B.S. Abdur Rahman Crescent Institute of Science & Technology

Deemed to be University u/s 3 of the UGC Act, 1956

Regulations 2019
Curriculum and Syllabi

(Amendments updated upto June 2020)

M.Tech.
(Communication Systems)

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

REGULATIONS 2019
CURRICULUM AND SYLLABI
(Amendments updated upto June 2020)

M.TECH.
COMMUNICATION SYSTEMS

VISION AND MISSION OF THE INSTITUTION

VISION

B.S.Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in multidisciplinary areas of importance and to play a vital role in the Socio-Economic progress of the Country in a sustainable manner.

MISSION

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

VISION AND MISSION OF THE DEPARTMENT OFELECTRONICS AND COMMUNICATION ENGINEERING

VISION

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

MISSION

- The Department of Electronics and Communication Engineering, endeavours 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 successful completion of the programme, the graduates will be able to

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Identify, formulate, research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- Use research –based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES

On successful completion of the programme, 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 CRESCENT INSTITUTE OF SCIENCE & TECHNOLOGY, CHENNAI – 600 048.

REGULATIONS - 2019 FOR

M.Tech. / MCA / M.Sc. DEGREE PROGRAMMES

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires **"Programme"** means Post Graduate Degree Programme (M.Tech. / MCA / M.Sc.)

"Course" means a theory / practical / laboratory integrated theory / mini project / seminar / internship / Project and any other subject that is normally studied in a semester like Advanced Concrete Technology, Electro Optic Systems, Financial Reporting and Accounting, Analytical Chemistry, etc.,

"Institution" means B.S. Abdur Rahman Crescent Institute of Science & Technology.

"Academic Council" means the Academic Council, which is the apex body on all academic matters of B.S. Abdur Rahman Crescent Institute of Science & Technology.

"Dean (Academic Affairs)" means Dean (Academic Affairs) of B.S. Abdur Rahman Crescent Institute of Science & Technology who administers the academic matters.

"Dean (Student Affairs)" means Dean (Student Affairs) of B.S. Abdur Rahman Crescent Institute of Science & Technology, who looks after the welfare and discipline of the students.

"Controller of Examinations" means the Controller of Examinations of B.S. Abdur Rahman Crescent Institute of Science & Technology who is responsible for the conduct of examinations and declaration of results.

2.0 PROGRAMMES OFFERED AND ADMISSION REQUIREMENTS

2.1 Programmes Offered

The various programmes and their mode of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
MCA	
M.Sc.	

2.2 ADMISSION REQUIREMENTS

2.2.1 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 Institution as specified in the clause 3.2 [Eligible entry qualifications for admission to P.G. programmes] or any other degree examination of any University or authority accepted by this Institution as equivalent thereto.

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

3.0 DURATION, ELIGIBILITY AND STRUCTURE OF THE PROGRAMME

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

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech.	4	8
MCA (3 years)	6	12
MCA (Lateral Entry)	4	8
MCA (2 years)	4	8
M.Sc.	4	8

3.1.1 Each academic semester shall normally comprise of 90 working days. Semester End Examinations shall follow within 10 days of the last Instructional day.

3.1.2 Medium of instruction, examinations and project report shall be in English.

3.2 ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO PROGRAMMES

Sl. No.	Name of the Department	Programmes offered	Qualifications for admission
1.	Aeronautical Engineering	M. Tech. (Avionics)	B.E. / B. Tech. (Aeronautical Engineering)
2.	Civil Engineering	M. Tech. (Structural Engineering)	B.E. / B. Tech. (Civil Engineering) / (Structural Engineering)

		M. Tech. (Construction Engineering and Project Management)	B.E. / B. Tech. (Civil Engineering) / (Structural Engineering) / B. Arch.
3.	Mechanical Engineering	M.Tech. (Manufacturing Engineering)	B.E. / B.Tech. (Mechanical / Automobile / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace /Aeronautical / Material Science / Marine Engineering)
		M.Tech. (CAD/CAM)	
4.	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 and Drives)	
5.	Electronics and Communication Engineering	M.Tech. (Communication Systems)	B.E. / B. Tech. (EEE/ ECE / E&I / CSE IT / I&C / Electronics / Instrumentation)
		M.Tech. (VLSI and Embedded Systems)	B.E. / B. Tech. (ECE / E&I / I&C / EEE / CSE / IT)
6.	Electronics and Instrumentation Engineering	M.Tech. (Electronics and Instrumentation Engineering)	B.E. / B. Tech. (EIE/ICE/Electronics/ECE/EEE)
7.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. / B. Tech. (CSE/IT/ECE/EEE/EIE/ICE/ Electronics / MCA)
8.	Information Technology	M.Tech. (Information Technology)	B.E. / B. Tech. (IT/CSE/ECE/EEE/EIE/ICE/ Electronics / MCA)

9.	Computer Applications	MCA (3 years)	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level
		MCA – (Lateral Entry)	B.Sc. Computer Science / B.Sc. Information Technology / BCA
		MCA (2 years)	Bachelor Degree in any discipline with Mathematics as one of the subjects (or) Mathematics at +2 level or B.Sc. Computer Science / B.Sc. Information Technology / BCA
10.	Mathematics	M.Sc. (Actuarial Science)	Any Degree with Mathematics / Statistics as one of the subjects of study
11.	Physics	M.Sc.(Physics)	B.Sc. (Physics / Applied Science / Electronics / Electronics Science / Electronics & Instrumentation)
12.	Chemistry	M.Sc.(Chemistry)	B.Sc. (Chemistry / Applied Science)
13.	Life Sciences	M.Sc. Molecular Biology & Biochemistry	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.Tech. Biotechnology	B.Tech. (Biotechnology / Chemical Engineering) / M.Sc. in any branch of Life Sciences

3.3. STRUCTURE OF THE PROGRAMME

3.3.1 The PG. programmes consist of the following components as prescribed in

the respective curriculum

i. Core courses
ii. Elective courses
iii. Laboratory oriented core courses
iv. Project work / thesis / dissertation
v. Laboratory Courses
vi. Seminars
vii. Mini Project
viii. Industrial Internship
ix. Value Added Courses
x. MOOC Courses (NPTEL, SWAYAM, etc.,)

3.3.2 The curriculum and syllabi of all programmes shall be approved by the Academic Council of this Institution.

3.3.3 For the award of the degree, the student has to earn a minimum total credits specified in the curriculum of the respective specialization of the programme.

3.3.4 The curriculum of 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	Range of credits
M.Tech.	74 - 80
MCA (3 years)	118 - 126
MCA (Lateral Entry)	80 - 85
MCA (2 years)	85 - 90
M.Sc.	77- 82

3.3.5 Credits will be assigned to the courses for all programmes as given below:

- One credit for one lecture period per week or 15 periods of lecture per semester
- One credit for one tutorial period per week or 15 periods per semester
- One credit each for seminar/practical session/project of two or three periods per week or 30 periods per semester
- One credit for four weeks of industrial internship or 160 hours per semester.

3.3.6 The number of credits the student shall enroll in a non-project semester and

project semester is as specified below to facilitate implementation of Choice Based Credit System.

Programme	Non-project semester	Project semester
M.Tech.	9 to 28	18 to 26
MCA	12 to 33	12 to 26
M.Sc.	9 to 32	10 to 26

3.3.7 The student may choose a course prescribed in the curriculum from any department offering that course without affecting regular class schedule. The attendance will be maintained course wise only.

3.3.8 The students shall choose the electives from the curriculum with the approval of the Head of the Department / Dean of School.

3.3.9 Apart from the various elective courses listed in the curriculum for each specialization of programme, the student can choose a maximum of two electives from any other similar programmes across departments, during the entire period of study, with the approval of the Head of the department offering the course and parent department.

3.4. ONLINE COURSES

3.4.1 Students are permitted to undergo department approved online courses under SWAYAM up to 20% of credits of courses in a semester excluding project semester with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean Academic Affairs during his/ her period of study. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

3.4.2 Students shall undergo project related online course on their own with the mentoring of the faculty member.

3.5 PROJECT WORK / DISSERTATION

3.5.1 Project work / Dissertation shall be carried out by the student under the supervision of a Faculty member in the department with similar specialization.

3.5.2 A student may however, in certain cases, be permitted to work for the project in an Industry / Research Organization, with the approval of the Head of the Department/ Dean of School. 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 meetings for evaluating the progress.

3.5.3 The timeline for submission of final project report / dissertation is within 30 calendar days from the last Instructional day of the semester in which Project / Dissertation is done.

3.5.4 If a student does not comply with the submission of project report / dissertation on or before the specified timeline he / she is deemed to have not completed the project work / dissertation and shall re-register in the subsequent semester.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 CLASS ADVISOR

A faculty member shall be nominated by the HOD / Dean of School 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 / Dean of School of the students shall 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 in every semester.

5.0 CLASS COMMITTEE

5.1 A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman will be constituted in every semester:

5.2 The composition of the class committee will be as follows:

i) One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department

ii) Faculty members of all courses of the semester

iii) All the students of the class

iv) Faculty advisor and class advisor

v) Head of the Department – Ex officio member

5.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first and second assessment. The second meeting shall be held within a week after the date of first assessment report, to review the students' performance and for follow up action.

5.4 During these two meetings the student members, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabus.

5.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

6.0 COURSE COMMITTEE

6.1 Each common theory / laboratory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers handling 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 handling the common course belong to a single department or from several departments. The Course Committee shall meet as often as possible to prepare a common question paper, scheme of evaluation and ensure uniform evaluation of the assessment tests and semester end examination.

7.0 REGISTRATION AND ENROLLMENT

7.1 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees.

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

7.3 A student can withdraw from an enrolled course at any time before the first assessment test for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

7.4 A student can change an enrolled course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

8.0 TEMPORARY BREAK OF STUDY FROM THE PROGRAMME

8.1 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. A student can avail the break of study before the start of first assessment test of the ongoing semester. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1). If any student is debarred for want of attendance or suspended due to any act of indiscipline, it will not be considered as break of study. A student who has availed break of study has to rejoin in the same semester only in the subsequent year. The student availing break of study is permitted to write arrear examinations by paying the prescribed fees.

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / 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.	18
MCA (3 years)	45
MCA (Lateral Entry)	22
MCA (2 years)	22
M.Sc.	18

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 ATTENDANCE

10.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds, representing for the institution 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. The courses in which the student is awarded "I" grade, shall register and redo the course when it is offered next.

10.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in that course to the Class Advisor. The Class Advisor will consolidate and furnish the list of students who have earned less that 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of School. Thereupon, the Dean (Academic Affairs) shall announce the names of such students prevented from writing the semester end examination in each course.

10.3 A student who has obtained 'I' grade in all the courses in a semester is not permitted to move to next higher semester. Such student shall redo all the courses of the semester in the subsequent academic year. However he / she is permitted to redo the courses awarded with 'I' grade / arrear in previous semesters. They shall also be permitted to write arrear examinations by paying the prescribed fee.

10.4 A student shall register to redo 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 chosen with the approval of Head of the Department / Dean of School.

11.0 REDO COURSES

11.1 A student can register for a maximum of two redo courses per semester in the evening after regular working hours, if such courses are offered by the concerned department. Students may also opt to redo the courses offered during regular semesters, without affecting the regular academic schedule

and not exceeding prescribed maximum credits.

11.2 The Head of the Department with the approval of Dean (Academic Affairs) may arrange for the conduct of a few courses in the evening after regular working hours, depending on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.

11.3 The number of contact hours and the assessment procedure for any redo course will be the same as those during regular semesters except that there is no provision for any substitute examination and withdrawal from an evening redo course.

12.0 ASSESSMENTS AND EXAMINATIONS

12.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessments	Weightage of Marks
Continuous Assessment 1	25%
Continuous Assessment 2	25%
Semester End Examination	50%

12.2 Appearing for semester end theory examination for each course is mandatory and a student should secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

Every practical course shall have 75% weightage for continuous assessments and 25% for semester end examination. However a student should have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

12.3 For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory component shall have a total of three assessments with two continuous assessments having 25% weightage each and semester end examination having 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination for the award of pass grade. The evaluation of practical component shall be through continuous assessment.

12.4 The components of continuous assessment for theory/practical/laboratory integrated theory courses shall be finalized in the first class committee meeting.

12.5 In the case of Industrial training, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research organisation. The weightage for Industry internship report shall be 60% and 40% for viva voce examination.

12.6 In the case of project work, a committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the Viva Voce examination.

12.7 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be considered for grading along with the marks scored in the semester end arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination to award grades and the internal assessment marks secured during the course of study shall not be considered.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end arrear examination for theory component. There shall be no arrear or improvement examination for lab component.

13.0 SUBSTITUTE EXAMINATIONS

13.1 A student who is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc.

by a committee constituted by the Head of the Department / Dean of School for that purpose. However there is no substitute examination for semester end examination.

13.2 A student shall apply for substitute exam in the prescribed form to the Head of the Department / Dean of School within a week from the date of assessment test. However the substitute examination will be conducted only after the last working day of the semester and before the semester end examination.

14.0 SUPPLEMENTARY EXAMINATION

14.1 Final Year students can apply for supplementary examination for a maximum of three courses thus providing an opportunity to complete their degree programme. Likewise students with less credit can also apply for supplementary examination for a maximum of three courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in both odd and even semester.

15. PASSING, DECLARATION OF RESULTS AND GRADE SHEET

15.1 All assessments of a course shall be made on absolute marks basis. However, the Class Committee without the student members shall meet within 5 days after the semester end examination and analyze the performance of students in all assessments of a course and award letter grades. The letter grades and the corresponding grade points are as follows:

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

"W" denotes withdrawal from the course.

"I" denotes inadequate attendance and hence prevented from appearing for semester end examination

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester end examination.

15.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student for improvement of grade.

15.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department / Dean of School and it shall be declared by the Controller of Examinations.

15.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee to the Controller of Examinations. Subsequently the Head of the Department/ Dean of School offered the course shall constitute a revaluation committee consisting of Chairman of the Class Committee as convener, the faculty member of the course and a senior faculty member knowledgeable in that course as members. The committee shall meet within a week to re-evaluate the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

15.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If C_i, is the number of credits assigned for the i^{th} course and GP_i is the Grade Point in the i^{th} course

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

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

“I” and "W" grades are excluded for calculating GPA.

"U", “I”, "AB" and **"W"** grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks is as follows:

Percentage Equivalent of Marks = CGPA X 10

15.6 After successful completion of the programme, the Degree shall be awarded upon fulfillment of curriculum requirements and classification based on CGPA as follows:

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the minimum prescribed period.
First Class	6.50 and above and completing the programme within a minimum prescribed period plus two semesters.
Second Class	Others

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 period of study and should have completed the P.G. programme within a minimum period (except break of study). To be eligible for First Class, a student should have passed the examination in all the 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 is not considered. The students who do not satisfy the above two conditions shall be classified as second class. For the purpose of classification, the CGPA shall 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.

16.0 DISCIPLINE

16.1 Every student is expected to observe disciplined and decorous behaviour both inside and outside the campus and not to indulge in any activity which tends

to affect the reputation of the Institution.

16.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action.

17.0 ELIGIBILITY FOR THE AWARD OF THE MASTERS DEGREE

17.1 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.
iii. Enrolled and completed at least one value added course.
iv. Enrollment in at least one MOOC / SWAYAM course (non-credit) before the final semester.

17.2 The award of the degree must have been approved by the Institute.

18.0 POWER TO MODIFY

Not withstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

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B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

CURRICULUM & SYLLABI FOR M.TECH. (COMMUNICATION SYSTEMS)

(FOUR SEMESTERS / FULL TIME)

Sl. No.	Course Code	Course Title	L	T	P	C
		SEMESTER I				
1	MAD 6184	Probability Matrix Theory & Linear Programming	**3**	**1**	**0**	**4**
2	ECD 6101	Wireless and Mobile Communication	**3**	**0**	**0**	**3**
3	ECD 6102	Satellite Communication	**3**	**0**	**0**	**3**
4	ECD 6103	Advanced Digital Communication Techniques	**3**	**0**	**2**	**4**
5	ECD 6104	Advanced Digital Signal Processing	**3**	**0**	**2**	**4**
6		Professional Elective (Minimum of 3 credits to be earned)				**3**
						21
		SEMESTER II				
1	ECD 6201	Research Methodology for Engineers	**3**	**1**	**0**	**4**
2	ECD 6202	Optical Networks	**3**	**0**	**0**	**3**
3	ECD 6203	Advanced Radiation Systems and practice	**3**	**0**	**2**	**4**
4	ECD 6204	Wireless and Optical Communication Laboratory	**0**	**0**	**2**	**1**
5		Professional Elective (Minimum of 9 credits to be earned)				**9**
6		Value added course	**0**	**0**	**0**	**0**
						21

Sl. No.	Course Code	Course Title	L	T	P	C
		SEMESTER III				
1	GED	General Elective	**3**	**0**	**0**	**3**
2	ECD 7101	Project Work - Phase I*	**0**	**0**	**12**	**6***
3	ECD7102	Internship**	**0**	**0**	**2**	**1**
4		Professional Elective (Minimum of 6 credits to be earned)				**6**
5		MOOC (Related to project)	**0**	**0**	**0**	**0**
						10
		SEMESTER IV				
1	ECD7101	Project Work - Phase II*	**0**	**0**	**36**	**18***
					Credits 18 + 6	**24**

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

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

Total credits: 76

PROFESSIONAL ELECTIVES

Sl.No.	Course Code	Course Title	L	T	P	C
1.	ECDY 001	Digital Image Processing	**3**	**0**	**0**	**3**
2.	ECDY 002	Advanced Microwave systems	**3**	**0**	**0**	**3**
3.	ECDY 003	Cognitive and Cooperative Radio Communications	**3**	**0**	**0**	**3**
4.	ECDY 004	Digital Communication Receivers	**3**	**0**	**0**	**3**
5.	ECDY 005	Electromagnetic Interference and Compatibility in System Design	**3**	**0**	**0**	**3**
6.	ECDY 006	Advanced optical wireless Communication systems	**3**	**0**	**0**	**3**
7.	ECDY 007	Error Control Coding	**3**	**0**	**0**	**3**
8.	ECDY 008	Medical Image Processing	**3**	**0**	**2**	**4**
9.	ECDY 009	Microwave Integrated Circuits	**3**	**0**	**0**	**3**
10.	ECDY 010	Multimedia Compression Techniques	**3**	**0**	**0**	**3**
11.	ECDY 011	Network Security	**3**	**0**	**0**	**3**
12.	ECDY 012	CMOS RF System Design	**3**	**0**	**0**	**3**
13.	ECDY 013	Medical Electronics and Data acquisition	**3**	**0**	**0**	**3**
14.	ECDY 014	Signal detect ion and estimation	**3**	**0**	**0**	**3**
15.	ECDY 015	Artificial Intelligence in Wireless Communication	**3**	**0**	**0**	**3**
16.	ECDY 016	RF Testing and Measurement	**3**	**0**	**0**	**3**
17.	ECDY 017	Human and Machine Speech Communication	**3**	**0**	**0**	**3**
18.	ECDY 018	Introduction to Quantum Computing	**3**	**0**	**0**	**3**
19.	ECDY 019	Computational Electromagnetics	**3**	**0**	**0**	**3**
20.	ECDY 020	Optical Codes and Applications	**3**	**0**	**0**	**3**
21.	ECDY 021	Antennas for IOT applications	**3**	**0**	**0**	**3**
22.	ECDY 022	RF MEMS	**3**	**0**	**0**	**3**
23.	ECDY 023	High Speed Circuit design	**3**	**0**	**0**	**3**
24.	ECDY 024	Internet of Things	**3**	**0**	**0**	**3**
25.	ECDY 025	Wireless Sensor Network	**3**	**0**	**0**	**3**

Sl.No.	Course Code	Course Title	L	T	P	C
26.	ECDY 026	RF System Design	**3**	**0**	**0**	**3**
27.	ECDY 027	Adaptive Signal Processing	**2**	**0**	**0**	**2**
28.	ECDY 028	Classical and Advanced Techniques For Optimization	**2**	**0**	**0**	**2**
29.	ECDY 029	Pattern Recognition Techniques and Applications	**3**	**0**	**0**	**3**
30.	ECDY 030	Radiation Systems for Personal area Network	**2**	**0**	**0**	**2**
31.	ECDY 031	Bio signal Processing	**1**	**0**	**0**	**1**
32.	ECDY 032	Ultrasonic Principles and Applications	**1**	**0**	**0**	**1**
33.	ECDY 033	Chaotronics	**3**	**0**	**0**	**3**
34.	ECDY 034	Software for Embedded Systems	**2**	**0**	**2**	**3**
35.	ECDY 035	Sensor Array Signal processing	**3**	**0**	**0**	**3**
36.	ECDY 036	Multimedia Systems	**3**	**0**	**0**	**3**
37.	ECDY 037	Global Tracking and Positioning Systems	**3**	**0**	**0**	**3**
38.	ECDY 038	Software Defined Networks	**3**	**0**	**0**	**3**
39.	ECDY 039	Ultra Wideband Communication	**3**	**0**	**0**	**3**
40.	ECDY 040	Signal Processing Techniques	**3**	**1**	**0**	**4**
41.	ECDY 041	Electro Optic Systems	**3**	**0**	**0**	**3**
42.	ECDY 042	MATLAB and Simulink Laboratory	**0**	**1**	**3**	**2**
43.	ECDY 084	Interoperability Challenges in Internet of Things	**3**	**0**	**0**	**3**
44.	ECDY 085	Embedded Automotive System	**3**	**0**	**0**	**3**

GENERAL ELECTIVE

Sl. No.	Course Code	Course Title	L	T	P	C
1.	GEDY 101	Project Management	3	0	0	3
2.	GEDY 102	Society, Technology & Sustainability	3	0	0	3
3.	GEDY 103	Artificial Intelligence	3	0	0	3

4.	GEDY 104	Green Computing	3	0	0	3
5.	GEDY 105	Gaming Design	3	0	0	3
6.	GEDY 106	Social Computing	3	0	0	3
7.	GEDY 107	Soft Computing	3	0	0	3
8.	GEDY 108	Embedded System Programming	3	0	0	3
9.	GEDY 109	Principles of Sustainable Development	3	0	0	3
10.	GEDY 110	Quantitative Techniques in Management	3	0	0	3
11.	GEDY 111	Programming using MATLAB & SIMULINK	1	0	2	2
12.	GEDY 112	JAVA Programming	1	0	2	2
13.	GEDY 113	PYTHON Programming	1	0	2	2
14.	GEDY 114	Intellectual Property Rights	1	0	0	1

SEMESTER I

MAD 6184 PROBABILITY, MATRIX THEORY AND LINEAR PROGRAMMING

L	T	P	C
3	1	0	4

OBJECTIVES:

The aim of this course is to

- Introduce the concepts of a random variable and a probability distribution.
- Identify and handle the situations involving more than one random variable.
- Find the eigen values of a matrix using QR transformations.
- Find the optimum value or optimum utilization of the resources using the LPP techniques.
- Familiarize students with variational problems.

PREREQUISITES:

Students should have a good knowledge in

- Evaluating differentiation and integration
- Matrix operations

MODULE I PROBABILITY DISTRIBUTIONS 10+3

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

MODULE II TWO DIMENSIONAL RANDOM VARIABLES 8+3

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

MODULE III ADVANCED MATRIX THEORY 9+3

Matrix norms – singular value decomposition – QR algorithm - pseudo inverse – least square approximations – Toeplitz matrices and some applications.

MODULE IV LINEAR PROGRAMMING 10+3

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

MODULE V CALCULUS OF VARIATIONS 8+3

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

L – 45; T – 15 Total Hours 60

TEXT BOOKS:

1. S.M.Ross, "A First Course in Probability", 10th edition, Pearson Education, 2018.
2. Lewis.D.W., "Matrix Theory", Allied Publishers, Chennai, 1995.
3. Taha, H.A., "Operations Research - An Introduction ", 10th edition, Pearson Prentice Hall, 2016.
4. A.S.Gupta, "Calculus of variations with applications", PHI Pvt. Ltd, New Delhi, 2017.

REFERENCES:

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

OUTCOMES :

At the end of the course, the student should be able to:

- Distinguish between discrete and continuous random variables.
- Solve real life problems using standard distributions.
- Solve algebraic eigen value problems.
- Analyse the LPP techniques in deriving the optimality for real life situations.
- Solve problems on calculus of variations
- Apply variational problems with moving boundaries and isoperimetric problems for real life situations.

ECD 6101 WIRELESS AND MOBILE COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES

- To analyze fundamental concepts of wireless communication.
- To expose the students to understand mobile radio communication principles
- To study the recent trends adopted in cellular systems and wireless standards.
- To discuss the modulation and multicarrier techniques used in wireless communication.
- To apply the different mobile communication standards.

PREREQUISITES :

- Digital Communication
- Knowledge on Probability and Random Process

MODULE I INTRODUCTION 10

Introduction about wireless communication - technical challenges of wireless communication applications; Cellular architecture - frequency reuse - channel assignment - handoff - coverage and capacity improvement; Multiple access - FDMA/CDMA/TDMA/SDMA.

MODULE II WIRELESS PROPAGATION 9

Propagation Principles- Propagation mechanisms - channel modelling- radio channels- indoor channels - outdoor channels - fading channels ; path loss and propagation models- Shadowing - parameters of mobile multipath channels - statistical models for multipath fading channels -Link budget, Free-space path loss, Noise figure of receiver.

MODULE III MODULATION AND MULTICARRIER SYSTEMS 8

Linear and constant envelope modulation techniques for wireless communication - error performance in fading channel; Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving. MIMO Systems: Beam forming - spatial multiplexing - Alamouti scheme - orthogonal and quasi orthogonal space time block codes- Performance of space time trellis codes - comparison of space-time block and trellis codes.

MODULE IV MOBILE STANDARDS 9

CDMA, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, CDMA 2000 layering structure and channels. System architecture and working principle: GSM - SCSD - GPRS – EDGE.

MODULE V ADVANCED MOBILE COMMUNICATIONS 9

Higher Generation Cellular Standards: 3G Standards: evolved EDGE, enhancements in 4Gstandard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.

Total Hours: 45

TEXT BOOKS:

1. T. S. Rappaport, “Wireless Communications Principles and Practice (2nd edition) Pearson, 2010
2. Andreas Molisch F, “Wireless Communications”, John Wiley and Sons Ltd., 2011.
3. John David Parsons, “Mobile Communication Systems”, Springer Science & Business Media, 2012.

REFERENCES

1. Haykin & Moher, "Modern Wireless Communications" Pearson 2011.
2. J. G. Proakis, "Digital Communications," McGraw Hill A. Goldsmith, "Wireless Communications," Cambridge Univ Press, 2005
3. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005
4. D. Tse and P. Viswanath, "Fundamentals of Wireless Communications," Cambridge University Press, 2005.

OUTCOMES :

At the end of the course, the student should be able to:

- Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques
- Design appropriate mobile communication systems
- Distinguish various multiple-access techniques for mobile communications
- Analyze path loss and interference for wireless telephony and their influences

on a mobile communication systems performance.

- Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology
- Describe the upcoming technologies like 3G, 4G, 5G etc.

ECD 6102 SATELLITE COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To describe the concept of orbits and spacecraft subsystems
- To illustrate uplinks and down links with various multiple access techniques.
- To analyse the list of services of satellites for different application
- To distinguish the functional details of VSAT, GPS and DTH system
- To investigate the satellite communication in various navigation systems.

PREREQUISITES :

- Basics of planetary motions
- Familiarity with analog and digital communication

MODULE I INTRODUCTION TO SATELLITE COMMUNICATION 10

Introduction: Overview of Satellite Communications, GEO, MEO and LEO satellite systems, frequency bands Orbital Mechanics: Orbit Equations, Locating the satellite w.r.t. the earth, Orbital elements, Look Angles, Orbital perturbation, Satellite eclipse, sun transit outage, Coverage angle, slant range, satellite launching.

MODULE II SPACE SEGMENT AND LINK BUDGET 9

Attitude and Orbit Control System (AOCS), Telemetry, Tracking and Command System (TT&C), Power System, Satellite antennas, Communications subsystem, transponders Satellite Link Design: Basic transmission theory , System noise temperature and G/T ratio, CNR, CIR, ACI, IMI, Down link design, Up link design.

MODULE III MULTIPLE ACCESS SCHEMES 8

: FDM/FM/FDMA, TDMA, Frame structure, frame acquisition, synchronization, TDMA in VSAT network, On-board processing, CDMA, Spread spectrum transmission and reception, DS-SS CDMA capacity.

MODULE IV SATELLITE DIGITAL AUDIO RADIO SERVICE 9

Issues in Space Segment and Satellite Implementation, Satellite Selection and System Implementation, Communications Payload Configurations, Direct-to-Home Satellite Television Broadcasting, VSAT Networks for Interactive Applications

MODULE V NETWORK TOPOLOGIES AND PROTECTION SCHEMES 9

Satellite Based Navigation System: Basic principles of satellite navigation, Signal travel time Determining position, The effect and correction of time error, functional segments of GPS, Improved GPS: DGPS, SBAS, A-GPS and HSGPS.

Total Hours 45

TEXT BOOKS:

1. Timothy Pratt, Charles W Bostian, Jeremy E Allnut, “Satellite Communication”, Wiley, Edition 2007.
2. GerardMaral, Michel Bousquet, “Satellite Communications Systems: Systems, techniques and Technology”, 5th edition, Wiley publication,2009

REFERENCES:

1. Bruce R. Elbert, “The Satellite Communication Applications Hand Book”, Artech House Boston, 1997.
2. Wilbur L. Pritchard, Hendri G. Suyderhood, Robert A.Nelson, “Satellite Communication Systems Engineering”, 2nd edition, Prentice Hall, New Jersey.1993.
3. Dennis Rody, “Satellite Communication”, 4th edition, Regents/Prentice Hall, Eaglewood Cliff, New Jersey, 2006.
4. Andrew Barron,”Amsats and Hamsats: Amateur Radio and other Small Satellites”, U.S.kindle edition, 2018.

OUTCOMES :

At the end of the course, the student should be able to:

- Define and describe the orbital parameters, launching mechanism and various orbital mechanisms.
- Recognize the space segment and its control units.
- Interpret the mathematical framework of satellite links to various types of satellites to compute the estimation of the uplinks and down links with various multiple access techniques
- Differentiate the different types of access techniques available for satellites.
- State the issues of space segment and satellite implementation.
- Develop the architecture of VSAT, GPS and DTH system to meet desired needs within realistic constraints.

ECD 6103 ADVANCED DIGITAL COMMUNICATION TECHNIQUES

L	T	P	C
3	0	2	4

OBJECTIVES

To make the student to analyze and apply

- The concepts of memory less and memory channels
- The difference between coherent and non-coherent communications.
- The effects of communication over band limited channels and methods to overcome the effects.
- The concepts of block coding and convolutional coding
- The basics of multicarrier modulation schemes.

PREREQUISITES :

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

MODULE I POWER SPECTRUM AND COMMUNICATION OVER MEMORY LESS CHANNEL 11

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

Practical

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

MODULE II COHERENT AND NON-COHERENT COMMUNICATION 11

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

Practical

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

MODULE III COMMUNICATION OVER BAND LIMITED CHANNELS 9

Pulse shape design for channels with ISI: Nyquist pulse, Partial response signalling-Optimum receiver for channels with ISI and AWGN. Equalization algorithms – Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms, Iterative equalization and decoding, Matched filter.

Practical

- Performance evaluation of Pulse shaping filters

MODULE IV BLOCK CODED DIGITAL COMMUNICATION 10

Channel capacity, Shannon's channel coding theorem:, Architecture and performance of Binary block codes: Orthogonal, Bi- orthogonal and Trans orthogonal. Linear block codes, cyclic codes, LDPC codes

Practical

- Simulation of LBC and LDPC codes

MODULE V CONVOLUTIONAL CODED DIGITAL COMMUNICATION 10

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

Practical

- Simulation of coding and decoding of Convolutional codes

MODULE VI MULTICHANNEL AND MULTICARRIER SYSTEMS 9

AWGN multi channels, Multicarrier communications: OFDM – modulation and demodulation, spectral characteristics, bit and power allocation, channel coding.

Practical

- Simulation of OFDM

Total Hours: 60

TEXT BOOKS:

1. J. G. Proakis and M. Salehi, "Fundamentals of Communication Systems", 2nd edition, Pearson Education, 2014
2. S. Haykins, "Communication Systems", 5th ed., John wiley,2008.
3. M. K. Simon, S. M. Hinedi and W. C. Lindsey," Digital Communication

Techniques: Signaling and detection", Prentice Hall India, N. Delhi,1995.
4. Andrew J. Viterbi, Jim K. Omura, "Principles of Digital Communication and Coding", McGraw-HillInc.1979.
5. M. K. Simon and M. S. Alouini," Digital Communication over Fading Channel", 2nd Edtion, Wiley publications,2000
6. Ian Glover, Peter Grant, "Digital Communications", Prentice Hall, 2003 Edition

REFERENCES:

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

OUTCOMES :

At the end of the course, the student should be able to:

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

ECD 6104	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To comprehend mathematical description and modelling of discrete time random signals.
- To familiar with estimation techniques of the spectrum
- To compare different types of random processes.
- To understand different types of prediction and filtering methods
- To study and compare different adaptive filter algorithms.

PREREQUISITES :

- Basics of Probability, Random Variable, Stochastic Process and Linear Algebra
- Fundamentals of Signals and Systems, Signal Processing Techniques.

MODULE I DISCRETE RANDOM SIGNAL PROCESSING 12

Wide sense stationary process – Ergodic process – Mean – Variance - Auto-correlation and Autocorrelation matrix - Properties - Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem

Practical

- Simulation of uniformly distributed/Gaussian distributed white noise
- Simulation of Sine wave mixed with Additive White Gaussian Noise

MODULE II SPECTRUM ESTIMATION 12

Bias and Consistency of estimators - Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Bartlett spectrum estimation - Welch estimation.

Practical

- Periodogram of a signal containing two Sinusoidal components corrupted with White noise using MATLAB.
- Power Spectrum estimation of a random signal using Bartlett Method
- Power Spectrum estimation of a random signal using Welch Method

MODULE III LINEAR ESTIMATION 12

Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method - Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion – Wiener filter - Discrete Wiener Hoff equations – Mean square error.

Practical

- Examine the performance of Yule-Walker equations to estimate the frequency peak of an AR(1) process, using MATLAB

MODULE IV LINEAR PREDICTION 12

Recursive estimators - Kalman filter - Linear prediction – Forward prediction and Backward prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

Practical

- Implementation of LMS algorithm for optimum filter coefficients using MATLAB
- Compute filter estimates for inputs using Kalman adaptive filter algorithm using MATLAB / Simulink

MODULE V ADAPTIVE FILTERS 12

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters - Exponentially weighted RLS – Sliding window RLS - Simplified IIR LMS Adaptive filter.

Practical

- Simulation of adaptive filtering using Steepest Descent Algorithm
- Experiment to identify a linear noisy system with the help of LMS algorithm

Total Hours: 60

TEXT BOOKS

1. Monson H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley and 3. Sons Inc., New York, 2009.
2. John G.Proakis&DimitrisG.Maolakis –“DSP principles, algorithms &

applications" – 4th edition – Pearson Education – 2007.
3. A.V.Oppenheim and R.W Schafer, Englewood, "Digital Signal Processing", Prentice Hall, Inc. 2006.
4. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.

REFERENCES:

1. Andreas Antoniou, "Digital signal Processing Processing", Tata McGraw Hill, second edition, 2008.
2. S.K.Mitra, "Digital Signal Processing- A Computer based approach", 4th Edition, Tata McGraw-Hill, New Delhi, 2011.
3. Venkatramani and M.Bhaskar, "Digital Signal Procesors architecture", "Programming and applications", Tata McGraw Hill, 2002.

OUTCOMES :

At the end of the course, the student should be able to:

- Conversant with important theorems and algorithms.
- Estimate the power spectrum of signals
- Derive the distributional results needed for signal modelling
- Implement various algorithms for optimum filter design
- Design & analyze the adaptive filters
- Apply adaptive algorithms for channel equalization and echo cancellation

SEMESTER II

ECD 6201 RESEARCH METHODOLOGY FOR ENGINEERS

L	T	P	C
3	1	0	4

OBJECTIVES:

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

PREREQUISITES :

- Basics knowledge of engineering, probability, statistics

MODULE I RESEARCH PROBLEM FORMULATION 9

Research – objective - types, Research methods and methodology, Research process, solving engineering problems-Identification of research topic - Formulation of research problem, literature survey and review.

MODULE II RESEARCH DESIGN 10

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

MODULE III USE OF STATISTICAL TOOLS IN RESEARCH 12

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

MODULE IV DATA COLLECTION, ANALYSIS AND INTERPRETATION OF DATA 10

Sources of Data, Use of Internet in Research, Types of Data - Research Data Processing and analysis - Interpretation of results- Correlation with scientific facts -

repeatability and reproducibility of results - Accuracy and precision –limitations, Application of Computer in Research- Spreadsheet tool, Presentation tool-Basic principles of Statistical Computation.

MODULE V OPTIMIZATION TECHNIQUES 10

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

MODULE VI THE RESEARCH REPORT 9

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

Total Hours: 60

TEXT BOOKS:

1. Ganesan R., Research Methodology for Engineers, MJP Publishers, Chennai, 2011.
2. Ernest O., Doebelin, Engineering Experimentation: planning, execution, reporting, McGraw Hill International edition, 1995.
3. George E. Dieter., Engineering Design, McGraw Hill – International edition, 2000.
4. Madhav S. Phadke, Quality Engineering using Robust Design, Printice Hall, Englewood Cliffs, New Jersey, 1989.
5. Kothari C.R., Research Methodology – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2003.
6. Kalyanmoy Deb., “Genetic Algorithms for optimization”, KanGAL report, No.2001002.

REFERENCES:

1. Holeman, J.P., Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2007.
2. Govt. of India, Intellectual Property Laws; Acts, Rules & Regulations, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2010.

OUTCOMES :

At the end of the course, the student should be able to:

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

ECD 6202	OPTICAL NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To analyse the evolution of optical network and their classification.
- To select suitable optical components and network for specific application.
- To explain and adopt optical networks architecture and standards
- To discuss the issues of different Optical Network topologies and protection schemes

PREREQUISITES :

- Basics of photo electronic devices and its functions
- Frequency spectrum
- Maxwell's equation
- Familiarity with optical communication

MODULE I INTRODUCTION TO OPTICAL NETWORKS 9

Telecommunication Networks-Architecture, Services, circuit switching and packet switching, Optical Networks- Optical layer, Multiplexing Techniques, Second generation Optical Networks, Optical Packet Switching, Transmission Basics-Wavelength, frequencies, and channel spacing, Wavelength standards, Optical power and loss, Network Evolution, Nonlinear Effects-Self-phase Modulation, Cross-phase Modulation, Four Wave mixing, Solitons. Components-Couplers, Isolators, Circulators, Multiplexers and Filters, Optical Amplifiers, Transmitters, Detectors, Switches, Wavelength Converters.

MODULE II TRANSMISSION SYSTEM ENGINEERING 9

System Model, Power Penalty, Transmitter, Receiver, Optical Amplifiers, Crosstalk, Dispersion, Wavelength Stabilization, Overall Design Considerations. Optical Internets-Migration to IP optical networking, IP and Optical backbone, IP Routing table, MPLS and optical cross connect table, Protocol stack Alternatives, Internetworking SS7 and Legacy Transport, Internet transport network protocol stack.

MODULE III SONET, SDH AND OPTICAL TRANSPORT NETWORKS (OTNs) 9

SONET and SDH: SONET multiplexing hierarchy, Frame structure, Functional Component, problem detection, concatenation. Architecture of Optical Transport Networks (OTNs): Digital wrapper, in-band and out-of band control signalling, Importance of Multiplexing and multiplexing hierarchies, SONET multiplexing hierarchies, SDH multiplexing hierarchies, New Optical Transport, OTN layered Model, Generic Framing Procedure (GFP)

MODULE IV WDM, NETWORK TOPOLOGIES, MPLS AND OPTICAL NETWORKS 9

WDM-WDM operation, Dense Wavelength Division Multiplexing (DWDM), Erbium-doped Fiber (EDF), WDM amplifiers, Add-Drop Multiplexers, Wavelength Continuity Property, Higher dispersion for DWDM, Tuneable DWDM Lasers.

MODULE V NETWORK TOPOLOGIES AND PROTECTION SCHEMES 9

Robust networks, Line and path protection switching, Types of topology, Point to point topology, bi-directional line-switched ring (BLSR), meshed topology, Passive optical networks, Metro optical networks 28 MPLS and Optical Networks: IS label switching, Forwarding equivalence class (FEC), Types of MPLS nodes, Label distribution and binding, label swapping and traffic forwarding, MPLS support of Virtual Private Networks (VPN), MPLS traffic engineering, Multi protocol Lambda switching (MPIS).

Total Hours 45

TEXT BOOKS

1. Rajiv Ramaswami and Kumar Sivarajan, "Optical Networks Practical Perspective", 3rd Edition, Morgan - Kaufmann Publishers, 2015.
2. John M. Senior, “Optical Fiber Communications –Principles and Practice”, Pearson Education India, 2014
3. C.Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Pearson Education India, 2016

REFERENCES

1. Optical Networks, Third Generation Transport Systems, Uyless Black, Pearson publisher 2010.

2. Biswanath Mukherjee, “Optical Communication Networks”, McGraw-Hill, 2017

OUTCOMES :

At the end of the course, the student should be able to:

- Design and analyze optical network and their classification.
- Select suitable optical components and network for specific application.
- Describe the optical transmission System Engineering
- Explain and adopt optical networks architecture and standards
- Discuss the issues of different Optical Network topologies and protection schemes
- Assess and Evaluate optical networks

ECD 6203 ADVANCED RADIATION SYSTEMS AND PRACTICE

L	T	P	C
3	0	2	4

OBJECTIVES

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

PREREQUISITES :

- Basics of Electromagnetics and Antenna Theory.

MODULE I ANTENNA FUNDAMENTALS 14

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

Experiment: Introduction and practice with simulation tool for antenna design.

MODULE II MICRO STRIP ANTENNA 11

Design and implementation: Microstrip dipole, Rectangular patch, Circular patch and Ring antenna. Input impedance and Radiation analysis from cavity model. Introduction to the effects of defected ground plane.

Experiment: Design of microstrip antenna using simulation tool.

MODULE III ARRAY ANTENNA 14

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

Experiment: Design and simulation of array antenna.

MODULE IV RADIATION FROM APERTURES 09

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

Experiment: Simulation of slot antenna.

MODULE V ANTENNA MEASUREMENTS 12

Measurements of Return loss, Gain, Power, HPBW, Impedance and antenna factor.

Experimentation of antenna parameters using Microwave test bench.

Total Hours: 60

TEXT BOOKS:

1. Constantine A. Ballanis, "Antenna Theory", John Wiley & Sons, Fourth edition, 2016.
2. E.C. Jordan and Balmain, "Electro Magnetic Waves and Radiating Systems", Pearson Education, Second Edition, 2015.

REFERENCES:

1. John D.Kraus and Ronald J. Marhefka, "Antennas for all applications", 3rd Edition Tata McGraw-Hill Book Company, 2006.
2. Ramesh Garg, PrakashBhartia, InderBahl, ApisakIttipiboon, “Microstrip Antenna Design Handbook”, Artech House, 2001.

OUTCOMES:

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

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

ECD 6204	WIRELESS AND OPTICAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To analyse the principles used in the design of channel modelling
- To design and validate the propagation Models and Path Loss Estimation in wireless and optical communication systems using simulation tools
- To estimate the performance of different fading model
- Performance evaluation of FDMA/TDMA/CDMA System using simulation
- To discuss about various wireless and optical communication systems
- Performance measures of VLC and Li Fi Systems

PREREQUISITES :

- Digital Communication
- Knowledge on channel modelling
- Fundamentals of optical communication

LIST OF EXPERIMENTS

Design and performance analysis of

1. Rayleigh Fading model
2. Rician Fading model
3. Nakagami Fading model
4. Weibull Fading model
5. Log-Normal Shadowing model
6. FDMA/TDMA/CDMA
7. ASK/FSK/GMSK MODULATION
8. Visible Light Communication System
9. LiFi System and its application
10. Mini project

Total Hours 30

TEXT BOOKS:

1. Rajiv Ramaswami and Kumar Sivarajan, "Optical Networks Practical Perspective", 3rd Edition, Morgan - Kaufmann Publishers, 2015.
2. Andreas Molisch F, “Wireless Communications”, John Wiley and Sons Ltd., 2011.

3. John David Parsons, “Mobile Communication Systems”, Springer Science & Business Media, 2012.

REFERENCES:

1. John M. Senior, “Optical Fiber Communications –Principles and Practice”, Pearson Education India, 2014.
2. C.Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Pearson Education India, 2016

OUTCOMES :

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

- Analyse the principles used in the design of channel modelling
- Use simulation tools to design and validate the propagation Models and Path Loss Estimation in wireless and optical communication systems
- Estimate the performance of different fading model
- Performance evaluation of FDMA/TDMA/CDMA System using simulation
- Discuss about various wireless and optical communication systems
- Performance measures of VLC and Li Fi Systems

VALUE ADDED COURSE	L	T	P	C
	0	0	0	0

OBJECTIVES:

- To expose the latest technology / tools used in the industry and enable the students acquire knowledge and skill set in the same.

GENERAL GUIDELINES:

- Students should undergo any relevant certification course offered by the institution or other institutions / universities / IIT / IISc etc. for a minimum of 40 hours.
- Selection and completion of value added course by the students shall be endorsed by Head of the Department.

OUTCOMES:

- Students should be exposed and gained knowledge in any one latest technology used in the industry

SEMESTER III

ECD 7101	PROJECT WORK – PHASE I	L	T	P	C
		0	0	12	6

OBJECTIVES :

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

GUIDELINES:

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

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

OUTCOMES:

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

- learn the tool required for the design, analysis of their preliminary work
- Select the specific devices for different application along with justification

- Apply the practical knowledge while solving real time problems
- Incorporate cost effective and efficient project models
- Conclude the subject knowledge through proto type models
- Prepare an appropriate documentation

ECD 7102	INTERNSHIP	L	T	P	C
		0	0	3	1

OBJECTIVES:

- To improve the professional competency, Industrial Exposure and research aptitude of students
- To develop the work practice through design skills inside the industry for solving real life problems

GUIDELINES:

1. This internship to be carried out in the industry for solving real life problems.
2. The internship is a core industry type of training to build an experimental/prototype project on any of the topics in electronics and communication.
3. Department will constitute an Evaluation Committee to review the internship periodically including the industry expert.
4. The Evaluation committee consists at least of three faculty members of which internal guide and another two experts in the specified area of the project.

OUTCOMES:

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

- Design and analyze an electronic and communication system
- Select or utilize the appropriate component\technology to solve the given problem
- Fabricate an electronic system/device in their area of interest
- Demonstrate the working MODULE
- Improve their presentation skills
- Improve the documentation skills

MOOC COURSE

L	T	P	C
0	0	0	0

OBJECTIVES:

- To learn the basics principles and concepts of the topic in which a project work is undertaken by the student.

GENERAL GUIDELINES:

- Students shall identify a MOOC course related to his/her project topic in consultation with the project supervisor.
- Student shall register for a MOOC course with minimum two credit offered by any recognized organization during the project phase I.
- Selection and completion of MOOC course by the students shall be endorsed by Head of the Department.

OUTCOMES:

Students will be able to

- Familiarize the basic principles and concepts related to the topic of his/her project work.
- Utilize the knowledge gained in the field of study to perform literature review with ease.
- Formulate the experimental / analytical methodology required for the project work

SEMESTER IV

ECD 7101	PROJECT WORK – PHASE II	L	T	P	C
		0	0	36	18

OBJECTIVES:

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

GUIDELINES:

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

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

OUTCOMES:

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

- learn the tool required for the design, analysis of their preliminary work
- Select the specific devices for different application along with justification
- Apply the practical knowledge while solving real time problems

- Incorporate cost effective and efficient project models
- Conclude the subject knowledge through proto type models
- Prepare an appropriate documentation\Report

PROFESSIONAL ELECTIVES

ECDY 001	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To describe and explain basic principles of digital image processing
- To discuss about image processing techniques
- To design and implement algorithms for advanced image analysis
- To compare various optimisation techniques for image processing
- To assess the performance of image processing algorithms
- To explain about basics of video processing

PREREQUISITES :

- Basic knowledge on Signal Processing
- Knowledge in Signal Transforms

MODULE I DIGITAL IMAGE FUNDAMENTALS 9

Review of Digital Image Processing fundamentals- Elements of visual perception, Image sampling & quantisation, Color image models-Image transforms-DFT,DCT, Haar, Hadamard & KLT, Noise models.

MODULE II IMAGE PROCESSING TECHNIQUES 9

Image Enhancement- Filters &Histogram techniques, Pseudo colour processing, SEM analysis application, Morphological image processing, Image restoration techniques- Remote sensing application, Image Compression-Scalar & Vector Quantisation, Wavelet based compression, Digital Image watermarking.

MODULE III ADVANCED IMAGE ANALYSIS 9

Image segmentation-types- Graph theory for segmentation -Object recognition-Parametric & Non-parametric method-Pattern matching, Neural networks & deep learning, Image fusion-types,3D image visualisation, image analysis for medical images.

MODULE IV OPTIMISATION TECHNIQUES FOR IMAGE PROCESSING 9

Need for optimisation-Types of optimisation techniques-Swarm intelligence based-Ant Colony Optimization (ACO), Harmony Search Algorithm (HSA) and Artificial Bee Colony (ABC) algorithm and Particle Swarm Optimization (PSO)

and Evolution based-Genetic Algorithm(GA)-Optimisation technique for image processing techniques-examples, Performance metrics for image processing techniques-SNR, Compression ratio, SSIM, Sensitivity and Specificity.

MODULE V INTRODUCTION TO VIDEO PROCESSING 9

Introduction to video processing-Video acquisition & representation-Spatial-temporal Sampling –Sampling Structure Conversion – Interpolation – Colour spaces – video formats.

Total Hours 45

TEXT BOOKS:

1. R. C. Gonzalez and R. E. Woods, “Digital Image Processing”, Fourth Edition, Pearson, 2018.
2. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition, Academic Press, 2012.
3. Rick S.Blum, Zheng Liu, “Multisensor image fusion and its Applications“, Taylor&Francis, 2006.
4. Vishal Monga ,“Handbook of Convex Optimization Methods in Imaging Science”, Springer, 2017.
5. Handbook of Image and Video processing – Al Bovik (Alan C Bovik), Academic Press, Second Edition, 2005.

REFERENCES:

1. John C. Russ, “The Image Processing Handbook”, Sixth Edition, CRC Press, 2011.
2. Digital Image Procesing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education, 2009.Pvt Ltd, New Delhi
3. David Salomon: Data Compression - The Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001.

OUTCOMES:

At the end of the course, the student should be able to:

- Acquire the knowledge of fundamental concepts of a digital image processing system& image transforms
- Describe various techniques for image enhancement, restoration& compression.
- Analyze various algorithms for advanced image analysis.

- Recognize and apply suitable optimization techniques for image processing applications
- Identify and use of appropriate performance metrics for various image processing applications
- Describe about basics of video processing concepts

ECDY 002 ADVANCED MICROWAVE SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES

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

PREREQUISITES :

- Basic knowledge on EMF and Transmission lines

MODULE I ELECTROMAGNETIC AND TRANSMISSION LINES THEORY 9

Introduction to microwave Engineering, Maxwell'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 MODERN TRENDS IN MICROWAVES ENGINEERING 7

Effect of Microwaves on human body. Medical and Civil applications of microwaves. Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC).

MODULE III MICROWAVE NETWORK ANALYSIS, IMPEDANCE MATCHING AND TUNING 11

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, and double stub tuning, quarter wave transformer. Series and parallel resonance circuits, transmission line resonators, rectangular waveguide cavity resonator, circular waveguide cavity

resonator, dielectric resonator, excitation of resonator, cavity perturbation.

MODULE IV MICROWAVE FILTERS 9

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

MODULE V MICROWAVE AMPLIFIER, OSCILLATOR AND MIXER DESIGN 9

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, and mixers.

Total Hours 45

TEXT BOOKS:

1. R.E.Collin, “Foundations of Microwave Engineering”, Wiley, 2nd edition 2007.
2. Ramo, Whinnery and Van Duzer, “Fields and Waves in Communication Electronics”, 3rd Edition, Wiley, 2007

REFERENCES:

1. David. M Pozar, “Microwave and RF System Design”, Wiley 2001.
2. Wayne Tomasi, “Advanced Microwave Communication Systems”, PHI, 2nd Edition, 2002.

OUTCOMES:

On completion of this course the student will be able to

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

ECDY 003	COOPERATIVE COMMUNICATION IN COGNITIVE RADIO	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
- To apply cooperative communications in CR spectrum sensing

PREREQUISITES :

- Digital communication
- Wireless communications
- Software Defined Radio
-

MODULE I COOPERATIVE COMMUNICATION 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 trade off 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; MAC for cognitive Radios Routing in Cognitive Radio Networks

MODULE V SPECTRUM MANAGEMENT OF COGNITIVE RADIO NETWORKS 9

Spectrum Sensing: Spectrum Sensing to Detect Specific Primary System, Dynamic Spectrum Access: Spectrum Management -Spectrum Sharing, Spectrum Pricing, Spectrum Sensing for Cognitive OFDMA Systems, Spectrum Sensing for Cognitive Multi-Radio Networks. Cooperative communication in Cognitive Radio

Total Hours 45

TEXT BOOKS

1. Rajiv Ramaswami and Kumar Sivarajan, "Optical Networks Practical Perspective", 3rd Edition, Morgan - Kaufmann Publishers, 2015.
2. John M. Senior, “Optical Fiber Communications –Principles and Practice”, Pearson Education India, 2014
3. C.Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Pearson Education India, 2016.

REFERENCES

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

OUTCOMES :

At the end of the course, the student should be able to:

- List various protocols used in cooperative communications
- Describe the network and transmission models of cooperative communications
- Demonstrate the channel coding techniques for cooperative communications.
- Identify the applications of cooperative broadband communications
- Explain the concepts of Cognitive Radio.
- Apply the concepts of Cooperative communications in Cognitive Radio spectrum sensing.

ECDY 004 DIGITAL COMMUNICATION RECEIVERS

L	T	P	C
3	0	0	3

OBJECTIVES

- To analyze linear and non-linear modulation techniques
- To explain optimum receivers and functions
- To describe the fading channel characterization and diversity techniques
- To analyze optimum receivers and coding techniques over fading channels.
- To discuss the receiver synchronization concepts
- To design adaptive Equalization concepts and algorithms

PREREQUISITES:

- Digital communication
- Wireless communications
- Principle of phase locked loop

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

TEXT BOOKS:

1. John. G. Proakis, MasoudSalehi, “Digital Communication”, 5th Edition, McGraw Hill Education, 2014.
2. Heinrich Meyr, Marc Moeneclaey, Stefan A. Fechtel, “Digital Communication Receivers - Synchronization, Channel Estimation, and Signal Processing”, Wiley-Interscience Publication, 2001.

REFERENCES:

1. E.A. Lee and D.G. Messerschmitt, “Digital Communication”, 2nd edition, Allied Publishers, New Delhi, 1994
2. Simon Marvin, “Digital Communication Over Fading channel; An unified approach to performance Analysis”, John Wiley, New York, 2000
3. Bernard Sklar, “Digital Communication Fundamentals and Applications, Prentice Hall,1998

OUTCOMES :

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

ECDY 005 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES

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

PREREQUISITES :

Basic Knowledge in Electromagnetics

MODULE I EMI ENVIRONMENT AND STATISTICAL MODEL 8

EMI/EMC concepts and definitions, Sources of EMI, conducted and radiated EMI, Emission and immunity concepts, ESD. High-Speed Digital Interconnects and Signal Integrity. Modelling of Interferences, Statistical and Physical model of EMI.

MODULE II EMI/EMC STANDARDS AND MEASUREMENTS 10

Civilian standards, FCC, CISPR, IEC, EN, Military standards : MIL STD 461D/ 462, International EMC compliance requirements

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 III EMI COUPLING PRINCIPLES 7

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 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

TEXT BOOKS:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Second edition, 2001.

2. C.R.Paul, “Introduction to Electromagnetic Compatibility”, John Wiley and Sons, IncSecond Edition, 2010.

REFERENCES:

1. Tim Williams, “EMC for Product Designers”, 5th Edition, Newnes publisher, 2016.
2. Patrick G. Andre, Kenneth Wyatt , Henry W. Ott, “EMI Troubleshooting Cookbook for Product Designers”, Scitech, 2014.
3. R.Paul, “Introduction to EMC” Wiley, 2nd edition, 2006.

OUTCOMES :

On completion of this course the student will be able to

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

ECDY 006	ADVANCED OPTICAL WIRELESS COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To apply the principle and techniques of optical wireless channel.
- To distinguish various coded modulation techniques
- To integrate Hybrid RF/FSO communications.

PREREQUISITES :

- Basics of communication theory
- Frequency spectrum
- Maxwell's equation
- Familiarity with optical communication

MODULE I CODED MODULATION TECHNIQUES FOR OPTICAL WIRELESS CHANNELS 9

Review of the optical wireless channel, Atmospheric turbulence channel modeling, Codes on graphs, Coded-MIMO free-space optical communication, Adaptive modulation and coding (AMC) for FSO communications, Multidimensional coded modulation for FSO communications, Free-space optical OFDM communication.

MODULE II WIRELESS OPTICAL CDMA COMMUNICATION SYSTEMS AND ERROR STATISTICS 8

OCDMA system description, Indoor wireless optical CDMA LAN, Free-space optical CDMA systems, Modulation, Pointing error statistics.

MODULE III EQUALIZATION AND MARKOV CHAINS IN CLOUD CHANNEL AND MIMO TECHNIQUES 10

Channel propagation modeling and eigen analyses, Issues on Equalization, Indoor optical wireless (OW) MIMO channel characteristics, MIMO for diffuse OW channels, Spot-diffusing OW MIMO systems, Point-to-Point OW MIMO communications.

MODULE IV CHANNEL CAPACITY 8

Review of optical wireless channel and its components, Unique channels, channel models, Capacity results, Numerical techniques.

MODULE V APPLICATIONS OF OPTICAL COMMUNICATION 10

Free-space optical communications underwater-ocean optics, link equation, Channel characterization, System design for uFSO links, Hybrid RF/FSO communications, Visible-Light Communication, Free-space optical (FSO) sensor network.

Total Hours 45

TEXT BOOKS:

1. Shlomi Arnon, John R. Barry, et al., “Advanced Optical Wireless communication Systems ", First Edition, Cambridge University Press, 2012
2. Gerd Keiser, "Optical Fiber Communication", 3rd Edition, McGraw-Hill International, Singapore, 2013.

REFERENCES

1. J. Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 3rd Edition, 2010.
2. J. Gowar, "Optical Communication System", Prentice Hall of India, 2011.

OUTCOMES:

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

- Apply the principle and techniques of optical wireless channel.
- Distinguish various coded modulation techniques
- Describe Markov chains in cloud channel and MIMO techniques
- Design and evaluate UFSO links
- Performance determination of ocean optics and under water channel characterization
- Integrate Hybrid RF/FSO communications.Design and Analyze Network Components.

ECDY 007 ERROR CONTROL CODING L T P C
3 0 0 3

OBJECTIVES

- Provide an introduction to traditional and modern coding theory.
- Identify the major classes of error detecting and error correcting codes and how they are used in practice.
- Study the behaviour of codes in AWGN channel.
- Specify specific error detecting and error correcting codes in a precise mathematical manner.
- Develop and execute encoding and decoding algorithms associated with the major classes of error detecting and error correcting codes.
- Develop a new code based on an application

PREREQUISITES :

- Basic knowledge on Probability theory
- Basic Network Concepts.

MODULE I INTRODUCTION TO CODING AND MODERN ALGEBRA 9

Linear Block Codes: Generator and parity-check matrices, Minimum Distance, Syndrome 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, E_b/N_o, 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, inter leavers, 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 inter leavers, Non systematic 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 Hours: 45

TEXT BOOKS

1. Shu Lin and Daniel. J. Costello Jr., “Error Control Coding: Fundamentals and applications”, Second Edition Prentice Hall Inc, 2004. ISBN 0-13-042672-5.
2. Rudiger Urbanke and Thomas Richardson “Modern coding theory”, Cambridge 2008.
3. W.C. Huffman and Vera Pless, “Fundamentals of Error correcting codes”, Cambridge University Press, 2003.
4. Branka Vucetic, Jinhong Yuan, “Turbo Codes - Principles and Applications,'' Kluwer Academic Publishers, 2000.

REFERENCES

1. Thierry Lestable, Moshe Ran, “Error Control Coding for B3G/4G Wireless Systems”, John Wiley & Sons ltd, 2011.
2. Ron M. Roth “Introduction to Coding Theory” Cambridge University Press, 2006 (An excellent textbook primarily covering block codes.)

OUTCOMES:

At the end of the course, the student should be able to:

- Describe the need for error correcting codes in data communication.
- Explain the behaviour of modern codes in AWGN Channel
- Compare the error correction capability of different error control codes and their performances
- Demonstrate the encoding and decoding procedures of various error control codes.
- Explore efficient design methods and the powerful modern iterative coding techniques for high capacity codes like LDPC codes and Turbo codes
- Design an error correcting code for a given application.

ECDY 008 MEDICAL IMAGE PROCESSING

L	T	P	C
3	0	2	4

OBJECTIVES

- To explain fundamental concepts of digital image processing
- To compare algorithms that perform basic image pre-processing
- To describe about reconstruction of medical image.
- To develop knowledge on feature extraction of medical images
- To classify medical images
- To explain the registration and visualization of medical images.

PREREQUISITES :

- Basic knowledge about signals and systems
- Fundamentals of signal and image processing

MODULE I IMAGE FUNDAMENTALS 12

Image perception- Modulation transfer function of the visual system- Image fidelity criteria, Image model, Image sampling and quantization –Image transforms – Image enhancement- Image restoration- Image Compression.

Practical Exercises:

Fundamental operations on medical images; Sampling and quantization of medical images

MODULE II MEDICAL IMAGE SOURCES 12

Multimodal images- Computed Tomography-Magnetic Resonance Imaging – ultrasound-nuclear medicine and molecular imaging-other imaging techniques-radiation protection.

Practical Exercises:

Compression of medical images; Enhancement techniques on multimodal images.

MODULE III MEDICAL IMAGE RECONSTRUCTION 12

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

Practical Exercises:

Reconstruction of MRI, ultrasound and CT images; Medical image Filtering.

MODULE IV IMAGE ANALYSIS AND CLASSIFICATION 12

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

Practical Exercises:

Pixel based and edge based segmentation on multimodal images; Feature extraction and classification of medical images.

MODULE V IMAGE REGISTRATIONS AND VISUALIZATION 12

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.

Practical Exercises:

Registration of medical images; Implementation of medical image rotation in 2D and 3D.

Total Hours: 60

TEXT BOOKS:

1. Wolfgang Birkfellner, “Applied Medical Image Processing – A Basic course", CRC Press, 2014.
2. Paul Suetens, "Fundamentals of Medical Imaging", Second Edition, Cambridge University Press, 2009.
3. Michael Fitzpatrick and Milan Sonka, "Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis", SPIE Publications, 2009.
4. Rafael C.Gonzalez, “Digital Image Processing “,Pearson 2017

REFERENCES:

1. Geoff Dougherty, "Digital Image Processing for Medical Applications", First Edition, Cambridge University Press, 2009.
2. Jerry L. Prince and Jonathan Links, "Medical Imaging Signals and Systems", Second Edition, Prentice Hall, 2015.
3. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2012.
4. John L. Semmlow, "Biosignal and Medical Image Processing", Third Edition, CRC Press, 2014.

OUTCOMES:

On completion of the course, students will be able to

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

ECDY 009 MICROWAVE INTEGRATED CIRCUITS

L	T	P	C
3	0	0	3

OBJECTIVES

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

PREREQUISITES :

- Basic knowledge on Electron devices
- Characteristics of electromagnetic waves

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 180 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

TEXT BOOKS:

1. David M.Pozar, “Microwave Engineering”, John Wiley & sons, 4th Edition, 2011.
2. Terry Edward s & Michael steer" Foundation for microstrip circuit design" Wiley-IEEE Press, 2016.
3. Mike Golio, Janet Golio, “The RF and Microwave Handbook”, CRC Press, 2008.

REFERENCES:

1. I.J.Bhal and P.Bhartia, “Microwave solid state circuit design”, John Wiley & sons, 2003.
2. S.Y.Liao, “Microwave Circuit Analysis and Amplifier Design”, Prentice Hall, 1987.
3. Hoffman, R.K- “Handbook of Microwave Integrated Circuits”- Artech House, 1987.
4. 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 should be able to:

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

ECDY 010 MULTIMEDIA COMPRESSION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES

- To describe various multimedia compression techniques and the need for data compression
- To describe the types of text compression techniques
- To analyze different audio compression methods
- To discuss about the various types of image compression
- To explain the types of video compression techniques
- To simulate various multimedia compression techniques

PREREQUISITES:

To know about the basics of data communication and compression.

MODULE I INTRODUCTION **12**

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 **10**

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

* Simulation of the various text compression codes using MATLAB.

MODULE III AUDIO COMPRESSION **7**

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 8

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

* Simulation of the various image compression algorithms using MATLAB.

MODULE V VIDEO COMPRESSION 8

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

Total Hours: 45

TEXT BOOKS:

1. Sayood, “Introduction to Data Compression”, Morgan Kauffman Harcourt, 4th Edition, 2012.
2. David Salomon: Data Compression – The Complete Reference, Springer Verlag New York Inc., 4th Edition, 2006.

REFERENCES:

1. FredHalsall:“Multimedia communications - Applications, Networks, Protocols& Standards”, Pearson Education, 2001.
2. Mark S. Drew, Ze-Nian Li: Fundamentals of Multimedia, PHI, 1st Edition, 2009.
3. Yun Q. Shi, Huifang Sun: Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards, CRC press, 2003.

OUTCOMES:

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

- Identify various compression techniques for different data types
- Describe the compression techniques used for text compression
- Explain various compression techniques for audio compression.
- Illustrate the various image compression techniques
- Discuss about the different video compression techniques
- Apply the compression techniques and estimate the compression factor for the given data

ECDY 011	NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES

The student will be able to,

- Describe security concepts, Ethics in Network Security.
- Distinguish and explain the concepts of encryption standards and algorithm
- Identify the security threats, and the security services and mechanisms to counter them.
- Discuss the performance of various cryptographic and cryptanalytic algorithms.
- Analyze role of Firewalls and Intrusion Detection Systems.

PREREQUISITES :

- Basic understanding of computer networking and cryptography
- Knowledge about communication protocols

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

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson, 2017
2. William Stallings, “Network Security Essentials”, 6th edition. Pearson, 2018

REFERENCES:

1. Charlie Kaufman, “Network Security: Private Communication in Public World”, 2nd edition, Pearson, 2017.

OUTCOMES :

On completion of the course the student will be able,

- To identify common network security vulnerabilities/attacks; explain the foundations of network security;
- To identify the appropriate procedures required to secure networks;

- To evaluate the risks and threats to networked computers;
- To demonstrate detailed knowledge of the role of encryption to protect data;
- Get knowledge on development of security policies, standards and practices.
- To determine firewall requirements, and configure a firewall.

ECDY 012 CMOS RF SYSTEM DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduces basic concepts of RF CMOS technology
- To predict accurately the characteristics of RF devices
- To focus on RFIC
- To describe different types of LNA
- To design CMOS dynamic circuit

PREREQUISITES ::

- Basics of RF CMOS devices and system design
- Fundamentals of amplifiers, oscillators and Mixers
- Principles of Phase Locked Loop circuits and ICs.

MODULE I RF CMOS SYSTEMS ON CHIPS 9

Modern RF Mobile technologies, RF transceiver systems, Modulation and demodulation techniques, Multiple access techniques, Receiver sensitivity and linearity, On chip power amplifier, Cellular phone concept, CMOS RF technology.

MODULE II RF CMOS DEVICES AND PROCESS DESIGN KITS 9

RF transistor – On chip Inductors – Baluns /Transformers – RF interconnects – Varactors – Capacitors – Process Design Kits.

MODULE III RF CMOS LOW NOISE AMPLIFIERS 9

Concepts of LNA, Input architecture of LNA, Input matching analysis – Design of a single band LNA

MODULE IV RF MIXERS AND OSCILLATORS 9

Common configuration of active mixers, - active mixer with current booster – passive mixer- Port isolation and DC offset in direct conversion mixer – image reject mixer for low IF architecture

MODULE V RF CMOS PHASE - LOCK LOOPS AND PRE SCALARS 9

Introduction – various LC VCO topologies – VCO design methodologies – PLL – Transient characteristics – Tracking – second order PLL – Acquisition Phase detector and loop filter – Noise characteristics of PLL – Pre scalar - Design and optimization of CMOS Dynamic Circuits Based pre scalar

Total hours 45

TEXT BOOKS

1. Kiat Seng Yeo, ManhAnh Do, ChirnChye Boon, “Design of CMOS RF Integrated Circuits and Systems” , World Scientific, 2010.
2. Robert Caverly, , “CMOS RFIC Design Principles, Artech House, 2007

REFERENCES:

1. M. Jamal Deen, Tor A. Fieldly, “CMOS RF Modelling, Characterization and Applications”, World Scientific, 2002.
2. Thomas H. Lee, , "The Design of CMOS Radio-Frequency Integrated Circuits" Cambridge University Press, 2004

OUTCOMES :

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

- Apply the concept of CMOS technology
- Analyse different characteristics of CMOS devices
- Create CMOS dynamic circuits
- Explain configuration of active mixers
- Use various types of oscillators and mixers
- Differentiate various LC VCO topologies.

ECDY 013	MEDICAL ELECTRONICS AND DATA ACQUISITION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To discuss the characteristics of bio medical signals and its extraction.
- To compare and analyze the sensors and transducers in biomedical system with safety measures
- To discuss the data acquisition methods of bio medical signals
- To realize ECG, EEG system design and the structure of hearing aid system
- To describe the modern medical devices and wearable electronic devices applied in medical diagnosis

PREREQUISITES :

- Electron devices principles and device applications
- Fundamentals of sensors and transducers

MODULE I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING **9**

The origin of Bio-potentials; bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, lead systems and recording methods, typical waveforms and signal characteristics.

Bio-Chemical and non electrical parameter measurement: pH, PO2, PCO2, colorimeter, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood Cell Counters.

MODULE II BIOMEDICAL INSTRUMENTATION AND DEVICES, SENSORS AND TRANSDUCERS **9**

Classification of Biomedical Instruments and Devices-Regulation of Biomedical Instrumentation and Devices-Safety of Biomedical Instrumentation and Devices-Micro-Electro-Mechanical Systems-Voltage Sensors-Optical Sensors-Displacement/Pressure Sensors and Accelerometers-Chemical Sensors-Acoustic Sensors.

MODULE III DATA ACQUISITION AND SAFETY OF BIOMEDICAL INSTRUMENTS AND DEVICES 9

Data Acquisition: Electronic Building Blocks of Analogue-to-Digital Converters-Analogue-to-Digital Converter Architectures-Commercial ADC Specifications-Characteristics of Biomedical Signals and Post-Acquisition Signal Processing.

Safety of Biomedical Instruments and Devices: Physiological Effects of Current Flow through the Human Body-Macro shock, Micro shock and Leakage Currents: Causes and Prevention-Classification of Medical Devices-Safety Testing Equipment-Safety of Implanted Devices.

MODULE IV BIOMEDICAL SYSTEM DESIGN 9

ECG System Design: Common-Mode Signals and Other Noise Sources-Reducing the Common-Mode Signal-Design of Lead-Off Circuitry-Filtering and Sampling.

Electroencephalography system Design: Electrodes and their Placement on the Scalp-Amplifiers/Filters and Digitizing Circuitry

Digital Hearing Aids: Basic Design of a Digital Hearing Aid-Different Styles of Hearing Aid-Components of a Hearing Aid- Ear moulds and Vents-Microphones.

MODULE V MOBILE HEALTH, WEARABLE HEALTH TECHNOLOGY AND WIRELESS IMPLANTED DEVICES 9

Mobile and Electronic Health: Mobile Phones and Smartphone Apps-Wearable Health Monitors-Design Considerations for Wireless Implanted Devices-Cardiovascular Implantable Electronic Devices-Continuous Glucose Monitors-Implanted Pressure Sensors for Glaucoma-Packaging for Implanted Devices.

Total Hours 45

TEXT BOOKS:

1. Andrew G. Webb , Principles of Biomedical Instrumentation Cambridge University Press, 2018.
2. Vinod Kumar Khanna, Implantable Medical Electronics Prosthetics, Drug Delivery, and Health Monitoring, Springer International Publishing Switzerland 2016
3. Kuniharu Takei, “Flexible and Stretchable Medical Devices”, Wiley, 2018

REFERENCES:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007.
2. 2.John G.Webster, “Medical Instrumentation Application and Design”, 3rd Edition, Wiley India Edition, 2007.

OUTCOMES :

At the end of the course, the student should be able to:

- Discuss various Biological signals
- Classify biomedical sensors for various applications
- Use and design of different biomedical instruments and devices,
- Apply modern tools to envision new and improved future technology and designs
- Apply the safety measurements in biomedical devices
- Estimate various biological signals of biomedical devices

ECDY 014 SIGNAL DETECTION AND ESTIMATION

L	T	P	C
3	0	0	3

OBJECTIVES

The aim of this course is to

- Describe and explain basic principles of digital signal processing
- Design and implement algorithms for advanced signal analysis
- Assess the performance of signal processing algorithms and systems.
- Design and implement algorithms that perform basic signal processing
- Introduce the concept of statistical theory.
- Acquire knowledge on signal estimation and detection.

PREREQUISITES :

- Digital Signal Processing
- Probability and Random Processes

MODULE I STATISTICAL DECISION THEORY 8

Bayesian Hypothesis Testing - Likelihood Ratio Tests - Minimax Hypothesis Testing - Neyman Pearson Hypothesis Testing - Composite Hypothesis Testing - M'ary Hypothesis Testing

MODULE II SIGNAL DETECTION IN DISCRETE TIME 8

Deterministic Signals - Stochastic Signals – Models and Detector Structures – Performance Evaluation - Chernoff Bounds - Applications of Detection in Signal Processing

MODULE III PARAMETER ESTIMATION 10

Fundamentals of Estimation Theory - Minimum Variance Unbiased Estimation – Cramer Rao Lower bound – Best Linear Unbiased Estimators - Linear Least Squares Estimation – Nonlinear Least Squares Estimation - Maximum Likelihood Estimation

MODULE IV BAYESIAN ESTIMATION 9

Bayesian philosophy – General Bayesian Estimators - Minimum Mean Square Error Estimators – Maximum A Posteriori Estimators – Linear MMSE Estimation

MODULE V DISTRIBUTION-FREE ESTIMATION 10

Orthogonality Principle – Autoregressive Techniques - Discrete Wiener Filter, Continuous Wiener Filter, Generalization of Discrete and Continuous Filter Representations, Kalman Filter, Extended Kalman Filter - Applications of Estimation in Signal Processing.

Total hours 45

TEXT BOOKS:

1. Thomas Schonhoff and Arthur A.Giordano, “Detection and Estimation Theory", Prentice Hall,2nd edition, reprint 2010.
2. Kay S M, “Fundamentals of Statistical Signal Processing, Volume Estimation Theory”, Prentice Hall, first impression, 2010.

REFERENCES:

1. Poor H V, “An Introduction to Signal Detection and Estimation”, Springer-Verlang, 2nd edition, 1998.
2. Scharf L L, “Statistical Signal Processing”, Addison Wesley, reprint, 2007.
3. Sam Shanmugam K and Breipohl A M, “Random Signals: Detection, Estimation and Data Analysis”, John Wiley, 2nd edition, 2011.

OUTCOMES :

On completion of the course the student will be able,

- Apply the detection theory for system design and analysis.
- Compare the various estimation theory for signal and system design and analysis
- Describe and analyze the different parameter estimation.
- Assess and justify performance of Bayesian estimation.
- Develop algorithms for various estimation problems.
- Apply suitable techniques for various estimation applications.

ECDY 015 ARTIFICIAL INTELLIGENCE IN WIRELESS COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the fundamentals of artificial intelligence.
- To provide basic understanding of Cognitive radio
- To inculcate concepts in SRDs and its limitations
- To provide knowledge on the optimization techniques
- To introduce Artificial intelligence and in wireless communication
- To understand the issues and uses of various networks in Cognitive Radio Networking

PREREQUISITES :

- Basics of SDR and Cognitive Radio

MODULE I INTRODUCTION **9**

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

MODULE II ARTIFICIAL INTELLIGENCE IN WIRELESS COMMUNICATIONS **9**

Introduction to Cognitive Radio - Cognitive Radio Design - Cognitive Engine Design- Component Descriptions - - Artificial Intelligence Techniques

MODULE III SOFTWARE DEFINED RADIOS AND OPTIMIZATION **9**

Benefits of Using SDR - Problems Faced by SDR - GNU Radio Design - Objective Space – Multi objective Optimization: Objective Functions – Multi objective Optimization: A Different Perspective – Multi objective Analysis

MODULE IV GENETIC ALGORITHMS FOR RADIO OPTIMIZATION **9**

The Knapsack Problem – Multi objective GA - Wireless System Genetic Algorithm - Case-Based Decision Theory - Cognitive Engine Architecture with CBDT - Simple CBDT Example - Cognitive Radio Example Problem

MODULE V Cognitive Radio Networking and Rendezvous **9**

Waveform Distribution and Rendezvous - Cognitive Radio Networks - Distributed AI

- Application to Multicarrier Waveforms

Total Hours 45

TEXT BOOKS:

1. Thomas W. Rondeau, Charles W. Bostian, "Artificial Intelligence in Wireless Communications", Artech house, 2009.

REFERENCES:

1. David Grace, Honggang Zhang, Cognitive Communications: Distributed Artificial Intelligence (DAI), Regulatory Policy and Economics, Implementation, John Wiley & Sons, 2012
2. Stuart Russel and Peter Norwig, “Artificial Intelligence: A Modern Approach”, Prentice Hall third edition, 2012.
3. Kevin Knight, Eline Rich B.Nair, “Artificial Intelligence”, McGraw Hill Education, 3rd edition 2012.

OUTCOMES:

The students will be able to

- Discuss the evolution of artificial intelligence in wireless communication
- Identify and describe the various components used in Cognitive Radio
- Identify the problem and optimize the same in SDR
- Describe the Genetic Algorithms
- Interpret various Cognitive Radio Networks
- Produce optimized solution in wireless communication for using Artificial Intelligence

ECDY 016 RF TESTING AND MEASUREMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the concepts of RF systems, analog and mixed signal basics.
- To learn about RF cables and measure the losses over the RF cables.
- To introduce the fundamental measurement devices and techniques.
- To familiarize the measurement techniques used for passive and active components.
- To understand the measuring standards and manufacturing standards in RF components.
- To design RF circuits for testing.

PREREQUISITES :

- Basics of RF components Signal and Systems, Measuring devices like Oscilloscope spectrum analyzers.
- Knowledge in Electromagnetics.
- Knowledge in Microwave Systems.

MODULE I ANALOG AND MIXED-SIGNAL TESTING 9

Introduction – Sampling basics, Time domain and frequency domain, Dynamic and static measurement, ENOB and noise floor, Parallel testing of SOC devices, Design of Test.

MODULE II RF CO-AXIAL CABLE INSERTION AND RETURN LOSS MEASUREMENT 9

Introduction - RF cables are used in transmission of rf and microwave signals. step-by-step way of measuring insertion and return loss of a coaxial (coax) cable. Relationship between return loss and VSWR is given.

MODULE III RF MEASUREMENT- SPECTRUM ANALYZER 9

Introduction - Time domain measurements, use of oscilloscope, and frequency domain measurements use of spectrum Analyzer. The characteristics and applications of Spectrum Analyzers, and the features of spectrum analyzer.

MODULE IV RF MEASUREMENTS - NOISE FIGURE MEASUREMENT 9

Introduction – Electronic equipment, a passive component [cable], an active component [amplifier] - the measurement of noise in electronic systems. Several methods of noise measurement, and the features

MODULE V TIME AND FREQUENCY STANDARDS 9

Time and frequency standards. The primary, secondary, and tertiary standards available, such as Cesium, Rubidium, and Crystal standards. Comparison of these standards and provides some organizations involved in the manufacture or maintenance of these standards.

Total Hours 45

TEXT BOOKS:

1. Robert A. Witte, “Spectrum and Network Measurements”, Scitech Publishing, second edition, 2014.
2. Miko Golio, ”RF and Microwave Circuits, Measurements and Modeling”, CRC press, second edition 2009.
3. Keith B.Schaub& Joe Kelly, “Production Testing of RF and System-on-a-Chip Devices for Wireless Communications”, Artech House Inc., 2004.
4. Frederique de Fornel, Pierre-Noël Favennec, “Measurements using Optic and RF Waves”, John Wiley & Sons, Inc, 2010.

REFERENCES:

1. Rowan Gilmore, Les Besser, “Practical RF Circuit Design for Modern Wireless Systems”, Artech House Inc., 2003.
2. Joe Kelly, Michael D. Engelhardt, “Advanced Production Testing of RF, SoC, and SiP Devices”, Artech House Publishers 2006.
3. D.M.Pozar, “Microwave Engineering”, John Wiley & sons,Inc.,4th Edition, 2006.
4. User Manual of NI Vector Network Analyzer.
5. User Manual of Agilent’s Spectrum Analyzer.

OUTCOMES :

At the end of the course, the student should be able to:

- Describe the concepts of RF systems and mixed signal basics.
- Illustrate the RF cables and losses on RF cables.

- Discuss about the fundamental measurement devices.
- Apply the measurement techniques used for the RF components.
- Describe measuring standards and manufacturing techniques
- Design RF circuits, test and measure the parameters

ECDY 017	HUMAN AND MACHINE SPEECH COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To discuss the mathematical foundations needed for speech processing
- To analyze the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing.
- To apply the basic concepts of automatic concept recognition.

PREREQUISITES :

- Transforms
- Signals and Systems
- Digital Signal Processing

MODULE I SPEECH PRODUCTION AND CATEGORIZATION OF SPEECH SOUNDS **9**

Introduction to speech signal processing, overview of speech signal processing applications, human speech production mechanism, acoustic theory of speech production, nature of speech signal, spectrographic analysis of speech, categorization of speech sounds, co articulation, prosody

MODULE II SPEECH ANALYSIS AND SYNTHESIS **9**

Time and frequency domain analysis, Review of DSP techniques-z-transform, Discrete Fourier transform, short time analysis of speech, linear prediction analysis, cepstral analysis, Contrasting linear prediction analysis and cepstral analysis, vector quantization(VQ) methods.

MODULE III SPEECH RECOGNITION **9**

Speech recognition, Bayes rule, segmental feature extraction, MEL frequency cepstral coefficient (MFCC), dynamic time – warping (DTW), Gaussian mixture models (GMM), hidden Markov model(HMM), approaches for speech, speaker and language recognition.

MODULE IV SPEECH CODING 9

Speech Synthesis and Enhancement: Speech coding, quality measures, speech redundancies, time-domain waveform coding, Linear predictive coding, LPC residual coding, principles of speech synthesis, fundamentals of speech enhancement

MODULE V AUTOMATIC SPEECH RECOGNITION 9

Introduction- Basic Pattern Recognition Approach-Pre processing –Parametric Representations –Evaluating the similarity of speech patterns –Accommodating both spectral and temporal variability-Networks for speech recognition-Adapting to variability in speech –Language models-Search Designs

Total Hours 45

TEXT BOOKS

1. Douglas O'Shaugnessy, "Speech Communication, Human and Machine", IEEE Press, 2000.
2. L. Rabiner, B. H. Juang and B. Yegnanarayana, "Fundamentals of Speech Recognition", Pearson India, 2009.

REFERENCES

1. T.F Quatieri, "Discrete-Time Speech Signal Processing- Principles and Practice", Pearson, 2002.
2. L.R. Rabiner and R. W. Schafer, "Theory and Applications of Digital Speech Processing", Pearson, 2010
3. J R Deller, J H L Hansen, J G Proakis, "Discrete-time Processing of Speech Signals, IEEE, Wiley.

OUTCOMES :

At the end of the course, the student should be able to:

- Identify the various temporal, spectral and cepstral features required to identify the speech units – phoneme, syllable and word.
- Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
- Justify the use of formant and concatenative approaches to speech synthesis
- Identify the appropriate approach of speech synthesis depending on the language to be processed
- Apply the various encoding techniques to represent the speech signal.
- Analyze the concepts of automatic speech recognition

ECDY 018 INTRODUCTION TO QUANTUM COMPUTATION L T P C
3 0 0 3

OBJECTIVES

- To introduce the basic concepts of quantum mechanics.
- To develop the knowledge on quantum computation and quantum information.
- To analyze the behaviour of basic quantum algorithms.
- To understand the simple quantum error correction techniques.
- To know the basic requirements for implementation of quantum computers
- To distinguish the behaviour of traditional computers & Quantum computers

PREREQUISITES :

Basic knowledge on Digital logic circuits& Linear Algebra

MODULE I INTRODUCTION TO QUANTUM MECHANICS 9

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 QUANTUM GATES 9

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 9

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

MODULE V QUANTUM ERROR CORRECTION 9

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

Total Hours: 45

TEXT BOOKS:

1. Nielsen, Michael A and Isaac L. Chuang, “Quantum Computation and Quantum Information”, Cambridge, UK: Cambridge University Press, 2002.
2. Eleanor G. Rieffel and Wolfgang H. Polak “Quantum Computing: A Gentle Introduction”, The MIT Press Cambridge, Massachusetts London, England, 2011.
3. Riley Tipton Perry, “Quantum Computing from the Ground Up”, World Scientific Publishing Ltd (2012).

REFERENCES:

1. Vishal SahniLov K Grover, “Quantum Computing”, Tata McGraw-Hill Publishing Company Limited, 2007. ISBN: 9780070657007
2. Dan C.Marinescu, Gabriela M.Marinescu “Approaching Quantum Computing”, Pearson Education, 2008-09.

OUTCOMES:

At the end of the course, the student should be able to:

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

ECDY 019 COMPUTATIONAL ELECTROMAGNETICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide students with the elementary knowledge & techniques on Basic Engineering Electromagnetics
- To describe and analyze the electromagnetic field distribution
- To give an overview of contemporary numerical approaches in electromagnetics
- To introduce Computational Electromagnetic techniques
- To discuss the concepts of IE, MOM, FEM and FDTD methods of analysis
- To provide hands-on simulation practices on Electromagnetism

PREREQUISITES

- Basic Linear Algebra and calculus
- Basing Engineering Electromagnetics

MODULE I OVERVIEWS AND REVIEWS 7

Review of vector calculus-Overview of computational electromagnetics-Review of Maxwell's equations, equivalence theorems - Review of numerical integration

MODULE II INTEGRAL EQUATION METHODS 11

Introduction to integral equations - Surface integral equations: mathematical derivation of Huygen's principle, Extinction theorem - Introduction to Green's functions: 1D example of string, 2D and 3D wave equation - Solving integral equations using the method of moments (MoM) - Example of MoM: 2D surface integral equations - 2D volume integral equations - Summary of integral equation methods; computation of radar cross-section (RCS)

MODULE III FINITE ELEMENT METHODS 9

Introduction and history of FEM, FEM in the method of moments framework; 1D and 2D basis functions in FEM - Weak form of FEM; Robin boundary conditions; example of solving the 1D wave equation using FEM - 2D edge-based (vector) FEM: Weak form of FEM; shape functions, weak form and radiation boundary conditions, total and scattered field formulations, assembly of equations, numerical aspects in computing 2D FEM matrix elements, and overall procedure

MODULE IV FINITE DIFFERENCE TIME DOMAIN METHODS 10

Introduction to FDTD: update equations, computational stencil in 2D - FDTD -- Analysis, convergence, accuracy and numerical dispersion - incorporating dielectric and dispersive materials; absorbing boundary conditions - failure of ABCs and introduction of perfectly matched layers (PML)- direct current sources, incident field introduction in scattering problems

MODULE V APPLICATIONS OF COMPUTATIONAL ELECTROMAGNETICS 8

Microwave inverse imaging - Antenna radiation problems -- Hertz dipole and its fields; Pocklington's integral equation for finding the current on a finite length wire; mutual coupling between array elements - Calculating the modes of a waveguide structure using the integral equation method -- solving a generalized eigen value problem - Hybrid methods in CEM -- Finite Element - Boundary Integral method

Total Hours 45

TEXT BOOKS

1. C. A Balanis**, "**Advanced Engineering Electromagnetics" 2nd ed. , Wiley, 2012.
2. Davidson, D. B, Computational Electromagnetics for RF and Microwave Engineering, Cambridge University Press, 2005.
3. Weng Cho Chew, Mei Song Tong, Bin Hu, "Integral Equation Methods for Electromagnetic and Elastic Waves", Morgan & Claypool, 2008.

REFERENCES

1. Stephen D. Gedney, "Introduction to the Finite-Difference Time-Domain (FDTD) Method for Electromagnetics", Morgan & Claypool, 2011.
2. John L. Volakis, KubilaySertel, Brian C. Usner, "Frequency Domain Hybrid Finite Element Methods for Electromagnetics", Morgan & Claypool, 2006.
3. William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, "Numerical Recipes in C++: The Art of Scientific Computing", Press Syndicate of the University of Cambridge, 2002.
4. Constantine A. Balanis, "Antenna Theory: Analysis and Design", 4th Edition, Wiley, 2016.
5. John L. Volakis, Arindam Chatterjee, Leo C. Kempel, "Finite Element Method Electromagnetics: Antennas, Microwave Circuits, and Scattering Applications", 1st

Edition, Wiley Interscience, 1998.
6. Andrew F. Peterson, Scott L. Ray, Raj Mittra, “Computational Methods for Electromagnetics”, Wiley, 1997.
7. Bondeson,A., Rylander,T., Ingelström,P., Computational Electromagnetics, Springer, 2005.
8. Weng Cho Chew, "Waves and Fields in homogenous Media", Wiley, 1999.

OUTCOMES :

At the end of the course, the student should be able to:

- Describe the EM phenomenon and and EM wave characteristics
- Identify conventional and state-of-the-art computational electromagnetic techniques for modeling wireless communication devices, high speed electronic circuits, and antenna populations.
- Apply electromagnetic wave theories and tools for the applications of wave propagation, radiation, scattering, and in particular, wireless communications.
- Analyse the numerical techniques and software packages for solving generalized practical electromagnetic problems
- Able to solve electromagnetic problems applied in systems.
- Apply the appropriate numerical methods technique to solve the EM problem

ECDY 020 OPTICAL CODES AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES

- To analyse the characteristics of Dynamic Optical Communications.
- To select suitable optical Coding Schemes for specific application.
- To explain and adopt Hybrid Multiplexing Techniques
- To discuss the issues of different Integration Technologies and protection schemes

PREREQUISITES :

- Basics of photo electronic devices and its functions
- Fundamentals of optical communication, Information Theory and Coding

MODULE I INTRODUCTION TO DYNAMIC OPTICAL COMMUNICATIONS **9**

Historical Perspective of Optical Communications, Optical Transmission and Optical Networking, Optical Communications Trends, Migration to 100 Gb/s Ethernet and Beyond, Dynamically Reconfigurable Optical Networks.

MODULE II OPTICAL CODING SCHEMES **9**

1-D, Constant-weight Symmetric OOCs, Constant-weight Asymmetric OOCs, Variable-weight Optical Orthogonal Codes, 2-D and 3-D Coding, Enabling Hardware Technologies, Potential Applications.

MODULE III HYBRID MULTIPLEXING TECHNIQUES **9**

Hybrid Multiplexing Transmission System, Photonic Gateway - Multiplexing Format Conversion, OCDMA/WDM Virtual Optical Path Cross Connect.

MODULE IV INTEGRATION TECHNOLOGIES **9**

Integration Strategies, Encoding/Decoding for OCDMA Systems- 1-D, 2-D and 3-D Optical Encoders and Decoders, Spectral-Amplitude Incoherent Optical Encoder and Decoder, coherent Optical Encoder and Decoder, Integrated modules.

MODULE V ARCHITECTURES, PROTOCOLS AND APPLICATIONS **9**

Interconnections of OCDMA Networks with WDM Networks and OTDM Networks, OCDM/WDM Hybrid Networks, OCDMA Local Area Networks and Access

Networks, Simple Communication Protocols, Optical Packet Switching Based on Optical Code Label, Information Transmission Confidentiality of OCDMA Networks.

Total Hours 45

TEXT BOOKS:

1. Hongxi Yin David J. Richardson “Optical Code Division Multiple Access communication Networks Theory and Applications’’ Tsinghua University Press, Beijing and Springer, 2011
2. Rajiv Ramaswami and Kumar Sivarajan, "Optical Networks Practical Perspective", 3rd Edition, Morgan - Kaufmann Publishers, 2015.
3. John M. Senior, “Optical Fiber Communications –Principles and Practice”, Pearson Education India, 2014
4. C.Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Pearson Education India, 2016

REFERENCES:

1. Optical Networks, Third Generation Transport Systems, Uyless Black, Pearson publisher 2010.
2. Biswanath Mukherjee, “Optical Communication Networks”, McGraw-Hill, 2017

OUTCOMES:

At the end of the course, the student should be able to:

- Characterise the Dynamic Optical Communications
- Select suitable optical Coding Schemes for specific application
- Describe the hardware technologies for the potential applications
- Explain and adopt Hybrid Multiplexing Techniques
- Discuss the issues of different Integration Technologies and protection schemes
- Design and Evaluate the protocols for optical networks

ECDY 021 ANTENNAS FOR IOT APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES

- To design RFID tag and NFC device antennas.
- To understand the design of capsule endoscopy antenna.
- To describe about the wearable antenna for inbody telecommunication
- To discuss the issues of different Optical Network topologies and protection schemes
- To know the implementation of planar antenna for multi band applications.

PREREQUISITES :

- Fundamentals of Maxwell's equation
- Basics of Frequency spectrum
- Antenna radiation mechanisms and antenna parameters.

MODULE I RFID TAG ANTENNA 10

Introduction to RFID characteristics, Standard of RFID tags, The design of the electromagnetic induction method's RFID tag antenna, The design of the radio frequency method's RFID tag antenna, Metal correspondence of RFID tag. Concepts of NFC – methods and designs for NFC device antenna.

MODULE II ANTENNA FOR A CAPSULE ENDOSCOPE 8

Medical telemeter, Capsule endoscope, Wireless power transmission to a capsule endoscope. Developments in capsule endoscopy.

MODULE III WEARABLE ANTENNA 9

Introduction to wearable antenna, The frequencies in BAN, Challenges of wearable antennas, Antenna for on-body telecommunication, Antenna for in-body telecommunication at 2.4GHz

MODULE IV WEARABLE FOLDED DIPOLE ANTENNA 9

Requirements for the helmet antenna, Folded dipole antenna, Characteristics of the planar FDA, Characteristics of the curved FDA, Consideration of radiation toward human head.

MODULE V MULTI-FREQUENCY DUPLEX TRANSMITTER AND RECEIVER USING MULTIBAND PLANE ANTENNA **9**

Introduction, theory of polarization switching type multi-band planar antenna, Prototype of multi-band antenna, Experimental Results of Antenna Element.

Total Hours 45

TEXT BOOKS:

1. Haruo Kawakami, Hisashi Morishita", Design technique of small antennas in the IoT generation," 1st Edition, John Wiley& Sons, 2011.
2. Raj Mittra, "Developments in Antenna Analysis and Design", (Electromagnetics and Radar) , Scitech publication, first edition 2018.

REFERENCES:

1. Anil Pandey, Practical Microstrip and Printed Antenna Design, Artech house, 1st edition, 2019.
2. Zhaoshen Li, Zhuan Liao, Mark Mc Alindon, Handbook of Capsule Endoscopy, Springer, 1st edition, 2014.
3. ZhiNing Chen," Antennas for Portable Devices", 1st edition, John Wiley & Sons, 2007.
4. Douglas H. Werner, ZhiHao Jiang," Electromagnetics of Body Area Networks: Antennas, Propagation, and RF Systems", 1st edition, John Wiley & Sons, 2016.

OUTCOMES :

At the end of the course, the student should be able to:

- Design and analyze RFID tag and NFC device antennas.
- Select suitable antenna for capsule endoscopy application.
- Describe about the wearable antenna for inbody telecommunication.
- Interpret the characteristics of wearable antenna for human head.
- Implement planar antenna for multi band applications.
- Execute the results of antenna using experimental setup.

ECDY 022	RF MEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explain the concept of micromachining.
- To describe actuation mechanisms in MEMS
- To design RF MEMS inductors and capacitors.
- To describe the RF MEMS Phase Shifters, Filters
- To discuss the Micro-machined transmission lines and antennas
- To explore various applications of RF MEMS devices

PREREQUISITES :

- Basics of Semiconductor devices
- Fundamentals of transmission lines and antennas, Phase Shifters, Filters.

MODULE I INTRODUCTION TO RF MEMS 9

Electrical and mechanical modelling of MEMS devices, Micromachining Processes, micro matching (Bulk, Surface, LIGA), Photolithography, other lithography Methods, Materials for MEMS ,RF MEMS relays and switches, Switch parameters, Actuation mechanisms, Bistable relays and micro actuators, Dynamics of switching operation.

MODULE II MEMS inductors and capacitors 9

Micro-machined inductor. Effect of inductor layout. Modeling and design issues of planar inductor. Fractal capacitor, variable capacitor, Gap-tuning and area-tuning capacitors. Dielectric tunable capacitors.

MODULE III RF Filters and Phase Shifters 9

Introduction, Modelling of Mechanical Filters, Micromechanical Filters, Surface Acoustic Wave Filters, Bulk Acoustic Wave Filters, Micro-machined Filters for Millimetre Wave Frequencies, FBAR filter fundamentals, Various types of MEMS phase shifters.

MODULE IV Micro-machined transmission lines and antennas 9

Microstrip antennas – design parameters. Micromachining to improve performance, Reconfigurable antennas, Coplanar lines, Micro-machined directional coupler and mixer, RF MEMS Oscillators.

MODULE V RF MEMS Based Circuit Design 9

X-Band RF MEMS Phase shifter for phased array applications, KaBand RF MEMS Phase shifter for radar systems applications, Film bulk acoustic wave filters, FBAR filter for PCS applications, 2.4 GHz MEMS based voltage controlled oscillator.

Total Hours 45

TEXT BOOKS

1. Vijay. K. Varadan, K.J. Vinoy, and K.A. Jose, “RF MEMS and their Applications”, Wiley, India, 2011
2. H.J.D.Santos, RF MEMS Circuit Design for Wireless Communications, Artech House, 2002.
3. S. Senturia, “Microsystem Design”, Kluwer, Springer, 2001.

REFERENCES

1. A. Luque, S Nihtianov, Smart Sensors and MEMS, Woodhead Publishing, 2018
2. Jia-Sheng Hong, Microstrip Filters for RF/Microwave Applications, 2nd Edition, 2011.
3. G.M.Rebeiz , RF MEMS Theory, Design and Technology, Wiley, 2003

OUTCOMES :

At the end of the course, the student should be able to:

- Analyze the concepts of micromachining processes
- Design RF MEMS inductors and capacitors.
- Design RF MEMS Filters and RF MEMS Phase Shifters.
- Identify the suitability of micro-machined transmission lines for RF MEMS
- Design Micro-machined Antennas and Reconfigurable Antennas
- Design RF MEMS Based Circuit

ECDY 023	HIGH SPEED CIRCUIT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics
- To analyse how high-frequency signals propagate on cables and circuit board traces
- To describe timing diagrams, setup and hold requirements and margins
- To analyse design parameters that affect signal integrity including reflections, attenuation and crosstalk

PREREQUISITES:

- Basics of circuit theory, digital design and communication theory.
- Fundamentals of electromagnetics and Laplace transforms
- Concepts of high speed circuits

MODULE I FUNDAMENTALS AND HIGH-SPEED PROPERTIES OF LOGIC GATES 9

Frequency and time, Time and distance, Lumped versus distributed systems, 3B and RMS frequencies, Four kinds of Reactance, Capacitance, Inductance, Power, speed, packaging.

MODULE II MEASUREMENT TECHNIQUES AND TRANSMISSION LINES 9

Rise time and bandwidth, self-inductance, Probing fixture, serial data transmission, cross talk, Measuring operating margin, Observing metastable states, Point-to point wiring, Infinite Uniform Transmission Line, Effects of source and load impedance, special transmission Line cases, Line impedance and propagation delay.

MODULE III GROUND PLANES, LAYER STACKING AND TERMINATIONS 9

High speed current follows and path of least inductance, Crosstalk in Solid Ground planes, slotted planes, Slotted Ground planes and Power and Ground Fingers, Guard traces, Near end and far end cross talk, End terminators, source terminators, middle terminators, AC biasing for End terminators, Resistor

selection Cross talk in terminators.

MODULE IV POWER SYSTEMS AND CONNECTORS 9

Stable voltage reference, Distributing Uniform voltage, Distribution problems, Bypass capacitor, Mutual Inductance, Series Inductance, Parasitic Capacitance, Coupling in a Connector, EMI problems, Connector Applications.

MODULE V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, cancelling parasitic capacitance, Clock jitter

Total Hours 45

TEXT BOOKS:

1. S. Hall, G. Hall, and J. McCall, High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices, Wiley-Interscience, 2000.
2. Eric Bogatin, Signal Integrity – Simplified, Prentice Hall PTR, 2003.

REFERENCES:

1. H. W. Johnson and M. Graham, High-Speed Digital Design: A Handbook of Black Magic, Prentice Hall, 1993.
2. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR, 2003.
3. William J Dally & John W Poulton, Digital Systems Engineering, Cambridge University Press, 1998

OUTCOMES:

The students will be able to

- Identify the basic of signal propagation
- Improve the signal transmission characteristics.
- Apply this knowledge to determine where signal integrity issues may arise
- Describe the timing margin and oscillators
- Analyse different power considerations
- Identify sources affecting the speed of digital circuits.

ECDY 024 INTERNET OF THINGS

L	T	P	C
3	0	0	3

OBJECTIVES

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

PREREQUISITES :

- Basics of Computer networks and Embedded system

MODULE I THE IoT NETWORKING CORE 9

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

MODULE II IoT ARCHITECTURE AND APPLICATIONS 9

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

MODULE III IoT PLATFORM OVERVIEW 9

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

MODULE IV IoT APPLICATION DEVELOPMENT 9

Application Protocols-MQTT, REST/HTTP, CoAP, MySQL -Back-end Application -

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

MODULE V CASE STUDY & ADVANCED IoT APPLICATIONS 9

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

Total Hours 45

TEXT BOOKS:

1. Jean-Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet”, Morgan Kuffmann, 2010
2. Vijay Madisetti, Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 2014.
3. Adrian McEwen (Author), Hakim Cassimally, “Designing the Internet of Things”, Wiley, 2013

REFERENCES:

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers, 2013
2. Barrie Sosinsky, “Cloud Computing Bible”, Wiley-India, 2010
3. Asoke K Talukder and Roopa R Yavagal, “Mobile Computing,” Tata McGraw Hill, 2010.
4. Adelstein and S.K.S. Gupta, “Fundamentals of Mobile and Pervasive Computing,” McGraw Hill, 2009
5. Ronald L. Krutz, Russell Dean Vines “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, Wiley, India, 2010.

OUTCOMES :

At the end of the course students will be able to

- Articulate the concepts, key technologies, strengths, limitations of cloud computing and the possible applications for state-of-the-art IoT

- Identify the architecture and infrastructure of IoT.
- Explain the core issues of IoT such as security, privacy, and interoperability
- Choose the appropriate technologies, algorithms, and approaches for the IoT related issues.
- Identify problems, and explain, analyze, and evaluate various IoT solutions
- Attempt to generate new ideas and innovations in IoT.

ECDY 025 WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES

- To 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

PREREQUISITES

- Basic concepts of networking and protocol

MODULE I NODE ARCHITECTURE 07

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

MODULE II NETWORK ARCHITECTURE 07

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

MODULE III MAC PROTOCOLS & TIME SYNCHRONIZATION 10

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

MODULE IV LOCALIZATION & ROUTING PROTOCOLS 12

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

MODULE V SENSOR NETWORK PROGRAMMING and IoT 09

Challenges in sensor network programming – Node Centric programming – Dynamic

programming – Sensor Network Simulators - Internet of Things (IoT): overview, Applications, potential & challenges, and architecture.

Total Hours: 45

TEXT BOOKS:

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.

REFERENCES:

1. 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.
2. “Adrian McEWen and Hakim Cassimalli, “Designing the Internet of Things” Wiley publications, November 2013.

OUTCOMES:

At the end of the course students will be able to

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

ECCY 026 RF SYSTEM DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES

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

PREREQUISITES :

- Basics of photo electronic devices and its functions
- Frequency spectrum
- Maxwell's equation
- Familiarity with optical communication

MODULE I RF ISSUES 7

Importance of RF design, Electromagnetic Spectrum, RF behaviour 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 8

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 7

Requirement of filter, Basic resonator and filter configuration, types of filters, their realization and implementation, Coupled filter. Modelling of special filters.

MODULE IV ACTIVE RF COMPONENTS AND MATCHING NETWORKS 8

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

MODULE V RF AMPLIFIER DESIGNS USING SMITH CHART 7

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

MODULE VI OSCILLATORS, MIXERS AND RF SYSTEMS 8

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

Total Hours 45

TEXT BOOKS

1. Reinhold Ludwig and Gene Bogdanov, “RF Circuit Design - Theory and Applications”, Upper Saddle River, NJ: Prentice-Hall, Second Edition, 2009.
2. Joseph. J. Carr, “Secrets of RF Circuit Design”, McGraw Hill Publishers, 3rd Edition, 2001.
3. Mathew M. Radmanesh, “Radio Frequency & Microwave Electronics Illustrated”, Pearson Education Asia, Second Edition, 2015.

REFERENCES

1. Ulrich L. Rohde and David P. NewKirk, “RF/ Microwave Circuit Design”, John Wiley & Sons, USA 2000.
2. David. M. Pozar, "Microwave Engineering", 4th Edition, John Wiley and Sons, 2012.
3. Roland E. Best, “Phase - Locked Loops: Design, Simulation and Applications”, McGraw Hill Publishers, 6th edition 2007.

OUTCOMES :

At the end of the course, the student should be able to:

- Apply the RF design and discuss its issues.
- Describe the concept of networks, their interconnections and applications
- Analyze the characteristics of amplifier circuits.
- Solve impedance matching for RF circuits.
- Design RF filters, Oscillators and mixers
- Design RF system MODULE.

ECDY 027 ADAPTIVE SIGNAL PROCESSING

L	T	P	C
2	0	0	2

OBJECTIVES

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

PREREQUISITES :

- Basics of Probability, Random Variable, Stochastic Process and Linear Algebra
- Fundamentals of Signal Processing Techniques.

MODULE I INTRODUCTION TO ADAPTIVE FILTERS 6

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

MODULE II WIENER FILTER, SEARCH METHODS AND THE LMS ALGORITHM 6

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

MODULE III CONVERGENCE AND STABILITY ANALYSES 6

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

MODULE IV VARIANTS OF THE LMS ALGORITHM 6

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

MODULE V CASE STUDY AND APPLICATION 6

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

Total Hours: 30

TEXT BOOKS

1. S. Haykin, Prentice Hall, Englewood Cliffs, “Adaptive Filter Theory”, NJ, Fourth Edition , 2002.
2. Jophn R. Treichler C. Richard Johnson, Jr. and Michael G. Larimore”, Theory and Design of Adaptive Filters”, Pearson education / PHI 2002.
3. B. Farhang- Boroujeny, “Adaptive Filters ,Theory and Applications”, John Wiley and Sons, 2013

REFERENCES

1. Andreas Antoniou, “Digital signal Processing Processing”, Tata McGraw Hill, second edition, 2008.
2. S.K.Mitra, "Digital Signal Processing- A Computer based approach", 4th Edition, Tata McGraw-Hill, New Delhi, 2011.

OUTCOMES :

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

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

ECDY 028 CLASSICAL AND ADVANCED TECHNIQUES FOR OPTIMIZATION

L	T	P	C
2	0	0	2

OBJECTIVES

- To discuss the basics of optimization techniques.
- To introduce the concepts of Non-Linear programming.
- To understand the concepts of Dynamic programming.
- To learn modern optimization methods.

PREREQUISITES :

- Basics in differential calculus and basic mathematics.

MODULE I INTRODUCTION AND BASIC CONCEPTS 5

Engineering applications of Optimization; Art of Modeling, Classification of optimization problems, Optimization techniques – classical and advanced techniques

MODULE II NONLINEAR PROGRAMMING 5

One-variable unconstrained and multivariable unconstrained optimization, Quadratic Programming

MODULE III DYNAMIC PROGRAMING 7

Dynamic programming, Network Optimization Models, Integer programming, Meta heuristics, Game Theory, Queuing Theory, Inventory Theory, Markov Decision Process.

MODULE IV MODERN METHODS OF OPTIMIZATION 7

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

MODULE V PRACTICAL ASPECTS OF OPTIMIZATION 6

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

Total Hours 30

TEXT BOOKS:

1. Deb K., “Multi-Objective Optimization using Evolutionary Algorithms”, First Edition, John Wiley & Sons Pte Ltd, 2002.
2. Singiresu S. Rao "Engineering Optimization Theory and Practice", 4th Edition, John Wiley 2009
3. Frederick S. Hillier & Gerald J. Lieberman, "Introduction to Operations Research", 10th Edition McGraw Hill Education, 2015.
4. Hamdy A. Taha, "Operations Research - An Introduction", 8th Edition, Pearson Education Inc., 2007.
5. Rao S.S., Engineering Optimization – Theory and Practice, Third Edition, New Age International Limited, New Delhi, 2000

REFERENCES:

1. Deb K., Optimization for Engineering Design – Algorithms and Examples, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
2. G. Hadley, “Linear Programming”, 5th Edition, Narosa Publishing House, 2002.
3. David G. Luenberger, “Optimization by Vector Space Methods”, John Wiley & Sons, 1997.

OUTCOMES :

At the end of the course, the student should be able to:

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

ECDY 029 PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basic concepts of pattern recognition
- To describe about linear and non-linear classifier methods
- To assess dimension reduction methods & clustering methods
- To recognize suitable pattern recognition algorithm for applications

PREREQUISITES :

- Basic knowledge on vector algebra and matrix.
- Knowledge in image processing techniques

MODULE I INTRODUCTION TO PATTERN RECOGNITION 9

Basics of Pattern recognition-Bayes Decision Theory-Discriminant functions & Decision surfaces-Bayesian classification for normal distributions-Estimation of unknown probability density functions-Nearest neighbour rule- Bayesian belief network.

MODULE II LINEAR CLASSIFIERS 9

Linear discriminant functions & decision-The Perceptron algorithm-Least square methods-Support vector machine, Parametric& Non-parametric methods.

MODULE III NON-LINEAR CLASSIFIERS 9

Two layer & three layer perceptron-The Back propagation algorithm-Networks with weight sharing-Polynomial classifiers-Support Vector Machines-non linear case-Combining Classifiers-Geometric average rule-Arithmetic average rule-Majority voting rule.

MODULE IV DIMENSION REDUCTION METHODS & CLUSTERING 9

Dimension reduction methods-Principal component analysis-Fisher discriminant analysis–The Ho-Kashyap method, Clustering-criterion functions-Algorithms for clustering-k-means, Hierarchical clustering, cluster validation.

MODULE V APPLICATIONS OF PATTERN RECOGNITION 9

Feature extraction, Template matching, Counting objects, Automated Gear

assembly inspection, and Medical imaging-Classification of white blood cells.

Total Hours 45

TEXT BOOKS:

1. Pattern Recognition, S.Theodoridis and K.Koutroumbas, 4th edition, Academic Press, 2009
2. Earl Gose, Richard Johnson baugh, Steve Jost, “Pattern Recognition & Image analysis”, Prentice Hall India, 1997.
3. C.M.Bishop, “Neural Networks for Pattern recognition”, Oxford University Press, 2007.

REFERENCES:

1. V.Susheela Devi, M.Narasimha Murt, “Pattern Recognition - An introduction, Universities Press(India), 2011.
2. Stephen Marsland, “Machine learning –An algorithmic perspective”, Taylor & Francis group, 2009.

OUTCOMES :

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

- Acquire the knowledge of fundamental concepts of Pattern recognition
- Distinguish various linear & non-linear classifiers in Pattern recognition
- Differentiate various parametric & non-parametric methods
- Analyze & apply suitable dimension reduction method
- Discriminate clustering methods for Pattern recognition
- Apply suitable pattern recognition algorithm for applications

ECDY 030	RADIATION SYSTEMS FOR PERSONAL AREA NETWORK	L	T	P	C
		2	0	0	2

OBJECTIVES

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

PREREQUISITES :

- Electromagnetic basics
- Antenna parameters and its basic concepts.

MODULE I INTRODUCTION TO WIRELESSS PAN AND PRINTED ANTENNAS 6

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

MODULE II WEARABLE ANTENNAS 6

Overview of Wearable Systems and its Characteristics, Antennas for Wearable Devices, Design requirements, Modelling and Characterization of Wearable Antennas, Domains of Operation, Compact Wearable Antenna for Healthcare Sensors.

MODULE III ACTIVE INTEGRATED ANTENNAS 6

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

MODULE IV RECONFIGURABLE ANTENNAS 6

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

MODULE V ARRAY ANTENNAS 6

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

Total Hours 30

TEXT BOOKS:

1. DebatoshGuha, Yahia M.M. Antar, “Microstrip and Printed Antennas”, 1st Edition, John Wiley & Sons, 2011.
2. Eng Hock Lim , Kwok Wa Leung, “Compact Multifunctional Antennas for wireless Systems”, John Wiley & Sons, 2012.

REFERENCES:

1. Taming the Borg, “Moving Wearables into the Mainstream”, Springer, 2008.
2. ZhiNing Chen, “Antennas for Portable Devices”, John Wiley & Sons, 2007.
3. ApostolosGeorgiadis, HendrikRogier, Luca Roselli, Paolo Arcioni, “Microwave & Millimeter Wave Circuits & Systems”, First Edition, John Wiley & Sons, 2013.
4. Warren L Stutzman, Gary A.Thiele, “Antenna Theory and Design”, 3rd edition, John Wiley & Sons, 2013.

OUTCOMES :

At the end of the course, the student should be able to:

- Discuss the basics of PA network
- Classify various types of printed antennas
- Describe about wearable antennas
- Analyze different materials for antennas
- Apply reconfigurability function in any antenna design
- Optimize different array configurations

ECDY 031 BIO SIGNAL PROCESSING L T P C

1 0 0 1

OBJECTIVES

- To explain the basics of bio-signal and characteristics.
- To classify bio signals.
- To analyze the processing techniques of biomedical signals
- To select appropriate feature extraction techniques for biomedical signals
- To discuss about noise reduction in bio signals.
- To use the simulation tools for bio signal processing.

PREREQUISITES :

- Basic knowledge about signals and systems
- Fundamentals of digital signal processing

MODULE I INTRODUCTION TO BIOMEDICAL SIGNALS 3

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

MODULE II ANALYSIS OF PCG 3

PCG-Characteristics and analysis using NILABVIEW

MODULE III ANALYSIS OF ECG 3

ECG signal analysis- parameters estimation-compression technique-MATLAB Simulation of analyzing ECG.

MODULE IV ANALYSIS OF EEG 3

EEG - artifacts in EEG -characteristics and processing - EEG segmentation - MATLAB Simulation and analyses of EEG

MODULE V ANALYSIS OF EMG 3

EMG - characteristics and analysis using NILABVIEW.

Total Hours 15

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
2. D.C.Reddy, "Biomedical Signal Processing: Principles and techniques",

Tata McGraw Hill, New Delhi, 2007
3. Myer Kutz, “Standard Handbook of Biomedical Engineering and Design”, McGraw Hill Publisher, 2003.
4. Rangaraj M. Rangayyan, ”Biomedical Signal Analysis - A case study approach”, John wiley, 2002

REFERENCES:

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.
2. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley andsons, New York, 2004.
3. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.

OUTCOMES:

On completion of the course, students will be able to

- Explain the fundamental characteristics of bio signals.
- Simulate and analyze PCG.
- Apply and evaluate different methods of signal processing for ECG signals
- Implement time and frequency domain analysis in EEG signals.
- Analyse the characteristics of EMG.
- Test the program with simulation tools.

ECDY 032	ULTRASONIC PRINCIPLES AND APPLICATIONS	L	T	P	C
		1	0	0	1

OBJECTIVES

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

PREREQUISITES:

- Basics of photo electronic devices and its functions
- Free space Frequency spectrum
- Maxwell's equation
- Familiarity with optical communication

MODULE I ULTRASONIC TECHNOLOGIES AND APPLICATIONS 8

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

MODULE II SCATTERING OF SOUND WAVES AND ADVANCED TECHNIQUES 7

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

Total Hours 15

TEXT BOOKS :

1 Dale Ensminger and Leonard J. Bond, "Ultrasonic Fundamentals Technologies and Applications, Third edition CRC Press, 2010.
2 Malcolm J.W.Povey, "Ultrasonic Techniques for Fluids Characterisation", Academic Press, California, 2012.

REFERENCES :

1 J. David N. Cheeke, "Fundamentals and Applications of Ultrasonic Waves", CRC Press LLC, 2012

2 E. G. Richardson, **"**Ultrasonic Physics", Elsevier Publishing Company, 2011.

OUTCOMES :

At the end of the course, the student should be able to:

- Design and Analyze the ultrasonic technologies and applications
- Determine the performance of ultrasonic transmitters and receivers
- Select appropriate ultrasonic transducers for a specific applications
- Compare an electromagnetic propagation and acoustic propagation
- Apply numerical techniques to characterise the scattering of sound waves
- Assess and Evaluate automation and computer tools applied in ultrasonic applications.

ECDY 033 CHAOTRONICS

L	T	P	C
3	0	0	3

OBJECTIVES

Make the students to

- Apply the concepts of chaos in electronic circuits
- Design and analyse low and higher order electronic circuits
- Analyse periodic, quasi-periodic and chaotic behaviours
- Develop discrete map based chaotic circuits
- Select specific type of chaotic circuits based on requirement
- Describe CNN base chaotic circuits

PREREQUISITE:

- Basics of linear and nonlinear circuit components
- Fundamentals of periodic and non periodic behaviours
- Maxwell's equation
- Familiarity with frequency spectrum

MODULE I LINEAR AND NONLINEAR CIRCUITS 9

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

MODULE II BIFURCATION AND CHAOS 9

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

MODULE III DISCRETE MAP BASED CHAOTIC CIRCUITS 9

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

MODULE IV CONTINUOUS TYPE CHAOTIC CIRCUITS 9

Introduction-autonomous chaotic circuits: Chua's circuit, Chua's canonical circuit-Wein bridge oscillator based chaotic circuit-Colpitts chaotic oscillator-negative resistance based chaotic circuits-LC oscillator based chaotic circuits, Non-autonomous chaotic circuits: RL-diode circuit, driven Chua's circuit- Murali-

Lakshmanan-Chua (MLC) circuit, Lindberg- Murali-Tamasevicius (LMT) oscillator-stochastic resonance circuit. Analog simulation circuits: Duffing oscillator, van-der Pol oscillator-Lorenz system-Rossler system-Threshold-controller based circuits.

MODULE V HIGHER-ORDER CHAOTIC CIRCUITS 9

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

Total Hours 45

TEXT BOOKS:

Author name and initials, Title, Edition, Publisher, Year.

1. Lakshmanan M, Rajasekar S, “Nonlinear Dynamics Integrability Chaos and patterns, Springer International Edition, 2009
2. F C M Lau and C K Tse, “Chaos-Based Digital Communication Systems, Springer-Verlag Berlin Heidelberg, 2003.
3. Branislav Jovic, “Synchronization Techniques for Chaotic Communication Systems”, Springer-Verlag Berlin Heidelberg, 2011
4. Lakshmanan M and Murali K, ―Chaotic oscillators: Controlling and synchronization‖, World Scientific, Singapore, First edition 1996, Revised Edition 2009.

REFERENCES:

1. Steven H. Strogatz, “Nonlinear Dynamics and Chaos”, Kindley edition, Second Edition, Special Indian Edition 2014
2. Marcio Eisencraft (Editor), RomisAttux • Ricardo Suyama “Chaotic signals in digital communications”, CRC press, 2014.

OUTCOMES:

On completion of the course the students will be able to

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

ECDY 034 SOFTWARE FOR EMBEDDED SYSTEMS

L	T	P	C
2	0	2	3

OBJECTIVES

The objective of the course is

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

PREREQUISITES :

- Embedded system

MODULE I C LANGUAGE PROGRAMMING 12

Basics of Program Writing- Declarations and Expressions-Arrays, Qualifiers-Control Statements- Functions-C pre-processor, Bit Operations-Advanced Types-Advanced Pointers-Modular programming-Portability Problems-C's Dustier Corners

Laboratory Practice

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

MODULE II C PROGRAMMING TOOLCHAIN IN LINUX ENVIRONMENT 12

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

Laboratory Practice

Practice C language programs using GCC compiler in Linux environment

MODULE III EMBEDDED C USING 8051 MICROCONTROLLER 12

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

Laboratory Practice

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

MODULE IV EMBEDDED OS 12

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

Laboratory Practice

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

MODULE V PYTHON LANGUAGE 12

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – MODULEs – Classes and OOP

Laboratory Practice

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

L- 30; P-30;Total Hours: 60

TEXT BOOKS:

1. Stephen Kochan, “Programming in C”, 3rd Edition, Sams Publishing, 2009.
2. Steve Oualline, ‘Practical C Programming 3rd Edition’, O’Reilly Media, Inc, 2006.

REFERENCES:

1. Michael J Pont, “Embedded C”, Pearson Education, 2007.
2. Mark Lutz, “Learning Python Powerful OOPs”, O’reilly, 2011.

OUTCOMES :

At the end of the course, the student should be able to:

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

ECDY 035 SENSOR ARRAY SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES

- To impart knowledge on sensor array systems.
- To explain the different types of wave fields and its relevance in sensor array systems,
- To describe the wave number processing methods.
- To discuss the various techniques on Source localization.
- To apply the knowledge of statistical signal processing for source estimation.
- To discuss the signal detection techniques.

PREREQUISITES :

- Basic Knowledge in Signals and signal processing.

MODULE I AN OVERVIEW OF WAVE FIELDS AND SENSOR ARRAY SYSTEMS **10**

Types of Wave fields and the Governing Equations, Wave field in open space, Wave field in bounded space, Stochastic wave field, Multipath propagation, Propagation through random medium.

Sensor Array Systems : Uniform linear array (ULA), Planar array, Distributed sensor array, Broadband sensor array, Source and sensor arrays, Multi-component sensor array

MODULE II FREQUENCY WAVE NUMBER PROCESSING **9**

Digital filters in the w-k domain, Mapping of 1D into 2D filters, Multichannel Wiener filters, Wiener filters for ULA and UCA, Predictive noise cancellation

MODULE III SOURCE LOCALIZATION **9**

Frequency wave number spectrum, Beam formation, Capon's w-k spectrum, Maximum entropy w-k spectrum, Doppler-Azimuth Processing, Narrowband and Broadband Subspace methods, Array calibration, Source in Bounded Space

MODULE IV SOURCE ESTIMATION **9**

Wiener filters, Minimum variance Capon method, Adaptive beam formation, Wideband adaptive beam formation, Frequency Invariant Beam formation

MODULE V SIGNAL DETECTION TECHNIQUES 8

Rician PDF, RMS, CFAR Detection, and ROC Curves, Statistical Modelling of Multipath.

Total Hours: 45

TEXT BOOKS:

1. Prabhakar S. Naidu, “Sensor Array Signal Processing”, Second Edition, CRC Press, 2017.
2. David C. Swanson, “Signal Processing for Intelligent Sensor Systems with MATLAB”, Second Edition, CRC Press, 2017.

REFERENCES:

1. Ramon Pallas- Arney, John G. Webster, “Sensors and Signal Conditioning, 2nd Edition, Wiley Publication, 2000.
2. Don H. Johnson , Dan E. Dudgeon, “Array Signal Processing: Concepts and Techniques”, Prentice Hall, 1993.
3. Mourad Barkat, “Signal Detection and Estimation”, Artech House Publishers; 2nd Revised edition, 2005.

OUTCOMES :

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

- Identify the sensor array systems.
- Classify the wave fields
- Explain the Wave number processing techniques
- Describe the source localization techniques,
- Differentiate the estimation techniques.
- Compare the signal detection methods.

ECDY 036	MULTIMEDIA SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Fundamentals of Multimedia systems
- Basics of audio and video processing
- Fundamentals of Multimedia communication
- Fundamentals of Hypermedia presentations
- Basics of Multimedia information systems

PREREQUISITES :

- Multimedia compression techniques.

MODULE I INTRODUCTION TO MULTIMEDIA SYSTEM AND AUDIO AND SPEECH 9

An overview of multimedia system and media streams architecture and components, synchronization & quality of service (QOS). Data acquisition, sampling and quantization, human speech, digital model of speech production, analysis and synthesis, psychoacoustics, low bit rate speech compression, MPEG audio compression

MODULE II IMAGES AND VIDEO FORMATS 9

Image acquisition and representation, bilevel image compression standards: ITU (formerly CCITT) Group III and IV standards, JPEG image compression standards, MPEG, H.264/AVC video compression standards, Transcoding

MODULE III MULTIMEDIA COMMUNICATION 9

Quality of service-Higher order protocols-HTML-, Bandwidth requirements of different media, Real time constraints: latency, video data rate, multimedia over LAN and WAN, Multimedia conferencing, video-on-demand broadcasting issues.

MODULE IV HYPERMEDIA PRESENTATION 9

Authoring and publishing, Linear and non-linear presentation, Structuring Information, Different approaches of authoring hypermedia documents, Hyper-media data models and standards.

MODULE V MULTIMEDIA INFORMATION SYSTEMS 9

Operating system support for continuous media applications: Media stream protocol, file system support for continuous media, data models for multimedia and hypermedia information, multimedia servers, databases and content management

Total Hours 45

TEXT BOOKS:

1. Srdjan Stanković, Irena Orovic, Ervin Sejdić, Multimedia Signals and Systems,Springer 2012.
2. KusumLata and RishabhAnandComputer Graphics And Multimedia, sathyapublisher ,New Delhi,Edition:2016, ISBN NO. 978-93-5192-003-8
3. Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindergh and Richard L. Baker Digital Compression for Multimedia: Principles and Standards Elsevier, 2006.

REFERENCES:

1. Khalid Sayood, “Introduction to Data Compression”, 3rd Edition, Elsevier, 2006.
2. Asit Dan and Dinkar Sitaram, “Multimedia Servers Elsevier”, 2006.

OUTCOMES :

At the end of the course, the student should be able to:

- Apply the concepts of multimedia systems
- Investigate the audio and video compression techniques
- Summarize the techniques for multimedia communication
- Discuss the concepts of Hypermedia presentation
- Describe operating system for multimedia information systems
- Analyze the concepts of multimedia servers

ECDY 037	GLOBAL TRACKING AND POSITIONING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To discuss evolution of GPS and various existing GPS Systems
- To describe about US based GPS System Segments
- To analyze the various functionalities and techniques applied in GPS
- To discuss the issues of GPS
- To apply the GPS in various fields
- To analyze the other constellations and augmentation systems

PREREQUISITES :

- Knowledge on satellite communication
- Basics of wireless communication

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 and 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

TEXT BOOKS:

1. A.Kleusberg and P.Teunisen(Eds), “GPS for Geodesy”, Springer-Verlag, Berlin,1996.
2. G.S.Rao,”Global Navigation Satellite Systems”, McGraw-Hill Publications, New Delhi, 2010.
3. Ahmed El-Rabbany, “Introduction to GPS,” Artech House, Boston, 2002.

REFERENCES:

1. B.HoffmanWellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice", 5th edition, Springer Wein, New york, 2001.
2. A.Leick, "GPS Satellites Surveying", 3rd edition, John Wiley &Sons,NewYork, 2003

OUTCOMES :

At the end of the course, the student should be able to:

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

ECDY 039 ULTRA WIDEBAND COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES

- To predict the need of UWB technology
- To focus on basic properties of UWB
- To know about the different UWB standards
- To focus on the different types of antenna and array
- To know the history of UWB communication systems
- To describe the applications of UWB systems

PREREQUISITES :

- Basic knowledge on analog and digital communication

MODULE I Introduction 9

UWB regulation overview - UWB and Shannon's theory - Challenges for UWB - Basic properties of UWB signals and systems - Generation of UWB waveforms - Signal-processing techniques for UWB systems

MODULE II Channel modelling and Communication 9

A simplified UWB multipath channel model - Path loss model - Two-ray UWB propagation model - Frequency domain autoregressive model- IEEE proposals for UWB channel models- UWB modulation methods- Pulse trains- UWB transmitter and Receiver - Multiple access techniques in UWB- Capacity of UWB systems - Comparison of UWB with other wideband communication systems- Interference and coexistence of UWB with other systems

MODULE III UWB antennas and arrays 9

Antenna fundamentals - Antenna radiation for UWB signals- Suitability of conventional antennas for the UWB system- Impulse antennas- Beamforming for UWB signal - Radar UWB array systems - Position and location with UWB signals- GPS techniques- Positioning techniques- Time resolution issues- UWB positioning and communications

MODULE IV UWB communication standards 9

UWB standardization in wireless personal area networks - DS-UWB proposal- MB-OFDM UWB proposal - UWB ad-hoc networks- UWB sensor networks- Multiple

inputs multiple outputs and space-time coding for UWB systems - Self-interference in high-data-rate UWB communications- Coexistence of DS-UWB with Wi-Max - Vehicular radars in the 22–29 GHz band

MODULE V Advanced Topics and Applications of UWB systems 9

UWB ad-hoc and sensor networks – MIMO and Space-time coding for UWB systems – Self interference in high data-rate - Military applications - Commercial applications - UWB potentials in medicine

Total Hours 45

TEXT BOOKS

1. M. Ghavami, L. B. Michael and R. Kohno, “Ultra-Wideband signals and systems in Communication Engineering”, 2nd Edition, John Wiley & Sons, NY, USA, 2007.
2. Jeffrey H. Reed, “An Introduction to Ultra-Wideband Communication systems”, Prentice Hall Inc., NJ, USA, 2012.

REFERENCES:

1. Roberto Aiello, Ph.D., AnujBatra, Ph.D., Ultra Wideband Systems: Technologies and Applications, Elsevier, 2006

OUTCOMES:

The students will be able to

- Review the growth and need of UWB communication systems.
- Distinguish UWB communication with other communication systems
- Discuss the concepts of transmitter, channel and receiver
- Recall the different UWB standards
- Analyse various types of antenna used for UWB communication
- Apply concepts of UWB communication in different applications

ECDY 040 SIGNAL PROCESSING TECHNIQUES

L	T	P	C
3	1	0	4

OBJECTIVES

- To impart knowledge on various mathematical transforms for signal processing applications.
- To explore the basics of adaptive filters
- To develop various adaptation algorithms
- To assess the adaptation algorithms in terms of convergence rate, computational complexity, robustness against noisy data.

PREREQUISITES :

- The readers are expected to have a basic understanding of Probability, Random Variable, Stochastic Process and Linear Algebra
- The readers must have knowledge on basic Signal Processing Techniques

MODULE I LAPLACE TRANSFORM FOR CONTINUOUS TIME SIGNALS **9**

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

MODULE II Z -TRANSFORM FOR DISCRETE TIME SIGNALS **15**

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

MODULE III DISCRETE FOURIER TRANSFORM FOR DISCRETE TIME SIGNALS **12**

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

MODULE IV DISCRETE COSINE TRANSFORM FOR DISCRETE TIME SIGNALS 12

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

MODULE V DISCRETE WAVELET TRANSFORM FOR DISCRETE TIME SIGNALS 12

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

Total Hours 60

TEXT BOOKS:

1. D.Sundararajan, “Discrete Wavelet Transform: A Signal Processing Approach”, Wiley – 2015.
2. Alexander D. Poularikas, “The Transforms and Applications Handbook” Chapter 6 on Z- Transforms - Boca Raton, CRC Press LLC - 2000.
3. JoelL.Schiff, “The Laplace Transform: Theory and Applications”, Springer, 1999.

REFERENCES:

1. D.Sundararajan, “The Discrete Fourier Transform: Theory”, Algorithm and Applications – World Scientific Publishers, 2001.
2. K.Rao and P.Yip, “Discrete Cosine Transform – Elsevier”, 1990.

OUTCOMES :

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

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

ECDY 041 ELECTRO OPTIC SYSTEMS L T P C
3 0 0 3

OBJECTIVES

- To describe the advanced concepts of Opto-electronics
- To utilize the applications of Opto-electronics in aviation systems.
- To provide exposure on various optical phenomena.
- To justify the advantages of Laser optics in the domain of avionics.
- To explain the various imaging system.
- To compare various image compression standards.

PREREQUISITES :

- Circuit theory fundamentals
- Electrical and Electronic device working principle and its application
- Basics of Opto electronics
- Characteristics of RF optical spectrum

MODULE I INTRODUCTION TO OPTICAL RADIATION 9

Electro Magnetic spectrum, Thermal radiation, Laws of Black body radiation, Emissivity and Kickoff's law, Black body sources, Atmospheric propagation characteristics: Scattering effect, Transmission through rain, Scintillations.

MODULE II LASER SYSTEMS 9

Theory of Laser operation, Optical resonators, Temporal and Spatial coherence, Introduction to gas, solid and semiconductor lasers, Modulators: Electro-optic, Magneto-optic and Acousto-optic modulators, Q switching, Mode locking, Cavity dumping, Introduction to Holography, Ring Laser gyro, Laser hazards and Safety measures.

MODULE III INFRARED SYSTEMS 9

Infrared and thermal detectors, Description and design features of typical passive search and detection, Infrared imaging, Forward Looking Infra Red (FLIR), Tracking and Homing systems. Satellite Radiometers.

MODULE IV IMAGING DEVICES AND TRACKING SYSTEMS 9

Imaging tubes: Vidicon, Pyroelectric-vidicon, Image intensifier tubes, CCD, Focal

plane arrays (FPA), Optical tracking, Sensor steering and stabilization, Servo Control. Opto mechanical design of camera and systems. Description and design features of laser ranging and guidance system, LIDAR.

MODULE V FIBER OPTIC SYSTEMS 9

Types of Fiber optic cables and their characteristics, fiber optic sources and detectors, Avionics fiber optic data busses: IEEE Std 1393, MIL STD 1773 etc. Multiplexing schemes for onboard avionics, Fiber optic gyro.

Total Hours 45

TEXT BOOKS:

1. John Wilson, John Hawkes, “Optoelectronics”, 3rd Edition, Pearson Education, 2018.
2. S.C.Gupta, “Optoelectronic Devices and Systems”, 2nd Edition, Prentice Hall of India, 2014.
3. Richard D. Hudson Jr., “Infrared System Engineering”, Wiley-Blackwell Publishing, 2006

REFERENCES:

1. Keith Atkins, “Jane's Electro-optic Systems, 2006/2007, 12th Edition, Janes Information Group Ltd, Surrey, 2006.
2. William L. Wolfe, “Introduction to Infrared System Design”, Illustrated Edition, SPIE Press, 1997.
3. “IEEE 1393-1999 - IEEE Standard for Space borne Fiber Optic Data Bus”, IEEE Standards Association, 1999.

OUTCOMES :

- To summarize the emission and propagation characteristics of radiations.
- To contrast the importance of infrared and thermal detection in aviation systems.
- To find solution for Tracking and detection issues using infrared and optical technology.
- To illustrate the principles of various imaging systems
- To relate the properties of LASER to the needs in avionics.
- To comprehend the applications of fiber-optic systems

ECDY 042 MATLAB AND SIMULINK LABORATORY

L	T	P	C
0	1	3	2

OBJECTIVES

- To introduce MATLAB and Simulink modelling environment.
- To analyze basic communication and instrumentation designs using simulation.
- To design and model aircraft subsystems, using Simulink.

PREREQUISITES:

- Engineering mathematics.
- Basic understanding in signals and communication systems.
- Basic awareness of flight control and instrumentations.

LIST OF EXPERIMENTS:

- Matrix and Vector, and solving Linear Equations using MATLAB
- Plotting of 2D and 3D Graph using MATLAB
- Image Processing with MATLAB
- Solving Ordinary Differential Equation with MATLAB
- GUI application design using MATLAB
- Spectral Analysis of Real-Time Signal with MATLAB
- Modelling of Communication Systems using Simulink.
- Radar Tracking Using MATLAB Function Block
- Create and Configure Flight Instrument Component and an Animation Object with Simulink.
- Lightweight Airplane Design modelling with MATLAB and Simulink

Total Hours 45

TEXT BOOKS:

1. Amos Gilat, “MATLAB: An Introduction with Applications”, 4th Edition, John Wiley, 2012
2. Shailendra Jain, “Modeling and Simulation using MATLAB – Simulink”, 2nd Edition, Wiley International, 2015.

REFERENCES:

1. Marcello R. Napolitano, “Aircraft Dynamics: From Modeling to Simulation”, 1st Edition, Wiley, 2011.
2. Raveendranathan K C, “Communication Systems Modelling and Simulation using Matlab and Simulink”, CRC Press, 2011.

OUTCOMES:

On completion of the course Students will be able to

- To recall the built-in Matlab functions for solving basic mathematical problems
- To demonstrate the properties of functions by graph plotting
- To apply MATLAB tools for image processing and differential equation
- To analyze and interpret the spectrum of real-time communication signals.
- To estimate the performance of communication systems and aircraft instrumentation by modelling and simulating them with Simulink
- To design a lightweight aircraft using Simulink modelling.

ECDY 084	INTEROPERABILITY CHALLENGES IN INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concept and characteristics of IoT interoperability.
- To discuss various middleware protocols used in IOT for connecting with different end devices and the challenges related to device interoperability
- To discuss wired and various short-range wireless networks related to devices interoperability
- To discuss on the types of interoperability and its key aspects
- To discuss on Interoperability Testing and the related performance challenges in a larger ecosystem

PREREQUISITES :

- Computer Networks

MODULE I INTRODUCTION 9

Introduction to IoT and its Interoperability challenges - Characteristics for IoT interoperability - barrier for adoption of lifestyle - Network connectivity – Middleware Protocols considered for interoperability - Types of Interoperability Connectivity; Technical; Syntactic; Semantic; Interoperability at Present state - Key Challenges - IoT Interoperability in a nutshell.

MODULE II INTEROPERABILITY STANDARDS 9

Interoperability Standards – onem2m; OPC; dot dot; OCF/ IoTivity; design Aspects for handling interoperability on devices, gateways and cloud; Open source software enabling interoperability; End-2-End system design for IoT interoperability; Interoperability between various service domains in a smart city

MODULE III PROTOCOLS 9

Middleware/Application protocols for handling IOT interoperability–Wi-Fi; Bluetooth; SIP; ZigBee; ZWave; CoAP; 6LowPAN; MQTT; DLNA; UPnP; HAP; RTSP; CAN; HART; MODBUS; RESTful; HTTP(s); MTP, RTP/ RTCP, HLS, MPEG-DASH, HTTP-PD; Home device products, Google Nest; Amazon-Echo; Philips-Bulbs; IKEA–Bulbs;August-Locks; Lockitron-Locks; Lifxulbs; Honeywell; Samsung; Grand stream; LG; Sony and the Interworking challenges.

MODULE IV CLOUD COMPUTING 9

Cloud Computing Architecture - Need for Cloud Computing Interoperability - Layers of interoperability in Cloud Computing - Levels of cloud computing interoperability - Major Concerns in Cloud Computing Interoperability - Approaches to solve interoperability issues

MODULE V TESTING AND APPLICATIONS 9

Interoperability Testing - Benefits; Challenges – Applications and Use cases- Smart Home; Industrial IOT; Smart City; Connected Vehicles; Logistics; A vision of future for IoT interoperability - Bridging the Interoperability Gap of the IoT; to standardize the Interoperability as an M3 protocol (Multi-vendor, Multi-device and Multi-domain).

Total Hours 45

TEXT BOOKS:

1. Jean-Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet”**,** Morgan Kuffmann, 2010
2. Dimitrios Serpanos, Marilyn Wolf, “Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies”, Springer International Publisher, 2018.
3. Ovidiu Vermesan, Peter Friess, ““Internet-of-Things – From Research and Innovation to Market Deployment”, River Publishers, Series in Communications, 2014.

REFERENCES:

1. Arne Broring, et al, “Advancing IoT Platforms Interoperability”, IoT European Platform Initiative, River Publishers, 2018.
2. Ovidiu Vermesan and Peter Friess, “Digi*t*izing the industry Internet of Things Connecting the Physical, Digital and Virtual Worlds”, River Publishers, Series in Communications, 2016

OUTCOMES :

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

- Apply the concept of Interoperability in IOT networks.
- Identify the design challenges and the issues related to interoperability in various verticals.
- Analyse the middleware protocol issues
- Evaluate the necessity and need of having interoperability framework.
- Design and select the interoperability framework.
- Describe the limitations of interoperability and to apply in specific application

ECDY 085 EMBEDDED AUTOMOTIVE SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES

- To describe the automotive electronics
- To utilize the automotive systems in automobiles.
- To explore the new trends in automotive industry
- To understand the applications of embedded systems in automotive industry.

PREREQUISITES :

- Embedded Systems

MODULE I ELECTRONICS IN THE AUTOMOBILE 9

Introduction- Body and convenience electronics: vehicle power supply controllers and lighting MODULEs, door control MODULEs, Safety electronics: active safety systems: ABS, ASR, ESP, passive safety systems: Restraint systems and their associated sensors in an automobile. Power train Electronics: Gasoline engine management, Infotainment electronics: Dashboard/instrument cluster, car audio, telematics systems, navigation systems, multimedia systems, cross application technologies.

MODULE II AUTOMOTIVE COMMUNICATION PROTOCOLS 9

CAN bus - Concepts of bus access and arbitration - Error processing and management - Definitions of the CAN protocol: 'ISO 11898-1' - Errors: their intrinsic properties, detection and processing – Physical layer, Application layers and development tools for CAN – LIN - Basic concept of the LIN 2.0 protocol. FlexRay - Event-triggered and time-triggered aspects - TTCAN – Time-triggered communication on CAN - Towards high-speed, X-by-Wire and redundant systems.

MODULE III AUTOMOTIVE EMBEDDED SYSTEMS 9

Automotive Embedded systems. Microcontroller in Automobile applications - Different Types of Microcontrollers in Automotive systems – Challenges in ECU design - Growth in the Automobile – Application in Vehicle Control - Power train - Driver Information – Steering – Telematics

MODULE IV DRIVE BY WIRE 9

Challenges and opportunities of X-by-wire: system & design requirements, steer-

by-wire, brake- by-wire, suspension-by-wire, gas-by-wire, power-by-wire, shift by wire. Future of Automotive Electronics.

MODULE V AUTOSAR 9

AUTOSAR Architecture- Basic concepts- Software components - Layered Architecture - Microcontroller Abstraction Layer – ECU Abstraction Layer - Complex Device Driver - Service Layer – RTE - Application Layer - Basic Software MODULEs – Diagnostics - Methodology - Tools in SW development using Autosar-EB tresos Studio.

TOTAL HOURS 45

TEXT BOOKS:

1. D.Paret, “Multiplexed Networks for Embedded Systems”, John Wiley & Sons, 2014
2. Marco Di Natale, Haibo Zeng, Paolo Giusto, Arkadeb Ghosal, “Understanding and Using the Controller Area Network Communication Protocol”, Springer publishers,2012

REFERENCES:

1. Konrad Etschberger,”Controller Area Network: Basics, Protocols, Chips and Application”, IXXAT Press, 2001.
2. Glaf P.Feiffer, Andrew Ayre and Christian Keyold, “Embedded Networking with CAN and CAN open”, Embedded System Academy 2008.

OUTCOMES :

On completion of the course the student will be able to

- Design and develop automotive embedded systems.
- Analyze various embedded products used in automotive industry.
- Implement CAN and LIN protocol
- Evaluate the opportunities involving technology, a product or a service required for developing a start-up idea used for automotive applications
- Interface devices and build a complete system.
- Analyze the features of AUTOSAR Architecture.

GENERAL ELECTIVES

GEDY 101	PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of the course would be to make the students

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

MODULE I INTRODUCTION & PROJECT INITIATION 09

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

MODULE II RISK ANALYSIS 09

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

MODULE III PROJECT PLANNING & IMPLEMENTATION 09

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

MODULE IV TECHNICAL ANALYSIS 09

Technical analysis for manufacturing/construction/infrastructure projects – process/technology - materials and inputs - product mix - plant capacity – plant location and site selection – plant layout - machinery and equipment – structures and civil works – schedule of project implementation – technical analysis for software projects.

MODULE V PROJECT MANAGEMENT TECHNIQUES 09

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

Total Hours: 45

REFERENCES:

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

OUTCOMES:

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

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

GEDY 102 SOCIETY, TECHNOLOGY & SUSTAINABILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I TECHNOLOGY AND ITS IMPACTS 09

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

MODULE II TECHNOLOGY AND ITS ADVANCEMENT 09

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

MODULE III SOCIETY AND TECHNOLOGY 09

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

MODULE IV IMPACT OF A SPECIFIC TECHNOLOGY ON HUMAN WELFARE 09

Impact of the following technologies on Human life – Medical and Biomedical – Genetics Technology – Electronics and Communications – Electronic media Technology – Information Systems Technology – Nanotechnology – Space Technology and Energy Technology.

MODULE V THE IMPORTANCE OF SUSTAINABILITY 09

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

Total Hours: 45

REFERENCES:

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

OUTCOMES:

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

- Apply 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.

GEDY 103	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

MODULE I HISTORY AND FOUNDATIONS 08

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

MODULE II SEARCH 10

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

MODULE III KNOWLEDGE REPRESENTATION AND REASONING 10

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

MODULE IV REPRESENTING AND REASONING WITH UNCERTAIN KNOWLEDGE 08

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

MODULE V CASE STUDY AND FUTURE APPLICATIONS 09

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

Total Hours: 45

TEXT BOOK:

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

OUTCOMES:

Students who complete this course will be able to

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

GEDY 104 GREEN COMPUTING **L T P C**
3 0 0 3

OBJECTIVES:

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

MODULE I INTRODUCTION 08

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

MODULE II CONSUMPTION ISSUES 10

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

MODULE III NEXT-GENERATION VIRTUAL DATA CENTERS 09

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

MODULE IV TECHNOLOGIES FOR ENABLING GREEN AND VIRTUAL DATA CENTERS 08

Highly Effective Data Center Facilities and Habitats for Technology - Data Center Electrical Power and Energy Management - HVAC, Smoke and Fire Suppression - Data Center Location - Virtual Data Centers Today and Tomorrow - Cloud Computing, Out-Sourced, and Managed Services.

MODULE V SERVERS AND FUTURE TRENDS OF GREEN COMPUTING 10

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

Total Hours: 45

REFERENCES:

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

OUTCOMES:

Students who complete this course will be able to

- Demonstrate issues relating to a range of available technologies, systems and practices to support green computing.
- Select appropriate technologies that are aimed to reduce energy consumption.

- Address design issues needed to achieve an organizations' green computing objectives.
- Analyze the functionality of Data Centers.
- Critically evaluate technologies and the environmental impact of computing resources for a given scenario.
- Compare the impact of Green Computing with other computing techniques.

GEDY 105 GAMING DESIGN L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I INTRODUCTION 09

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

MODULE II THE DESIGNER CREATES AN EXPERIENCE 09

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

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

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

MODULE IV GAMES THROUGH AN INTERFACE 09

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

MODULE V BALANCED GAME MECHANICS 10

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

Total Hours: 45

REFERENCES:

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

OUTCOMES:

Students who complete this course will be able to

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

GEDY 106 SOCIAL COMPUTING L T P C
3 0 0 3

OBJECTIVES:

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

MODULE I BASIC CONCEPTS 09

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

MODULE II SOCIAL LINK 09

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

MODULE III SOCIAL MEDIA 08

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

MODULE IV SOCIAL INFORMATION FILTERING 09

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

MODULE V SOCIAL NETWORK STRATEGY 10

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

Total Hours: 45

REFERENCES:

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

OUTCOMES:

Students who complete this course will be able to

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

GEDY 107	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The aim of the course is to

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

MODULE I SOFT COMPUTING - BASICS 06

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

MODULE II ARTIFICIAL NEURAL NETWORK 12

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

MODULE III FUZZY SYSTEMS 09

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

MODULE IV NEURO FUZZY SYSTEMS 09

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

MODULE V EVOLUTIONARY COMPUTING 09

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

Total Hours: 45

TEXTBOOKS:

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

OUTCOMES:

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

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

GEDY 108 EMBEDDED SYSTEM PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I INTRODUCTION OF EMBEDDED SYSTEM 09

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

MODULE II SOFTWARE TECHNOLOGY 09

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

MODULE III INPUT/OUTPUT PROGRAMMING 09

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

MODULE IV DATA REPRESENTATION IN EMBEDDED SYSTEMS 09

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

MODULE V EMBEDDED C 09

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

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

Total Hours: 45

REFERENCES:

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

OUTCOMES:

On completion of this course the student will be able to

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

GEDY 109 PRINCIPLES OF SUSTAINABLE DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

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

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 09

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

MODULE II COMPONENTS AND DIMENSIONS OF SUSTAINABLE DEVELOPMENT 09

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

MODULE III FRAMEWORK FOR ACHIEVING SUSTAINABILITY 09

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

MODULE IV SUSTAINABLE DEVELOPMENT OF SOCIO ECONOMIC SYSTEMS 09

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

sustainable development –Urbanization and sustainable Cities –Sustainable Energy and Agriculture –sustainable livelihoods.

MODULE V SUSTAINABLE DEVELOPMENT AND INTERNATIONAL RESPONSE 09

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

Total Hours: 45

REFERENCES:

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

OUTCOMES:

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

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

GEDY 110	QUANTITATIVE TECHNIQUES IN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

To impart knowledge on

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

MODULE I OPERATIONS RESEARCH 09

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

MODULE II PRODUCTION MANAGEMENT 09

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

MODULE III FINANCIAL MANAGEMENT 09

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

MODULE IV DECISION THEORY 09

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

MODULE V MANAGERIAL ECONOMICS 09

Cost concepts–Breakeven Analysis–Pricing techniques–Game Theory applications.

Total Hours: 45

REFERENCES:

1. Vohra, N.D. , Quantitative Techniques in Management, Tata McGraw Hill Co., Ltd, New Delhi, 2009.
2. Seehroeder, R.G., Operations Management, McGraw Hill, USA, 2002.

3. Levin, R.I, Rubin, D.S., and Stinsonm J., Quantitative Approaches to Management, McGraw Hill Book Co., 2008.
4. Frank Harrison, E., The Managerial Decision Making Process, Houghton Miffin Co. Boston, 2005.
5. Hamdy A. Taha, Operations Research- An Introduction, Prentice Hall, 2002.

OUTCOMES:

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

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

GEDY 111 PROGRAMMING USING MATLAB & SIMULINK

L	T	P	C
1	0	2	2

OBJECTIVES:

The aim of this course is to:

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

MODULE I INTRODUCTION TO MATLAB AND DATA PRESENTATION 10

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

Lab Experiments

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

MODULE II ROOT FINDING AND MATLAB PLOT FUNCTION 10

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

Lab Experiments

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

MODULE III LINEAR AND NON-LINEAR DIFFERENTIAL EQUATIONS 13

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

Lab Experiments

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

b. Euler method

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

MODULE IV INTRODUCTION OF SIMULINK 12

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

Lab Experiments

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

Total Hours (Including Practicals): 45

REFERENCE:

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

OUTCOMES:

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

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

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

GEDY 112 JAVA PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

- To study the syntax and necessity of decision making and iterative statements.
- To create a class and invoke the methods with ability handle abnormal conditions.
- To learn to work with various string methods and collection framework.
- To establish a connection to database from java application.
- To understand why Java is useful for the designing web applications.
- To design a graphical user interface (GUI) with Java Swing.

MODULE I INTRODUCTION TO JAVA PROGRAMMING 06

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

MODULE II METHODS AND CLASSES 08

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

MODULE III STRING HANDLING AND COLLECTIONS 07

String Handling - Special String Operations - String Literals- String Conversion - Collections Overview - The Collection Interfaces -The Collection Classes - Accessing a collection Via an Iterator - Working With Maps, Comparators.

MODULE IV DATABASE CONNECTIVITY 08

JDBC - JDBC Driver Types - JDBC Packages - Database Connection - Associating the JDBC/ODBC Bridge with the Database - Statement Objects – Result Set - Transaction Processing – Metadata - Exceptions.

MODULE V SERVER PROGRAMMING 09

The Life Cycle of a Servlet - Using Tomcat for Servlet Development -The Servlet API - Handling HTTP Requests and Responses - Using Cookies - Session Tracking - Java Server Pages (JSP)-Session Objects

MODULE VI SWING PROGRAMMING 07

Concepts of Swing - Java Foundation Class (JFC) - Swing Packages and Classes - Working with Swing - Swing Components

L – 45; TOTAL HOURS-45

REFERENCES :

1. Herbert Schildt, “Java The Complete Reference”, 11th Edition, McGraw Hill, 2018, ISBN: 9781260440249.
2. Joshua Bloch , “Effective Java Paperback”,3rd Edition, Addison Wesley,2017,ISBN: 978-0134685991.
3. E Balagurusamy, “Programming with Java”, 6th Edition, Tata Mcgraw Hill, 2019,ISBN: 978-9353162344.

OUTCOMES:

Students who complete this course will be able to

- Understand the fundamentals java programming language
- Use the Java programming language for various programming technologies.
- Perform various string operations on any given text from user.
- Connect any database with java program and manipulate the contents.
- Write a server side programming which can evaluate the input and respond to user request
- Develop user interface using java swings.

GEDY 113 PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES :

- To study the control statements and string functions of python.
- To practice python data structures - lists, tuples, dictionaries.
- To organize input/output with files in Python.
- To learn the python tools as well as Unicode process.
- To explore advance python including decorators and metaclasses.
- To integrate python with embedded systems.

MODULE I INTRODUCTION TO PYTHON PROGRAMMING 07

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

MODULE II LISTS, TUPLES AND DICTIONARIES 08

Lists - list operations - list slices - list methods - list loop – mutability- aliasing - cloning lists - list parameters - Tuples: tuple assignment- tuple as return value- Dictionaries- operations and methods- advanced list processing - list comprehension- selection sort - insertion sort- merge sort- histogram.

MODULE III FILES, MODULES AND PACKAGES 08

Files and exception - text files - reading and writing files - format operator - command line arguments - errors and exceptions - handling exceptions – modules – packages - word count- copy file.

MODULE IV UNICODE AND BYTE STRINGS 07

String basics - coding basic strings –coding Unicode strings- 3.X bytes objects- 3.X/2.6+ byte array object- text and binary files – Unicode files

MODULE V DECORATORS AND METACLASS 08

Decorator basics- coding function decorators- coding class decorators – managing functions and classes –the metaclass model- declaring metaclasses-coding metaclasses-inheritance and instance-metaclass methods

MODULE VI EMBEDDED PROGRAMMING USING PYTHON 07

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

L – 45; Total Hours : 45

REFERENCES :

1. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016, ISBN-13:978-1491939369.
3. Nick Goddard, “Python Programming”, 2nd edition, ISBN: 1533337772, 2016.
4. Mark Lutz, Learning Python: Powerful Object-Oriented Programming, 5th Edition, O'Reilly Media, 2013.
5. Pratik Desai, “Python Programming for Arduino”, 1st edition, Packt publishing, 2015, ISBN: 9781783285938.
6. Richard H. Barnett, Sarah Cox, Larry O'Cull, “Embedded C Programming and the Atmel AVR”, 2nd edition, 2006.
7. Michael Barr, Anthony Massa, “Programming Embedded Systems”, 2nd Edition, O'Reilly Media, 2006.

OUTCOMES :

Students to complete this course will be able to

- Implement date and time function programming using python.
- Represent compound data using Python lists, tuples, dictionaries
- Read and write data from/to files in Python Programs.
- Instrument the unicode process using python tools
- Build advance python programs using decorators and metaclass.
- Develop embedded system with python programming.

GEDY 114 INTELLECTUAL PROPERTY RIGHTS (IPR)

L	T	P	C
1	0	0	1

OBJECTIVES:

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

MODULE I INTRODUCTION 07

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

MODULE II PATENT 08

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

Total Hours: 15

REFERENCES

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

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

OUTCOMES:

Students should be able to

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