feasibility analysis - creation of project plan – project implementation: pre-requisites - forms of project organization

MODULE IV TECHNICAL ANALYSIS 09

Technical analysis for manufacturing/construction/infrastructure projects – process/technology - materials and inputs - product mix - plant capacity – plant location and site selection – plant layout - machinery and equipment –

structures and civil works – schedule of project implementation – technical analysis for software projects.

MODULE V PROJECT MANAGEMENT TECHNIQUES 09

Project scheduling - network construction – estimation of project completion time – identification of critical path - PERT & CPM – crashing of project network - complexity of project scheduling with limited resources - resource allocation - resource leveling – resource smoothing – overview of project management software.

Total Hours: 45

REFERENCES:

1. Projects: Planning, Analysis, Financing, Implementation and Review, Prasanna Chandra, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
2. Project Management and Control, Narendra Singh, Himalaya Publishing, New Delhi, 2015.
3. A Management Guide to PERT/CPM, Jerome, D. Weist and Ferdinand K. Levy, Prentice Hall of India, New Delhi, 1994.

OUTCOMES:

On successfully completing this course, the student will be able to:

- Evaluate & select a project as well as develop a project profile.
- Identify various risks associated with the project and manage it effectively.
- Prepare a detailed project plan addressing its components.
- Perform technical analysis for effective project implementation
- Apply project management techniques for maximizing resource utilization.

GECY102 SOCIETY, TECHNOLGY & SUSTAINABILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To aware of new technologies through advances in Science and Engineering.
- To make them realise the profound impact on society.
- To understand the ethical issues raised by technological changes and its effect on society.
- To introduce students a broad range of perspectives on the adoption and use of technologies.
- To make them realize the need of sustainability in the context of emerging technologies.

MODULE I TECHNOLOGY AND ITS IMPACTS 09

Origin and evolution of technologies – Nature of technology- Innovation – Historical Perspective of technology – Sources of technological change - Co-evolution of technology and economy – Scientific knowledge and technological advance – Science and Engineering aspects of Technology – Impact on the Society – Social and Ethical Issues associated with technological change – Social and environmental consequences - Impact of technological change on human life –Technology and responsibility – Technology and social justice.

MODULE II TECHNOLOGY AND ITS ADVANCEMENT 09

Sociological aspects of technology – Ethics and technology – Technology and responsibility – International Economics, Globalisation and Human Rights – Sustainability and Technology – Population and environment - Technology, Energy and Environment – Organisations and technological change.

MODULE III SOCIETY AND TECHNOLOGY 09

Impact of technologies on contemporary society – Role of society in fostering the development of technology – Response to the adaption and use of technology – Impact of technology on developer and consumers – Technological change and globalisation.

MODULE IV IMPACT OF A SPECIFIC TECHNOLOGY ON HUMAN WELFARE 09

Impact of the following technologies on Human life – Medical and Biomedical – Genetics Technology – Electronics and Communications – Electronic media

Technology – Information Systems Technology – Nanotechnology – Space Technology and Energy Technology.

MODULE V THE IMPORTANCE OF SUSTAINABILITY 09

Sustainability – A brief history – Concepts and contexts for sustainability – Ecological imbalance and biodiversity loss – Climate change – Population explosion. Industrial ecology – systems approach to sustainability – Green engineering and technology- sustainable design- sustainable manufacturing- Green consumer movements – Environmental ethics – Sustainability of the planet Earth – Future planning for sustainability.

Total Hours: 45

REFERENCES:

1. Volti Rudi, “Society and Technology Change”, 6th Edition, Worth publishers Inc, USA, 2009.
2. Arthur W.A, “The nature of Technology: What it is and how it evolves”, Free Press, NY, USA, 2009.
3. Winston M and Edelbach R, “Society, Ethics and Technology”, 3rd Edition, San Francisco, USA, 2005.
4. Martin A.A Abraham, “Sustainability Science and Engineering: Defining Principles”, Elsevier Inc, USA, 2006.
5. R.V.G.Menon, “Technology and Society”, Pearson Education, India, 2011.

OUTCOMES:

At the end of this course, the students will be able to

- Understand the benefits of modern technology for the well-being of human life.
- Connect sustainability concepts and technology to the real world challenges.
- Find pathway for sustainable society.

GECY103 ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

OBJECTIVES:

- Expose the history and foundations of artificial intelligence.
- Showcase the complexity of working on real time problems underlying the need for intelligent approaches.
- Illustrate how heuristic approaches provide a good solution mechanism.
- Provide the mechanisms for simple knowledge representation and reasoning.
- Highlight the complexity in working with uncertain knowledge.
- Discuss the current and future applications of artificial intelligence.

MODULE I HISTORY AND FOUNDATIONS 08

History – Scope – Influence from life – Impact of computing domains - Agents in environments - Knowledge representation – Dimensions of Complexity – Sample application domains – Agent structure.

MODULE II SEARCH 10

Problem solving as search – State spaces – Uninformed Search – Heuristic search – Advanced search – Constraint satisfaction - Applications.

MODULE III KNOWLEDGE REPRESENTATION AND REASONING 10

Foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.

MODULE IV REPRESENTING AND REASONING WITH UNCERTAIN KNOWLEDGE 08

Probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications.

MODULE V CASE STUDY AND FUTURE APPLICATIONS 09

Design of a game / Solution for problem in student's domain. Natural Language processing, Robotics, Vehicular automation – Scale, Complexity, Behaviour – Controversies.

Total Hours: 45

TEXT BOOK:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2010.
2. David Poole, Alan Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
3. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, Online edition, 2013.
4. Keith Frankish, William M. Ramsey (eds) The Cambridge Handbook of Artificial Intelligence, Cambridge University Press, 2014.

OUTCOMES:

Students who complete this course will be able to

- Discuss the history, current applications, future challenges and the controversies in artificial intelligence.
- Apply principle of AI in the design of an agent and model its actions.
- Design a heuristic algorithm for search problems.
- Analyze and represent the fact using logic for a given scenario
- Represent uncertainty using probabilistic models
- Develop a simple game or solution using artificial intelligence techniques.

GECY104 GREEN COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To focus on the necessity of green computing technology.
- To expose to various issues with information technology and sustainability.
- To attain knowledge on the technologies for enabling green cloud computing.
- To elaborate on the energy consumption issues
- To illustrate a Green and Virtual Data Center
- To develop into a Green IT Technologist.

MODULE I INTRODUCTION 08

Trends and Reasons to Go Green - IT Data Center Economic and Ecological Sustainment - The Growing Green Gap: Misdirected Messaging, Opportunities for Action - IT Data Center “Green” Myths and Realities - PCFE Trends, Issues, Drivers, and Related Factors - Green Computing and Your Reputation- Green Computing and Saving Money- Green Computing and the Environment

MODULE II CONSUMPTION ISSUES 10

Minimizing power usage – Cooling - Electric Power and Cooling Challenges - Electrical – Power -Supply and Demand Distribution - Determining Energy Usage - From Energy Avoidance to Efficiency - Energy Efficiency Incentives, Rebates, and Alternative Energy Sources - PCFE and Environmental Health and Safety Standards- Energy-exposed instruction sets- Power management in power-aware real-time systems.

MODULE III NEXT-GENERATION VIRTUAL DATA CENTERS 09

Data Center Virtualization - Virtualization beyond Consolidation - Enabling Transparency - Components of a Virtual Data Center - Datacenter Design and Redesign - Greening the Information Systems - Staying Green- Building a Green Device Portfolio- Green Servers and Data Centers- Saving Energy

MODULE IV TECHNOLOGIES FOR ENABLING GREEN AND VIRTUAL DATA CENTERS 08

Highly Effective Data Center Facilities and Habitats for Technology - Data Center Electrical Power and Energy Management - HVAC, Smoke and Fire

Suppression - Data Center Location - Virtual Data Centers Today and Tomorrow - Cloud Computing, Out-Sourced, and Managed Services.

MODULE V SERVERS AND FUTURE TRENDS OF GREEN COMPUTING 10

Server Issues and Challenges - Fundamentals of Physical Servers - Types, Categories, and Tiers of Servers - Clusters and Grids - Implementing a Green and Virtual Data Center - PCFE and Green Areas of Opportunity- 12 Green Computer Companies- What's in Green computer science-Green off the Grid aimed for data center energy evolution-Green Grid Consortium- Green Applications- Green Computing Making Great Impact On Research

Total Hours: 45

REFERENCES:

1. Bud E. Smith,"Green Computing Tools and Techniques for Saving Energy, Money, and Resources", Taylor & Francis Group, CRC Press, ISBN-13: 978-1-4665-0340-3, 2014.
2. Jason Harris, "Green Computing and Green IT Best Practices, On Regulations and Industry Initiatives, Virtualization and power management, materials recycling and Tele commuting, Emereo Publishing .ISBN-13: 978-1-9215-2344-1,2014.
3. Ishfaq Ahmed & Sanjay Ranka, "Handbook of Energy Aware and Green Computing", CRC Press, ISBN: 978-1-4665-0116-4, 2013.
4. Kawahara, Takayuki, Mizuno, "Green Computing with Emerging Memory", Springer Publications, ISBN:978-1-4614-0811-6, 2012
5. Greg Schulz, "The Green and Virtual Data Center", CRC Press, ISBN-13:978-1-4200-8666-9, 2009.
6. Marty Poniatowski, "Foundation of Green IT: Consolidation, Virtualization, Efficiency, and ROI in the Data Center", Printice Hall, ISBN: 9780-1-3704-375-0, 2009.

OUTCOMES:

Students who complete this course will be able to

- Demonstrate issues relating to a range of available technologies, systems and practices to support green computing.
- Select appropriate technologies that are aimed to reduce energy consumption.
- Address design issues needed to achieve an organizations' green

computing objectives.

- Analyze the functionality of Data Centers.
- Critically evaluate technologies and the environmental impact of computing resources for a given scenario.
- Compare the impact of Green Computing with other computing techniques.

GECY105 GAMING DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To master event-based programming
- To learn resource management as it relates to rendering time, including level-of-detail and culling.
- To become familiar with the various components in a game or game engine.
- To explore leading open source game engine components.
- To become familiar of game physics.
- To be compatible with game animation.

MODULE I INTRODUCTION 09

Magic Words – What Skills Does a Game Designer Need? – The Most Important Skill -The Five Kinds of Listening-The Secret of the Gifted.

MODULE II THE DESIGNER CREATES AN EXPERIENCE 09

The Game Is Not the Experience -Is This Unique to Games? -Three Practical Approaches to Chasing Rainbows -Introspection: Powers, Perils, and Practice -Dissect Your Feelings -Defeating Heisenberg -Essential Experience.

MODULE III THE EXPERIENCE IN THE PLAYER MIND AND GAME MECHANICS 08

Modeling – Focus -Empathy – Imagination – Motivation – Space – Objects, Attributes, and States – Actions – Rules.

MODULE IV GAMES THROUGH AN INTERFACE 09

Breaking it Down – The Loop of Interaction – Channels of Information – Other Interface.

MODULE V BALANCED GAME MECHANICS 10

Balance – The Twelve Most Common Types of Game Balance – Game Balancing Methodologies - Balancing Game Economies.

Total Hours: 45

REFERENCES:

1. Jesse Schell, "The Art of Game Design: A Book of Lenses", 2nd Edition ISBN-10: 1466598646, 2014.
2. Ashok Kumar, Jim Etheredge, Aaron Boudreaux, “Algorithmic and Architectural Gaming Design: Implementation and Development", 1st edition, Idea Group, U.S ISBN-10: 1466616342, 2012.
3. Katie SalenTekinba, Melissa Gresalfi, Kylie Peppler, Rafi Santo, "Gaming the System - Designing with Gamestar Mechanic" MIT Press , ISBN-10: 026202781X, 2014.
4. James M. Van Verth, Lars M. Bishop "Essential Mathematics for Games and Interactive Applications", Third Edition, A K Peters / CRC Press, ISBN-10: 1482250926, 2015.

OUTCOMES:

Students who complete this course will be able to

- Realize the basic history and genres of games
- Demonstrate an understanding of the overall game design process
- Explain the design tradeoffs inherent in game design
- Design and implement basic levels, models, and scripts for games
- Describe the mathematics and algorithms needed for game programming
- Design and implement a complete three-dimensional video game

GECY106 SOCIAL COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To create original social applications, critically applying appropriate theories and effective practices in a reflective and creative manner.
- To critically analyze social software in terms of its technical, social, legal, ethical, and functional features or affordances.
- To encourage the development of effective communities through the design, use, and management of social software.
- To give students with a base of knowledge and advances for them to critically examine existing social computing services.
- To plan and execute a small-scale research project in social computing in a systematic fashion.
- To become familiar with the concept of computational thinking.

MODULE I BASIC CONCEPTS 09

Networks and Relations: Relations and Attributes, Analysis of Network Data, Interpretation of network data -New Social Learning – Four Changes that Shift Work - Development of Social Network Analysis: Sociometric analysis and graph theory, Interpersonal Configurations and Cliques – Analysing Relational Data.

MODULE II SOCIAL LINK 09

Individual Actors, Social Exchange Theory, Social Forces, Graph Structure, Agent Optimization Strategies in Networks – Hierarchy of Social Link Motivation- Social Context.

MODULE III SOCIAL MEDIA 08

Trends in Computing – Motivations for Social Computing – Social Media: Social relationships, Mobility and Social context – Human Computation – Computational Models- Business use of social Media.

MODULE IV SOCIAL INFORMATION FILTERING 09

Mobile Location Sharing – Location based social media analysis – Social Sharing and Social Filtering – Automated recommender Systems – Traditional and Social Recommender Systems.

MODULE V SOCIAL NETWORK STRATEGY 10

Application of Topic Models – Opinions and Sentiments – Recommendation Systems – Language Dynamics and influence in online communities – Psychometric analysis – Case Study: Social Network Strategies for surviving the zombie apocalypse.

Total Hours: 45

REFERENCES:

1. Tony Bingham, Marcia Conner, “The New Social Learning, Connect. Collaborate. Work”, 2nd Edition, ATD Press, ISBN-10:1-56286-996-5, 2015.
2. Nick Crossley, Elisa Bellotti, Gemma Edwards, Martin G Everett, Johan Koskinen, Mark Tranmer, “Social Network Analysis for Ego-Nets”, SAGE Publication, 2015.
3. Zafarani, Abbasi and Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014.
4. Christina Prell, “Social Network Analysis: History, Theory and Methodology”, 1st Edition, SAGE Publications Ltd, 2012.
5. John Scott, “Social Network Analysis”, Third Edition, SAGE Publication, 2013.
6. Jennifer Golbeck, “Analyzing the Social Web”, Elsevier Publication, 2013.
7. Huan Liu, John Salerno, Michael J. Young, “Social computing and Behavioral Modeling”, Springer Publication, 2009.

OUTCOMES:

Students who complete this course will be able to

- Realize the range of social computing applications and concepts.
- Analyze data left after in social media.
- Recognize and apply the concepts of computational models underlying social computing.
- Take out simple forms of social diagnostics, involving network and language models, applying existing analytic tools on social information.
- Evaluate emerging social computing applications, concepts, and techniques in terms of key principles.
- Design and prototype new social computing systems.

GECY107 SOFT COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

The aim of the course is to

- Enumerate the strengths and weakness of soft computing
- Illustrate soft computing methods with other logic driven and statistical method driven approaches
- Focus on the basics of neural networks, fuzzy systems, and evolutionary computing
- Emphasize the role of euro-fuzzy and hybrid modeling methods
- Trace the basis and need for evolutionary computing and relate it with other soft computing approaches

MODULE I SOFT COMPUTING - BASICS 06

Soft computing – Hard Computing – Artificial Intelligence as the basis of soft computing – Relation with logic driven and statistical method driven approaches- Expert systems – Types of problems: Classification, Functional approximation, Optimizations – Modeling the problem – Machine Learning – Hazards of Soft Computing – Current and future areas of research

MODULE II ARTIFICIAL NEURAL NETWORK 12

Artificial Neuron – Multilayer perceptron – Supervised learning – Back propagation network –Types of Artificial Neural Network: Supervised Vs Un Supervised Network – Radial basis function Network – Self Organizing Maps – Recurrent Network – Hopfield Neural Network – Adaptive Resonance Theory – Issues in Artificial Neural Network – Applications

MODULE III FUZZY SYSTEMS 09

Fuzzy Logic – Membership functions – Operators – Fuzzy Inference systems – Other sets: Rough sets, Vague Sets – Fuzzy controllers - Applications

MODULE IV NEURO FUZZY SYSTEMS 09

Cooperative Neuro fuzzy systems – Neural network driven fuzzy reasoning – Hybrid Neuro fuzzy systems – Construction of Neuro Fuzzy systems: Structure Identification phase, Parameter learning phase – Applications

MODULE V EVOLUTIONARY COMPUTING 09

Overview of evolutionary computing – Genetic Algorithms and optimization –

Genetic Algorithm operators – Genetic algorithms with Neural/Fuzzy systems – Variants of Genetic Algorithms– Population based incremental learning – Evolutionary strategies and applications

Total Hours: 45

TEXTBOOKS:

1. Samir Roy, “Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms”, Pearson, 2013
2. Anupam Shukla, Ritu Tiwari and Rahul Kala, “Real life applications of Soft Computing”, CRC press, 2010.
3. Fakhreddine O. Karray, “Soft Computing and Intelligent Systems Design: Theory, Tools and Applications”, Pearson, 2009

OUTCOMES:

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

- Enumerate the theoretical basis of soft computing
- Explain the fuzzy set theory
- Discuss the neural networks and supervised and unsupervised learning networks
- Demonstrate some applications of computational intelligence
- Apply the most appropriate soft computing algorithm for a given situation

GECY108 EMBEDDED SYSTEM PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the design of embedded computing systems with its hardware and software architectures.
- To describe entire software development lifecycle and examine the various issues involved in developing software for embedded systems.
- To analyze the I/O programming and Embedded C coding techniques
- To equip students with the software development skills necessary for practitioners in the field of embedded systems.

MODULE I INTRODUCTION OF EMBEDDED SYSTEM 09

Embedded computing – characteristics and challenges – embedded system design process – Overview of Processors and hardware units in an embedded system – Compiling, Linking and locating – downloading and debugging – Emulators and simulators processor – External peripherals – Memory testing – Flash Memory.

MODULE II SOFTWARE TECHNOLOGY 09

Software Architectures, Software development Tools, Software Development Process Life Cycle and its Model, Software Analysis, Design and Maintenance.

MODULE III INPUT/OUTPUT PROGRAMMING 09

I/O Instructions, Synchronization, Transfer Rate & Latency, Polled Waiting Loops, Interrupt – Driven I/O, Writing ISR in Assembly and C, Non Maskable and Software Interrupts

MODULE IV DATA REPRESENTATION IN EMBEDDED SYSTEMS 09

Data representation, Twos complement, Fixed point and Floating Point Number Formats, Manipulating Bits in -Memory, I/O Ports, Low level programming in C, Primitive data types, Arrays, Functions, Recursive Functions, Pointers, Structures & Unions, Dynamic Memory Allocation, File handling, Linked lists, Queues, Stacks.

MODULE V EMBEDDED C 09

Embedded Systems programming in C – Binding & Running Embedded C program in Keil IDE – Dissecting the program - Building the hardware. Basic

techniques for reading & writing from I/O port pins – switch bounce - LED Interfacing using Embedded C.

Total Hours: 45

REFERENCES:

1. Marilyn Wolf, "Computers as components ", Elsevier, 2012.
2. Qing Li and Carolyn Yao, "Real-Time Concepts for Embedded Systems", CMP Books, 2003.
3. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education
4. Michael Bass, "Programming Embedded Systems in C and C++", Oreilly, 2003.

OUTCOMES:

On completion of this course the student will be able to

- Design the software and hardware components in embedded system
- Describe the software technology
- Use interrupt in effective manner
- Use keil IDE for programming
- Program using embedded C for specific microcontroller
- Design the embedded projects

GECY109 PRINCIPLES OF SUSTAINABLE DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge in the concepts and dimensions of sustainable development.
- To gain knowledge on the framework for achieving sustainability.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 09

Environment and Development - Population poverty and Pollution – Global and Local environmental issues – Resource Degradation- Greenhouse gases – Desertification-industrialization – Social insecurity, Globalization and environment. History and emergence of the concept of sustainable development-Objectives of Sustainable Development.

MODULE II COMPONENTS AND DIMENSIONS OF SUSTAINABLE DEVELOPMENT 09

Components of Sustainability – Complexity of growth and equity – Social economic and environmental dimensions of sustainable development – Environment – Biodiversity – Natural – Resources – Ecosystem integrity – Clean air and water –Carrying capacity – Equity, Quality of Life, Prevention, Precaution – Preservation and Public Participation Structural and functional linking of developmental dimensions.

MODULE III FRAMEWORK FOR ACHIEVING SUSTAINABILITY 09

Operational guidelines – interconnected prerequisites for sustainable development Empowerment of Women, children, Youth, Indigenous People, Non-Governmental Organizations Local Authorities, Business and industry – Science and Technology for sustainable development – performance indicators of sustainability and assessment mechanism – Constraints and barriers for sustainable development.

MODULE IV SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 09

Demographic dynamics of sustainability – Policies for socio-economic development – Strategies for implementing eco-development programmes Sustainable development through trade – Economic growth – Action plan for implementing sustainable development – Urbanization and sustainable Cities –

Sustainable Energy and Agriculture – sustainable livelihoods.

MODULE V SUSTAINABLE DEVELOPMENT AND INTERNATIONAL RESPONSE 09

Role of developed countries in the development of developing countries – international summits – Stockholm to Johannesburg – Rio principles – Agenda-Conventions – Agreements – Tokyo Declaration – Doubling statement – Tran boundary issues integrated approach for resources protection and management

Total Hours: 45

REFERENCES:

1. Sayer J. and Campbell, B., The Science of Sustainable Development: Local Livelihoods and the Global environment - Biological conservation restoration & Sustainability, Cambridge university Press, London, 2003.
2. M.K. Ghosh Roy. and Timberlake, Sustainable Development, Ane Books Pvt. Ltd, 2011.
3. Mackenthun K.M., Concepts in Environmental Management, Lewis Publications London, 1999.
4. APJ Abdul Kalam and Srijan Pal Singh, Target 3 Billion: Innovative Solutions Towards Sustainable Development, Penguin India, 2011

OUTCOMES:

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

- Describe the concepts of sustainable development
- Define the components and dimensions of sustainable development
- Outline the Frame work for achieving sustainability.
- State the policies and strategies for implementing sustainable development for Socio economic programmes.
- Examine the role of developed countries in sustainable development.

GECY110	QUANTITATIVE TECHNIQUES IN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

To impart knowledge on

- Concepts of operations research
- Inventory control in production management
- Financial management of projects
- Decision theory and managerial economics

MODULE I OPERATIONS RESEARCH 09

Introduction to Operations research – Linear programming – Graphical and Simplex Methods, Duality and Post-Optimality Analysis – Transportation and Assignment Problems

MODULE II PRODUCTION MANAGEMENT 09

Inventory control, EOQ, Quantity Discounts, Safety Stock – Replacement Theory – PERT and CPM – Simulation Models – Quality Control.

MODULE III FINANCIAL MANAGEMENT 09

Working Capital Management – Compound Interest and Present Value methods – Discounted Cash Flow Techniques – Capital Budgeting.

MODULE IV DECISION THEORY 09

Decision Theory – Decision Rules – Decision making under conditions of certainty, risk and uncertainty – Decision trees – Utility Theory.

MODULE V MANAGERIAL ECONOMICS 09

Cost concepts – Break even Analysis – Pricing techniques – Game Theory applications.

Total Hours: 45

REFERENCES:

1. Vohra, N.D. , Quantitative Techniques in Management, Tata McGraw Hill Co., Ltd, New Delhi, 2009.
2. Seehroeder, R.G., Operations Management, McGraw Hill, USA, 2002.
3. Levin, R.I, Rubin, D.S., and Stinsonm J., Quantitative Approaches to Management, McGraw Hill Book Co., 2008.

4. Frank Harrison, E., The Managerial Decision Making Process, Houghton Miffin Co. Boston, 2005.
5. Hamdy A. Taha, Operations Research- An Introduction, Prentice Hall, 2002.

OUTCOME:

At the end of the course, the students will be able to

- Apply the concepts of operations research for various applications
- Create models for inventory control in production management
- Compute the cash flow for a project
- Choose a project using decision theory based on the risk criterion.
- Apply the concepts of managerial economics in construction management

GECY111 PROGRAMMING USING MATLAB & SIMULINK

L	T	P	C
1	0	2	2

OBJECTIVES:

The aim of this course is to:

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

MODULE I INTRODUCTION TO MATLAB AND DATA PRESENTATION 10

Introduction to MATLAB-Vectors, Matrices -Vector/Matrix Operations & Manipulation- Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically.

Lab Experiments

1. Study of basic matrix operations and manipulations.
2. Numerical and symbolical solution of linear equations.

MODULE II ROOT FINDING AND MATLAB PLOT FUNCTION 10

Linearization and solving non-linear systems of equations- The Newton-Raphson method- Integers and rational numbers in different bases- Least squares regression -Curve fitting-Polynomial fitting and exponential fitting.

Lab Experiments

1. Solution of non linear equations using Newton-Raphson method.
2. Determination of polynomial fit and exponential fit for the given data.

MODULE III LINEAR AND NON-LINEAR DIFFERENTIAL EQUATIONS 13

Numerical integration and solving first order, ordinary differential equations (Euler's method and Runge-Kutta) - Use of ODE function in MATLAB-Converting second order and higher ODEs to systems of first order ODEs-Solving systems of higher order ODEs via Euler's method and Runge-Kutta) - Solving single and systems of non-linear differential equations by linearization-Use of the function ODE in MATLAB to solve differential equations - Plot Function –Saving & Painting Plots.

Lab Experiments

1. Solution of fourth order linear differential equations using
    a. Trapezoidal Rule

b. Euler method

2. Solution of fourth order non-linear differential equations using
   a. Modified Euler method
   b. Runge – Kutta method

MODULE IV INTRODUCTION OF SIMULINK 12

Simulink & its relations to MATLAB – Modelinga Electrical Circuit- Modeling a fourth order differential equations- - Representing a model as a subsystem- Programme specific Simulink demos.

Lab Experiments

1. Solution of fourth order non-linear differential equations using simulink.
2. Programme specific experiment based on simulink.

Total Hours (Including Practicals): 45

REFERENCE:

1. Griffiths D V and Smith I M, “Numerical Methods for Engineers”, Blackwell, 1991.
2. LaureneFausett, “Applied Numerical Analysis Using MATLAB”, Pearson 2008.
3. Moin P, “Fundamentals of Engineering Numerical Analysis”, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB”, CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving, “Mathematical Exploration with MATLAB”, Cambridge University Press, 1999.

OUTCOMES:

At the end of this unit students will be able to:

- Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
- Write programs using first principles without automatic use of built-in ones.
- Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
- Be fluent in exploring Matlab’s capabilities, such as using matrices as the fundamental data-storage unit, array manipulation, control flow, script

and function m-files, function handles, graphical output.

- Make use of Maltab visual capabilities for all engineering applications.
- An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering fields

GECY112 JAVA PROGRAMMING

L	T	P	C
1	0	2	2

OBJECTIVES:

- To learn the fundamentals of Java programming such as data types, variables and arrays.
- To study the syntax and necessity of decision making and iterative statements.
- To create a class and invoke the methods.
- To instigate programming in overloading of methods.
- To emphasize the concept of packages.
- To learn the exception handling routines.

MODULE I INTRODUCTION TO JAVA PROGRAMMING 08

History and Evolution of Java – Overview of Java – Data types, variables and arrays – Operators – Control statements.

MODULE II METHODS AND CLASSES 07

Class fundamentals – Declaring objects – Methods – Constructors – Garbage collection – Overloading methods – Constructor overloading – Access control – Inheritance – Packages - Exception handling.

L: 15, P: 30, Total Hours: 15

REFERENCES:

1. Herbert Schildt, “Java The Complete Reference”, 9th Edition, Oracle Press, 2014, ISBN: 978007180855-2.
2. Nicholas S. Williams, **“**Professional Java for Web Applications: Featuring WebSockets, Spring Framework, JPA Hibernate and Spring Security (WROX)”, John Wiley & Sons, 2014, ISBN: 978111865651-8.
3. E Balagurusamy, “Programming with Java”, 5th Edition, Tata Mcgraw Hill, 2014.
4. YashavantKanetka**, “**Let Us Java”, 2nd Edition, BPB Publications, 2012**.**

OUTCOMES:

Students who complete this course will be able to

- Implement basic Java programming.
- Create a class and invoke methods for real world problems.

- Construct simple overloading of methods programs.
- Implement various types of inheritance concepts.
- Describe the access control mechanism.
- Handle exception thrown while implementing programming.

GECY113 PYTHON PROGRAMMING

L	T	P	C
1	0	2	2

OBJECTIVES:

- To learn the list and records of python programming.
- To study the control statements and string functions of python.
- To instigate the fundamental python programming.
- To emphasize GUI in python.
- To integrate python with embedded systems.
- To implement programs in python.

MODULE I INTRODUCTION TO PYTHON PROGRAMMING 08

Installation and environment set up – syntax used in python – variable types – operators – Loops – decision making – string functions - formatted files - GUI basics.

MODULE II EMBEDDED PROGRAMMING USING PYTHON 07

Web interface – system tools – script execution context - Motion-triggered LEDs – Python - Arduino prototyping-storing and plotting Arduino data-Remote home monitoring system.

L: 15, P: 30, Total Hours: 15

REFERENCES:

1. Nick Goddard, “Python Programming”, 2nd edition, ISBN: 1533337772, 2016.
2. Pratik Desai, “Python Programming for Arduino”, 1st edition, Packt publishing, 2015, ISBN: 9781783285938.
3. Mark Lutz, Learning Python: Powerful Object-Oriented Programming, 5th Edition, O'Reilly Media, 2013.
4. Richard H. Barnett, Sarah Cox, Larry O'Cull, “Embedded C Programming and the Atmel AVR”, 2nd edition, 2006.
5. Michael Barr, Anthony Massa, “Programming Embedded Systems”, 2nd Edition, O'Reilly Media, 2006.

OUTCOMES:

Students who complete this course will be able to

- Implement date and time function programming using python.

- Write formatted file programming.
- Construct simple python programs.
- Create web interface using python programming
- Develop embedded system with python programming.
- Build Arduino prototype using python programming.

GECY114 INTELLECTUAL PROPERTY RIGHTS (IPR)

L	T	P	C
1	0	0	1

OBJECTIVES:

- To study about Intellectual property rights and its need
- To explore the patent procedure and related issues

MODULE I INTRODUCTION **07**

Introduction and the need for intellectual property right (IPR) – IPR in India – Genesis and Development – IPR in abroad – Important examples of IPR – Copyrights, Trademarks, Patents, Designs, Utility Models, Trade Secrets and Geographical Indications – Industrial Designs

MODULE II PATENT **08**

Concept of Patent – Product / Process Patents & Terminology – Duration of Patents – Law and Policy Consideration Elements of Patentability –- Patentable Subject Matter – Procedure for Filing of Patent Application and types of Applications – Procedure for Opposition – Revocation of Patents – Working of Patents- Patent Agent – Qualification and Registration Procedure – Patent databases and information system – Preparation of patent documents – Process for examination of patent application- Patent infringement – Recent developments in patent system

Total Hours: 15

REFERENCES

1. B.L.Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000
2. AjitParulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010.
4. E. T. Lokganathan, Intellectual Property Rights (IPRs): TRIPS Agreement & Indian Laws Hardcover, 2012
5. Alka Chawla, P N Bhagwati , Law of Copyright Comparative Perspectives 1st Edition, LexisNexis, 2013
6. V. K. Ahuja, Law Relating to Intellectual Property Rights 2nd Edition, LexisNexis, 2nd Edition, 2013

7. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 2015
8. Jatindra Kumar Das, Law of Copyright, PHI Learning, 2015

COURSE OUTCOMES:

Students should be able to

- Identify the various types of intellectual property and their value
- Apply the procedure to file a patent and to deal the related issues
- Search and extract relevant information from various intellectual database