UNIVERSITY VISION AND MISSION

VISION

B.S. Abdur Rahman Institute of Science & 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 OF ELECTRONICS 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.

B.S.ABDUR RAHMAN
UNIVERSITY
B.S. ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd.u/s 3 of the UGC Act, 1956)
(FORMERLY B.S.ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048.

REGULATIONS 2013
FOR
M.TECH. DEGREE PROGRAMMES
(WITH AMENDMENTS INCORPORATED TILL JUNE 2015)

B.S. ABDUR RAHMAN UNIVERSITY, CHENNAI 48.
REGULATIONS -2013 FOR M.TECH / MCA / M.Sc. DEGREE PROGRAMMES

(With amendments incorporated till June 2015)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

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

ii) **"Course"** means a theory or practical subject that is normally studied in a semester, 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 autonomous or off campus institution means B.S.Abdur Rahman University.

v) **"Academic Council"** means the Academic Council of this University.

vi) **"Dean (Academic Affairs)"** means Dean (Academic Affairs) of B.S.Abdur Rahman University.

vii) **"Dean (Student Affairs)"** means Dean(Student Affairs) of B.S.Abdur Rahman University.

viii) **"Controller of Examinations"** means the Controller of Examinations of B.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.	Full Time
M.Tech.	Part Time – Day / Evening
M.C.A.	Full Time
M. Sc.	Full Time
M. Sc.	Full Time

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 Projectwork in part-time mode for valid reasons, shall apply to the Dean (Academic Affairs) through the Head of the Department, if the student satisfies the clause 2.3.4 of this Regulation. 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 - Day time

In this mode of study, the students are required to attend classes for the courses registered along with full time students.

2.2.4 Part time - Evening

In this mode of study, the students are required to attend normally classes in the evening and on Saturdays, if necessary.

2.2.5 A part time student is not permitted to convert to full time mode of study.

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 A student eligible for admission to M.Tech. Part Time / Day Time programme shall have his/her permanent place of work within a distance of 65km from the campus of this Institution.

2.3.5 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. (Full Time) – (Lateral Entry)	4	8
M.Sc. (Full Time)	4	8

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

i. Core courses
ii. Elective courses
iii. Project work / thesis / dissertation
iv. Laboratory Courses
v. Case studies
vi. Seminars
vii. 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. degree Mech./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)	
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. in ECE / Electronics / EIE / ICE / EEE
		M.Tech.(Signal Processing)	
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)
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 and Predictive Analytics)	
		M.Tech. (Computer Science and Engineering with specialization in Big Data Analytics)	
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)	

ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO P.G. PROGRAMMES

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
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. (Full Time) – (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)	
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)	
13	Chemistry	M.Sc.(Chemistry)	B.Sc (Chemistry) of B.Sc. (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 credit range
M.Tech.	75 to 85
M.C.A.	120 to 130
M.Sc.	75 to 85

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
* 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.

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	Non-project Semester	Project semester
M.Tech. (Full Time)	15 to 29	12 to 20
M.Tech. (Part Time)	6 to 18	12 to 16
M.C.A. (Full Time)	15 to 29	12 to 20
M.Sc. (Full Time)	15 to 25	12 to 20

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

3.10 A student may be permitted by the Head of the Department to choose electives offered from other PG programmes either within the Department or from other Departments up to a maximum of three courses during the period of his/her study, provided the Heads of the Departments offering such courses also agree.

3.11 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.

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

3.13 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.

3.14 PROJECT WORK/THESIS/DISSERTATION

3.14.1 Project work / Thesis / Dissertation shall be carried out under the supervision of a qualified teacher in the concerned Department.

3.14.2 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.

3.14.3 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.

3.14.4 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.

3.14.5 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.

3.14.6 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.

3.14.7 A student who has acquired the minimum number of total credits prescribed in the Curriculum for the award of Masters Degree will not be permitted to enroll for more courses to improve his/her cumulative grade point average (CGPA).

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 and enroll for all the courses.

7.2 For the subsequent semesters registration for the courses will be done by the student during a specified week before the semester-end examination 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 Adviser for the choice of courses. The Registration form shall be filled in and signed by the student and the Faculty Adviser.

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 Adviser. 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 should have registered for all preceding semesters before registering for a particular semester.

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)	18 (III semester)
M.Tech. (Part time)	18 (V semester)
M.C.A. (Full time)	45 (V semester)
M.C.A. (Full time) – (Lateral Entry)	22 (V semester)
M.Sc.(Full time)	30 (IV semester) if project is in IV semester 18 (III semester) if project is in III semester

9.2 If the student has not earned minimum number of credits specified, 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.

10.3 Every student should have been certified by the HOD that his / her conduct and discipline have been satisfactory.

11.0 ATTENDANCE

11.1 Attendance rules for all Full Time Programme and Part time - day 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 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.

13.0 ASSESSMENTS AND EXAMINATIONS

13.1 The following rule shall apply to the full-time and part-time 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, in each lecture based course.

13.3 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.

13.4 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

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i} \qquad Where\ \ n = number\ of\ courses$$

where Ci 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:

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

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

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
1.	MAB6186	Applied Mathematics for Electronics Engineers	3	1	0	4
2.	ECB6102	Advanced Radiation Systems	3	0	0	3
3.	ECB6107	Advanced digital communication Techniques	3	1	0	4
4.	ECB6104	Advanced Digital Signal Processing	3	1	0	4
5.		Elective I	3	0	0	3
6.	ECB6101	Research Methodology for Electronics Engineers	3	0	0	3
7.	ECB6105	Communication System Lab	0	0	3	1
8.	ECB6106	Seminar	0	0	2	1
						23

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
1	ECB6211	Mobile Communication Networks	3	0	0	3
2	ECB6212	Satellite Communication	3	0	0	3
3	ECB6213	Microwave Integrated Circuits	3	0	0	3
4	ECB6214	Multimedia Compression Techniques	3	0	0	3
5		Elective II	3	0	0	3
6		Elective III	3	0	0	3
7	ECB6217	RF and Microwave Lab	0	0	3	1
8	ECB6216	Design / Fabrication Project	0	0	3	1
9	ECB6218	Mobile Communication Lab	0	0	3	1
						21

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	C
1.	Elective IV		3	0	0	3
2.	Elective V		3	0	0	3
3.	Elective VI		3	0	0	3
4.	ECB7102	Project Management	3	0	0	3
5.	ECB7101	Project Work - Phase I	0	0	12	6*
						12

SEMESTER IV

Sl. No	Course Code	Course Title	L	T	P	C
1.	ECB7101	Project Work - Phase II	0	0	36	18*
						18 + 6 = 24

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

TOTAL CREDITS : 80

LIST OF ELECTIVES

Sl. No	Course Code	Course
1.	ECBY01	Digital Image Processing
2.	ECBY02	Simulation of Communication Systems and Networks
3.	ECBY03	Global Tracking and Positioning Systems
4.	ECBY04	Electromagnetic Interference and Compatibility in System Design
5.	ECBY05	High Performance Communication Networks
6.	ECBY06	Digital Communication Receivers
7.	ECBY07	Optical Communication Networks
8.	ECBY08	Advanced Microwave systems
9.	ECBY09	Speech and Audio Signal Processing
10.	ECBY10	Network Security
11.	ECBY11	Wireless Communications
12.	ECBY12	Medical Image Processing
13.	ECBY13	Network Management
14.	ECBY14	Internet Working Multimedia
15.	ECBY15	Internet Denial of Service
16.	ECBY16	QoS in Ad Hoc Wireless Networks
17.	ECBY17	Wireless sensor Networks
18.	ECBY18	RF System Design
19.	ECBY19	MIMO systems
20.	ECBY20	Cognitive and Co-operative Radio Communications
21.	ECBY21	RF Wireless Systems And Standards
22.	ECBY22	Software Radio Architecture
23.	ECBY23	Soft Computing
24.	ECBY24	Quantum Computing
25.	ECBY25	Error Control Coding
26.	SSBY01	Society, Technology & Sustainability
27	ECBY47	Microstrip Antennas

SEMESTER I

MAB6186 APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS **L T P C 3 1 0 4**

(Common to M.Tech. Comm. & VLSI)

OBJECTIVES:

- The roots of linear (algebraic or transcendental) equations, solutions of large system of linear equations and eigen value problem of a matrix can be obtained numerically where analytical methods fail to give solution.
- To expose the students in applying laplace transform in engineering fields.
- To acquire the knowledge of special functions and their properties.
- To teach about the probability and random variable of the various functions.
- To introduce the concepts of queuing models.

MODULE I LINEAR ALGEBRAIC EQUATIONS AND EIGEN VALUE PROBLEM **7**

System of Equations – Solution by Gauss Elimination, Gauss-Jordon and LU decomposition method – Jacobi, Gauss-Seidal iteration method – Eigen values of a matrix by Jocobi and Power methods.

MODULE II WAVE EQUATION **8**

Solution of initial and boundary value problems-Characteristics-D'Alembert's Solution –Significance of characteristic curves - Laplace transform solution for displacement in a long string – a long string under its weight-Longitudinal vibration of a elastic bar with prescribed force on one end - free vibrations of a string.

MODULE III SPECIAL FUNCTIONS **8**

Bessel's equation - Bessel Functions - Legendre's equation - Legendre polynomials -Rodrigue's formula - Recurrence relations - generating functions and orthogonal property of Bessel function and Legendre Polynomials.

MODULE IV RANDOM VARIABLES **7**

One dimensional Random Variables - Moments and MGF - Binomial, Poisson Geometrical, Uniform, Exponential, Normal and Weibull distributions.

MODULE V TWO DIMENSIONAL RANDOM VARIABLES **7**

Two -dimensional Random Variables – Marginal and Conditional distribution – Covariance and Correlation coefficient – Functions of one-dimensional and two - dimensional Random Variables.

MODULE VI QUEUING THEORY **7**

Single and Multiple serve Markovian queuing models-Steady state system size probabilities – Little's formula – Customer impatience – Priority quences - M/G/1 queuing system - P-K formula.

Total Hours : 60

TEXT BOOKS:

1. Jain M.K., Iyengar .S.R.K: & Jain.R.K, "Numerical Methods for Scientific and Engineering Computation", New Age International (P) Ltd, Publishers, 2003.
2. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 2005.
3. Taha H.A, "Operations Research – An Introduction", Prentice Hall of India, 2001.

REFERENCES:

1. Sankara Rao K., "Introduction to Partial Differential Equation", Prentice Hall of India, 1997.
2. Kapur J.N & Saxena. H.C, "Mathematical Statistics", S. Chand & Company Limited, New Delhi, 2003.
3. Gross.D & Harris.C.M, "Fundamentals of Queuing Theory", John Wiley & Sons, 1985.

OUTCOMES:

- Be capable of solving large system of linear equations and eigen value problem of a matrix numerically.
- Acquires the knowledge of special functions and applications of laplace transform.
- Able to solve ordinary differential equations numerically.
- Able to solve wave equation using several techniques.
- Learnt the concepts of random variables and queuing models

ECB6102 ADVANCED RADIATION SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To discuss fundamentals of antennas and their characteristics.
- To explain array antennas, reflector antennas and aperture antennas.
- To design monopole micro strip antenna for wireless applications.
- To measure various antenna parameters.

MODULE I ANTENNA FUNDAMENTALS 12

Antenna fundamental parameters, Retarded vector potentials: Heuristic approach and Maxwell's equation approach. 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, reciprocity theorem, Broadband antennas and matching techniques: BALUN transformer, polarization states.

MODULE II ARRAY ANTENNA 9

Linear arrays, Two dimensional uniform array: Phased array, beam scanning, grating lobe, feed network. Pattern multiplication .Linear array synthesis techniques: Binomial, Dolph-Chebyshev distributions, Schelkunoff polynomial method and Fourier transform method.

MODULE III RADIATION FROM APERTURES 9

Field equivalence principle, Huygens Principle, Radiation from Rectangular and Circular apertures, Uniform aperture distribution on an infinite ground plane. Slot antenna, Horn antenna, Reflector antennas, aperture blockage and design consideration.

MODULE IV MICRO STRIP ANTENNA 9

Radiation from patch: Excitation techniques, Microstrip dipole, Rectangular patch, Circular patch, and Ring antenna. Radiation analysis from cavity model. Input impedance, Microstrip array and feed network. Applications.

MODULE V EMC AND ANTENNA MEASUREMENTS 6

EMC measuring antenna: Log periodic dipole, Biconical, Ridge guide, Multi turn loop antenna. Measurement and instrumentation: Gain, Impedance and antenna factor measurement. Antenna test range Design.

Total Hours: 45

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:

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

- Analyze the characteristics of various types of antennas.
- Perform antenna measurements using appropriate instruments.
- Design of monopole, slot and micro strip antennas for different applications.

ECB 6107 ADVANCED DIGITAL COMMUNICATION TECHNIQUES **L T P C 3 1 0 4**

OBJECTIVES:

- To analyze the coherent and non-coherent communication techniques.
- To study the effects of band-limited and fading channels on digital Communication
- To discuss the performance of various coding and spread spectrum Techniques

MODULE I COMMUNICATION OVER MEMORYLESS CHANNEL 9

Signal Space representation of waveforms. Gram-Schmidt procedure. Power Spectral Densities of synchronous random signals. Scalar and Vector communication over Memoryless Channel. Detection criteria.

MODULE II COHERENT AND NON-COHERENT COMMUNICATION 9

Representation of Digitally Modulated Signals. Memoryless Digital Modulation: PAM, PSK, QAM. Modulation with Memory: CP-FSK, CPM. PSD of Digitally Modulated signals.

MODULE III COMMUNICATION OVER AWGN CHANNELS 9

Vector Channel Models. Optimal Receiver for Vector AWGN Channels. Probability of Error for band-limited signals. Bit Error Rate for ASK, PSK, QAM, QPSK. Non-Coherent Detection. Differential PSK. Adaptive Equalization techniques.

MODULE IV CAPACITY OF FADING CHANNELS 9

Characterization of Fading Channels, Diversity Techniques, Slowly fading channel: The RAKE Demodulator, Multi-carrier Modulation-OFDM, Capacity of Finite-State Fading Channel, Coding for Fading Channels, Spread Spectrum Signals.

MODULE V CODED DIGITAL COMMUNICATION 9

Linear Block Codes, Optimum Hard-decision Decoding, Block and Bit Error Probability, Cyclic codes, Convolutional codes, Transfer function of

convolutional codes, Decoding of convolutional codes. Turbo codes and Iterative decoding.

Total Hours = 60

REFERENCES

1. John. G. Proakis, Masoud Salehi, "Digital Communications", 5th Edition, McGraw Hill Higher Education, 2008.
2. M.K. Simon, S.M. Hinedi and W.C. Lindsey, “Digital Communication Techniques; Signaling and Detection”, Prentice Hall India, New Delhi, 2010.
3. Apurba Das, "Digital Communication - Principles and System Modelling", Springer 2010.
4. Simon Haykin, “Digital Communications”, John Wiley and Sons, 2011.
5. Ian Glover, Peter Grant, “Digital Communications”, Prentice Hall, 2003 Edition.
6. Wayne Tomasi, “Advanced Electronic Communication Systems”, 4th Edition, Pearson Education Asia.
7. B.P. Lathi “Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press.
8. Andrew J. Viterbi, Jim K. Omura, "Principles of Digital Communication and Coding", McGraw-Hill Inc.1979.
9. Bernard Sklar – “Modern Digital Communication Technique – Fundamental & Applications”, Prentice Hall, 2001 Edition.

OUTCOMES:

On completion of the course the student will be able to

- Design and model the digital communication systems.
- Evaluate the performance of various digital modulation schemes over AWGN and fading channels
- Design and analyze digital coding methods and spread spectrum techniques.

ECB6104 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

MODULE I TRANSFORMS AND THEIR APPLICATIONS **7**

Review of Z Transform, Discrete Fourier Transform, Discrete Time Fourier Transform, Discrete Fourier Series. Introduction to Discrete Wavelet Transform.Haar wavelet . Application of transforms to discrete signals.

MODULE II DISCRETE TIME RANDOM PROCESSES AND SPECTRUM ESTIMATION **12**

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 **9**

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 **9**

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 8

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

Total Hours: 60

REFERENCES:

1. Monson H.Hayes – Statistical digital signal processing and modeling – John-Wiley & Sons – 2005.
2. John G.Proakis & Dimitris G.Maolakis – DSP principles, algorithms & applications – 4th edition – Pearson Education – 2007.

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

ECB6101 RESEARCH METHODOLOGY FOR ELECTRONICS ENGINEERS

L	T	P	C
3	0	0	3

OBJECTIVE:

To make the students to discuss:

- The different aspects in the formulation and design of research problems
- The utilization of various statistical tools to analyze and to interpret data.
- The importance of documenting the research results and the methods of presenting them for dissemination, adhering to Intellectual Property Rights.

MODULE I RESEARCH PROBLEM FORMULATION **7**

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

MODULE II RESEARCH DESIGN **8**

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, Multivariate analysis - correlation and regression, Curve fitting.

MODULE IV ANALYSIS AND INTERPRETATION OF DATA **10**

Research Data analysis - Interpretation of results - Correlation with scientific facts - repeatability and reproducibility of results - Accuracy and precision - limitations, Use of optimization techniques - Traditional methods – evolutionary optimization techniques.

MODULE V THE RESEARCH REPORT **8**

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, IPR.

Total Hours: 45

REFERENCES:

1. Ganesan.R., ”Research methodology for Engineers”, MJP Publishers,Chennai,2011
2. Kothari C.R., “Research, Methodology - Method and Techniques”. New Age International (P) Ltd., New Delhi, Reprint 2003.
3. Doebelin, Ernest. O., “Engineering Experimentation: planning, execution, reporting”- Tata McGraw - Hill International edition, 1995.
4. Rao S.S. “Engineering Optimization:Theory and Practice”, John Wiley & Sons, 2009
5. Dan Jones, “Technical writing style”, Pearson Education Company, Massachusetts, 1998.
6. Abdul Rahim R., “Thesis writing: A Manual for Researchers”, New Age International (P) Ltd., 2005.

OUTCOME

On completion of this course, the graduates will:

- Distinguish the different aspects in the formulation and design of research problems.
- Use statistical tools to analyze and interpret data
- Document the research results, present them for dissemination, adhering to Intellectual Property Rights.

ECB6105	COMMUNICATION SYSTEM LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

Simulation and performance analysis of

- Various modulation techniques in AWGN and fading Channels.
- Different coding techniques used in communication
- Different adaptive filters
- Spread spectrum communication techniques

LIST OF EXPERIMENTS

Simulation of:

1. Modulation techniques in AWGN Communication Channel.
2. Modulation techniques in fading Communication Channel.
3. Spread Spectrum Communication
4. Linear Codes
5. Cyclic Codes.
6. Adaptive filter design
7. Spectrum Estimation
8. Convolutional encoder
9. Mini Project

OUTCOMES:

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

- Analyze the various modulation techniques in AWGN and fading Channels.
- Assess the performance of various coding techniques used in communication.
- Design and analyze adaptive filters
- Evaluate the performance of spread spectrum communication techniques.

SEMESTER II

ECB6211 MOBILE COMMUNICATION NETWORKS L T P C

3 0 0 3

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

MODULE I MOBILE COMMUNICATION NETWORKS 9

Review of 1G, 2G, 3G and 4G wireless networks, 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.

MODULE II PROPAGATION MODELS AND AIR PROTOCOL 9

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)

MODULE III MOBILE NETWORK ARCHITECTURE 9

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 and SS7, Role of Signaling Interfaces, Network Entities Relation, The Physical Channel, The Logical Channels, Terminals, Call and Network Management Procedures.

MODULE IV WIRELESS LOCAL AREA NETWORKS 9

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 9

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.

Total Hours : 45

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, Imrich Chlamtac, “Wireless and mobile network architectures”, Wiley India, 2011.
6. Holger Karl, Andreas Willig, “ 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 architecture of mobile networks
- Explain the characteristics of wireless LAN systems and
- Express various security algorithms used in wireless networks

ECB6212 SATELLITE COMMUNICATION L T P C

3 0 0 3

OBJECTIVES:

- To know the concept of orbits and spacecraft subsystems
- To design uplinks and down links with various multiple access techniques
- To know the services of satellites

MODULE 1 SATELLITE SUBSYSTEMS 9

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

MODULE 2 SATELLITE LINK DESIGN AND ERROR CONTROL FOR DIGITAL SATELLITE LINKS 9

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 3: 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 4: 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 5: DTH **6**

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 understand

- The orbital parameters, launching mechanism and various subsystems of spacecraft.
- Design of satellite links and various types of satellites and its services.

ECB6213 MICROWAVE INTEGRATED CIRCUITS L T P C

3 0 0 3

OBJECTIVE:

- To explain the different technologies of microwave integrated circuits.
- To design and analyze micro strip lines and microwave devices.

MODULE I TECHNOLOGY OF MICs 8

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 9

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 1800 degree hybrid.

MODULE IV PASSIVE DEVICES 9

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 9

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

- Describe the different types of MICs
- Design and analyze different types of micro strip line and microwave devices.
- Design and analyze non reciprocal components.

ECB6214 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 9

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 9

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

MODULE III AUDIO COMPRESSION 9

Lossy and lossless compression of audio data - μ-law and A-law compression-Differential coder –Jayant quantizer- 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- Zig zag scanning of transform coefficients - JPEG- JPEG 2000 – JBIG -JBIG 2- Haar wavelet based compression- EZW & SPIHT coders -Fractal compression.

MODULE V VIDEO COMPRESSION **6**

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. Fred Halsall: Multimedia communications - Applications, Networks, Protocols & Standards, Pearson Education, 2001.

OUTCOMES:

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

- Apply various data compression techniques
- Estimate compression factor, RMSE & PSNR parameters.

ECB6217	RF AND MICROWAVE LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

To get an exposure on the practical aspects of

- Microwave and RF Components and Instruments
- Measurements at high frequencies.
- Modelling and Simulation of High Frequency systems

LIST OF EXPERIMENTS

1. Study of RF Measurement Instrumentations
2. S-parameter estimation of Microwave devices.
3. Gain and VSWR measurement of Microwave Antennas.
4. Simulation and Measurement of Radiation pattern of Antennas.
5. Measurement of dielectric properties.
6. Design and Simulation of Microstrip Antennas.
7. Design and testing of a Microstrip coupler / Filter.
8. Design and Simulation of passive RF Circuits.

OUTCOMES:

On completion of the course students will be

- Design, Fabricate and Test passive Microstrip and RF components.
- Measurements for antennas and RF components.
- Evaluate the performance of active RF circuits

ECB6216	DESIGN / FABRICATION PROJECT	L	T	P	C
		0	0	3	1

OBJECTIVES :

To improve the professional competency and research aptitude of scholars

GUIDELINES:

- This design skill will help the students to develop the work practice to apply the design skills for real life problems.
- The project can be an experimental project on any of the topics in electronics.
- The project work is allotted individually on different topics.
- The students shall be encouraged to do their project in the parent institute itself.
- 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.

ECB6218	MOBILE COMMUNICATION LAB	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To get an exposure on propagation Models and Path Loss Estimation in Cellular Mobile Communication
- To discuss and evaluate the performance of CDMA and GPS System

List of Experiments

1. Propagation Models and Path Loss Estimation in Cellular Mobile Communication
2. Performance evaluation of CDMA System.
3. Estimation of Received Bit Energy for Data Rates in Wireless Communication
4. Multipath Fading in Cellular Mobile Communication
5. Power-Delay Profile and Doppler Spectrum for Channel Classification in Cellular Mobile Communication
6. Design of Cellular Mobile System
7. Mini project
8. Simulation of Security Algorithms
9. Simulator based performance analysis of wireless networks.

COURSE OUTCOMES:

On completion of the course the student will be able to

- 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 and GPS System

SEMESTER-III

ECB7102	PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of the course is

- To provide knowledge to students about the stages of a project and how each stage can be effectively managed
- To impart design considerations of safety organization and control.

MODULE I **9**

Project definition, Project Profile and standards, Feed back information (MIS), Evaluation and Modification, Selection, Criteria.

MODULE II **9**

Planning the process, Strategic and Managerial Planning, Organising the process planning, cost and costing, Cost Control systems, Economic Balancing, Network Planning, Methods (PERT/CPM), Engineering Flow Diagrams, Cost requirements, Analysis and Estimation of Process Feasibilities (Technical/Economical) Analysis, Cost – Benefit Ratio Analysis, Project Budgeting, Capital Requirements, capital Market, Cash Flow Analysis, Break even strategies.

MODULE III **9**

Plant Engineering Management, Objectives, Programme, Control, Plant Location and Site Selection, Layout diagrams, Selection and procurement of equipment and machineries, Installation, Recommission, Commissioning and performance appraisal, Strategies choice and Influence, Product planning and development, Provision and maintenance of service facilities.

MODULE IV **9**

Process safety, Materials safety and Handling regulations, Safety in equipment and machinery operations, Design considerations of safety organization and control, Pollution, Pollution control and Abatement, Industrial Safety Standard Analysis.

MODULE V **9**

Government regulations on procurement of raw materials and its allocation. Export – Import regulations, Pricing policy, Industrial licensing procedure, Excise and other commercial taxes, Policies on depreciation and corporate tax, Labour laws, Social welfare legal measurements, Factory act, Regulations of Pollution Control Board.

Total Hours : 45

REFERENCES:

1. Cheremisinoff, N. P., Practical Guide to Industrial Safety: Methods for Process Safety Professionals, CRC Press, 2001
2. Couper, J. R., Process Engineering Economics, CRC Press, 2003.
3. Perry, J. H. "Chemical Engineer's Hand Book", 8th Ed., McGraw Hill, New York, 2007.
4. Peters, M. S., Timmerhaus, C. D. and West, R. E., "Plant Design and Economics for Chemical Engineers", 5th Edn., McGraw Hill, 2003.
5. Silla, H., Chemical Process Engineering: Design and Economics, CRC Press, 2003.
6. Vinoski, W., Plant Management Handbook, Pearson Education, Limited, 1998
7. Watermeyer, P., Handbook for Process Plant Project Engineers, John Wiley and Sons, 2002.

OUTCOMES:

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

- Identify key components of a project.
- Describe the stages of a project and how each stage can be effectively managed.
- Recollect design considerations of safety organization and control
- Use government regulations on procuring raw materials.

ELECTIVES

ECBY01 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 **9**

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 **9**

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

MODULE III IMAGE ENHANCEMENT AND RESTORATION **9**

Histogram modification and specification techniques, Noise distributions, Spatial averaging , Directional Smoothing, Median, Geometric mean, Harmonic Mean, Homomorphic filtering, Color image enhancement, Image degradation model – Unconstrained and constrained restoration, Inverse filtering, Removal of blur caused by uniform linear motion, Wiener filtering, Geometric transformations, Spatial transformations, Gray level interpolation.

MODULE IV IMAGE SEGMENTATION AND RECOGNITION **9**

Edge detection, Image segmentation by region growing, region splitting & merging and edge linking, Image Recognition, Patterns and pattern classes, Matching by minimum distance classifier, Matching by correlation, Neural Network applications in image processing.

MODULE V IMAGE COMPRESSION **9**

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

Total Hours : 45

REFERENCES:

1. Rafael C. Gonzalez, Richard E.Woods, Digital Image Processing, Pearson Education, 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, Springer Verlag New York Inc., 2nd Edition, 2001
4. Rafael C. Gonzalez, Richard E.Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson Education, Inc., 2004.
5. William K.Pratt, Digital Image Processing, John Wiley, NewYork, 2002

OUTCOMES:

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

- Acquire the knowledge of fundamental concepts of a digital image processing system
- Analyze 2D signals in the frequency domain through the various transforms.
- Implement suitable algorithms for various digital image processing applications
- Implement concepts of image processing using simulation techniques.

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ECBY02	SIMULATION OF COMMUNICATION SYSTEMS & NETWORKS	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 build the concept of communication networks in terms of modeling
- To analyze the routing model for any communication network

MODULE I MODELLING OF COMMUNICATION SYSTEM 9

Model of speech and picture signals, Pseudo noise sequences, Non-linear sequences, 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 system models, Light wave system models.

MODULE II SIMULATION OF RANDOM VARIABLES AND RANDOM PROCESS 9

Univariate and multivariate models, Transformation of random variables,Bounds and approximation, Random process models-Markov and ARMA Sequences, Sampling rate for simulation, Computer generation and testing of random numbers.

MODULE III ESTIMATION OF PERFORMANCE MEASURES 9

Quality of an estimator, estimator for SNR, Probability density functions of analog communication system, BER of digital communication systems, Monte Carlo method and Importance of sampling method, Estimation of power spectral density.

MODULE IV COMMUNICATION NETWORKS 9

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 **9**

Queues in tandem, Store and forward communication networks, Capacity allocation, Congestion and flow chart, Routing model, Network layout and Reliability.

Total Hours : 45

REFERENCES:

1. M.C.Jeruchim, Philip Balaban and K.Sam Shanmugam, "Simulation of communication systems", Plenum Press, New York,1992
2. A.M.Law and W.David Kelton, "Simulation Modelling and analysis", Mc Graw Hill 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”, Prentice Hall Inc., New Jersey, 1984
5. MC. Jeruchim, P.Balaban, S.Shanmugam, “Simulation of Communication systems- Modelling methodology and techniques”, Plenum publication, 2000.

OUTCOMES:

At the end of the course the student will be

- Analyze different modeling methods of channel
- Model and estimate the channel property

ECBY03 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

MODULE I INTRODUCTION TO TRACKING AND GPS SYSTEM **9**

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 **9**

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 **9**

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 **9**

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 **9**

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.Hoffman Wellenhof, 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

- Describe 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.

ECBY04 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY SYSTEM DESIGN

L	T	P	C
3	0	0	3

OBJECTIVE:

- To introduce the concepts of electromagnetic interference coupling principles and control techniques
- To learn electromagnetic interference measurements and standards
- To explain electromagnetic compatibility design of PCBS

MODULE I EMI ENVIRONMENT **7**

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 **8**

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 the EMI Specification, Standards and Limits.
- Describe the EMI Measurements and Control Techniques.
- apply EMC Design of PCBs.

ECBY05 HIGH PERFORMANCE COMMUNICATION NETWORKS **L T P C**
3 0 0 3

OBJECTIVES:

- To explain 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

MODULE I PACKET SWITCHED NETWORKS **9**

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` **9**

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

MODULE III ATM AND FRAME RELAY **9**

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 **9**

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

MODULE V HIGH PERFORMANCE NETWORKS **9**

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. Sumit Kasera, Pankaj Sethi, “ATM Networks”, Tata McGraw-Hill, New Delhi, 2000.
4. Jean Walrand and Pravin Varaiya, “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, Arunabha Ghosh and Rias Muhamed, “Fundamentals of WiMAX Understanding Broadband Wireless Networking”, Prentice Hall of India, 2008.
7. Stefania Sesia, Issam Toufik, Matthew Baker, “LTE – The UMTS Long Term Evolution”, Wiley, 2011.

OUTCOMES:

At the end of the course student will be able to

- Distinguish various high speed network architectures and protocols
- Compare various advanced network architecture
- Describe the technologies used in wiMax and LTE

ECBY06 DIGITAL COMMUNICATION RECEIVERS L T P C

3 0 0 3

OBJECTIVE:

- To analyze liner and non-linear modulation techniques
- To explain 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 9

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 9

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 9

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 9

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:

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

- Analyze linear and nonlinear modulation techniques
- Construct optimum receivers for communication over AWGN channel and fading channels
- Describe the fading channels characterization and various diversity techniques
- Explain receiver synchronization concepts
- Describe various equalization algorithms

ECBY07 OPTICAL COMMUNICATION NETWORKS L T P C

3 0 0 3

OBJECTIVES:

- To describe the optical technology and network components for Optical communication.
- To classify the various network architectures and topologies for optical networks.
- To discuss the issues in the network design
- To investigate the design and cost tradeoff of wavelength routing in optical networks.
- To explain the networking protocols and its test beds.
- To illustrate the high capacity networks

MODULE I OPTICAL TECHNOLOGY 6

Light Propagation in optical fiber, Non linear effects, subcarrier modulation and multiplexing, spectral efficiency, Demodulation, error detection and correction.

MODULE II OPTICAL NETWORKING COMPONENTS 7

First- and second-generation optical networks, Components: couplers, isolators, circulators, multiplexers, filters, amplifiers, switches, and wavelength converters.

MODULE III SONET AND SDH NETWORKS 7

Integration of TDM signals, Layers, Framing, Transport overhead, Alarms, Multiplexing, Network elements, Topologies, Protection architectures, Ring architectures, Network Management.

MODULE IV BROADCAST AND SELECT NETWORKS 8

Topologies, Single-hop, Multihop, and Shufflenet multihop networks, Media-Access control protocols, Test beds.

MODULE V WAVELENGTH-ROUTING NETWORKS 8

Node designs, Issues in Network design and operation, Optical layer cost Tradeoffs, Routing andWavelength assignment, Wavelength routing test beds.

MODULE VI HIGH CAPACITY NETWORKS 9

SDM, TDM, and WDM approaches, Application areas, Optical TDM Networks: Multiplexing and demultiplexing, Synchronization, Broadcast networks, Switch-based networks, OTDM test beds.

Total Hours : 45

REFERENCES:

1. Rajiv Ramaswami and Kumar Sivarajan, Optical Networks: A practical perspective, Morgan Kaufmann, 2nd edition, 2001.
2. Vivek Alwayn, Optical Network Design and Implementation, Pearson Education, 2004.
3. Hussein T.Mouftab and Pin-Han Ho, Optical Networks: Architecture and Survivability, Kluwer Academic Publishers, 2002.
4. Biswanath Mukherjee, Optical Communication Networks, McGraw Hill, 1997.

OUTCOMES:

On completion of this course the student will understand

- Analyze and select the optical networking components.
- Describe the architecture of SONET/SDH and network elements.
- Compare different topologies of broadcast and select networks.

ECBY08 ADVANCED MICROWAVE SYSTEMS L T P C

3 0 0 3

OBJECTIVE:

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

MODULE I ELECTROMAGNETIC AND TRANSMISSION LINES THEORY 7

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 7

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 MATCHING AND TUNING 8

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 8

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 **8**

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 **7**

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:

The course ensures that students acquire the following educational outcomes:

- Explain the underlying principles of microwave theory.
- Identify the concepts to design microwave devices satisfying a given set of specifications and to predict their behavior.
- Mastery of the use of microwave equipment such as network and spectrum analyzers.

ECBY09 SPEECH AND AUDIO SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVE:

- To learn the basic digital audio algorithms
- To discuss the operation of the processors and the way in which these processes effect sound.

MODULE I INTRODUCTION **5**

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 **7**

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 **7**

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 **8**

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 – Homomorphic Vocoders.

MODULE V LINEAR PREDICTIVE ANALYSIS OF SPEECH 9

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 9

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 manipulate, visualize and analyze speech signals
- The student will be able to apply various decomposition techniques and modifiy the speech signals.

ECBY10 NETWORK SECURITY L T P C

3 0 0 3

OBJECTIVES:

- Discuss the major algorithms of historical and modern cryptography as documented in open literature
- Knowledge of issues involved in choice of algorithm and key size
- Ability to analyze performance of various cryptographic and cryptanalytic algorithms

MODULE I SYMMETRIC CIPHERS (TECHNIQUES AND STANDARDS) –I 9

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 9

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 9

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 **9**

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 **9**

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

- Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attacks.
- Get knowledge on development of security policies, standards and practices.
- Identify some of the factors driving the need for network security.

ECBY11 WIRELESS COMMUNICATIONS 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 broad band modulation
- To impart knowledge on multiuser systems .

MODULE I INTRODUCTION 7

Wireless spectrum and allocation, 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 DIVERSITY OF WIRELESS CHANNELS 7

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

MODULE III MULTIPLE ANTENNA SYSTEMS 8

Narrow band MIMO model, MIMO channel capacity, MIMO Diversity and beam forming, diversity multiplexing tradeoff, space time modulation and coding, frequency selective fading MIMO channels, smart antennas.

MODULE IV MULTI CARRIER MODULATION 9

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 9

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 Soo Cho , 'MIMO – OFDM wireless communications with MATLAB', IEEE press, John Wiley publications, 2010.

OUTCOMES

On completion of this course the student will be able to

- Describe ray tracing models and path loss models
- Characterize wireless channels and describe channel models
- Discuss MIMO system model and channel models.
- Explain multi carrier modulation schemes
- Explore on Broadband modulation and Multiuser systems

ECBY12 MEDICAL IMAGE PROCESSING L T P C

3 0 0 3

OBJECTIVES:

- To explain fundamental idea on image representation, preprocessing, analysis, classification, reconstruction, registration and visualization of medical images.
- To interpret medical images through various multimodal imaging sources

MODULE I IMAGE FUNDAMENTALS 9

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 9

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 9

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

MODULE IV IMAGE ANALYSIS AND CLASSIFICATION 9

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, Rule based, Neural Network approaches.

MODULE V IMAGE REGISTRATIONS AND VISUALIZATION 9

Rigid body visualization: Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration,

Image visualization: 2D display methods, 3D display methods, virtual reality based interactive visualization.

Total Hours : 45

REFERENCES:

1. Atam P.Dhawan, “Medical Image Analysis”, Wiley Interscience Publication, 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”, Second edition Springer Verlag Network, 1991.
5. Kavyan Najarian and Robert Splerstor, “Biomedical signals and Image processing”, CRC, Taylor and Francis, New York, 2006.
6. John L.Semmlow, “Biosignal and Biomedical Image Processing Matlab Based applications”, 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

- Define medical images in digital format
- Compare various imaging sources(i.e.,MRI,CT,SPECT etc)
- extract, analyze and interpret information from medical data

ECBY13 NETWORK MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To discuss the fundamental concepts of network management
- To have an exposure to network security aspects
- To explain about the architecture, standard and services of broadband networks.

MODULE I FUNDAMENTALS OF COMPUTER NETWORK TECHNOLOGY 9

Network Topology, LAN, Networks node components : Hubs, Bridges, Routers, Gateways, Switches, WAN, ISDN : Transmission technology, Communication Protocols and standards.

MODULE II OSI NETWORK MANAGEMENT 9

OSI Network Management Model: Organizational model, Information Model, Communication model. Abstract Syntax notation : Encoding structure, Macros Functional model CMIP / CMIS.

MODULE III INTERNET MANAGEMENT 9

SMMO: Organization model, System overview, the information model, communication model, Functional model, SNMP Proxy server, Management information and Protocol remote monitoring.

MODULE IV BROADBAND NETWORK MANAGEMENT 9

Broadband networks and services, ATM Technology: VP, VC, ATM Packet, Intergrated service, emulation, Virtual Lan. ATM Network Management-ATM Network reference model, Integrated Management Interface: ATM Management Information base, Role of SNMD and ILMIin, Management, M1, M2, M3, M4 Interface, ATM Digital Exchange Interface Management.

MODULE V NETWORK MANAGEMENT APPLICATIONS 9

Configuration management, Fault management, Peformance management,

Event Corelation Techniques security Management, Accounting management, Report Management, Policy Based Management Service Level Management.

Total Hours : 45

REFERENCES:

1. Mani Subramanian, “Network Management Principles and practice”, Addison, Wesly New York, 2000.
2. Salah Aiidarous, Thomas Plevayk, “Telecommunications Network Management Technologies and Implementations”, eastern Economy Edition IEEE press, New Delhi, 1998.
3. Lakshmi G. Raman, “Fundamentals of Telecommunication Network Management”, Eastern Economy Edition IEEE Press, New Delhi, 1999.

OUTCOMES:

On completion of the course the student will be able to

- Describe the organizational model and the concepts of network management
- Differentiate internet and broadband network management techniques.

ECBY14 INTERNETWORKING 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 9

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 9

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 9

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 9

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 9

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

- Able to The evolution of Internet service models.
- Design and analyze Multimedia broadband networks.
- Apply different coding and compression techniques.

ECBY15	INTERNET DENIAL OF SERVICE	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To study about the Denial of Service attacks in crippling applications, servers and old networks.
- To illustrate the prevention of DoS attacks.

MODULE I INTRODUCTION AND HISTORY OF DoS AND DDoS 9

Difference between DoS and DDoS, Understanding DoS: Ulterior motive, Attackers,Distribution effects, DDoS: Hype or reality, Vulnerability to DoS, History: Motivation, Design principles of the internet,DoS and DDoS Evolution.

MODULE II ATTACK WAGING AND DDoS DEFENSES 9

Recruitment of the agent network, Controlling the DDoS agent network, Semantic levels of DDoS attacks-Attack toolkits, IP spoofing, DDoS attack trends, DDoS defense challenges, prevention Vs. Protection and reaction, DDoS defense goals and locations, Defense approaches.

MODULE III DEFENSE APPROACHES 9

Thinking about defense, general strategy for DDoS defense, preparing to handle a DDoS attack, Handling ongoing DDoS attack as a target and source, Agreement with local ISP, Analysing DDoS tools.

MODULE IV SURVEY OF DEFENSE RESEARCH APPROACHES 9

Pushback- Trace back-D-Ward-Net bouncer-Security overlay services (SOS), Proof of work, Def COM-COSSACK-PI-SIFF: An end-host capability mechanism to mitigate DDoS flooding attacks, Hop-count filtering, Locality and entropy principles.

MODULE V LEGAL ISSUES 9

Basics of the US legal system, Laws that may apply to DDoS attacks, Victims of DDoS, Legal assistance in DDoS, case initiating legal proceedings as a victim of DoS, Estimating damages, Jurisdictional issues, Domestic legal issues, International legal issues, Current trends in international cyber law.

Total Hours : 45

REFERENCES:

1. Jelena Mirkovic, Sven Dietrich, David Dittrich, Peter Reiher, “Internet Denial of Service: Attack and Defense Mechanisms”, Published by Prentice Hall PTR, 2004.
2. James Kempf, “Wireless Internet Security: Architecture and Protocols”, Published in the United States of America by Cambridge University Press, New York 2008.
3. Kaufman, C., Perlman, R., & Speciner, M (2002), “Network Security: PRIVATE Communications”, PUBLIC World. Upper Saddle River, NJ: Prentice Hall.
4. Ed Skoudis; Tom Liston, “Counter Hack reloaded”, Second Edition: A Step-by - Step Guide to Computer Attacks and Effective Defences, Prentic Hall, PTR, 2005.

OUTCOMES:

On completion of this course the student will

- Describe new threat in DoS and DDoS attacks
- Provide solution for these attacks, preventing them when possible, and dealing with them when they occur.

ECBY16 QoS IN ADHOC WIRELESS NETWORKS L T P C

3 0 0 3

OBJECTIVE:

- 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 9

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

MODULE II MEDIUM ACCESS PROTOCOLS 9

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 9

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 9

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 9

Issues and challenges, Classification of QoS solution : 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 understand

- The general concept of Ad-hoc networks.
- protocols of ad hoc wireless networks.
- issues, challenges and solution of QoS in Ad-hoc networks.

ECBY17 WIRELESS SENSOR NETWORKS L T P C

3 0 0 3

OBJECTS

- 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 7

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 7

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 9

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. Waltenegus Dargie 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 Mc EWen 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

ECBY18 RF SYSTEM DESIGN L T P C

3 0 0 3

OBJECTS

- 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.

MODULE I RF ISSUES 9

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 9

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 9

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 9

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 9

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 9

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

Total Hours : 45

REFERENCES:

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

OUTCOMES:

On completion of this course the student will be able to

- Know the importance of RF design.
- Analyze the characteristics of amplifier circuits.
- Solve impedance matching for RF circuits.
- Design RF system module.

ECBY19	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 9

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

MODULE II SPATIAL MULTIPLEXING AND CHANNEL MODELING 9

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 9

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

MODULE IV SPACE TIME CODING AND MIMO -OFDM 9

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 9

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, Pramod Viswanath, '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
- Analyze MIMO receiver design

ECBY20	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 9

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 9

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 9

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 9

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.

OUTCOME:

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

- Describe cooperatives communication.
- Illustrate the system models of cooperatives communication.
- Differentiate the protocol and network architecture for cognitive radios.

ECBY21 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, WIMAX and UWB standards

MODULE I INTRODUCTION TO CELLULAR STANDARDS 9

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 9

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 9

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 9

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

MODULE V RECENT ADVANCES **9**

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

Total Hours : 45

REFERENCES:

1. Assuncion Santamaria, Francisco Lopez-Hernandez, “Wireless LAN Standards and Applications”, Artech House, 2001.
2. Dharma Prakash Agarwal and Qing- An zeng, “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

OUTCOME:

On completion of this course the students will:

- Develop knowledge on the cellular standards and modulation techniques
- Explain the latest technologies introduced in wireless systems
- Describe the 3G, 4G and UWB standards

ECBY22 SOFTWARE RADIO ARCHITECTURE L T P C

3 0 0 3

OBJECTIVES:

To discuss

- The concepts of software radio
- Design issues in software radio
- Signal generation and processing and RF design
- Cognitive radio and its spectrum issues

MODULE I INTRODUCTION 7

The Need for Software Radios. Characteristics and Benefits of a Software Radio – Design Principles of a Software Radio.

MODULE II RADIO FREQUENCY IMPLEMENTATION ISSUES 9

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. ADC and DAC Distortion.

MODULE III DIGITAL GENERATION OF SIGNALS 9

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 12

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.

MODULE V COGNITIVE RADIO **8**

Introduction-communication policy and spectrum-spectrum sensing-spectrum management –spectrum mobility-spectrum sharing-SDR as Platform for Cognitive radio.

Total Hours : 45

REFERENCES:

1. Jeffrey H Reed, “Software Radio: A Modern Approach to Radio Engineering”, PEA Publication, 2002.
2. Walter Tuttle bee, “Software Defined Radio: Enabling Technologies”, Wiley Publications, 2002.
3. Paul Burns, “Software Defined Radio for 3G”, Bartech House, 2002.
4. Markus Dillinger, “Software Defined Radio: Architectures, Systems and Functions”, 2003.
5. Bard,Kovarik,”Software Defined Radio, The Software Communications Architecture”, Wiley 2007.
6. Peter Kenington, “RF And Baseband Techniques for Software Defined Radio. Artech House Publishers”, 2005,
7. Bruce Alan Fette,”Cognitive radio technology”, Academic Press, 2009.

OUTCOMES:

On completion of this course, the students can able to:

- Explain the software radio architecture
- List cognitive radio and its spectrum issues
- Describe RF design issues.

ECBY23 SOFT COMPUTING L T P C

3 0 0 3

OBJECTIVES:

- To learn soft computing algorithms.
- To introduce new ideas of neural networks, fuzzy logic and use of heuristics based on human experience.
- To understand the concepts of Genetic algorithm and its applications.

MODULE I NEURAL NETWORK 7

Machine Learning Basics, Fundamental concept, Evolution of Neural Networks, Basic Models of Artificial Neural Networks, Important Terminologies of ANNs, McCulloch, Pitts Neuron, Supervised Learning Network:, Multiple Adaptive Linear Neurons – Back, Propagation Network, Radial Basis Function Network.

MODULE II ARTIFICIAL NEURAL NETWORK 7

Associative Memory Networks: Training Algorithms for Pattern Association – Autoassociative Memory Network, Heteroassociative Memory Network – Bidirectional Associative Memory, Hopfield Networks, Iterative Autoassociative Memory Networks, Temporal Associative Memory Network. Unsupervised Learning Networks: Fixed weight Competitive Nets, Kohonen Self,Organizing Feature Maps, Learning Vector Quantization, Counter propagation Networks, Adaptive Resonance Theory Networks, Special Networks.

MODULE III FUZZY SET THEORY 7

Introduction to Classical Sets and Fuzzy sets, Classical Relations and Fuzzy Relations, Tolerance and Equivalence Relations, Membership Functions: Fuzzification, Methods of Membership Value Assignments, Defuzzification, Lambda, Cuts for Fuzzy sets and Fuzzy Relations, Defuzzification Methods.

MODULE IV FUZZY SET THEORY 7

Fuzzy Arithmetic and Fuzzy Measures: Fuzzy Rule Base and Approximate Reasoning: Truth values and Tables in Fuzzy logic, Fuzzy Propositions, Formation of Rules, Decomposition and Aggregation of rules, Fuzzy Reasoning, Fuzzy Inference Systems (FIS), Fuzzy Decision Making, Fuzzy Logic Control Systems.

MODULE V GENETIC ALGORITHM **8**

Introduction, Basic Operators and Terminologies in GAs, Traditional Algorithm vs. Genetic Algorithm, Simple GA, General Genetic Algorithm, The Scheme Theorem, Classification of Genetic Algorithm, Holland Classifier Systems , Genetic Programming.

MODULE VI APPLICATIONS OF SOFT COMPUTING **9**

A Fusion Approach of Multispectral Images with SAR Image for Flood Area Analysis, Optimization of Travelling Salesman Problem using Genetic Algorithm Approach, Genetic Algorithm based Internet Search Technique, Soft Computing based Hybrid Fuzzy Controllers, Soft Computing based Rocket Engine, Control.

Total Hours : 45

REFERENCES:

1. S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2003.
2. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004.
3. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications and Programming Techniques”, Pearson Edition., 2003.

OUTCOMES:

- To obtain the theoretical and practical knowledge for design and development of basic intelligent systems.
- Develop an application using various soft computing algorithms.
- Solving various real world problems using soft computing algorithms.

ECBY24	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an introduction to the theory and practice of quantum computation.
- To develop the basic knowledge on quantum information and circuits.
- To understand about various quantum algorithms and quantum error correction

MODULE I INTRODUCTION TO 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 9

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 6

Errors and correction for errors. Simple examples of error correcting codes in

classical computation.Linear codes. Quantum error correction and simple examples. Shor code.

Total Hours: 45

REFERENCES:

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

OUTCOMES:

On the completion of this course, the students will

- Relate quantum mechanics and classical mechanics.
- Acquire a working knowledge of quantum information theory, with a focus on quantum simulation.
- Get insight knowledge on quantum algorithms and error correction techniques.

ECBY25 ERROR CONTROL CODING L T P C

3 0 0 3

OBJECTIVES:

- Introduce traditional and modern coding techniques.
- Intoduce the coding Algebra
- Recognize the importance of Coding techniques in Digital Communication
- Introduce the recent advancements in codes
- Develop application of coding knowlwdge in different fields

MODULE I CODING AND ALGEBRA 9

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 9

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 9

Turbo codes: Encoders, interleavers, Puncturing. turbo decoder.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 9

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 9

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:45 Hrs

REFERENCES:

1. Shu Lin and Daniel Costello, “Error Control Coding”, Pearson, II edition, 2004.
2. Rudiger Urbanke 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. Dhouha Kbaier 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 the course the student will be able to

- Describe modern coding techniques.
- Compare and analyze the performance of all type of codes
- Develop an efficient coding technique for a given application.

SSBY01 SOCIETY, TECHNOLOGY AND SUSTAINABILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- Aware of new technologies through advances in Science and Engineering.
- To make them realise the profound impact on society.
- 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 **9**

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 **9**

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 **9**

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 **9**

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 **9**

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.

ECBY47	MICROSTRIP ANTENNAS	L	T	P	C
		3	0	0	3

OBJECTIVE

- To understand the basic concepts of antenna and 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 understand 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 9

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 II MICROSTRIP TRANSMISSION LINES 9

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 III INTRODUCTION TO MICROSTRIP ANTENNA 9

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

MODULE IV RECTANGULAR MICROSTRIP ANTENNAS 9

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 9

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 : 45 PERIODS

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, 3rd ed, 2007.
5. I.J. Bahl and P. Bhartia,” Microstrip Antennas”, Artech House, Inc.,1980

OUTCOME:

On completion of this course the student will

- Describe the basic concepts of antenna properties and parameters.
- Analyze the radiation mechanism and feeding techniques of microstrip patch antennas.
- Analyze and design of various rectangular, circular microstrip antennas.