ACHARYA NAGARJUNA UNIVERSITY

A State Government University, Accredited with "A" Grade by NAAC

Nagarjuna Nagar - 522 510, Guntur, Andhra Pradesh, India.

M.Tech. COMMNUCATION ENGINEERING AND SIGNAL PROCESSING

SYLLABUS

2023 - 2024 onwards

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

PROGRAM CODE: ANUCETPG04

Revised Regulations,
Scheme of Instructions,
Examination and Syllabi

for

ELECTRONICS & COMMUNICATION ENGINEERING

2-Year M.Tech. Degree Course
(Semester System)

w.e.f. 2023-2024

ABOUT UNIVERSITY

ACHARYA NAGARJUNA UNIVERSITY (ANU)

- A Brief Profile

Acharya Nagarjuna University, a State University established in 1976, has been constantly striving towards achieving progress and expansion during its existence for over four decades, in terms of introducing new courses in the University Colleges, affiliated colleges and professional colleges. Spread over 300 acres of land on the National High Way (NH-16) between Vijayawada and Guntur of Andhra Pradesh, the University is one of the front ranking and fastest expanding Universities in the state of Andhra Pradesh. The University was inaugurated on 11th September, 1976 by the then President of India, Sri Fakruddin Ali Ahmed and celebrated its Silver Jubilee in 2001. The National Assessment and Accreditation Council (NAAC) awarded "A" grade to Acharya Nagarjuna University and also has achieved 108 International ranks, 39 National ranks UI Green Metrics rankings and many more It is named after Acharya Nagarjuna – one of the most brilliant preceptors and philosophers, whose depth of thought, clarity of perception and spiritual insight were such that even after centuries, he is a source of inspiration to a vast number of people in many countries. The University is fortunate to be situated on the very soil where he was born and lived, a soil made more sacred by the aspiration for light and a state of whole someness by generations of students. With campus student strength of over 5000, the University offers instruction for higher learning in 68 UG & PG programs and guidance for the award of M.Phil. and Ph.D. in 48 disciplines spread over six campus colleges and one PG campus at Ongole. It also offers 160 UG programs in 440 affiliated colleges in the regions of Guntur and Prakasam Districts. It has a Centre for Distance Education offering 87 UG & PG programs. Characterized by its heterogeneous students and faculty hailing from different parts of the state and the country, the University provides most hospitable environment for pursuing Higher Learning and Research. Its aim is to remain connected academically at the forefront of all higher educational institutions. The University provides an excellent infrastructure and on-Campus facilities such as University Library with over one lakh books & 350 journals; Computer Centre; University Scientific Instrumentation Centre; Central Research Laboratory with Ultra-modern Equipment; Well-equipped Departmental Laboratories; Career Guidance and Placement Cell; Health Centre; Sports Facilities with Indoor & Outdoor Stadiums and Multipurpose Gym; Sports Hostel; Separate hostels for Boys, Girls, Research Scholars and International Students; Pariksha Bhavan (Examinations Building); Computers to all faculty members; Wi-Fi connectivity to all Departments and Hostels; Canteen, Student Centre & Fast-food Centre; Faculty Club; Dr. H.H. Deichmann & Dr. S.John David Auditorium cum Seminar Hall; Post office; Telecom Centre; State Bank of India; Andhra Bank; Energy Park; Silver Jubilee Park; Fish ponds; internet center; xerox center; cooperative stores; Water harvesting structures.

VISION, MISSION & OBJECTIVES OF THE UNIVERSITY

ACHARYA NAGARJUNA UNIVERSITY

VISION

To generate sources of knowledge that dispels ignorance and establish truth through teaching, learning and research.

MISSION

To promote a bank of human talent in diversified faculties – Commerce & Management Studies, Education, Engineering & Technology, Humanities, Law, Natural Sciences, Pharmacy, Physical Education & Sports Sciences, Physical Sciences and Social Sciences that would become an investment for a prosperous society.

OBJECTIVES

- To inspire and encourage all who would seek knowledge through higher education and research.
- To provide quality instruction and research for the advancement of science and technology.
- To promote teaching and research studies in disciplines of societal relevance.
- To bridge the gap between theory and practice of the principles of higher education.
- To develop human talent necessary for the industry.
- To open up avenues of higher education and research through non-formal means.
- To invite and implement collaborations with other institutes of higher learning on a continuous basis for mutual academic progress.
- To motivate and orient each academic department/center to strive for and to sustain advanced levels of teaching and research so that the university emerges as an ideal institute of higher learning.
- To focus specially on the studies involving rural economy, justifying its existence in the rural setting.

VISION
&
MISSION OF THE COLLEGE

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

ABOUT ANUCET

The ANU college of Engineering & Technology is established in the academic year 2009-2010 in the University campus under the able leader ship of the Vice-chancellor, Prof. Hara Gopal Reddy. The College offers UG and PG courses that include B.Tech. and M.Tech. The college commenced its operations with an annual intake of 60 into 5 branches of B.Tech. (Civil Engineering, Computer Science Engineering, Electronics & Communication Engineering, Electrical & Electronics Engineering & Mechanical Engineering) and 20 into 5 branches of M.Tech. The institution has been growing from strength to strength and got recognition in limited period.

VISION OF THE COLLEGE

ANU College of Engineering & Technology is started with an aim of imparting technical values in the students, who can change the shape of global scenario in engineering arena.

MISSION OF THE COLLEGE

- To educate students for careers of leadership, innovation in engineering and its related fields.
- To expand the base of engineering knowledge through original research and by developing technology to serve the needs of society.

OBJECTIVES

- To inspire and encourage all knowledge seekers of higher education and research.
- To provide quality instruction and research for the advancement of science and technology.
- To promote teaching and research studies in disciplines of societal relevance.
- To bridge the gap between theory and practice.
- To develop human talent necessary for the industry.

VISION & MISSION OF THE DEPARTMENT

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

B.Tech. ELECTRONICS & COMMUNICATION ENGINEERING

VISION OF THE DEPARTMENT:

To evolve into a globally recognized department in the frontier areas of Electronics & Communication Engineering (ECE) by producing innovative, creative and ethical Electronics & Communication Engineers with research focus to meet socio-economic needs.

MISSION OF THE DEPARTMENT:

M1- Imparting quality education with professional ethics to Electronics and Communication Engineering students to overcome challenges in professional career.

M2- Aimed to produce graduates having professional excellence.

M3- To carry out quality research having social & industrial relevance.

M4- To provide technical support to budding entrepreneurs and existing Industries.

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

B.Tech. ELECTRONICS & COMMUNICATION ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEO's):

- PEO1: Practice engineering in a broad range of industrial, societal and real world applications.
- PEO2: Pursue advanced education, research and development, and other creative and innovative efforts in science, engineering, and technology, as well as other professional careers.
- PEO3: Conduct themselves in a responsible, professional, and ethical manner.
- PEO4: Participate as leaders in their fields of expertise and in activities that support service and economic development throughout the world.

PROGRAM OUTCOMES (PO's):

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: 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.
PO4	Conduct investigations of complex problems: 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.
PO5	Modern tool usage: 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.
PO6	The engineer and society: 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.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: 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.
PO11	Project management and finance: 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.
PO12	Life-long learning: 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.

Program Specific Outcomes (PSOs):

PSO1	An ability to Understand the theoretical and mathematical concepts to analyze real time problems.
PSO2	An Ability to Design and Analyze systems based on the theoretical and Practical Knowledge

ACHARYA NAGARJUNA UNIVERSITY :: NAGARJUNA NAGAR

REVISED REGULATIONS FOR
TWO - YEAR M.TECH. DEGREE COURSE
(CHOICE BASED CREDIT SYSTEM)

(With effect from the batch of students admitted during the academic year 2023-2024)

1.0 ELIGIBILITY FOR ADMISSION

1.1 The candidates, both non-sponsored and sponsored, for Admission into M.Tech programme shall have one of the following qualifications.

S.No.	Programme	Qualifications
1.	Chemical Engineering	Bachelor Degree in Chemical Engineering / Chemical Technology / Biotechnology or its equivalent Degree recognized by Acharya Nagarjuna University
2.	Civil Engineering	Bachelor Degree in Civil Engineering or its equivalent Degree recognized by Acharya Nagarjuna University
3.	Computer Science & Engineering	B.Tech / B.E Computer Science and Engineering / Information Technology / M.C.A / M.Sc., Computers / M.Sc., Electronics / M.Sc., Mathematics or its equivalent Degree recognized by Acharya Nagarjuna University.
4.	Electrical and Electronics Engineering	Bachelor Degree in Electrical & Electronics Engineering / Electrical Engineering / Electrical Power Engineering / AMIE (Electrical Engineering) or its equivalent Degree recognized by Acharya Nagarjuna University.
5.	Electronics and Communication Engineering	Bachelor Degree in Electronics & Communication / Electronic & Instrumentation Engineering / AMIE or its equivalent Degree recognized by Acharya Nagarjuna University.
6.	Information Technology	B.Tech / B.E Computer Science and Engineering / Information Technology / M.C.A / M.Sc., Computers / M.Sc., Electronics / M.Sc., Mathematics or its equivalent Degree recognized by Acharya Nagarjuna University.
7.	Mechanical Engineering	Bachelor Degree in Mechanical Engineering or its equivalent Degree recognized by Acharya Nagarjuna University.

1.2 Admission of Non-sponsored category students: Admission of non-sponsored category students is made on the basis of GATE/PGECET rank. When GATE/PGECET qualified candidates are not available, admission will be on the basis of merit in the qualifying examination. Students with or without GATE/PGECET rank should have obtained a minimum of 50% marks in the qualifying examination to become eligible for admission.

Reservation of seats to the candidates belonging to Scheduled Castes and Scheduled Tribes is as prescribed by the State Govt./University from time to time. If suitable candidates are not available to fill all the seats reserved for S.T category, they shall be filled by students S.C. Category and vice-versa.

If suitable candidates are not available for reserved seats, they shall be filled by the general category candidates.

1.3 Admission of Sponsored Category students: Sponsored category students should have at least 50% marks in the qualifying examination to become eligible for admission to the Post Graduate Program. Preference will be given to those candidates who are GATE/PGECET qualified.

The candidates must have a minimum of two years of full-time work experience in a registered firm / company/ industry / educational and research institutions / any government department or government autonomous organizations in the relevant field in which the admission is being sought.

A letter from the employer must be furnished stating that the candidate is being sponsored to get admission. The employer should also indicate that the candidate will not be withdrawn midway till the completion of the course. The rule of reservation shall not apply to the admission of sponsored category students.

1.4 The total number of full-time candidates admitted into a course with or without GATE/PGECET rank should not exceed the sanctioned strength.

2.0 MEDIUM OF INSTRUCTION, DURATION AND STRUCTURE

2.1. The total number of full-time candidates admitted into a course withor without GATE/PGECET rank should not exceed the sanctioned strength.

2.2. The medium of instruction shall be in English.

2.3. The minimum and maximum period for completion of the P.G. Program is 4 Semesters for full time students.

2.4. Each Semester shall normally spread over sixteen weeks.

(a) The Programme may consist of
    i. Core Courses
    ii. Elective Courses
    iii. Seminars
    iv. Internship
    v. Project Work

(b) The structure of the Programme comprises of two semesters of course work consisting of 6 Core subjects + 6 Elective subjects and 3 Lab courses + 1 Mini Project / Seminar (or) 2 Lab courses + 2 Seminars / Mini Project, followed by two semesters of Project work. In summer break, the student should undergo internship for four weeks duration. The student should present a seminar on the project work done at the end of the third semester. At the end of fourth semester the students should submit Project Thesis.

(c) Core subjects are fixed in each semester and a student must opt them without any choice. Whereas electives can be chosen by a student from the list of electives given (minimum 18 and maximum 24) according to his choice.

2.5. Project work shall be carried out under the Supervision of aFaculty Member in the concerned department.

2.6. A candidate may, however, in certain cases, be permitted to workon his Project/Dissertation at the place of employment, any recognized Institution/R&D Organization/Industry with the approval of the Head of the Department concerned and Head of the Organization. In such cases, the Project Work shall be jointly supervised by a member of the faculty and a person from the Organization holding a minimum of P.G. Degree in the concerned area of specialization.

2.7. Five copies of the Project Report certified by the Supervisor(s) and the Head of the Department concerned shall be submitted within one Calendar Year after completion of the second semester.

2.8. The student is eligible for the submission of M.Tech. Project Report at the end of fourth semester if he/she passed all the course work in the first & second semesters.

2.9. In a special case, if any candidate unable submit his/her Project Report at the end of fourth semester due to ill health or any other reason permitted by the head of the institution, he/she will be allowed submit at a later date and the viva-voce examination will be conducted, if clause 2.7 is satisfied.

3.0 ATTENDANCE

3.1 The candidate shall put up a minimum of 75% attendance in each subject.

3.2 Condonation of shortage in attendance up to 10% in any subject may be condoned by the University on the recommendations of thePrincipal of the concerned College for reasons of ill health and the application is submitted at the time of actual illness and is supported by acertificate from the authorized Medical Officer approved by the Principal.

3.3 If the candidate does not satisfy the attendance requirement in any subject he or she shall not be permitted to appear for the University examination in that subject and has to repeat that subject when next offered or study any other specified subject as may be required. In case of repetition the new internal marks will be taken intoamount.

3.4 Failure in securing minimum prescribed attendance in any subject of previous Semester (s) is no bar for enrollment to the next semester.

4.0 EVALUATION

4.1 The performance of the candidate in each semester shall be evaluated subject wise. The maximum marks for each subject, seminar etc, will be as prescribed in the curriculum. The Internal Evaluation for Theory subjects shall be based on two mid-term examinations and two assignments. In every theory subject, out of 40 sessional marks, 30 marks are allotted to mid-term examination and 10 marks for assignments. The best of the performances in the two midterm examinations, one held in the middle of the semester and another held immediately after the completion of the instruction, will be considered.The internal evaluation for practical subjects is based on the day-to-day performance and semester end internal practical Examination.

4.2 The marks for Seminar will be awarded by internal evaluation made by two staff members of the faculty of the department concerned.

4.3 For taking the University examination in any theory or practical subject, candidates shall be required to obtain a minimum of 50% marks in Internal evaluation in that subject failing which he/she shall be required to repeat the course in that subject when next offered or study any other specified subject as may be required. In case of repetition the newinternal marks will be taken into amount.

4.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he or she secures a minimum of50% marks in internal evaluation.

4.5 In case the candidate does not secure the minimum academic requirement in any subject he/she has to reappear in the University examination in that subject or any equivalent subject prescribed.

4.6 Failure to attain the minimum academic requirement in any subjectof previous semester (s) is no bar for enrollment to the next semester.

4.7 The performance of the students in each semester shall be evaluated subject wise The distribution of marks between sessional work (based on internal assessment) and University Examination will be as follows:

Nature of the subject	Sessional	University
	Marks	Exam. Marks
Theory subjects	40	60
Practical's	40	60
Seminar / Internship / Project Seminar	100	--
Project work	50	150 (viva voce)

5.0 AWARD OF CREDITS

Credits are awarded for each Theory/Practical/Seminar/Project Subjects. Each theory subject is awarded 4 credits and each practical/Seminar subjects is awarded 2 credits. Project seminar in III Semester is awarded 8 credits and Project Viva-voce at the end of IV Semester is awarded 16 credits.

6.0 AWARD OF GRADES

S.No.	Range of Marks	Grade	Grade Points
1	≥85%	S	10.0
2	75%-84%	A	9.0
3	65%-74%	B	8.0
4	60%-64%	C	7.0
5	55%-59%	D	6.0
6	50%-54%	E	5.0
7	≤49%	F(Fail)	0.0
8	The grade 'W' represents withdrawal / absent (subsequently changed into passor E to S or F grade in the same semester)	W	0.0

A Student securing ‘F’ grade in any subject there by securing 0 grade points has to reappear and secure at least ‘E’ grade at the subsequent examinations in that subject

‘W’ denotes withdrawal/absent for a subject:

- After results are declared and Grade sheets will be issued to each student which will contain the following details:
- The list of subjects in the semester and corresponding credits and Grade obtained

- The Grade point average(GPA) for the semester and

- The Cumulative Grade Point Average(CGPA) of all subjects put together up to that semester from first semester onwards

GPA is calculated based on the fallowing formula:

$$\frac{\text{Sum of [No.Credits X Grade Point]}}{\text{Sum of Credits}}$$

CGPA will be calculated in a similar manner, considering all the subjects enrolled from first semester onwards.

7.0 AWARD OF DEGREE AND CLASS

A candidate who becomes eligible for the award of the degree shall be placed in the following three divisions based on the CGPA secured by him/her for the entire Programme

S.No.	Class	CGPA
1	First Class With Distinction	8.0 or more
2	First Class	6.5 or more but less than 8.0
3	Second Class	5.0 or more but less than 6.5

8.0 WITH-HOLDING OF RESULTS

The result of a candidate may be withheld in the following cases.

i. The candidate has not paid dues to the institution.
ii. A case of indiscipline is pending against the candidate.
iii. A case of malpractice in examination is pending against the candidate The issue of degree is liable to be withheld in such cases.

9.0 GENERAL

9.1 The University reserves the right of altering the regulations as and when necessary.

9.2 The regulations altered will be applicable to all the candidates on the rolls Irrespective of the fact that the regulations at the time of admission of the student to the programme are different.

9.3 The Academic Regulations should be read as a whole for purpose of any Interpretation Whenever there is a dispute regarding interpretation of regulations, the decision of the Vice-Chancellor is final.

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ACHARYA NAGARJUNA UNIVERSITY, NAGARJUNA NAGAR

SCHEME OF EXAMINATION AND INSTRUCITON FOR

M.TECH (COMMUNICATION ENGINEERING & SIGNAL PROCESSING)

FIRST SEMESTER

S.No.	Code No. & Subject	Hours / Week		Credits	Evaluation of Marks		Total
		L	P		INT	EXT	
1	CESP-511: Advanced Digital Communication	4	--	4	40	60	100
2	CESP-512:Coding Theory And Techniques	4	--	4	40	60	100
3	CESP-513: Speech Signal Processing	4	--	4	40	60	100
4	Elective Subject – 1	4	--	4	40	60	100
5	Elective Subject – 2	4	--	4	40	60	100
6	Elective Subject – 3	4	--	4	40	60	100
7	CESP-551: Communication Lab	--	3	2	40	60	100
8	CESP-552: Seminar	--	3	2	100	--	100
TOTAL		24	6	28	380	420	800

SECOND SEMESTER

S.No.	Code No. & Subject	Hours / Week		Credits	Evaluation of Marks		Total
		L	P		INT	EXT	
1	CESP-514:Real Time Signal Processing	4	--	4	40	60	100
2	CESP-515:Multirate Systems and Filter Banks	4	--	4	40	60	100
3	CESP-516: Wireless Communication	4	--	4	40	60	100
4	Elective Subject – 4	4	--	4	40	60	100
5	Elective Subject – 5	4	--	4	40	60	100
6	Elective Subject – 6	4	--	4	40	60	100
7	CESP-553: Signal Processing Lab	--	3	2	40	60	100
8	CESP-554: Mini Project / Term paper	--	3	2	100	--	100
TOTAL		24	6	28	380	420	800

LIST OF ELECTIVE SUBJECTS:

I Semester Subjects		II Semester Subjects	
Subject Code	**Subject Title**	**Subject Code**	**Subject Title**
CESP-611	Video Processing	CESP-623	Embedded Systems
CESP-612	Wavelet Signal Processing	CESP-624	Global PositioningSystems
CESP-613	Radar Signal Processing	CESP-625	Telecommunication Switching Systems
CESP-614	Spread Spectrum Communication	CESP-626	Fuzzy Techniques
CESP-615	Advanced signal processing	CESP-627	Optimization Techniques
CESP-616	Fiber Optic Communication	CESP-628	OFDM for Wireless Communication Systems
CESP-617	Artificial Neural Networks	CESP-629	Machine Learning
CESP-618	Adaptive Signal Processing	CESP-630	Data Science
CESP-619	Microwave Measurements	CESP-631	Deep Learning
CESP-620	Block Chain Technology	CESP-632	Satellite Communication Systems
CESP-621	Pattern Recognition	CESP-633	Internet of Things
CESP-622	Random Processing & Information Theory	CESP-634	System On Chip Architecture

THIRD SEMESTER

S.No.	Code No. & Subject	Hours / Week		Credits	Evaluation of Marks		Total
		L	P		INT	EXT	
1	CESP-711: Internship	--	--	2	100	--	100
2	CESP-712: Project Seminar	--	--	6	100	--	100
TOTAL		--	--	6	200	--	200

FOURTH SEMESTER

S.No.	Code No. & Subject	Hours / Week		Credits	Evaluation of Marks		Total
		L	P		INT	EXT	
1	CESP-713 Project	--	--	16	50	150	200

CESP 511 ADVANCED DIGITAL COMMUNICATION

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand Intersymbol interference, Correlative-level coding, Duo-binary signaling, and modified duo-binary signaling.
CO2	Analyze PN sequences and their role in spread spectrum communication.
CO3	Describe the model of the encryption and decryption process.
CO4	Characterize mobile radio propagation, including signal time spreading and time variance of the channel caused by motion.
CO5	Represent codes using Polynomial, State diagram, Tree diagram, and Trellis diagram.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	2	-
CO2	-	-	-	3	2	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	2	-	-	-	-	-
CO4	-	-	-	3	2	-	-	3	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-

UNIT – I

Digital Modulation Techniques:

Intersymbol interference, Correlative - level coding: Duo-binary signaling and modified duo-binary signaling, Introduction to pass band data transmission, Coherent PSK: BPSK, QPSK, coherent FSK, QAM, Non-coherent binary modulation techniques, Non-coherent orthogonal modulation: BFSK, DFSK, M- ary modulation techniques: M-ary PSK, M-ary QAM, Synchronization: Carrier Synchronization, Symbol synchronization.

UNIT –II

Spread Spectrum Modulation:

PN sequences, A Notion of spread spectrum, Direct – Sequence spread coherent BPSK, Signal – space dimensionality and processing gain, probability of error, frequency – hop spread spectrum, synchronization of spread spectrum signals: Acquisition and tracking

UNIT –III

Encryption and Decryption:

A model of the encryption and decryption process. Cipher systems, stream encryption and Public key encrypto system.

UNIT –IV

Fading Channels:

Characterization of mobile radio propagation, Signal time spreading, Time variance of the channel caused by motion, frequency selective, non-selective, Diversity Techniques for fading multi-path channels.

UNIT-V

CONVOLUTIONAL CODED DIGITAL COMMUNICATION

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

Text Books:

1. Simon Haykin – Digital Communications
2. B.Sklar, Digital Communications, Addison Wesley.

Reference Books:

1. J.G. Proakis, Digital Communications, McGraw Hill.
2. Taub and Schiling – Principles of Communication Systems 2nd edition

CESP 512 CODING THEORY AND TECHNIQUES

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand mathematical models of information, logarithmic measure of information, average and mutual information, and entropy.
CO2	Apply coding techniques for discrete memoryless sources, including Huffman code, run length codes, Lempel-Ziv codes, and Shanon-Fano coding.
CO3	Introduce linear block codes, understand generated matrix, systematic linear block codes, and encoder implementation of linear block codes.
CO4	Analyze parity check matrix, syndrome testing, and error-detecting and correcting capabilities of linear block codes, with a focus on Hamming codes.
CO5	Understand maximum likelihood decoding of convolutional codes, Viterbi algorithm, sequential decoding algorithm, and distance bounds for convolutional codes.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	3	-
CO2	3	3	3	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	-	-	-	-	-	-	2	-
CO4	3	3	3	-	-	-	-	-	-	-	2	-
CO5	3	3	3	-	-	-	-	-	-	3	3	-

UNIT – I

Source Coding : Mathematical models of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, coding for Discrete Memory less Sources, Properties of Codes, Huffman Code, Run Length Codes, Lempel-Ziv Codes, Shanon – Fano coding.

UNIT – II

Channel Coding : Introduction to Linear Block Codes, Generated Matrix, Systematic Linear Block Codes, Encoder Implementation of Linear Block Codes, Parity Check Matrix, Syndrome Testing, Error Detecting and Correcting Capability of Linear Block Codes, Hamming Codes, Probability of an Undetected Error for Linear Codes Over a BSC- Perfect Codes.

UNIT – III

Cycle Codes : Algebraic Structure of Cyclic Codes, Binary Cyclic Code Properties, Encoding in Systematic Form, Syndrome Computation and Error Detection, Decoding of Cyclic Codes, Cyclic Hamming Codes

BCH Codes: Description of the Codes, Minimum Distance and BCH Bounds, Decoding Procedure for BCH Codes, Implementation of Galors Field Arithmetic, Implementation of Error Correction

UNIT-IV

Convolutional Codes : Encoding of Convolutional Codes, Structural Properties of Convolutional Codes, Time domain approach, Transform domain approach, State Diagram, Tree Diagram, Trellis Diagram, Maximum, Likelihood Decoding of

Convolutional Codes, Viterbi Algorithm, Sequential decoding algorithm, distance bounds for convolutional codes, advantages and disadvantages of convolutional codes.

UNIT –V

Trellis Coded Modulation:

Introduction to TCM, concept of coded modulation, mapping by set partitioning, Ungerboeck's TCM design rules, TCM decoder, Performance evaluation for Additive White Gaussian Noise (AWGN) channel, TCM for fading channels.

Text Books :

1. Error Control Coding – Fundamentals and Applications by SHU LIN and Daniel J. Costello, JR., Prentice Hall Inc
2. Simon Haykin – Communication Systems, 4th edition
3. Digital Communications – Fundamentals and Applications by Bernard Sklar, Pearson Education Asis, 2003.
4. Digital Communications – John G. Proakis, Mc. Graw Hill Publications
5. J. Das, Sk. Mallik, PK Chattergee – Princiiples of Digital Communication, NAI (P) Ltd, 2000
6. Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill, 2003.

CESP 513 SPEECH SIGNAL PROCESSING

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the discrete-time signal processing framework, production, and classification of speech sounds, anatomy, physiology of speech production, categorization of speech sounds (phonemes), and digital models for speech signals.
CO2	Apply short-time speech analysis techniques, including windowing, spectra of windows, and time-domain models for speech processing.
CO3	Understand homomorphic speech processing, complex cepstrum of speech, and the homomorphic vocoder.
CO4	Apply automatic speech recognition techniques, including basic pattern recognition approaches, speech recognition systems (isolated digit recognition system and continuous digit recognition system), and networks for speech recognition such as hidden Markov model (HMM) and artificial neural networks (ANN).
CO5	Recognize speaker recognition techniques, including speaker verification systems, speaker identification systems, and features that distinguish speakers.

CO-PO/PSO Mapping Matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	-	-	-	3	-	-
CO2	3	3	3	2	2	2	-	-	-	3	-	-
CO3	3	3	3	2	2	2	-	-	-	3	-	-
CO4	3	3	3	3	3	3	-	-	-	3	2	-
CO5	3	3	3	2	2	2	-	-	-	3	2	-

UNIT – I

INTRODUCTION: A Discrete-Time signal processing framework, Production and Classification of Speech Sounds: Introduction, Anatomy and Physiology of Speech Production Categorization of Speech Sounds (PHONEMES), Digital Models for Speech Signals.

SPEECH ANALYSIS: Short–Time Speech Analysis, Windowing, Spectra of Windows, time –Domain Models for Speech Processing: Introduction, Time –Dependent Processing of Speech, short time energy, short time average magnitude, short time Average zero-crossing rate and auto correlation function, short time Average Magnitude Difference Function.

UNIT – II

Frequency Domain (Spectral) Parameters: Short –Time Fourier Transform Analysis, Spectral Displays, Formant Estimation and Tracking, Filter Bank Summation (FBS) Method, Pitch Period Estimation using Parallel Processing Approach, Pitch Period Estimation using Autocorrelation Function.

Linear predictive coding (LPC) of Speech: Introduction ,Basic principles of Linear predictive Analysis ,Solution of the LPC Equation- Cholesky Decomposition Solution for covariance method and Durbin's Recursive Solution for the Autocorrelation Equations, comparisons between the methods of solutions of LPC analysis equations, The prediction error Signal , Frequency domain interpretation of mean squared prediction error, Applications of LPC parameters – pitch detection using LPC parameters and Formant analysis using LPC parameters, Mel-scale cepstrum.

UNIT – III

Homomorphic Speech processing: Introduction, Homomorphic systems for Convolution, The complex cepstrum of speech,The Homomorphic Vocoder.

Speech enhancement: Introduction, Preliminaries, speech enhancement techniques - spectral subtraction and cepstral mean subtraction, Nature of interfering sounds, Filtering and Multi-Microphone Adaptive Noise Cancellation.

UNIT – IV

Automatic speech recognition: Basic pattern recognition approaches, speech recognition systems – Isolated Digit Recognition system and continuous Digit Recognition system.

Networks for speech recognition: Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, training and testing using HMMs, adapting to variability in speech, Artificial Neural Networks (ANN).

UNIT – V

Speaker recognition: Recognition Techniques-speaker verification system and speaker identification system, Features that distinguish speakers.

Text books :

1. Douglas O' Shaughnessy, Speech Communications:Human & Machine -,second Edition, Oxford University Press, 2000
2. L.R. Rabiner and S.W. Schafer, digital Processing of speech signals, Person
3. Thomas F. Quatieri , Discrete –Time Speech signal Processing principles and practice, Person Education

References :

1. Owens, Signal Processing of Speech
2. Dr. Shaila D. Apte, Speech and Audio Procesing , WILEY Precise Textbook
3. Dellar and Proakis, Digital Signal Processing, PHI
4. Claudio Becchetti and Klucio Prina Ricotti, Speech Recognition Theory and C++ Implementation,WILEY
5. A.M. KONDOZ,Digital Speech, second edition, WILEY

CESP 514 REALTIME SIGNAL PROCESSING

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand real-time concepts, signal processing, and DSP systems.
CO2	Familiarize with the TMS320C6x architecture, functional units, fetch and execute cycles, packets, pipelining, and registers.
CO3	Comprehend addressing modes, including direct, indirect addressing, linear, and circular addressing modes.
CO4	Understand data representation in DSP processors, including data types, floating-point format, Q-format number representation, fixed-point DSP, and finite word length effects. Explore finite impulse response (FIR) filters, FIR lattice structure, and window functions.
CO5	Explore infinite impulse response (IIR) filters, IIR filter structures, direct form I structure, direct form II structure, direct form II transpose, cascade structure, and lattice structure.

CO-PO/PSO Mapping Matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	-	-	2	3	3	2
CO2	3	3	3	2	2	2	-	-		3	2	-
CO3	3	3	3	2	2	2	-	-	2	3	-	-
CO4	3	3	3	2	2	2	-	-	2	3	2	-
CO5	3	3	3	2	2	2	-	-	2	3	2	-

UNIT – I

Introduction: Introduction to real time concepts, Signal Processing and DSP systems, Comparison between general purpose and DSP processors.

Architecture: TMS320C6x Architecture, Functional Units, Fetch and Execute, Packets, Pipelining, Registers.

Addressing modes: Direct, Indirect Addressing Linear and Circular Addressing Modes, Circular Addressing

UNIT – II

Instruction Set of the C6x Processor : TMS320C6x Instruction Set- Assembly Code Format, Types of Instructions , Assembler Directives, Timers, Interrupts- Interrupt Control Registers , Interrupt Acknowledgment, Multichannel Buffered Serial Ports , Direct Memory Access , Memory Considerations-Data Allocation, Data Alignment, Pragma Directives, Memory Models.

Data representation DSP Processors : Data Types, Floating-Point Format, Q- format Number Representation Fixed-Point DSP, Finite Word Length Effects on Fixed-Point DSPs, Overflow and Scaling, Division, Code Improvement - Trip Directive for Loop Count, Cross-Paths, Software Pipelining, Constraints - Memory Constraints, Cross-Path Constraints, Load/Store Constraints, Pipelining Effects with More Than One EP within an FP.

UNIT – III

Finite Impulse Response Filters: Introduction to the *z*-Transform, Mapping from*s*-Plane to *z*-Plane, Difference Equations, Discrete Signals, FIR Filters, FIR Lattice Structure, Window Functions, Hamming Window, Hanning Window, Blackman Window, Kaiser Window.**Infinite Impulse Response Filters:** IIR Filter Structures, Direct Form I Structure, Direct Form II Structure, Direct Form II Transpose, Cascade Structure, Parallel Form Structure, Lattice Structure.

UNIT – IV

Adaptive Filters: Introduction, Adaptive Structures, Adaptive Linear Combiner, Performance Function Searching for the Minimum.

Multirate Signal Processing: Concepts of multirate signal processing, Sampling rate converter, multistage implementation, decimators and interpolators**,** Applications

UNIT – V

Code Optimization: Introduction to optimization, Optimization Steps, Procedure for Code Optimization, Software Pipelining for Code Optimization, and Execution Cycles for Different Optimization Schemes.

Text books :

1. Digital Signal Processing and Applications with the C6713 and C6416 DSK Rulph Chassaing, A JOHN WILEY & SONS, INC., PUBLICATION.

Reference books :

1. Real-Time Digital Signal Processing Based on the TMS320C6000 by NasserKehtarnavaz.
2. Digital Signal Processors: Architectures, Implementations, and Applications by Kuo, woon seng – s gen, Pearson education.
3. Digital signal processors architecture, programming and applications, by B. Venkataramani, M. Bhaskar, TMH Edition.
4. Digital signal processing implementations using DSP microprocessors with examples from 4. TMS320C54xx by Avtar Singh, Srini Srinivasan,Thomson/Brooks/Cole, 2004
5. Digital Signal Processing Principles Algorithms, and Applications – John G. Proakis, DG.Manolakis , 4TH EDITION PHI Publications

CESP 515 MULTIRATE SYSTEMS AND FILTER BANKS

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the fundamentals of multirate systems, including basic multirate operations, interconnection of building blocks, polyphase representation, multistage implementations, and applications of multirate systems.
CO2	Comprehend maximally decimated filter banks, including errors created in the QMF bank, a simple alias-free QMF system, power symmetric QMF banks, M-channel filter banks, polyphase representation, perfect reconstruction systems, alias-free filter banks, tree-structured filter banks, and transmultiplexers.
CO3	Understand paraunitary perfect reconstruction filter banks, lossless transfer matrices, filter bank properties induced by paraunitariness, two-channel FIR paraunitary QMF banks, the two-channel paraunitary QMF lattice, and transform coding with the LOT (Lapped Orthogonal Transform).
CO4	Gain knowledge about cosine modulated filter banks, including the pseudo QMF bank, design of pseudo QMF bank, efficient polyphase structures, deeper properties of cosine matrices, and cosine modulated perfect reconstruction systems.
CO5	Understand the short-time Fourier transform, wavelet transform, discrete-time ortho-normal wavelets, and continuous-time ortho-normal wavelets.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	3	3	2	2	2	3	2	2
CO3	3	3	3	2	2	2	2	2	2	3	2	2
CO4	3	3	3	3	2	2	2	2	2	3	2	2
CO5	3	3	3	2	2	2	2	2	2	3	2	2

UNIT – I

Fundamentals of Multirate Systems: Basic Multirate Operations, Interconnection of Building Blocks, The Polyphase representation, Multistage Implementations, Some Applications of Multirate Systems, Special Filters and Filter Banks

UNIT – II

Maximally Decimated Filter Banks: Errors created in the QMF Bank, A Simple Alias Free QMF System, Power Symmetric QMF Banks, M-Channel Filter Banks, Polyphase representation, Perfect Reconstruction Systems, Alias Free Filter Banks, Tree Structured Filter Banks, TransMultiplexers

UNIT – III

Paraunitary Perfect Reconstruction (PR) Filter Banks: Lossless Transfer Matrices, Filter Bank Properties Induced by Paraunitariness, Two channel FIR Para unitary QMF Banks, The Two channel Para unitary QMF Lattice, Transform Coding and the LOT.

UNIT – IV

Cosine Modulated Filter Banks: The Pseudo QMF Bank, Design of Pseudo QMF Bank, Efficient Polyphase Structures, Deeper Properties of Cosine Matrices, Cosine Modulated Perfect Reconstruction Systems

UNIT-V

Wavelet Transform: Short-time Fourier transform, Wavelet transform, discrete-time Ortho-normal wavelets, continuous time Ortho-normal wavelets.

TEXT BOOK:

1. Multirate Systems and Filter Banks, P.P.Vaidyanathan, Pearson Education, Low Priced Edition, 2006.

REFERENCE BOOKS:

1. Multirate Signal Processing for Communication Systems by F.J.Harris, Pearson Education, Low Priced Edition.
2. Digital Signal Processing, A computer Based Approach by Sanjit K Mitra, Tata Mc Graw Hill Publishing.

CESP 516 WIRELESS COMMUNICATION

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Evaluate mobile radio communication, understand mobile radio systems globally, and recognize examples of wireless communication systems.
CO2	Comprehend cellular concept, system design fundamentals, and related strategies
CO3	Analyze mobile radio propagation and small-scale fading
CO4	Understand equalization and diversity techniques
CO5	Review modulation techniques, multiple access techniques, and wireless standards

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	2	3	-	-
CO2	3	3	3	2	2	2	-	-	2	2	-	-
CO3	3	3	3	2	2	2	-	-	2	3	-	-
CO4	3	3	2	2	2	2	-	-	2	3	-	-
CO5	3	3	3	2	1	1	-	-	1	2	-	-

UNIT – I

Introduction : Evaluation of Mobile Radio Communication, Mobile Radio Systems around the world, Examples of Wireless Communication Systems: Paging systems, Cordless Telephone Systems, Cellular Telephone Systems Modern Wireless Communication Systems, Second generation cellular networks, third generation networks, Wireless Local Loop (WLL) LMDS, Wireless Local Area Networks (WLAN), Bluetooth & Personal Area Networks.

UNIT – II

The Cellular Concept – System Design Fundamentals : Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems. Mobile Radio Propagation: Large-Scale Path Loss: Introduction, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection, Ground Reflection, Diffraction Scattering, Practical Link Budget Design Using Path Loss Models, Outdoor Propagation Models-(Longley_Rice Model & Durkin's Model_ A Case Study), Indoor Propagation Model (Partition Losses (Same Model) & Partition Losses between Floors), Singal Penetration into Buildings, Ray Tracing and Site Specific Modeling.

UNIT – III

Mobile Radio Propagation : Small-Scale Fading and Multipath : Small-Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small- Scale Multipath Measurements, Parameters of Mobile Multipath Channels, Types of Small Scale Fading, Rayleigh and Ricean Distributions, Statistical Models for Multipath Fading Channels, Theory of Multipath Shape Factors for Small-Scale Fading Wireless Channels, Examples of Fading Behavior, Second-Order Statistics Using Shape Factors, Applying Shape Factors to Wideband Channels Revisiting Classical Channel Models with Shape Factors.

UNIT – IV

Equalization: Fundamentals of equalizers, Equalizers in a communication receiver, Linear equalizers, Nonlinear equalizers: Decision feedback equalizers, Maximum likelihood sequence Estimation (MLSE) equalizer. Diversity Techniques: Space diversity: Selection diversity, feedback, MRC, EGC diversity Polarization diversity, Frequency diversity, Time diversity, Rake Receiver.

UNIT – V

Review of the Modulation Techniques for mobile radio, Review of the Multiple Access techniques for Wireless Communication, Wireless data networking, Wireless Data Services, AMPS, Global System for Mobile(GSM)

Text Books:

1. TS Rappaport, wireless communications: principles and practice, Pearson education 2nd edition.
2. J G Proakis, Digital Communication, McGraw Hill, 1995.
3. GE Stuber, Priniciples of Mobile Communications, KIuwer academic 1996.

CESP 611 - VIDEO PROCESSING

CO1	Describe video formation, perception, and representation, including color perception, video capture, and display technologies. Analyze analog video raster, analog color television systems, and digital video characteristics with frequency domain representation.
CO2	Execute signal conversion techniques for signals sampled on different lattices. Perform sampling rate conversion for video signals
CO3	Explain the basics of video modeling, including camera, illumination, object, and scene models. Implement two-dimensional models and motion estimation techniques in video processing.
CO4	Describe various video modeling aspects including camera, illumination, object, and scene models. Implement different types of two-dimensional motion estimation methods, including Optical Flow and Block Matching Algorithm.
CO5	Analyze Video Coding Systems along with discussion on various Video Compression Standards.

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CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2	3	2	3	3	3
CO2	3	3	3	3	2	2	2	3	2	3	3	3
CO3	3	3	3	3	2	2	2	3	2	3	3	3
CO4	3	3	2	2	2	2	2	2	2	2	2	2
CO5	3	3	2	2	2	2	2	2	2	3	3	2

UNIT – I

Video formation, perception and representation – color perception and specification – video capture and display – Analog video raster – Analog color television systems, Digital video, Frequency Domain characterization of Video Signals.

UNIT – II

Video sampling – Basics of the Lattice theory, Sampling of Video Signals, Conversion of Signals Sampled on Different Lattices, Sampling Rate Conversion of Video Signals.

UNIT – III

Video modeling-Camera model, Illumination model, Object model and Scene model, Two dimensional models, Two Dimensional motion estimation-Types, Optical Flow, Pixel Based Motion, Block matching Algorithm.

UNIT – IV

Video coding systems – waveform based video coding – content dependent video coding.

UNIT V

Video compression standards – Standardization, video telephony with H.261,H.263, Standards for visual communication systems, consumer video communications with MPEG-1, digital TV with MPEG-2, coding of audiovisual objects with MPEG -4, video bit stream syntax, multimedia content description using MPEG-7

TEXT BOOKS

1. Video Processing and Communication – 1st edition - Yao Wang, J.Ostermann, Ya Zhang, Prentice Hall, 2001.

REFERENCE BOOKS:

1. Image processing, analysis, and machine vision, 2nd Edition,- Sonka M, Hlavac V, Boyle R. Brooks Cole publishing, 1999.
2. Multidimensional, signal, image and video processing and coding, - Woods, Elsevier, Academic press, 2006.

CESP 612 WAVELET SIGNAL PROCESSING

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand orthogonal signal spaces, approximations of functions, Fourier series, and Fourier transforms.
CO2	Comprehend time-frequency analysis and continuous wavelet transform.
CO3	Introduce the discrete wavelet transform and orthogonal wavelet decomposition.
CO4	Understand Parseval's identity, inverse CWT, and biorthogonal wavelet basis.
CO5	Explore signal and image compression, signal detection, and wavelets in adaptive filtering.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	-	-	2	2	-	-
CO2	3	3	3	2	1	2	-	-	1	2	-	-
CO3	3	3	3	2	1	2	-	-	1	2	-	-
CO4	3	3	3	2	1	2	-	-	1	2	-	-
CO5	3	3	3	1	2	1	-	-	2	2	-	-

UNIT – I

Orthogonal Signal Spaces, Approximations of Functions by a Set of Mutually Orthogonal Functions, Orthogonality in Complex Functions, Trigonometric & Exponential Fourier Series, Concepts of Fourier Transforms, Properties and their Significance, Energy and Power Spectral Density Functions

UNIT – II

Time-Frequency Analysis: Window function, Short –Time Fourier Transform, Properties of Short-Time Fourier Transform, Discrete Short-Time Fourier Transform.

Continuous Wavelet Transform: Continuous-Time Wavelets, Definition of the CWT, The CWT as a Correlation, Constant Q-Factor Filtering Interpretation and Time-Frequency Resolution, The CWT as an Operator, Inverse CWT

UNIT – III

Introduction to the Discrete Wavelet Transform and Orthogonal Wavelet Decomposition: Approximation of Vectors in Nested Linear Vector Subspaces, Example of an MRA.

MRA, Orthonormal Wavelets and their relationship to filter banks: Formal Definition of MRA, Construction of a General Orthonormal MRA, a wavelet basis for the MRA, Digital Filtering Interpretation, Interpreting Orthonormal MRAs for discrete-time signals

UNIT – IV

Parseval's Identity for the CWT, Inverse CWT is a many to one operation, Wavelet Inner Product as a Projection Operation, CWT with an Orthonormal basis generating wavelet, A trous algorithm Biorthogonal Wavelet basis, filtering

relationship for biorthogonal filters, two dimensional wavelets, wavelet packets

UNIT-V

Signal and Image compression, Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in signal acquisition, coding and lossy transmission, Digital Communication and Multicarrier Modulation, Trans multiplexers , Image fusion, Edge Detection and object isolation.

TEXT BOOKS :

1. Signal Processing and Linear Systems, B.P. Lathi, Berkley Cambridge
2. Wavelet Transforms - Introduction to Theory and Applications, Raghuveer M. Rao, Ajit opardikar, Pearson Education, Asia

REFERENCES :

1. Signals and Systems, B.P. Lathi
2. Fundaments of Wavelets - Theory, Algorithms and Applications, Jaideva C. Goswami, Andrew K. Chan, John Wiley & Sons

CESP 613 RADAR SIGNAL PROCESSING

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand radar functions, applications, target detection, and basic surveillance radar implementation.
CO2	Understand matched filter processing, correlation functions, and detection criteria in radar systems.
CO3	Explore transmit waveforms, radar ambiguity functions, and optimization in radar systems.
CO4	Understand principles, decoding techniques, and noise/clutter performance of phase coding techniques.
CO5	CO5: Comprehend principles, generation, decoding, and properties of linear FM and frequency coded pulses.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	2	3	-	-
CO2	3	3	2	2	2	-	-	-	2	3	-	-
CO3	3	3	3	2	2	-	-	-	2	3	-	-
CO4	3	3	2	2	2	-	-	-	2	3	-	-
CO5	3	3	2	2	2	-	-	-	2	2	-	-

UNIT – I

Introduction : Radar functions and Applications, Target Detection, Resolution and Clutter , Basic Surveillance Radar – Implementation.

Radar Engineering Equation – Parameters, loss factors, Radar Detection with Noise, Jamming, Volume Clutter and Area Clutter, Detection Probability, false alarm sensitivity and introductions to CFAR Technique, Basics of CACFAR processor, Resolution Cell and Measurement Accuracy, Ambiguities in Range and Doppler

UNIT – II

Signal Processing & Waveform Selection–1 : Introduction, Matched Filter Processing (with examples), Matched Filter Receiver, Matched Filter and Correlation Function, Efficiency of Practical Filters, Effect of Transmitted waveform, Correlation Detection, Cross correlation Receiver. Detection Criteria, Neyman Pearson Observer, Ideal Observer, Sequential Observer, Likelihood, Ration, Maximum Likelihood Function, Inverse Probability Criterion, Uncertainty Relation

UNIT – III

Signal Processing & Waveform Selection – 1I : Transmit Waveforms, Types, Design Criteria, radar Ambiguity Function – Principles, Properties, Examples, Radar Environmental Diagram, Optimization, Desirability of Range – Doppler Ambiguities.

UNIT – IV

Phase Coding Techniques : Principles, Random Binary coding, Binary periodic Sequences, Ambiguity Function for PR Sequences, Maximal Length Binary Codes, Perfect words and Codes, Poly Phase Codes. Decoding Techniques, Analog and Digital Schemes, Noise and Clutter Performances

UNIT – V

Linear FM and Frequency Coding Techniques: Principles, Linear FM pulses, Generation and Decoding, Distortion effects on LFM Signals, Discrete Frequencies, Waveform Analysis, Capabilities, Resolution properties of Frequency Coded Pulses

Text Books:

1. F.E. Nathanson, Radar Design Principles – Signal Processing and the Environment , McGraw-Hill, First Edition (1969)
2. Ramon Nitzberg, radar Signal Processing and Adaptive Systems, Artech House, 1999
3. M.I. Skolnik, Introduction to Radar Systems, McGraw-Hill
4. M.I. Skolnik (ed.) Radar Hand Book, McGraw Hill, wnd ed, 1992

CESP 614 SPREAD SPECTRUM COMMUNICATION

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the principles and applications of Direct Sequence Systems, spreading sequences, and waveforms, including the analysis of systems with PSK modulation and quaternary systems.
CO2	Evaluate the characteristics and modulations of Frequency Hopping Systems, along with analyzing codes for partial band interference and frequency synthesizers.
CO3	Demonstrate knowledge of code synchronization, acquisition of spreading sequences, serial search acquisition, acquisition correlator, and code tracking, as well as understanding frequency hopping patterns.
CO4	Analyze phase coding techniques, including principles of random binary coding, binary periodic sequences, maximal length binary codes, and decoding techniques, both analog and digital.
CO5	Explore the principles of linear FM and frequency coding techniques, including the generation and decoding of linear FM pulses, distortion effects on LFM signals, discrete frequencies, and capabilities of frequency-coded pulses.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	-	2	2	3	-	-
CO2	3	3	3	3	2	3	-	2	2	3	-	-
CO3	3	3	3	3	2	3	-	2	2	3	-	-
CO4	3	3	3	3	2	3	-	2	2	3	-	-
CO5	3	3	3	3	2	3	-	2	2	3	-	-

UNIT – I

Direct Sequence Systems, definitions and concepts, Spreading sequences and waveforms, Systems with PSK Modulatioin, Quaternary Systems, Pulsed Interference, Rejection of Narrowband Interference.

UNIT – II

Frequency Hopping Systems, Concepts and Characteristics, Modulations, Codes for partial band interference, Frequency Synthesizers.

UNIT – III

Code Synchronization, Acquisition of Spreading sequences, Serial Search Acquisition, Acquisition correlator, code Tracking, Frequency Hopping Patterns.

UNIT – IV

Detection of Spread Spectrum Signals, Detection of Direct sequence signals, Detection of Frequency Hopping Signals.

UNIT-V

Spread Spectrum Signal Processing: Spread spectrum modulation and demodulation techniques, Correlation and synchronization, Error detection and correction in spread spectrum systems, Jamming and anti-jamming techniques.

Applications of Spread Spectrum Communications: Wireless communication systems, Satellite communication**,** Military applications**,** Commercial applications (e.g., Wi-Fi, Bluetooth)

Text Book:

1. Principles of Spread Spectrum Communication Systems by Don.J.Torrieri, Springer Publishers,2005.

References:

1. Introduction to spread-spectrum communications by Roger L. Peterson, Rodger E. Ziemer, David E. Borth, Prentice Hall, 1995.
2. Spread Spectrum in Communications, R.Skaug, J.F.Hjelmstad, Published by Institution of Electrical Engineers

CESP 615 ADVANCED SIGNAL PROCESSING

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Demonstrate the ability to apply non-parametric power spectrum estimation methods, such as Welch and Blackman, for finite-duration observations of a signal.
CO2	Apply Yule-Walker, Burg, and Unconstrained Least Squares methods to estimate power spectra and analyze their relationship with auto-correlation and model parameters.
CO3	Utilize FIR Wiener Filtering principles to perform linear prediction, filtering, and noise cancellation, and represent the FIR Wiener Filter using lattice structures.
CO4	Implement IIR Wiener Filtering and causal Wiener Filtering techniques, including Wiener deconvolution and Discrete Kalman Filtering.
CO5	Apply array signal processing techniques, including beamforming and Direction-of-Arrival estimation, and utilize statistical signal processing methods, such as maximum likelihood estimation and Bayesian estimation, in practical scenarios.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	-	-	-	2	1	-	-
CO2	2	3	3	2	2	-	-	-	2	1	-	-
CO3	2	3	3	2	2	-	-	-	2	1	-	-
CO4	2	2	2	3	3	-	-	-	2	1	-	-
CO5	2	2	2	3	3	3	3	3	2	1	-	-

UNIT – I

POWER SPECIRAL ESTIMATION:

Estimation of Spectra from Finite Duration Observations of a Signal, the Periodogram, Use of DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Turkey methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods.

UNIT – II

PARAMETRIC METHOD OF POWER SPECTRUM ESTIMATION

Parametric Methods for power spectrum estimation, Relationship between Auto -Correlation and Model Parameters, AR(Auto-Regressive) Process and Linear prediction, Yule-Walker, Burg and Unconstrained Least Squares Methods, Sequential Estimation, Moving Average(MA) and ARMA Models Minimum Variance Method, Piscaranko's Harmonic Decomposition Method, MUSICMethod.

UNIT – III

Wiener Filtering: Introduction, The FIR Wiener Filter, Filtering, Linear Prediction, Noise Cancellation, Lattice Representation for the FIR Wiener Filter

UNIT – IV

The IIR Wiener Filter, Non Causal IR Wiener Filter, The Causal Wiener Filtering, Causal Linear Prediction, Wiener Deconvolution, Discrete Kalman Filter.

UNIT-V

Array Signal Processing: Introduction to array processing**,** Beamforming techniques**,** Direction-of-Arrival (DOA) estimation**,** Array processing for communication systems.

Statistical Signal Processing: Maximum likelihood estimation**,** Bayesian estimation, Kalman filtering**,** Hidden Markov Models (HMMs).

TEXT BOOKS:

1. ProakisJG and Manolakis DG Digital Signal Processing Principles, Algorithms and applications, PHI (For Unit I and II)
2. Statistical digital Signal Processing and Modelling by Monson Hayes, Wiley India Publications. (For Unit III and Unit IV,V)
3. "Array Signal Processing" by Don H. Johnson and Dan E. Dudgeon. (UNIT V)
4. "Adaptive Filter Theory" by Simon Haykin

REFERENCE BOOKS:

1. Openheim AV & Schafer RW, Discrete Time Signal Processing PHI.
2. Orfanadis S, Introduction to Digital Signal Processing PHI
3. Orfanadis S Optimum Signal Processing PHI

CESP 616 - FIBRE OPTIC COMMUNICATION

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the modes and configurations of optical fibers, including step-index and graded-index structures, and distinguish between various fiber types.
CO2	Demonstrate knowledge of optical sources, including Light-Emitting Diodes (LEDs) and Laser Diodes, and their modulation techniques.
CO3	Explain the operation of optical receivers, including fundamental receiver principles, digital signal transmission, and receiver configurations.
CO4	Describe the basic applications and types of optical amplifiers, including semiconductor optical amplifiers, and analyze amplifier noise and optical Signal-to-Noise Ratio (SNR).
CO5	Understand the fundamentals of optical networks, including network topologies, SONET/SDH transmission formats and speeds, and optical interfaces. Additionally, demonstrate proficiency in optical measurements, including fiber attenuation, dispersion, cutoff wavelength, numerical aperture, and Optical Time Domain Reflectometer (OTDR) usage.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	2	-	1	2	-	-
CO2	3	3	2	2	1	2	2	-	1	2	-	-
CO3	2	2	3	2	2	2	2	-	1	2	-	-
CO4	2	2	2	3	2	2	1	-	1	2	-	-
CO5	2	2	2	2	3	1	2	-	1	2	-	-

UNIT – I

Optical Fibers: Optical Fiber Modes and Configurations: Fiber Types, Rays and Modes, Step-Index Fiber Structure, Graded – Index Fiber Structure. Fiber materials: Glass Fibers, Plastic Optical Fibers, Signal Degradation in Optical Fibers.

Attenuation: Attenuation Units, Absorption, Scattering Losses, Bending Losses, Core and Cladding Losses. Signal Distortion in Optical Waveguides: Information Capacity Determination, Group Delay, Material Dispersion, Waveguide Dispersion, intermodal Dispersion.

UNIT – II

Optical Sources: Light-Emitting Diodes (LEDs), LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation of an LED. Laser Diodes: Laser Diode Modes and Threshold Conditions, Laser Diode Rate Equations, Single-Mode Lasers.

Photo detectors: Physical Principles of Photodiodes, The PIN Photo detector, Avalanche Photodiodes, Photo detector Noise, Structures for In GaAs APDs.

UNIT III

Optical Receiver Operation: Fundamental Receiver operation, Digital Signal Transmission, Error Sources, Receiver Configuration, Preamplifiers.

Digital Transmission Systems: Point –to-Point Links, System Considerations,

Link Power Budget, Rise – Time Budget

WDM Concepts and Components: Operational Principles of WDM: Passive Components, The 2x2 Fiber Coupler, Scattering Matrix Representation, The 2 x 2 Waveguide Coupler, Star Couplers.

UNIT IV

Optical Amplifiers: Basic applications and Types of Optical amplifiers, Semi-conductor Optical amplifiers, Amplifier Noise, Optical SNR, Raman Amplifier, Wideband Optical amplifiers.

UNIT V

Optical Networks: Basic Networks, Network Topologies, SONET/SDH: Transmission Formats and Speeds, Optical Interfaces, SONET/SDH Rings, SONET/SDH Networks.

Measurements: Introduction, Fiber attenuation measurements, Fiber dispersion, measurements, Fiber cutoff wave length measurements, Fiber numerical aperture measurements, Optical Time Domain Reflectometer (OTDR).

TEXT BOOKS:

1. Gerd Keiser , Optical Fiber Communications , 3rd Edition , McGraw Hill
2. John M.Senior Optical Fiber Communications, 2nd Edition, PHI

CESP 617 ARTIFICIAL NEURAL NETWORKS

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the history and basic elements of artificial neural networks, including different network architectures, learning rules, and activation functions.
CO2	Evaluate different learning rules and algorithms applicable to single-layered networks, understanding their limitations and modifications.
CO3	Explore various multi-layered networks such as Madalines, Backpropagation, and their applications in optimization and problem-solving.
CO4	Study associative memory networks, including bi-directional associative memory, Hopfield Networks, and their applications.
CO5	Understand Support Vector Machines, Radial Basis Function and application of ArtificialNeural Networks.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2	2	1	-	-	1	-	-
CO2	3	2	2	2	2	1	1	-	-	1	-	-
CO3	3	2	2	2	2	2	1	-	-	1	-	-
CO4	2	2	2	2	2	2	2	-	-	1	-	-
CO5	2	2	2	2	2	2	1	-	-	1	-	-

UNIT-I: FUNDAMENTALS OF ANN

History of Neural Networks, Structure and function of Biological and artificial neural networks, Basic Elements of ANN, Model of an ANN, evaluation of neural networks., Activation functions used in ANNs. Typical classes of network architectures, Different Learning Rules, Types of Activation Functions, Problems Solving Using Learning Rules, and Algorithms.

UNIT-II: Single Layered Networks:

Single layer networks, McCulloch Pitts Neuron, Model, Hebbian Learning Rule, Perceptron Learning, Limitations of Perceptron, Delta learning rule, Competitive Learning Rules, Linear Separability Limitation and Its Over Comings, Adaline and modifications.

UNIT-III: Multi Layered Networks:

Madalines, Backpropagation algorithm, importance of learning parameter and momentum term, polynomial networks. learning vector quantizers, counter propagation networks, Kohonen self-organizing networks, adaptive resonance theory, Hamming Net, Max Net

UNIT-IV: Associative memories:

Introduction to Associative memory networks, Bi-directional associative memory, Hopfield Networks, Radial basis functions, Applications of neural networks : Optimization, Travelling Salesman.

UNIT-V: Introduction to Deep Learning

Support Vector Machines, Applications to Image classification, Radial Basis Function Networks, Applications of ANN-Texture Classification, Character Recognition Introduction to Convolution Neural Networks- CNN Architecture and Layers, Convolution and Pooling Operations.

Text Books:

1. Principles Of Soft Computing, 2nd Ed Book by S. N. Deepa and S. N. Sivanandam
2. Kishan Mehrotra, Chelkuri K. Mohan, Sanjav Ranka, elements of Artificial Neural Networks, Tenram International.
3. J.M. Zurada Introduction to Artificial Neural Systems, Jaico Publications.
4. B. Yegnanarayana, Artificial Neural Networks, PHI, New Delhi.
5. Waserman: Neural Computing – Theory and Practice.

CESP 618 ADAPTIVE SIGNAL PROCESSING

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Define adaptive systems, understand their characteristics, applications, and exemplify their usage in various scenarios.
CO2	Explore the principles of linear optimum filtering, addressing problems related to filtering, smoothing, and prediction. Understand the principle of orthogonality and the Minimum-Mean-Squared Error.
CO3	Investigate methods and ideas of gradient search methods in adaptive systems. Understand gradient searching algorithms, stability, rate of convergence, learning curves, and compare different gradient search methods.
CO4	Analyze LMS adaptation algorithms, stability, and performance. Explore adaptive modeling techniques for equalization and deconvolution, particularly in the context of telephone channels.
CO5	Apply adaptive systems in noise canceling and canceling echoes in long-distance telephone circuits. Understand Kalman filtering theory, recursive mean square estimation, innovation process, and the variants of the Kalman filtering, including Extended Kalman Filtering.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	3	3	-	3	2	3	-	-
CO2	3	3	3	2	-	2	-	2	3	3	-	-
CO3	2	2	3	3	-	3	2	3	-	2	-	-
CO4	3	2	3	3	3	3	2	3	-	2	-	-
CO5	3	3	2	3	3	2	1	2	3	3	-	-

UNIT – I

Adaptive Systems :Definitions,Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner: Description, Weight Vectors, Desired Responses, Performance Function, Gradient and Mean-Suare Error.

UNIT – II

Approaches to the Development of Adaptive Filter Theory: Introduction to Filtering Smoothing and Prediction-Linear Optimum Filtering ,Problem Statement . Principle of Orthogonality , Minimum – Mcan- Squared Error, Winer – Hopf Equations, Error Performance , Normal Equation .

UNIT – III

Searching the Performance Surface – Methods and Ideas of Gradient Search Methods, Gradient Searching Algorithm and its Solution, Stability and Rate of Convergence, Learning Curves, Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves

UNIT – IV

LMS Algorithms – Overview, LMS Adaptation Algorithms, Stability and Performance Analysis of LMS Algorithms, LMS Gradient and Stochastic Algorithms, Convergence of LMS Algorithms

Inverse adaptive modeling: Equalization, and deconvolution adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis

UNIT – V

Applications – Noise Cancelling, Cancelling Echoes in Long Distance Telephone Circuits, Adaptive Beam Forming

Kalman Filtering Theory – Introduction, Recursive Mean Square Estimation for Scalar Random Variables, Statement of Kalman Filtering Problem, Innovation Process. Estimation of State using the Innovation Process, Filtering, Initial Conditions, Summary of Kalman Filters, Variants of the Kalman Filtering the Extend Kalman Filtering, Identification as a Kalman Filtering Problem

TEXT BOOKS:

1. Bernand Widrow – Advaptive Signal Processing, PH/Pearson Education, Asia
2. Simon Haykins - Adaptive filter Theory , PH/Pearson Education, Asia

REFERENCES :

1. Sophocles J. Orfamidis - Optimum Signal Processing – An Introduction, 2nd Edition, McGraw Hill
2. S. Thomas Alexander – Adaptive Signal Processing – Theory and Applications, Springer – Verlag

CESP 619 MICROWAVE MEASUREMENTS

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Proficiently measures wavelength and frequency using various techniques, with a deep understanding of wavemeter principles.
CO2	Demonstrates advanced skills in direct measurement methods and additive frequency techniques.
CO3	Expertly constructs and analyzes slotted sections, uses standing wave detectors, and applies Smith charts proficiently.
CO4	Demonstrates advanced skills in power measurement methods and effectively uses various elements and circuits.
CO5	Proficiently performs measurements on microwave circuits and components, with a deep understanding of network properties.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	-	1	-	2
CO2	2	3	3	2	3	-	-	-	-	1	-	2
CO3	2	3	2	2	3	-	-	-	-	1	-	2
CO4	2	3	2	3	2	-	-	-	-	1	-	2
CO5	2	3	2	2	2	-	-	-	-	1	-	2

UNIT – I

Measurement of wavelength and frequency, Equivalent circuit of the cavity wave meters, Typical wavemeters, Resonant cavities

Methods of Frequency Measurements : Direct measurement, Interpolation method, Additive frequency method

UNIT – II

Measurement of Impedance : Constructional details of slotted section and its limitations, standing wave detector, Techniques in standing wave detector measurements, Measurement of low & high VSWR., Location of voltage minims, Use of Smith chart in impedance measurements, Errors in standing wave detector impedance measurements, Reflectometers

Measurement of Power : Methods of power measurement, Typical barrette elements, thermistor, bolometer bridge circuits, Extending the range of Bolometer devices, Crystal Detector, Dielectric Measurement for Solids

UNIT – III

Measurements on Microwave circuits and components, T and P network, Measurement of scattering coefficients, Graphical determination of scattering coefficients, Coupling and Directivity of directional coupler

UNIT – IV

Measurement of Attenuation: Insertion of Power ratio method, substitution method, scattering coefficient method, Return Loss

Antenna Measurements: Measurement of radiation patterns, Antenna gain

measurements, Antenna impedance Measurements, Polarization Measurements

UNIT-V

Microwave integrated circuit design: Microwave integrated circuit design, introduction, hybrid microwave integrated circuits (HMIC), monolithic microwave integrated circuit (MMIC), MIC materials, substrate material, conductor material, dielectric materials, resistive filMS, types of mics, microwave monolithic integrated circuits (MMIC'S)

TEXT BOOKS

1. E.L. Ginzton, Microwave Measurements, Mc Graw Hill
2. Annapurna Das & Sisir K Das, Microwave Engineering, TMH, 2000
3. P. Rizzi, Microwave Engineering Passive Circuits, Prentice Hall, 1987
4. D.M. Pozar, Microwave Engineering, John Wiley, 1998

REFERENCE BOOKS :

1. M.L. Sisodia & GS Raghuvanshi, Basic Microwave Techniques and Laboratory Manual, Wiley Eastern, 1987
2. Dennis Roddy, Microwave Technology, PHI, 1986

CESP 620 BLOCK CHAIN TECHNOLOGY

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the growth and evolution of blockchain technology, including the history of blockchain and Bitcoin, and different types of blockchains.
CO2	Explore decentralization methods and routes, emphasizing their significance in the blockchain ecosystem, and analyze smart contracts' applications in decentralized organizations and platforms.
CO3	Trace the history of blockchain and Bitcoin, distinguish different types of blockchains, and understand public key cryptography, asymmetric cryptography, and the use of public and private keys in financial markets and trading.
CO4	Examine limitations of Bitcoin, including scalability issues and alternative cryptocurrencies.
CO5	Study the Bitcoin network, including wallets, payments, and innovations in the Bitcoin ecosystem, and explore various Bitcoin clients and Application Programming Interfaces (APIs).

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	3	2	2	2
CO2	2	1	2	2	1	-	-	-	3	2	2	2
CO3	1	1	3	3	1	-	-	-	3	2	2	2
CO4	2	1	1	2	3	-	-	-	3	2	2	2
CO5	2	2	3	3	2	-	-	-	3	2	1	2

UNIT – I

Blockchain, the growth of blockchain technology, distributed systems, the history of blockchain and Bitcoin, types of blockchain.

UNIT – II

Decentralization, methods of decentralization, routes of decentralization, blockchain and full ecosystem decentralization, smart contracts, Decentralized organizations and platforms for decentralization.

UNIT - III

Symmetric Cryptography, working with the OpenSSL command line, cryptographic primitives. Public Key Cryptography, asymmetric cryptography, public and private keys and financial markets and trading.

UNIT - IV

Introducing Bitcoin, Bitcoin, digital keys and addresses, transactions, blockchain, mining, alternative coins. Limitations of Bitcoin

UNIT – V

Bitcoin Network and payments, The Bitcoin network, wallets, Bitcoin payments, innovation in Bitcoin, Bitcoin Clients and APIs.

Text Book:

1. Mastering Blockchain 2nd Edition, Imran Bashir, PACKT Publications.

Reference Book:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and steven Goldfeder.
2. Bitcoin and cryptocurrency technologies a comprehensive introduction. Princeton University press, 2016.

CESP 621 PATTERN RECOGNITION

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the importance of pattern recognition, including features, feature vectors, and classifiers.
CO2	Explore non-linear classifiers, including the XOR problem, two-layer perceptron, three-layer perceptrons, and the Backpropagation Algorithm.
CO3	Explore non-linear classifiers, including the XOR problem, two-layer perceptron, three-layer perceptrons, and the Backpropagation Algorithm.
CO4	Apply feature selection techniques, including pre-processing, statistical hypothesis testing, ROC curve, and class separability measures.
CO5	Explore recent advances in pattern recognition, including fuzzy logic, fuzzy pattern classifiers, genetic algorithms, and case studies using fuzzy pattern classifiers and perception.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	-	2	-	-
CO2	3	3	2	2	-	2	-	-	-	2	-	-
CO3	3	3	2	-	1	3	-	-	-	2	-	-
CO4	3	3	2	-	2	2	-	-	-	2	-	-
CO5	3	3	1	2	2	2	-	-	-	2	-	-

UNIT – I

Importance of pattern recognition, Features, Feature Vectors and Classifiers, Supervised, Unsupervised and Semi Supervised Learning.

Classifiers based on Baye's Decision Theory : Baye's decision theory, Discriminant Functions and decision surfaces, Bayesian classification for Normal Distributions, Estimation of Unknown probability density functions, The Nearest Neighbor Rule.

UNIT – II

Linear Classifiers: Linear Discriminant functions and Decision Hyperplanes, The perceptron Algorithm, Least Squares Method.

Support Vector Machine: Separable classes, Nonseparable classes, The multiclass case, v-SVM, Support Vector Machines-A geometric View Point

UNIT – III

Non Linear Classifiers: The XOR problem, The two layer perceptron, Three layer perceptrons, The Backpropagation Algorithm, The cost function choice, choice of the network size, A simulation example, Networks with weight sharing, generalized linear classifiers, polynomial classifiers, Radial basis Function Networks.

UNIT – IV

Feature Selection: Pre processing, The peaking phenomenon, Feature selection based on statistical hypothesis testing, ROC curve, class separability measures, feature subset selection.

Feature Generation: Basis Vectors and Images, The KL Transform, The Singular Value Decomposition, Independent Component Analysis, Non negative Matrix Factorization, Regional features, Features for shape and size characterization.

UNIT-V

RECENT ADVANCES: Fuzzy logic – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms – Case Study Using Fuzzy Pattern Classifiers and Perception.

Text Book:

1 Pattern Recognition (4 edition) by Sergios Theodoridis, Konstantinos Koutroumbas, Academic Press, 2009.

2 M. Narasimha Murthy and V. Susheela Devi, “Pattern Recognition”, Springer 2011.

Reference Books:

1 Pattern Classification (2 edition) – Richard Duda, Peter E Hart, David G Stork, John Wiley & Sons, 2001.

2 Pattern Recognition and Machine Learning , Christopher M.Bishop, Springer Publications 2006.

CESP 622 RANDOM PROCESSING & INFORMATION THEORY

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the concept of random variables, including their definition, probability distribution function, and probability density function.
CO2	Apply mathematical definitions of random processes, including stationary processes, mean, correlation, and covariance functions.
CO3	Explore advanced topics in random processes, including mean square calculus, stochastic continuity, and derivatives.
CO4	Apply random processes to statistical signal processing, including the estimation of random variables, innovation sequences, Kalman filtering, and Wiener filters for random sequences.
CO5	Understand information theory, including measures of information, joint entropy, conditional entropy, relative entropy, and mutual information.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	1	1	1	1	1	1	-	-
CO2	2	2	2	2	1	1	1	1	1	1	-	-
CO3	3	2	2	2	1	1	1	1	1	1	-	-
CO4	3	3	2	2	1	1	1	1	1	1	-	-
CO5	2	2	2	2	2	2	1	1	1	1	-	-

UNIT-I

RANDOM VARIABLES

Definition of Random Variable, Probability of Distribution Function, Probability Density Function(PDF), Conditional and Joint Distribution and Densities,Functions of Random Variables, Determining the PDF of Y = g(X), Expected value of a Random Variable, Conditional Expectations, Moments, Joint Moment, Properties of Uncorrelated Random Variables, Jointly Gaussian Random Variables.

UNIT – II

RANDOM PROCESSES

Introduction, Mathematical definition of a Random Process, Stationary Processes, Mean, Correlation, and Covariance Functions, Ergodic Processes, Transmission of a Random Process through a Linear Time-invariant Filter, Power Spectral Density, Gaussian Process, Noise, Narrowband Noise, Representation of Narrowband Noise in terms of In-phase and Quadrature Components, Representation of a Narrowband Noise in terms of Envelope and Phase Components.

UNIT – III

ADVANCED TOPICS IN RANDOM PROCESSES

Mean square (m.s.) calculus, Stochastic Continuity and Derivatives, Furtherresults on m.s. Convergence, m.s. Stochastic Integrals, m.s. Stochastic Differential Equations, Karhunen-Loeve Expansion, Representation of Band limited and Periodic Processes, Band limited processes, Band pass Random Processes.

UNIT – IV

APPLICATION TO STATISTICAL SIGNAL PROCESSING

Estimation of random variables, innovation sequences and Kalman filtering, wiener filters for random sequences, hidden markov models.

UNIT-V

Information Theory Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

TEXT BOOKS:

1. Probability And Random Processes Henry Stark John W. Woods, 3"° PEA
2. Communication Systems Simon Haykin, 4th Ed
3. Probability And Random Variables Pebbels
4. Probability, Random Variables And Stocastic Processes Papoolis

CESP 623 EMBEDDED SYSTEMS

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the fundamentals of embedded systems, including the role of processor selection, ESD, and co-design issues in system development.
CO2	Acquire knowledge about real-time operating systems (RTOS), including their structure and components.
CO3	Gain insights into processor and memory organization, devices, and buses for device networks.
CO4	Understand the need for communication interfaces and gain knowledge about various communication protocols.
CO5	Acquire knowledge about embedded networking, including serial/parallel communication, synchronous serial protocols, and communication interfaces.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	-	-	-	-	1	-	-
CO2	3	2	2	1	1	-	-	-	-	1	-	-
CO3	3	2	2	1	1	-	-	-	-	1	-	-
CO4	3	-	-	2	2	-	-	-	-	1	-	-
CO5	2	-	-	2	2	2	-	-	-	1	-	-

UNIT – I

Introduction :

Introduction to Embedded System, Role of processor selection in Embedded Systems, ESD and Co design issues in System development Process, Embedded System project management, design cycle in the development phase for an Embedded System, using of target system or its Emulator and in-Circuit emulator, use of software tools for development of an Embedded Systems -, introduction to assembler, compiler, cross compilers, and Integrated Development Environment.

UNIT – II

RTOS and its overview

Real-time operating systems, Structure of a Real Time System, Inter process communication and synchronization of processes, Threads and Tasks. Priority Inversion, Inheritance and Ceiling. Task Assignment and Scheduling – Fault Tolerance Techniques – Reliability, Evaluation – Clock Synchronization

UNIT – III

Processor and memory organization, Devices and buses for device networks, Device drivers and interrupt servicing mechanism, Testing, simulation and debugging techniques and tools-Testing on host machine, Simulators.

UNIT-IV

Need for communication interfaces, RS232 / UART, RS422 / RS485, USB, Infrared, IEEE 1394 Firewire, Ethernet, IEEE 802.11, Blue tooth.

UNIT – V

Embedded Networking: Introduction – Serial/Parallel Communication Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming - ISA/PCI Bus protocols – Firewire

TEXT BOOKS:

1. Embedded Systems: Architecture, Programming and design by Raj KamalTata McGraw Hill Education Private Limited (1-4 units).
2. Embedded / Real Time Systems – KVKK Prasad, Dreamtech Press, 2005.

REFERENCE BOOKS:

1. Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2009.
2. An Embedded Software Primer – David E. Simon, Pearson Ed., 2005.An Embedded software primer by David E. Simon, Pearson Education.

CESP 624 GLOBAL POSITIONING SYSTEMS

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Gain an understanding of the fundamental concepts of GPS, including its architecture, space segment, and user segment.
CO2	Acquire knowledge about GPS signals, their structure, and key features such as anti-spoofing and selective availability.
CO3	Gain insights into GPS coordinate frames and time references, including geodetic and geocentric coordinate systems.
CO4	Understand GPS orbits, satellite position determination, and key data formats such as Receiver Independent Exchange Format (RINEX).
CO5	Familiarize with standard formats in GPS such as RINEX, NGS-SP3, RTCM SC-104, and NMEA 0183.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	1	1	-	-
CO2	3	2	-	1	-	-	-	-	1	1	-	-
CO3	3	2	2	1	-	-	-	-	1	1	-	-
CO4	3	2	2	2	1	-	-	-	1	1	-	-
CO5	3	-	1	1	2	-	-	-	1	1	-	-

UNIT – I

Overview of GPS : Basic concept, system architecture, space segment, user segment, GPS aided Geo-augmented navigation (GAGAN) architecture.

UNIT – II

GPS Signals, Signal structure, anti spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.

UNIT – III

GPS coordinate frames, Time references : Geodetic and Geo centric coordinate systems, ECEF coordinate world geodetic 1984 (WGS 84), GPS time.

UNIT – IV

GPS orbits and satellite position determination : GPS orbital parameters, description of receiver independent exchange format (RINEX) – Observation data and navigation message data parameters, GPS position determination. GPSErrors : GPS error sources – clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver.

UNIT-V

GPS Standard Formats: RINEX, NGS-SP3, RTCM SC-104 and NMEA 0183.

GPS Applications: GPS for utilities industry, forestry and natural resources, precision farming.

TEXTBOOKS :

1. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, 'GPS – Theory and Practice', Springer – Wien, New York (2001).

REFERENCE BOOKS :

1. James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software approach', John Wiley & Sons (2001).

CESP 625 TELECOMMUNICATION SWITCHING SYSTEMS

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the evolution of telecommunications, basics of switching systems, and electronic space division switching.
CO2	Acquire knowledge about subscriber loop systems, switching hierarchy, routing, and signaling techniques in telephone networks.
CO3	Gain insights into the fundamentals of data communications and networking, including network architecture, protocols, and standards.
CO4	Understand data-link protocols, data communications networks, and digital T-carriers.
CO5	Familiarize with ISDN, dialup, home networking concepts, and network convergence.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	1	1	-	-
CO2	3	3	3	-	-	-	-	-	1	1	-	-
CO3	3	3	3	-	-	-	-	-	1	1	-	-
CO4	3	3	3	2	-	-	-	-	1	1	-	-
CO5	3	3	1	1	2	-	-	-	1	1	-	-

UNIT – I

TELECOMMUNICATION SWITCHING SYSTEMS:

Evolution of Telecommunications, Simple Telephone Communication, Basics of Switching System, Electronic Space Division Switching, Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture Two Stage Networks, Three Stage Networks, N Stage Networks, Time Division Switching, Basic Time Division Time Switching, Combination Switching, Three Stage Combination Switching, N Stage Combination Switching.

UNIT – II

TELEPHONE NETWORKS:

Subscriber Loop Systems, Switching Hierarchy and Routing, Transmission Plan, Signaling Techniques, In-channel Signaling, Common Channel Signaling, Network Traffic Load and Parameters, Grade of Service and Blocking Probability.

UNIT – III

FUNDAMENTAL CONCEPTS OF DATA COMMUNICATIONS:

Introduction to Data Communications and Networking: History of Data communications, Data Communications Network Architecture, Protocols and Standards, Layered Network Architecture, Data Communications Circuits, Serial and Parallel Data Transmission, Data Communications Networks, Data Communications Codes, Bar Codes, Character Synchronization, Data Communications Hardware, Data Communications Circuits, Line Control Unit, Serial Interfaces.

UNIT – IV

DATA-LINK PROTOCOLS AND DATA COMMUNICATIONS NETWORKS:

Introduction Data Link Protocol Functions, Character- and Bit- Oriented Data Link Protocols, Asynchronous Data-Link Protocols, Synchronous Data-Link Protocols, Synchronous Data-Link Control, High-Level Data-Link Control, Public Switched Data Networks, Asynchronous Transfer Mode.

DIGITAL T-CARRIERS AND MULTIPLEXING:

Time-Division Multiplexing, T1 Digital Carrier North American Digital Hierarchy, Digital Carrier, European Digital Carrier System, Digital Carrier Frame Synchronization, Bit Versus Word Interleaving, Statistical Time Division Multiplexing, Frequency Division Multiplexing.

UNIT V

SDN: What Is ISDN? ISDN Components, ISDN Channel Types, Basic andPrimary Rate Interfaces, ISDN Protocols, ISDN Features.

DIALUP AND HOME NETWORKING: Dialup Networking, Analog Modem Concepts, DSL Service, Cable Modems, Home Networking Concepts and Issues.
NETWORK CONVERGENCE: What Is Network Convergence? Networking Issues and Convergence, Effects of Network Convergence on BusinessConvergence At Home.

TEXT BOOKS:

1. T Viswanathan, Telecommunication Switching Systems and Networks, PHI, 2004
2. Wayne Tomasi, Advanced Electronic Communications Systems, Pearson, 6th Edition, 2004
3. Machael A. Gallo and William M. Hancock, Computer Communications and Networking Technologies, Cengage Learning, 1st Edition, 2002

REFERENCE BOOKS:

1. J E Flood, Telecommunications Switching, Traffic and Networks, Person, 1999
2. Ray Horak, Communication Systems and Networks, 3rd Edition, Wiley, 2002

CESP 626 FUZZY TECHNIQUES

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand classical and fuzzy sets, their operations, properties, and mapping to functions.
CO2	Acquire knowledge about membership functions, fuzzification, and fuzzy-to-crisp conversions.
CO3	Explore classical logic and fuzzy logic, including predicate logic, tautologies, contradictions, and fuzzy rule-based systems.
CO4	Acquire knowledge about fuzzy decision-making, including fuzzy synthetic evaluation, ordering, and fuzzy classification.
CO5	Familiarize with advanced applications of fuzzy logic, including fuzzy logic controllers, adaptive fuzzy systems, and applications in control systems.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	1	1	-	-
CO2	2	2	2	2	2	2	-	-	1	1	-	-
CO3	2	2	2	2	2	2	-	-	1	-	-	-
CO4	1	1	1	2	2	1	-	-	-	-	-	-
CO5	1	1	1	1	2	1	-	-	-	1	-	-

UNIT – I

Classical and fuzzy sets:

Classical sets- operations, properties of classical sets, mapping of classical sets to the functions. Fuzzy sets-membership, uncertainty, fuzzy set operations, properties of fuzzy sets. Classical and fuzzy relations: Cartesian product, crisp relations-cardinality, operations and properties of crisp relations, Fuzzy relations-cardinality operations and properties of fuzzy relations. Non interacting fuzzy sets, Tolerance and equivalence relations.

UNIT – II

Membership functions:

Futures of membership functions, fuzzification, membership value assignments-intuition, ranking ordering, angular fuzzy sets, neural nets, genetic algorithms, inductive reasoning, Fuzzy-to-crisp conversions: Lambda-cuts for fuzzy sets, lambda-cuts for fuzzy relations, defuzzification methods. Fuzzy arithmetic, numbers and vectors and extension principle: fuzzy members, approximate methods of extension-vertex method, DSW algorithm, restricted DSW algorithm, fuzzy vectors.

UNIT – III

Classical logic and fuzzy logic:

Classical predicate logic-tautologies, contradictions, equivalence, exclusive orand exclusive nor, logical proofs, deductive inferences. Fuzzy logic, approximate

reasoning, Fuzzy tautologies, contradictions, equivalence and logical proofs, other forms of the implication operation, other forms of the composite operation. Fuzzy rule-based systems: Natural language, linguistic Hedges, rule-based systems-canonical rule forms, decomposition of compound rules, likelihood and truth qualification, aggregation of Fuzzy rules, Graphical techniques inference.

UNIT – IV

Fuzzy decision-making:

Fuzzy synthetic evaluation, fuzzy ordering, preference and consensus, Multi objective decision making, Fuzzy Bayesian Decision method, Decision making under Fuzzy states and fuzzy actions. Fuzzy classification: Classification by Equivalence Relations-crisp relations, Fuzzy relations, Cluster validity, C-Means clustering-Hard C-Means (HCM). Fuzzy C-Means (FCM), classification Metric, Hardening the Fuzzy C-partition, similarity relations from clustering.

UNIT-V

ADVANCED FUZZY LOGIC APPLICATIONS

Fuzzy logic controllers – principles – review of control systems theory – various industrial applications of FLC adaptive fuzzy systems – fuzzy decision making – Multiobjective decision making – fuzzy classification – fuzzy pattern recognition – image processing applications – systactic recognition – fuzzy optimization.

TEXT BOOKS:

1. Timothy J. Ross, Fuzzy logic with engineering applications, Mc Graw Hill, 1997
2. Klir and Ywan, Fizzy sets and Fuzzy logic, Prentice Hall of India
3. S.Rajasekharan & Y.A.Vijayalakshmi Pai, Neural Networks, Fuzzy logic and Genetic Algorithms, Prentice Hall of India

REFERENCE BOOK:

1. Fuzzy - Neural Control: Principles, Algorithms and applications by Nie and Linkens, PHI.

CESP 627 OPTIMIZATION TECHNIQUES

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand classical optimization techniques, including single-variable optimization, multivariable optimization with no constraints, and optimization with equality constraints.
CO2	Acquire knowledge about one-dimensional unconstrained minimization, including elimination methods and interpolation methods.
CO3	Gain insights into integer linear programming, network techniques, and optimization algorithms for solving unconstrained optimization problems.
CO4	Acquire knowledge about optimization algorithms for solving constrained optimization problems, including direct methods and penalty function methods.
CO5	Familiarize with modern methods of optimization, including genetic algorithms, simulated annealing, ant colony optimization, neural-network-based optimization, fuzzy optimization techniques, and their applications.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	-	-	-	1	1	-	-
CO2	2	2	-	-	2	-	-	-	1	1	-	-
CO3	-	-	2	-	-	-	-	-	1	1	-	-
CO4	-	-	-	2	-	-	-	-	1	1	-	-
CO5	-	-	-	-	3	-	-	-	1	1	-	-

UNIT – I

Classical Optimization Techniques Single variable optimization – Multivariable optimization with no constraints – Hessian matrix – Multivariable saddle point – Optimisation with equality constraints – Lagrange multiplier method – Multivariable optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT – II

One dimensional unconstrained minimization. Elimination methods – unrestricted search method – Fibonacci method – Interpolation methods – Quadratic interpolation and cubic interpolation methods. Unconstrained minimization. Gradient of a function – steepest descent method – Newton's method – Powell's method – Hooke and Jeeve's method.

UNIT – III

Integer – Linear programming problem Gomory's cutting plane method – Gomory's method for all integer programming problems, mixed integer programming problems. Network techniques. Shortest path model – Dijkstra's algorithm – Floyd's algorithm – minimum spanning tree problem – PRIM algorithm – Maximal flow problem algorithm.

UNIT-IV

Optimization algorithms for solving unconstrained optimization problems – Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method.

Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – steepest descent method – Engineering applications of constrained and unconstrained algorithms.

UNIT – IV

Modern methods of Optimization: Genetic Algorithms – Simulated Annealing – Ant colony optimization – Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications. Use of Matlab to solve optimization problems.

TEXT BOOKS:

1. Rao S. S. – 'Engineering Optimization, Theory and Practice' – New Age International Publishers – 2012 – 4th Edition
2. Neural Networks, Fuzzy Logic and Genetic Algorithms Synthesis and Applications by S.Rajasekaran, G.A.Vijayalakshmi Pai, Prentice Hall of India Publishing,2007.

REFERENCE BOOK:

1. Optimisation concepts and applications in Engineering – A. D. Belegundu, T. R. Chandrupatla, Pearson Education Asia.

2. Arora J. – 'Introduction to Optimization Design' – Elsevier Academic Press, New Delhi – 2004

CESP 628 OFDM FOR WIRELESS COMMUNICATION SYSTEMS

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the future of wireless technology, including Orthogonal Frequency-Division Multiplexing (OFDM), WLANs, and WPANs.
CO2	Acquire knowledge about the channel model for OFDM systems, including characterization of the mobile radio channel and basics of OFDM and synchronization.
CO3	Gain insights into OFDM time and frequency domain synchronization, including system performance with frequency and timing errors.
CO4	Understand the peak power problem in OFDM, including PAPR reduction techniques and a novel hybrid OFDM concept.
CO5	Familiarize with the detailed structure of various multiple-access schemes, comparison to MC-CDMA, and analytical/simulation performance in fading channels.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	-	-	-	1	1	-	-
CO2	3	2	-	-	-	-	-	-	1	1	-	-
CO3	3	-	2	-	-	-	-	-	1	1	-	-
CO4	2	2	-	2	-	-	-	-	1	1	-	-
CO5	1	-	2	-	3	-	-	-	1	1	-	-

UNIT – I

Introduction

Wireless Technology in the Future- Orthogonal Frequency-Division Multiplexing- WLANs: MAC in WLAN Standards, QoS over WLANs, Security in IEEE 802.11- WPANs: Technical Challenges of a WPAN Technology, Enabling Technologies, Ongoing Research, Research Issues for Future WPAN Technology.

UNIT – II

Channel Model for OFDM Systems : Introduction, Characterization of the Mobile Radio Channel, FD Channel Modeling, FD Channel Simulation, Application to Millimeter-Wave Radio Channels.

Basics of OFDM and Synchronization: OFDM Introduction and System Model, Performance of an Uncoded OFDM System.

UNIT – III

OFDM Time and Frequency domain Synchronization : System Performance with Frequency and Timing Errors, Synchronization Algorithms, Comparison of Frequency Acquisition Algorithms, BER performance with frequency synchronization.

UNIT – IV

Peak Power Problem

Introduction, Distribution of the PAPR, Clipping and Peak Windowing: Required Backoff with a Non ideal Power Amplifier, Coding and Scrambling. Peak Cancellation, PAPR Reduction Codes: Generating Complementary Codes,

Minimum Distance of Complementary Codes, Maximum-Likelihood Decoding of Complementary Codes, Suboptimal Decoding of Complementary Codes, Large Code Lengths, Symbol Scrambling.

UNIT – IV

A Novel Hybrid OFDM Concept

Detailed Structure of Various Multiple-Access Schemes, Comparison to MC-CDMA, Analytical Performance in Fading Channels and Simulation in AWGN Channels, Performance in Fading Channels with Perfect Estimation, Performance in Fading Channels with Realistic Estimation.

TEXT BOOK:

1. Ramjee Prasad, “OFDM for wireless Communication Systems”, Artech House Publishers, 2004.

REFERENCE BOOKS:

1. Lajos Hanzo, M.yunster, B.J.Cho! and T. Keller,” OFDM and *MC - COMA*for Broadband Mult User Communications - WLANs and Broadcasting”, *John* Wiley and sons, IEEE press, 2003

CESP 629 MACHINE LEARNING

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the fundamentals of machine learning, including well-posed learning problems, designing a learning system, and perspectives/issues in machine learning.
CO2	Acquire knowledge about decision tree learning, including representation, algorithm, hypothesis space, and evaluation of hypotheses.
CO3	Gain insights into Bayesian learning, including Bayes' theorem, maximum likelihood hypotheses, and computational learning theory.
CO4	Acquire knowledge about instance-based learning, including K-Nearest Neighbour, Locally Weighted Regression, and Genetic Algorithms.
CO5	Familiarize with combining inductive and analytical learning, including reinforcement learning.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	-	-	-	2	1	-	-
CO2	2	2	-	-	2	-	-	-	2	1	-	-
CO3	-	-	3	-	-	-	-	-	2	1	-	-
CO4	-	-	-	2	-	-	-	-	1	1	-	-
CO5	1	-	-	-	3	-	-	-	1	1	-	-

UNIT-I

INTODUCTION- Well-posed learning problems, designing a learning system, perspectives and issues in machine learning. Concept learning and the General to Specific Ordering- Introduction , A concept learning task, Concept learning as search, find-S : finding a maximally specific hypothesis , Version spaces and the Candidate – Elimination algoritm , Remark on version spaces and Candidate Elimination.

UNIT-II

Decision tree Learning- Intoduction , Decision tree representation, appropriate problems for decision tree learning, The basic decision tree learning algorithm, hypothesis space search in decision tree learning, Iductive bias in decision tree learning , issues in decision tree learning. Evaluation Hypotheses- Motivation, Estimation hypothesis accuracy, Basis of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms.

UNIT-III

Bayesian learning- Introduction , Bayes therorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibbsalgorithm, Navie Bayes classifier, An example learning to classify text , Bayesian belief networks The EM algorithm Computational Learning theory- Introduction, probablitity Learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for finite hypothesis space, The mistake bound model of learning.

UNIT-IV

Instance-Based Learning- Introduction, K–Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on lazy and eager Learning. Genetic Algoritms- Motivation, Genetic Algorithms, An illustrative example, Hypothesis Space Search, Genetic Programming, Models of evolution and learning , parallelizing genetic algorithms.

UNIT-V

Combining Inductive and Analytical Learning- Motivation, Inductive- Analytical Approaches to Learning, Using Prior Knowledge to initialize the hypothesis, Using prior knowledge to Alter the search objective , Using prior Knowledge to Augment Search Operators. Reinforcement Learning- Introduction, the learning task, Q Learning , Non-Deterministic, Rewards and actions, temporal Differnce Learning, Generalizing from examples, Relationship to Dyanamic Programming.

TEXT BOOK:

1. Machine Learning- Tom M. Mitchell, -MGH

REFERENCE BOOK:

1. Introduction to machine learning,- ethem Alpaydin, - PHI
2. Machine Learning: An Algorithm perspective, Stephan Marsland, Taylor & Francis.

CESP 630 DATA SCIENCE

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the core concepts and technologies in data science, including the data science process, toolkit, types of data, and example applications. Gain insights into mathematical foundations for data science, including linear algebra, analytical and numerical solutions of linear equations, mathematical structures, concepts, and notations used in discrete mathematics.
CO2	Acquire knowledge about data collection and management, including sources of data, data collection and APIs, exploring and fixing data, data storage and management, using multiple data sources.
CO3	Explore data analysis, including terminology and concepts, introduction to statistics, central tendencies and distributions, variance, distribution properties and arithmetic, samples/ClT, basic machine learning algorithms, linear regression, SVM, Naïve Bayes.
CO4	Acquire knowledge about data visualization, including types of data visualization, data for visualization: data types, data encodings, retinal variables, mapping variables to encodings, visual encodings.
CO5	Familiarize with applications and tools of data science, including technologies for visualization, Bokeh(python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	-	-	-	-	1	1	1
CO2	2	2	-	-	2	-	-	-	3	3	3	3
CO3	-	-	3	-	-	-	-	-	-	2	2	2
CO4	-	-	-	2	-	-	-	-	-	2	2	2
CO5	1	-	-	-	3	-	-	-	-	2	2	2

Unit I:

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications, Mathematical Foundations for Data science: linear algebra; Analytical and numerical solutions of linear equations; Mathematical structures, concepts and notations used in discrete mathematics. Introduction to Statistical Methods: basic and some advanced concepts of probability and statistics; Concepts of statistics in solving problems arising in data science.

Unit II:

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

Unit III:

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/ClT, Basic machine learning algorithms, Linear regression, SVM, Naïve Bayes.

Unit IV:

Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

Unit V:

Applications and Tools: Applications of Data Science, Technologies for visualization, Bokeh(python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Text Books:

1. Cathy O'Neil,RACHEL Schutt,Doing data science,Straight Talk from The Frontline. O'Reilly, 2013.
2. Introducing Data Science, Davy Cielen, Arno D.B.Meysman, Mohamed Ali,Manning Publications CO., 1 st edition,2016.
3. An Introduction to Statistical Learning: with Applications in R, Gareth james ,Daniela Witten,Trevor Hastie,Robert Tibshirani ,Springer,1 st edition,2013.

Reference Books:

1. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, Mining Of Massive Datasets. V2.1, Cambridge university Press, 2014.
2. Data Science from Scratch: First Principles with Python, JOEL Grus, O'Reilly, 1 st edition, 2015.
3. Doing Data Science , Straight Talk from the Frontline, Cathy O'Neil,Rachel schutt, O'reilly, 1 st edition, 2013.
4. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition , 2014.

CESP 631 DEEP LEARNING

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand feedforward networks and their training, machine learning vs. deep learning, and various aspects of deep learning model development.
CO2	Acquire knowledge about convolutional neural networks (CNNs), architectures, spatial localization, and recurrent neural networks (RNNs).
CO3	Acquire knowledge about deep generative models, including Boltzmann Machines, Autoencoders, and Generative Adversarial Networks (GANs).
CO4	Gain insights into deep reinforcement learning, temporal difference learning, policy gradient methods, Q-learning, and Deep Q-Learning.
CO5	Understand deep reinforcement learning techniques, including temporal difference learning, policy gradient methods, and Q-learning.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	3	-	-	-	-	-	-	-
CO2	3	2	3	3	3	-	-	-	-	-	-	-
CO3	2	-	3	3	2	-	-	-	-	-	-	-
CO4	2	-	-	2	2	2	3	-	-	-	-	-
CO5	2	-	-	1	1	2		3	3	3	-	-

UNIT – I

Feed forward networks and training, Machine learning vs and Deep learning, Activation functions, initialization, regularization, batch normalization, model selection, ensemble techniques.

UNIT – II

Convolutional neural networks, Fundamentals, architectures, pooling, visualization Deep learning for spatial localization, Transposed convolution, efficient pooling, object detection, semantic segmentation. Recurrent neural networks.

UNIT – III

Recurrent neural networks(RNN), long-short term memory(LSTM), language models, machine translation, image captioning, video processing, visual question answering, and video processing, and learning from descriptors.

UNIT - IV

Deep generative models Boltzmann Machine and Auto-encoders, vibrational auto encoders, generative adversarial networks, auto regressive models, generative image models.

UNIT – V

Deep reinforcement learning, temporal difference learning, Policy gradient methods, Q-learning, Deep Q-Learning.

Text Book:

1. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.

Reference Book:

1. Francois chollet, Deep learning with python, 2017 manning publications.

CESP 632 SATELLITE COMMUNICATION SYSTEMS

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the historical development of Satellite Communications and the orbital aspects of satellite orbits.
CO2	Gain insights into satellite subsystems, including Attitude and Orbit Control, Telemetry, and Communication Systems.
CO3	Design satellite links, considering transmission theory, system noise, and Earth station technology.
CO4	Understand satellite packet communications, including message transmission, error correction, and routing protocols.
CO5	Acquire knowledge about Very Small Aperture Terminal (VSAT) systems, including architectures, implementation, and access control protocols.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	1	1	-	-	1	1	-	-
CO2	3	3	-	-	1	1	-	-	1	1	-	-
CO3	3	3	-	-	2	1	-	-	1	1	-	-
CO4	3	3	-	-	2	1	-	-	1	1	-	-
CO5	3	3	2		1	1	-	-	1	1	-	-

UNIT – I

INTRODUCTION AND ORBITAL ASPECTS OF SATELLITE COMMUNICATIONS:

A brief history of Satellite Communications, Types of Orbits, Orbital Mechanics: Developing the Equation of the orbit, Kepler's laws of planetary motion, locating the satellite in the orbit, locating the Satellite with respect to the Earth, Orbital elements, Look angle determination, Orbital perturbations, launch and launch vehicles, Orbital effects in Communication System performance.

UNIT – II

SATELLITE SUBSYSTEMS: Introduction, Attitude and Orbit Control System (AOCS), Telemetry, Tracking, Command and Monitoring (TTC&M), Power Systems, Communication Subsystems, Satellite Antennas.

MULTIPLE ACCESS TECHNIQUES: Introduction, FDMA, TDMA, DAMA and CDMA Satellite Systems Encoder, Decoder, Comparison between FDMA, TDMA & CDMA .

UNIT – III

SATELLITE LINK DESIGN : Basic transmission theory,System Noise Temperature and G / T ratio, Design of Uplink and Down link models, Design of Satellite links for specified C / N ratio.

EARTH STATION TECHNOLOGY : Earth Station Design, Design of large antennas, Small earth station Antennas, Propagation Effects on Satellite: Quantifying Attenuation and Depolarization, Rain and Ice Effects, Prediction of Rain Attenuation.

UNIT – IV

SATELLITE PACKET COMMUNICATIONS : Message transmission by FDMA: The M/G/1 Queue, Message transmission by TDMA, Forward Error Correction (FEC) in satellite communications, Pure ALOHA: Satellite packet switching - slotted ALOHA - Packet Reservation, TCP/IP over satellite links, Routing protocols for satellite networks, Tree algorithm.

UNIT-V

VSAT SYSTEMS : Introduction, overview of VSAT Systems, Network Architectures, One – way Implementation, Split – Two-Way (Split IP) Implementation, Two-Way Implementation, Access Control Protocols, Delay Considerations, Basic Techniques: Multiple Access Selection, Signal Formats, Modulation, Coding, and Interference Issues.

TEXT BOOKS:

1. T Pratt and W Bostiain, Satellite Communications, 2nd Edition, John Wiley
2. Tri T. Ha Digital Satellite communications , 2nd Edition, McGraw Hill
3. Taub and Schilling, Principles of Communication Systems, TMH, 2003.
4. Simon Haykin, Communication Systems, 4th Edition, John Wiley & Sons, 2004.

REFERENCE BOOKS:

1. D C Agarwal, Satellite Communications, Khanna Publishers, 2003
2. Robert M Gagliardi, Satellite Communications.

CESP 633 INTERNET OF THINGS

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the fundamental concepts of the Internet of Things (IoT), including its physical and logical design.
CO2	Gain insights into domain-specific applications of IoT in areas such as home automation, cities, environment, energy, retail, logistics, agriculture, industry, health, and lifestyle.
CO3	Differentiate between IoT and Machine-to-Machine (M2M) communication, understand Software-Defined Vehicles (SDV) and Network Function Virtualization (NFV) for IoT, and explore IoT system management with NETCONF-YANG.
CO4	Understand the design methodology for IoT platforms,and gain practical knowledge in designing IoT systems using Python, including data types, control flow, functions, modules, packages, file handling, date/time operations, and classes.
CO5	Explore IoT physical devices and endpoints, with a focus on Raspberry Pi and its interfaces.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	2	1	-	-	-	-	-	-	-
CO2	3	3	-	2	1	-	-	-	-	-	-	-
CO3	2	3	2	1	-	-	-	-	-	-	-	-
CO4	2	2	3	1	-	-	-	-	-	-	-	-
CO5	1	2	2	2	-	3	-	-	-	-	-	-

UNIT-I

Introduction to Internet of Things- Introduction, Physical design, Logical design ,IoT enabled technologies, IoT levels & Deployment templates.

UNIT-II

Domain specific IoTs: Introduction, Home automation, cities, environment, energy, retile, Logistics, agriculture, Industry and health & life style.

UNIT-III

IoT and M2M- Introduction, M2M, Differnce between IoT and M2M , SDV and NFV for IoT. IoT system management with NETCONF-YANG – need for IoT systems management, SNMP, Network operator requirements, NETCONF,YANG.

UNIT-IV

IoT platforms design methodology – Introduction, IoT design methodology, case study, motivation for using Python. IoT Systems – logical design using Python- Introduction, python data types and structures, control flow, functions, modules, packages, file handling, date/time operations, classes and packages.

UNIT-V

IoT physical devices and end points – IoT devices, Raspberry pi, Raspberry pi interfaces, programming Raspberry pi with Python. Case studies Illustrating IoT Design – Home automation, cities, environment and agriculture &
productivity applications.

Text Book:

Internet of Things – A hands-On Approach, Arsdeep Bahga & Vijay Madisetti, Universities Press

Reference Books:

1. The Internet of Things Enabling Technologies, platforms and Use cases, pethuru raj and Anupama C. Raman, CRC press.
2. IoT Fundamentals Networking Technologies, protocols and use cases for internet of things, David, Hanes & Salguerio Gonzalo, Pearson.

CESP 634 SYSTEMON CHIP ARCHITECTURE

COURSE OUTCOMES:

After completion of this course, students will be able to:

CO1	Understand the fundamentals of the system approach, including system architecture, hardware and software components, processor architectures, and memory addressing.
CO2	Comprehend the design aspects of processors, including buffering techniques, robust processors, vector processors, VLIW processors, and superscalar processors.
CO3	Understand the overview of SOC external memory, internal memory, cache memory, cache organization, and strategies for line replacement.
CO4	Acquire knowledge about SOC customization, reconfiguration technologies, instance-specific design, and customizable soft processors.
CO5	Apply SOC design principles to case studies such as the AES algorithm, and evaluate the design and performance of image compression techniques like JPEG compression.

CO-PO/PSO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	-	-	-	-	-	-	1	2	-
CO2	3	2	3	-	-	-	-	-	-	1	2	-
CO3	3	2	2	-	-	-	-	-	-	1	1	-
CO4	3	2	2	2	-	-	-	-	-	-	1	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-

UNIT – I

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT – II

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT – III

Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor – memory interaction.

UNIT - IV

Interconnect Customization and Configuration: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview,

Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, InstanceSpecific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

UNIT – V

Application Studies / Case Studies: SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

TEXT BOOKS:

1. Computer System Design System-on-Chip by Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
2. ARM System on Chip Architecture – Steve Furber –2 ndEed., 2000, Addison Wesley Professional.

REFERENCES:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., Springer,2004.
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM
3. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, Kluwer Academic Publishers, 2001.

CESP 551 COMMUNICATION LAB

List of Experiments:

1. Time Division Multiplexing of signals & Framing in the TDM
2. Study of Manchester Coder – Decoder
3. Forming a PC-to-PC Communication Link using Optical Fiber and RS 232 interface.
4. Measurement of Data rate for Analog Optical Link.
5. Measurement of Numerical Aperture for optical Link
6. Measurement of Losses for Analog optical link.
7. Comparative study of EMI in copper and Optical media
8. Measure the Scattering parameters of the devices: Circulator & Magic TEE
9. Measurement of Radiation Pattern of an E-Plane Pyramadal Horn Antenna
10. Measurement of Radiation Pattern of an H-Plane Pyramadal Horn Antenna
11. Study of spectrum analyzer
12. Measurement of Q-factor of cavity resonator
13. Study of Cellular communication Systems
14. Study of Satellite communication Receiver
15. Experiments Based on Software Defined Radio.

Note: A minimum of 10 (ten) experiments have to be performed and recorded bythe candidate to attain eligibility for the university practical examination.

CESP 553 SIGNAL PROCESSING LAB

S.No.	List of Experiments
1.	Program to implement enhancement techniques for images.
2.	Program to implement various spatial and frequency domain filters for images
3.	Program for adding Gaussian Noise and clean the Image using Adaptive Filtering
4.	Program to perform Edge detection using several operators
5.	Program to perform Point detection & Line detection
6.	Program to separate the frames in a video and process them.
7.	Implementation of Digital Data Scrambler
8.	Implementation of Digital Data Descrambler
9.	Implementation of Convolutional Encoder
10.	Implementation of Viterbi decoder
11.	Implementation of Adaptive Filter
12.	Program to perform Linear convolution using DSP Processor
13.	Program to perform Circular convolution using DSP Processor
14.	Program to perform FFT operation using DSP Processor
15.	Program to perform DFT operation using DSP Processor

Note: A minimum of 10 (ten) experiments have to be performed and recorded bythe candidate to attain eligibility for the university practical examination.