DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Book for

B. Tech. in Electronics and Communication Engineering

For

Academic Year
2019 - 2020

Visvesvaraya National Institute of Technology,

Nagpur-440 010 (M.S.)

Institute Vision Statement

To contribute effectively to the National and International endeavour of producing quality human resource of world class standard by developing a sustainable technical education system to meet the changing technological needs of the Country and the World incorporating relevant social concerns and to build an environment to create and propagate innovative technologies for the economic development of the Nation.

Institute Mission Statement

The mission of VNIT is to achieve high standards of excellence in generating and propagating knowledge in engineering and allied disciplines. VNIT is committed to providing an education that combines rigorous academics with joy of discovery. The Institute encourages its community to engage in a dialogue with society to be able to effectively contribute for the betterment of humankind.

Department Vision Statement

The Department endeavors to facilitate state of the art technical education in the field of Electronics and Communication Engineering by infusing scientific temper in the students leading towards research and to grow as centre of excellence in the field. The vision of the department is to provide education to students that is directly applicable to problems and situations encountered in real life and thus foster a successful career. The department aims to provide the best platform to students and staff for their growth

Department Mission Statement

1. To be the epitome of academic rigour, flexible to accommodate every student and faculty for basic, current and future technologies in Electronics and Communication Engineering.
2. Strengthening and providing support in sustaining a healthy society by improving the quality of life through the application of technology.

Brief about Electronics and Communication Department:

The Department of Electronics and Computer Science was created in 1994 from the Department of Electrical Engineering. Later, the Department of Electronics and Communication Engineering has been created in May 2014. It offers under-graduate program (B.Tech.) in Electronics and Communication Engineering and post-graduate program (M.Tech.) in Communication Systems Engineering. The department has well qualified and well motivated faculty members and support staff. There are more than 30 full time PhD students enrolled in the department in the areas of Communication Engineering, Image Processing, Embedded System Design, RF and Antenna Design. The laboratories are adequately equipped with state-of-the-art facilities. The department is undergoing vigorous growth in emerging areas of Embedded Systems, RF Testing and Communications. Currently, the department has been awarded Center of Excellence in Combedded Systems by MHRD (NPIU). The department is actively involved in R & D as well as consultancy projects and has collaborations with several industries, academic institutes, and R&D organizations in the country. The B.Tech. (ECE) program offered by the Department is accredited by National Board of Accreditation (NBA) for five years w.e.f. July 1, 2015.

List of faculty Members

Sr No	Faculty Name	Areas of specialization
1.	Dr. A. G. Keskar	Fuzzy Logic, Image Processing, Embedded Systems.
2.	Dr. K. D. Kulat	Wireless Communication, Devices and Circuits
3.	Dr. A. S. Gandhi	Wireless communication, RF circuits and systems, Computer networks
4.	Dr. K. M. Bhurchandi	Embedded Systems, Image Processing
5.	Dr. Ashwin Kothari	Communication, Signal processing, Rough Sets, Cognitive Radio, Reconfigurable Antennas, COMMBEDDED Systems: Hybridization of Communication and Embedded Systems.
6.	Dr. V. R. Satpute	Image Processing, Computer Vision, Signal Processing, Cryptography, Bio-metrics.
7.	Dr. (Mrs.) P. H. Ghare	Body Area Networks, Wireless Sensors Network, Analog Circuit Design

8.	Dr. J. Sengputa	Communication & Microwave
9.	K. Surender	Control and Instrumentation
10.	Dr. Vinay Kumar Tripathi	Wireless Sensor Networks(WSNs), Non-Conventional WSNs (Under water & Under Ground Sensor Networks), UAV (Unmanned Arial Vehicles) With sensor Networks and Magnetic Induction (MI) based Communications.
11.	Dr. Saugata Sinha	Image Processing, Pattern Recognition, Medical Imaging. Signal Processing.
12.	Dr. Prabhat Sharma	Wireless Communications, Evolutionary algorithms, Internet of Things, Machine Learning for communications.
13.	Dr. Deep Gupta	Medical Imaging, Signal & Image Processing, Ultrasound , Medical Image Processing and Analysis, Multimedia application
14.	Dr. Neeraj Rao	Antennas and Microwave
15.	Ms. Snigdha Bhagat	Image Processing, Computer Vision, Machine Learning

UG/ PG Programmes Offered by Electronics and Communication Department:

The department offers following undergraduate and postgraduate programmes

	Program	Description
UG	B. Tech. in Electronics and Communication Engineering	Intake: 135

Credit System at VNIT :

Education at the Institute is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance / progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation. A student's performance/progress is measured by the number of credits he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum number of credits and a minimum grade point average must be acquired by a student in order to qualify for the degree.

Course credits assignment

Each course, except a few special courses, has certain number of credits assigned to it depending on lecture, tutorial and laboratory contact hours in a week.

For Lectures and Tutorials: One lecture hour per week per semester is assigned one credit and

For Practical/ Laboratory/ Studio: One hour per week per semester is assigned half credit.

Example: Course XXXXXX with (3-0-2) as (L-T-P) structure, i.e. 3 hr Lectures + 0 hr Tutorial + 2 hr Practical per week, will have (3x1 + 0x1 + 2x0.5 =) 4 credits.

Grading System

The grading reflects a student's own proficiency in the course. While relative standing of the student is clearly indicated by his/her grades, the process of awarding grades is based on fitting performance of the class to some statistical distribution. The course coordinator and associated faculty members for a course formulate appropriate procedure to award grades. These grades are reflective of the student's performance vis-à-vis instructor's expectation. If a student is declared pass in a subject, then he/she gets the credits associated with that subject.

Depending on marks scored in a subject, a student is given a Grade. Each grade has got certain grade points as follows:

Grade	Grade points	Description
AA	10	Outstanding
AB	9	Excellent
BB	8	Very good
BC	7	Good
CC	6	Average
CD	5	Below average
DD	4	Marginal (Pass Grade)
FF	0	Poor (Fail) /Unsatisfactory / Absence from end-sem exam
NP	-	Audit pass
NF	-	Audit fail
SS	-	Satisfactory performance in zero credit core course
ZZ	-	Unsatisfactory performance in zero credit core course
W	-	Insufficient attendance

Performance Evaluation

The performance of a student is evaluated in terms of two indices, viz, the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time. CGPA is rounded up to second decimal.

The Earned Credits (ECR) are defined as the sum of course credits for courses in which students have been awarded grades between AA to DD. Grades obtained in the audit courses are not counted for computation of grade point average.

Earned Grade Points in a semester (EGP) = **Σ** (Course credits x Grade point) for courses in which AA-DD grade has been obtained.

SGPA = EGP / Σ (Course credits) for courses registered in a semester in which AA- FF grades are awarded.

CGPA= EGP / Σ(Course credits) for courses passed in all completed semesters in which AA- DD grades are awarded.

Overall Credits Requirement for Award of Degree

SN	Category of Course	Symbol	Credit Requirement			
			B. Tech. (4-Year)	B. Arch. (5 Year)	M. Tech. (2 Year)	M. Sc. (2 Year)
	Program Core					
1	Basic Sciences (BS)	BS	18	04	-	-
2	Engineering Arts & Sciences (ES)	ES	20	18	-	-
3	Humanities	HU/ HM*	05	06	-	-
4	Departmental core	DC	79-82	168	33-39	54-57
	Program Elective					
3	Departmental Elective	DE	33-48	17-23	13-19	06-09
4	Humanities & Management	HM	0-6	0-3	-	-
5	Open Course	OC	0-6	0-3	-	-
Total requirement :BS + ES + DC+ DE + HM + OC =			**170**	**219**	**52**	**63**
Minimum Cumulative Grade Point Average required for the award of degree			**4.00**	**4.00**	**6.00**	**4.00**

Attendance Rules

1. All students must attend every class and 100% attendance is expected from the students. However, in consideration of the constraints/ unavoidable circumstances, the attendance can be relaxed by course coordinator only to the extent of not more than 25%. Every student must attend minimum of 75% of the classes actually held for that course.
2. A student with less than 75% attendance in a course during the semester will be awarded W grade. Such a student will not be eligible to appear for the end semester and re-

examination of that course. Even if such a student happens to appear for these examinations, then, answer books of such students will not be evaluated.

3. A student with W grade is not eligible to appear for end semester examination, reexamination & summer term.

Program Outcomes (Department Specific) for B. Tech in Electronics and Communication Engineering

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **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.
6. **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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.

11. **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.
12. **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.

Curriculum of the courses of study

Courses to Register in First Year B. Tech.

I Semester						
CORE						
S. No	**Code**	**Course Title/ Name**	**Type**	**L-T-P**	**Credits**	**Page No.**
		Please refer Scheme of Basic Sciences				--

II Semester						
CORE						
S. No	**Code**	**Course Title/ Name**	**Type**	**L-T-P**	**Credits**	**Page No.**
		Please refer Scheme of Basic Sciences				--

Courses to Register in Second Year B. Tech.

III Semester						
CORE						
S. No	**Code**	**Course Title/ Name**	**Type**	**L-T-P**	**Credits**	**Page No.**
1	MAL204	Linear Algebra & Application	DC	3-1-0	4	**1**
2	EEL209	Linear Network Theory	DC	3-0-0	3	**3**
3	ECL201	Electronic Devices	DC	3-1-0	4	**5**
4	ECP201	Electronic Devices	DC	0-0-2	1	**6**
5	ECL205	Object Oriented Programming	DC	2-0-2	3	**7**
6	ECL211	Signals and Systems Analysis	DC	3-1-0	4	**9**
7	ECP211	Signals and Systems Analysis	DC	0-0-2	1	**11**
ELECTIVE * (Maximum ONE theory)						
1	OC	OC	DE	3-0-0	3	
2	HM	HM	DE	3-0-0	3	
		Total No. of Credits (21+3)			**23**	

IV Semester						
CORE						
S. No	**Code**	**Course Title/ Name**	**Type**	**L-T-P**	**Credits**	**Page No.**
1	MAL205	Numerical Methods and Probability Theory	DC	3-1-0	4	**13**
2	ECL304	Digital Signal Processing	DC	3-0-0	3	**15**
3	ECP304	Digital Signal Processing	DC	0-0-2	1	**17**
4	ECL305	Electromagnetic Fields	DC	3-1-0	4	**19**
5	ECL203	Digital Circuits and Microprocessor Systems	DC	3-0-0	3	**21**
6	ECP203	Digital Circuits and Microprocessor Systems	DC	0-0-2	1	**23**
7	ECP307	Electronic Product Engineering Workshop	DC	0-0-2	1	**25**

8	ECL308	Analog Circuit Design	DC	3-0-0	3	**26**
9	ECP308	Analog Circuit Design	DC	0-0-2	1	**28**
ELECTIVE* (Maximum ONE theory)						
1	OC	OC	DE	3-0-0	3	
2	HM	HM	DE	3-0-0	3	
		Total No. of Credits (20+3)			**24**	

Courses to Register in Thirds Year B. Tech.

V Semester						
CORE						
S. No	**Code**	**Course Title/ Name**	**Type**	**L-T-P**	**Credits**	**Page No.**
1	ECL312	Control Engineering	DC	3-0-0	3	**29**
2	ECP312	Control Engineering	DC	0-0-2	1	**31**
3	ECL403	Embedded Systems	DC	3-0-0	3	**32**
4	ECP403	Embedded Systems	DC	0-0-2	1	**34**
5	ECL301	Analog Communication	DC	3-1-0	4	**36**
6	ECP301	Analog Communication	DC	0-0-2	1	**38**
7	ECL204	Measurement & Instrumentation	DC	3-0-0	3	**42**
8	ECP204	Measurement & Instrumentation	DC	0-0-2	1	**44**
9	ECL405	Wave Guides and Antennas	DC	3-0-0	3	**45**
ELECTIVE* (Maximum ONE theory)						
1	PHL208	Physics of Semiconductor Devices	DE	3-0-0	3	**47**
2	CSL311	Computer Architecture & Organization	DE	3-0-0	3	**48**
3	ECL310	CMOS Design	DE	3-0-0	3	**50**
4	ECL311	Automotive Electronics	DE	3-0-0	3	**52**
5	ECL414	Electronic Product Design and Reliability	DE	3-0-0	3	**54**
6	ECL415	Electronic System Design	DE	3-0-0	3	**55**
7	ECL307	Statistical Signal Processing	DE	3-0-0	3	**57**
8	OC	OC	DE	3-0-0	3	
9	HM	HM	DE	3-0-0	3	
		Total No. of Credits (20 + 3)		**=**	**23**	

VI Semester						
CORE						
S. No	**Code**	**Course Title/ Name**	**Type**	**L-T-P**	**Credits**	**Page No.**
1	ENL302	Device Modeling	DC	3-0-0	3	**58**
2	ENP302	Device Modeling	DC	0-0-2	1	**60**
3	ECL303	Digital Communication	DC	3-0-0	3	**61**
4	ECP303	Digital Communication	DC	0-0-2	1	**63**
5	ECL313	Digital Hardware Design	DC	3-0-0	3	**66**
6	ECP313	Digital Hardware Design	DC	0-0-2	1	**68**
7	ECL404	RF & Microwave Engineering	DC	3-0-0	3	**69**
ELECTIVE* (Maximum TWO theory, ONE lab)						
1	CSL312	Concepts in Operating Systems	DE	3-0-0	3	**70**
2	ECL420	Smart Antennas	DE	3-0-0	3	**72**
3	ECL411	Digital Image Processing	DE	3-0-0	3	**73**
4	ECL412	Advanced Digital Signal Processing	DE	3-0-0	3	**74**
5	ECL314	Power Electronic Devices and Circuits	DE	3-0-0	3	**76**
6	ECP412	Advanced Digital Signal Processing	DE	0-0-2	1	**78**
7	ECP404	RF & Microwave Engineering	DE	0-0-2	1	**80**
8	ECP411	Digital Image Processing	DE	0-0-2	1	**81**
9	ECL408	Biomedical Engineering	DE	3-0-0	3	**83**
10	OC	OC	DE	3-0-0	3	
11	HM	HM	DE	3-0-0	3	
		Total No. of Credits (15+7)		**=**	**22**	

Courses to Register in Fourth Year B. Tech.

VII Semester						
CORE						
S. No	**Code**	**Course Title/ Name**	**Type**	**L-T-P**	**Credits**	**Page No.**
1	ECD401	Project Phase – I	DC	0-0-4	2	**84**
ELECTIVE* (Maximum SIX theory and THREE labs)						
1	ECL429	Communication Networks	DE	3-0-0	3	**85**
2	ECP429	Communication Networks	DE	0-0-2	1	**87**
3	ECL407	Radar Engineering	DE	3-0-0	3	**88**
4	ECL410	Satellite Communication	DE	3-0-0	3	**89**
5	ECL430	Biomedical Signal Processing	DE	3-0-0	3	**91**
6	ECL436	Optimal Systems	DE	3-0-0	3	**93**
7	ECL437	Fundamentals of Information Theory	DE	3-0-0	3	**95**
8	ECL421	Advanced Sensors and Instrumentation	DE	3-0-0	3	**96**
9	ECL438	Project Design Course	DE	3-0-0	3	**98**
10	ECL439	Wireless Communication	DE	3-0-0	3	**100**
11	ECL426	Advanced Microprocessors & Interfacing	DE	3-0-0	3	**102**
12	ECP426	Advanced Microprocessors & Interfacing	DE	0-0-2	1	**103**
13	ECL413	Adaptive Signal Processing	DE	3-0-0	3	**105**
14	ECP413	Adaptive Signal Processing	DE	0-0-2	1	**106**
15	OC	OC	DE	3-0-0	3	
16	HM	HM	DE	3-0-0	3	
		Total No. of Credits (2 + 21)		=	**23**	

VIII Semester						
CORE						
S. No	**Code**	**Course Title/ Name**	**Type**	**L-T-P**	**Credits**	**Page No.**
1	ECD402	Project Phase II	DC	0-0-8	4	**108**
ELECTIVE* (Maximum SIX theory and ONE lab)						
1	MAL408	Statistical Analysis & Queing Theory	DE	3-0-0	3	**109**
2	ECL440	Cellular Systems	DE	3-0-0	3	**111**
3	ECL409	Radio Frequency Circuit Design	DE	3-0-0	3	**113**
4	ECP409	Radio Frequency Circuit Design	DE	0-0-2	1	**114**
5	ECL423	Image Analysis and Computer Vision	DE	3-0-0	3	**116**
6	ECP423	Image Analysis and Computer Vision	DE	0-0-2	1	**118**
7	ECL417	Multimedia Networks	DE	3-0-0	3	**122**
8	ECL418	Network Planning and Management	DE	3-0-0	3	**123**
9	ECL419	Wireless Sensor Networks	DE	3-0-0	3	**124**
10	ECP419	Wireless Sensor Networks	DE	0-0-2	1	**126**
11	ECL427	Broadband Communication	DE	3-0-0	3	**127**
12	ECL424	Optical Communication	DE	3-0-0	3	**128**
13	ECP424	Optical Communication	DE	0-0-2	1	**130**
14	OC	OC	DE	3-0-0	3	
15	HM	HM	DE	3-0-0	3	
		Total No. of Credits (4+19)		=	**23**	

MAL204 Linear Algebra and Applications [(3-0-0); Credits: 3] Top

Pre-requisite: -

Course Outcomes

1. Understand the basic concepts of linear algebra as matrix calculus, vector space and basic vector operations)
2. Use the Gauss elimination to solve the linear system equations
3. Compute the eigen values and vectors to find diagonalize matrices
4. Apply the matrix calculus in solving a system of linear algebraic equations
5. Understand the importance of linear algebra and its applications to science and engineering

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

Contents:

Matrices: Review of Matrix Algebra; Rank of matrix; Row reduced Echelon form; Determinants and their properties; Solution of the matrix Equation Ax = b; Gauss elimination method. Vector space, subspaces, linear dependence/independence, basis, dimension, linear transformation, range space and rank, null space and nullity, rank nullity theorem, matrix representation of a linear transformation, linear operators on Rn and their representation as square matrices, invertible linear operators, inverse of a non-singular matrix, eigenvalues and eigenvectors of a linear operator, properties of eigenvalues and eigen vectors of Hermitian, skew-Hermitian, unitary, and normal matrices (symmetric, skew-symmetric,and orthogonal matrices), characteristic equation, bounds on eigenvalues,Cayley-Hamilton theorem, diagonalizability of a linear operator, invariant sub spaces, annihilators, minimal polynomials. Inner product spaces, norm; orthonormal sets, Gram-Schmidt orthogonalisation process; projections and least squares approximation, Ad-joint operator, normal, unitary and self-adjoint operator. Spectral theorem for normal operator, applications of linear algebra in engineering.

Text Books:

1. Hoffman and Kunze : Linear Algebra, Prentice Hall of India, New Delhi

2. Gilbert Strang : Linear Algebra And Its Applications (Paperback) , Nelson Engineering (2007)

Reference Books :

1. V. Krishnamoorthy et al : An introduction to linear algebra , Affiliated East West Press, New Delhi

2. P.G. Bhattacharya, S.K. Jain and S.R. Nagpaul : First course in Linear Algebra, Wiley Eastern Ltd., New Delhi

3. K.B.Datta : Matrix and Linear Algebra, Prentice Hall of India, New Delhi

EEL209 Linear Network Theory [(3-0-0); Credits: 3] Top

Pre-requisite:-

Course Outcomes

1. Understand basics electrical circuits with nodal and mesh analysis.

2. Appreciate electrical network theorems.

3. Apply Laplace Transform for steady state and transient analysis.

4. Determine different network functions.

5. Appreciate the frequency domain techniques.

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

Contents:

Node and Mesh Analysis: Node and mesh equation, matrix approach of complicated network containing voltage and current sources, and reactances, source transformation and duality. Network theorem: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits. Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor , effective values, Fourier transform and continuous spectra, three phase unbalance circuit and power calculation.

Laplace transforms and properties: Partial fraction, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions. Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero integral solutions. locations, convolution theorem and Two four port network and interconnections,

Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

Text/Reference Books

1. Van, Valkenburg.; Network analysis; Prentice hall of India, 2000

2. Sudhakar, A., Shyammohan, S. P.; Circuits and Network; Tata Mcgraw-Hill New Delhi, 1994

ECL201 Electronic Devices [(3-1-0); Credits: 4] Top

Pre-requisite:-

Course Outcomes

Students will

1. Get a comprehensive introduction of electronic properties of semiconductors,

2. Be familiar with electronic devices, and their applications to circuits.

3. Be able to link knowledge of biasing and other characteristics with circuit operation

4. Have the ability to formulate problems, problem solving skills.

5. Be able to analyze performance of various types of amplifiers

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

Contents:

Syllabus: Semiconductor diodes V-I characteristics, Modeling for various circuit applications, rectifier, Clipping and clamping circuits RC filters, Bipolar junction transistor (BJT), V-I characteristics, Biasing, Small signal low frequency amplifier. LED photodiode, optocoupler, V-I characteristics, optoelectronic circuits. Power devices, power diode, IGBT, SCR TRIAC, Switching Devices, DIAC, UJT characteristics and applications. Power amplifiers : Class A, B, AB,C, Efficiency calculations, Push pull complimentary symmetry ,Feedback amplifier, Oscillators.

Books

1. “Electronic Devices and Circuits”, “Millman Halkias”, “TMH”, 2000

2. “Electronic Devices and Circuits”, “David A. Bell”, “PHI”, 4th Edition

3. “Electronic devices and Circuit Theory”, “R. Boylestad”, “Pearson Education”, 9th Edition

4. “Electron devices” , “S. Poornachandra, Sasikala”, “Scitech”, 2nd Edition

5. “Foundation of Electronics Circuits and Devices”, “Meade”, “Thompson”, 4th Edition

ECP201 Electronic Devices Lab [(0-0-2); Credits: 1] Top

Course Outcomes:

Student will be:

1. Familiar with various passive components, Active components, various devices such as Diode, Transistor, SCR, DIAC, TRIAC, etc., will also familiar with Data sheets of various Devices.
2. Familiar with basic laboratory instruments such as DC Power supply, Function Generator, Multimeter, CRO, etc., and their handling.
3. Familiar with how to construct the circuit and procedure to test the circuit.
4. Understanding how to study V-I characteristics of various devices and the working principle of this devices.
5. Understanding the input and output characteristics of this devices and hence the application of this devices. To study and understand the devices in detail to use this devices for various application.

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

List of Experiments:

1. Diode Characteristics

2. Zener Diode as Regulator

3. Full Wave Rectifier and Filters

4. Bipolar Junction Transistor

5. Junction Field Effect Transistor Characteristics

6. Single Stage BJT Amplifier

7. RC Phase Shit Oscillator

8. After finishing those experiments students have to complete one practical, problem assigned to them.

ECL205 Object Oriented programming [(2-0-2); Credits: 3] Top

Course Outcomes

After completion of the course, the students will learn

1. About fundamental concepts of object oriented programming
2. About principles of object oriented programming.
3. To perform object oriented analysis modeling and design.
4. To perform basic object oriented programming using C++
5. To perform basic object oriented programming using python

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

Contents:

Fundamental concepts of object oriented programming: Introduction to the principles of object-oriented programming (classes, objects, messages, encapsulation, inheritance, polymorphism, exception handling, and object-oriented containers).

Building and execution a C program in C++, writing equivalent programs in C++, procedural Extensions of C, Overview of OOP in C++ , inheritance : generalization / specialization of object modelling in C++, polymorphism : static and dynamic binding, type casting & exceptions : C++ cast operators; C++ exceptions & standard exception classes

General Introduction to Python and the class. Using the command interpreter and development environment, Introduction to git and GitHub, basic data types, functions: definition and use, arguments, block structure, scope, recursion, modules and import conditionals and Boolean expressions, Sequences: Strings, Tuples, Lists, iteration, looping and control flow, string methods and formatting, Dictionaries, Sets and Mutability, files and Text processing, exceptions, testing, list and dict Comprehensions, functions as objects, classes, class instances, methods, multiple inheritance properties

Text & Reference Books

1. Bertrand Meyer, Object Oriented Software Construction, Prentice-Hall.
2. Grady Booch, Object Oriented Analysis and Design, Addison-Wesley.
3. The C++ Programming Language by Bjarne Stroustrup, 2013.
4. The C Programming Language by Brian W. Kernighan and Dennis M. Ritchie, 2015
5. C++ reference (C++98 and C++03). http://en.cppreference.com/w/
6. The Python Tutorial (https://docs.python.org/3/tutorial/)
7. Code Academy Python Track (http://www.codecademy.com/tracks/python)

ECL211 Signals and System Analysis [(3-1-0); Credits: 4] Top

Pre-requisite:-

Course Outcomes

Students will

1. Understand the fundamentals of signals and basic engineering systems.

2. Understand concepts of frequency domain representations, analysis and synthesis using Fourier theorem.

3. Understand the fundamentals and applications of Laplace and Z transform.

4. Learn to analyse and characterise the basic discrete time systems.

5. Understand the fundamentals of stochastic signals.

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

Contents:

Elements of Signal Space Theory: Different types of signals, Linearity, Time invariance and causality, Impulse sequence, Impulse functions and other singularity functions.

Convolution: Convolution sum, Convolution integral and their evaluation, Time domain representation and analysis, of LTI systems based on convolution and differential equations.

Transform Domain Considerations: Laplace transforms and Z-transforms, Application of transforms to discrete and continuous systems analysis, Transfer function, Block diagram representation, DFT. Fourier series and Fourier Transform, Probability and statistics, Introduction to stochastic systems.

Introduction to stochastic signal processing: Probability, random variable, Gaussian distribution, stochastic stationary matrix and function, power spectral density, AR, MA and ARMA prouss, YULE WALKER equation, correlation and covariance.

Text Book

1. Alan V Oppenheim, Alan S Wilsky and Hamid Nawab S, “Signals & Systems”, Prentice Hall, New Delhi, 2005.

2. Simon Haykin and Barry Van Veen, “Signals & Systems”, John Wiley and Sons Inc., New Delhi, 2008.

Reference Books

1. Ashok Ambardar, “Introduction to Analog and Digital Signal Processing”, PWS Publishing Company, Newyork, 2002.

2. Rodger E Zaimer and William H Tranter, “Signals & Systems – Continuous and Discrete”, McMillan Publishing Company, Bangalore ,2005.

3. John .G.Proakis , “Digital Signal Processing Principles, Algorithms and Applications , Prentice Hall, New Delhi 2006,.

4. Sanjit .K. Mitra “Digital Signal Processing A Computer based approach” ‘Tata McGraw Hill Edition ,New Delhi,2001,

5. Emmanuel C.Ifeachor “Digital Signal Processing A Practical Approach”, Pearson Education Limited, England, 2002.

ECP211 Signals and Systems Analysis [(0-0-2); Credits: 1] Top

Course Outcomes:

1. To understand basic signals operations such as convolution, correlation, signal shifting
2. To understand linear system dynamics such as stability, time invariance and causality.
3. To compute DFT of a signal.
4. To understand and verify different properties of DFT.
5. To compute and apply Z transform of a signal.

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

List of Experiments:

1. To demonstrate generation of some simple signals such as the complex exponential signal and real sinusoids.
2. To explore the commutation of even and odd symmetries in a signal with algebraic operations.
3. To explore the effect of transformation of signal parameters (amplitude-scaling, and time-shifting).
4. To explore the various properties of the impulse signals.
5. To verify different properties of a given system as linear or non-linear, causal or non-causal, stable or unstable etc.
6. To compute discrete Fourier transform of a signal.
7. Verification of Perceval's theorem associated with Fourier series analysis for a periodic square wave sampled using appropriate sampling frequency.
8. Verification of Multiplication property associated with Fourier series analysis for a periodic triangular wave sampled using appropriate sampling frequency.
9. Verification of shifting property associated with Fourier series analysis for a periodic square wave sampled using appropriate sampling frequency.

10. Verification of symmetry properties associated with Fourier series analysis for a real valued and complex valued periodic square wave sampled using appropriate sampling frequency.
11. Verification of Fourier series properties associated with down sampling of a periodic square wave sampled using appropriate sampling frequency.
12. To compute Z transform of a sequence

MAL205 Numerical Methods and Probability Theory [(3-1-0); Credits: 4] Top

Pre-requisite:

Course Outcomes

Students will

1. study basics of numerical Analysis: Solutions of algebraic and transcendental equations by Iteration method, method of false position, Newton-Raphson method and their convergence.
2. know details about the random variables, various methods for numerical analysis.
3. study numerical solution of ordinary differential equations: Taylor's series method, Euler's modified method, Runge-Kutta method, Adam's Bashforth and Adam's Moulton, Milne's predictor corrector method
4. study random processes, autocorrelation and cross correlation applicable in the field of electronics and communication engineering.
5. be able to understand and analyze the problems associated with engineering applications

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

Contents:

Numerical Analysis: Solutions of algebraic and transcendental equations by Iteration method, method offalse position, Newton-Raphson method and their convergence. Solutions of system of linear equations by Gauss elimination method, Gauss Seidal method, LU decomposition method. Newton-Raphson method for system of nonlinear equations. Eigen values and eigen vectors : Power and Jacobi methods. Numerical solution of ordinary differential equations: Taylor's series method, Euler's modified method, Runge-Kutta method, Adam's Bashforth and Adam's Moulton, Milne's predictor corrector method. Boundary value problems: Shooting method, finite difference methods. Probability theory: Random variables, discrete and continuous random variable, probability density function; probability distribution function for discrete and continuous random variable joint distributions. Definition of mathematical expectation, functions of random variables, The variance and standard deviations, moment generating function other measures of central tendency and dispersion, Skewness and Kurtosis. Binomial, Geometric

distribution, Poisson distribution, Relation between Binomial and Poisson's distribution, Normal distribution, Relation between Binomial and Normal distribution. Random processes, continuous and discrete, determinism, stationarity, ergodicity etc. correlation functions, autocorrelation and cross-correlation, properties and applications of correlation functions.

TEXTBOOKS

1. Jain, Iyengar and Jain : Numerical Methods for Engineers and Scientists, WileyEastern

Books

1. S. D. Cante and C. de Boor, Elementary Numerical Analysis, analgorithmic approach, McGraw-Hill.

2. Gerald andWheatley :Applied NumericalAnalysis, Addison-Wesley.

3. Spiegel, M.R.; Theory and problems of Probability and statistics; McGraw-HillBookCompany; 1980.

4. K.S. Trivedi: Probability Statistics with Reliability, Queuing and Computer Science applications, Prentice Hall ofIndia Pvt. Ltd.

ECL304 Digital Signal Processing [(3-0-0); Credits: 3] Top

Pre-requisite: MAL204

Course Outcomes

1. Able to do analysis and characterization of the discrete time systems
2. Use fourier analysis concept for frequency domain representation and analysis
3. Realize the implementation of discrete time systems
4. Design the different aspects of IIR and FIR filters
5. Calculate the spectral density parameters for measuring the performance.

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

Contents:

Introduction to discrete time signals and systems

Discrete Fourier Transform, Linear filtering methods based on the DFT, Filtering of long sequences. Direct computation of the DFT, Divide and Conquer approach, Radix -2, radix-3 and radix-4 Fast Fourier Transform, Goertzel algorithm, Chirp-z transform, quantization effect in computation of the DFT.

Implementation of the Discrete time stystems: Structure for the realization of discrete time FIR and IIR systems, Direct Form, cascade form, Frequency sampling structure, lattice structure. State space system analysis and structures. Round-off effects in digital filter

Design of Digital filters: Magnitude and phase response of digital filter, frequency response of Linear phase FIR filters, Design Techniques for FIR (Lowpass, highpass, bandpass and bandreject) filters. Design of Optimal Linear phase FIR Filters, Design of Minimum phase FIR Filters.

IIR filter design by approximation of derivatives, impulse invariant approach and bilinear transformation. Butterworth filters, Chebyshev filters, Inverse Chebychev filter and elliptic filters, Design of Lowpass, highpass, bandpass and band reject IIR filters. Spectral transformation of IIR filter

Effects of Fiite word length in digital filters,

Spectral estimation, Energy Density Spectrum, Estimation of autocorrelation and power spectrum, DFT in spectral estimation, Parameteric and nonparametric method for power spectrum estimation.

Text/Reference Book

1. Discrete Time Signal Processing, Oppenheim & Schafer, PHI Ltd, Third Edition

2. Digital Signal Processing: Principles Algorithms and Applications, Proakis John and Manolakis.

3. Digital Signal Processing- A computer based approach, Sanjit K. Mitra, McGraw Hill Education.

ECP304 Digital Signal Processing [(0-0-2); Credits: 1] Top

Course Outcomes:

1. To verify and implement basic digital signal processing techniques like convolution, correlation and Fourier transform.
2. To design and implement different FIR filters
3. To design and implement different IIR filters
4. To characterize stochastic process
5. To implement basic digital processing algorithms in dedicated DSP platforms

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

Contents:

1. Compute linear convolution, circular convolution and cross correlation of two sequences.
2. Verify different properties of Discrete Fourier Transform.
3. Implement different FFT algorithms.
4. Design and implementation of low pass, high pass, band pass and band reject FIR filters.
5. Design and implementation of low pass, high pass, band pass and band reject IIR filters of different types.
6. Computation of power spectral density, correlation function and correlation matrix of stochastic systems.
7. Implementation of basic digital signal processes algorithms for different applications like demising, edge detection etc. using computer programming.
8. Implementation of basic digital signal processes algorithms for different applications like denoising, edge detection etc. using digital signal processors like TMS DSP kits.

Text/Reference Book:

1. Discrete Time Signal Processing, Oppenheim & Schafer, PHI Ltd, Third Edition

2. Digital Signal Processing: Principles Algorithms and Applications, Proakis John and Manolakis.
3. Digital Signal Processing- A computer based approach, Sanjit K. Mitra, McGraw Hill Education.

ECL305 Electromagnetic Field [(3-1-0); Credits: 4] Top

Pre-requisite:MAL204

Course Outcomes

After completing this course the student will demonstrate the knowledge and ability to:

1. apply vector calculus to understand the behavior of static electric and magnetic fields in standard configurations in different coordinate systems.
2. calculate electric and magnetic field due to charge, charge distributions in space.
3. solve boundary value problems for electromagnetic fields.
4. describe and analyze electromagnetic wave propagation in free-space.
5. to understand the concept of power associated with an EM wave.

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

Contents:

Vector calculus: Cartesian, Cylindrical and spherical co-ordinate systems, differential lengths, surfaces and volumes

Electrostatics: Coulomb's law, Electric field, intensity, electric flux density, Gauss's law and applications, divergence and divergence theorem, potential difference and potential gradient, Electric dipole and dipole moment, Energy in electric field.

Steady magnetic fields: Biot Savart's law, Amperes circuital law and application, Curl and Stroke's theorems, Magnetic flux density and magnetic flux, scalar and vector magnetic potentials, Maxwell's equations and time varying fields, Faraday's law, displacement current, Maxwell's Equations in point & integral form, Retarded potentials.

Uniform Plane waves: Maxwell's equation in phasor form, wave equation in general medium and perfect dielectric mediums, Solution of wave equations, intrinsic impedance, velocity and wavelength, conductors and dielectrics, depth of penetration, Poynting's vector theorem.

Reflection of Electromagnetic Waves: Reflection of Electromagnetic waves: Normal incidence, standing waves, laws of reflection, reflection of obliquely incident waves, Brewsters angle.

Text Books

1. David K. Cheng , “Field and Wave Electromagnetics” 2E, Pearson

2. William H. Hayt, Jr., John A. Buck, “Engineering Electromagnetics”, 6E, Tata McGraw Hill Ed.

3. M.N.O. Sadiku, “Elements of Electromagnetics” 3E, Oxford .

Reference Books

1. John D. Kraus, Keith R. Carver “**Electromagnetics”** McGraw-Hill.

2. Jorden, Ballman, “ Electromagnetic Fields & Radiating Systems”, 3E, PHI.

ECL203 Digital Circuits and Microprocessor Systems [(3-0-0); Credits: 3] Top

Pre-requisite:-

Course Outcomes:

1. Realize logic functions utilizing fundamentals

2. Design complex digital systems

3. Understand the architecture and Interfacing ICs of 8085

4. Identify and use various addressing modes and perform various microprocessor based programs

5. To interface various devices to the microprocessor

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

Contents:

Motivation for digital systems-logic and Boolean algebra Propositions, Truth tables, Minimization of combinational circuits. Karnaugh maps and tabulation procedure, Implementation of sum of product and product of sum in hardware.

Decoders, Multiplexers, and code converters, Adders: ripple and carry look–ahead addition. Storage elements, Flip-flops and latches: D, T, J/K flip-flops, shift register, counter.

Asynchronous and synchronous –design using state and excitation tables.

Architecture of Intel's 8085 microprocessor, Addressing modes of 8085 and its timing diagrams, Machine cycle, T- states, Bus structure. Instruction set of 8085, Groping of instructions, Instruction cycle and their timing diagrams, Assembly language Programming.

Memory Interfacing, I/O mapped and memory mapped modes, interfacing of input and output devices, Stacks and sub routines, related instructions, Interrupts and associated instructions, Expanding interrupts, ALP for stacks and interrupt service routines.

Study and Interfacing of 8255 and 8254 with 8085.

Books:

1. R. S. Gaonkar, “Microprocessors Architecture, Programming and applications with 8085”. Penram Publishing

2. J. Uffenbeck, “Microprocessors and Microcontrollers”, Prentice Hall of India

3. D.V. Hall, “Microprocessors and Interfacing”, McGraw Hill

4. Ray and Bhurchandi,”Advanced Microprocessors and Peripherals”, Tata McGraw Hill

ECP203 Digital Circuits and Microprocessor System [(0-0-2); Credits: 1] Top

Course Outcomes:

Student will

1. To implement combinational and sequential circuit using the minimization techniques (K-map, Quine-McCluskey algorithm).
2. Apply the combinational circuits and sequential circuit in the real world scenario by implementing different circuits and sequential circuits in the real world scenarios by implementing different circuits.
3. Design problems associated for minimizing the design error probability
4. Be able to write program in assembly language for simple and advanced problems
5. Design and implement interfacing Circuit with peripheral

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

List of Experiments:

1. Study of the basic and derived logic gates as electrical circuits.
2. Study and verification of truth tables of basic and derived gates.
3. Study, verification and implementation of universal gates using basic gates.
4. Study of combinational logic circuit designing with simple circuits (Study of POS and SOP implementations)
5. Study of K-maps (up to 6-variable K-maps) to simplify/optimize combinational circuits.
6. Implementation of combinational circuit such as half adder, full adder, multiplexers, de-multiplexers, encoders and decoders, Magnitude Comparator etc.
7. Understanding basics of multiplexers and de-multiplexers.
8. To study and implement 16:1 MUX using 2:1 MUX only.
9. To study and implement 1:16 De-MUX using 1:2 De-MUX only.
10. Study of basics of various codes used in digital circuits.
11. To study and implement Code Conversion circuits using combinational logic circuit designing.

i. Binary to BCD
ii. Binary to Excess-3
iii. Binary to gray code
iv. BCD to Binary
v. Excess-3 to Binary
vi. Gray code to Binary

12. To study and implement S-R Flip-flop using universal gates.
13. To study and implement J-K Flip-flop using universal gates.
14. To study and implement various types of shift registers.
15. To study and implement various types of counters.
16. **Design problem:** To implement one given design problem.

ECP307 Electronics Product Engineering Workshop [(0-0-2); Credits: 1] Top

Pre-requisite:ECL201

Course outcomes:

1. They should be able to differentiate between Active and Passive component, AC source and DC source, regulated and unregulated supply, and various measurement equipment for AC and DC applications.

2. They should be able to understand the use of diode for AC and DC applications, low frequency and high frequency application, use of diode, transistor and switch.

3. They should be able to construct, test the circuit by measuring voltage and current at various power.

4. They should be able to find out the fault and rectify it and able to make use of PCB design software's to prepare the track on the board and the design should be cost .

5. They should be able to assemble the designed circuit in appropriate box to give it a look of connection product

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

ECL308 Analog Circuit Design [(3-0-0); Credits: 3] Top

Pre-requisite:ECL201

Course Outcomes

1. This course provides in depth knowledge about operational amplifiers using BJT and FET.

2. Through the course student will learn about various op-amp based ICs for various applications.

3. Through the course student is able to design op-amp based circuits required in embedded system design, communications, instrumentation etc

4. It facilitates students to learn circuit design concept.

5. It helps students to know about analog filter design.

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

Contents:

Differential amplifier, configurations, DC & AC analysis, constant current bias, current mirror, cascaded differential amplifier stages, level translator..

OPAMP, inverting, non-inverting, differential amplifier configurations, negative feedback, voltage gain, input & output impedance, Bandwidth. Input offset voltage, input bias and offset current, Thermal drift, CMRR, PSRR, Frequency response.

Linear applications, DC, ac amplifiers, summing differential amplifier, instrumentation amplifier, V to I and I to V converters, Integrator, Differentiator.

Non linear applications, Comparators, Schmitt Trigger, Clipping and Clamping circuits, Absolute value circuits, Peak detectors, Sample and hold circuits, Log and antilog amplifiers.

First / Second order low/ high/ bandpass, band reject active filters, All pass filter, phase shift oscillator, Wein bridge oscillator, Square wave and triangular waveform generators.

Study of ICs LM-741, LM-555, LM-566, LM-565, LM-339, LM-723.

Text Books

1 Tobey, Graeme ,Huelsman , Operational amplifiers, Design and applications, McGraw Hills, Edition

2. Gaikwad R.A Operational Amplifiers and Linear Integrated Circuits , PHI 1990 Edition

Reference Books

1. Fransis S , Design with OPAMPS and Analog Ics, "McGraw Hills

2. Fiore J.M , OPAMPS and Linear Ics , delmer-Thomson",USA 2001.

ECP308 Analog Circuit Design [(0-0-2); Credits: 1] Top

Course Outcomes:

Students should

1. Have good knowledge about operational amplifiers.
2. Learn about various ICs such as 741 and 555.
3. be able to design op-amp based circuits required in embedded system design, communications, instrumentation etc
4. be able to simulate circuits using multisim tool.
5. know about analog filter design.

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

List of experiments:

• Design Experiments

1. op-amp characteristics (02-03 experiments)
2. linear applications of op-amp (3-4 experiments)
3. non-linear applications of op-amp (3-4 experiments)
4. 4) filter design (2-3 experiments)
5. based on IC555 (2-3 experiments)

• Simulation Based Experiments

1. linear applications of op-amp using multisim or T-spice
2. non-linear applications of op-amp using multisim or T-spice
3. IC555 using multisim or T-spice

ECL312 Control Engineering [(3-0-0); Credits: 3] Top

Pre-requisite:ECL308

Course Outcomes

1. Study about the modelling of the linear dynamic systems.
2. Understand the concept of stability of system.
3. Analyse the systems in time and frequency domain.
4. Gain the knowledge of state space modelling of system and its analysis.
5. Use the concept of feedback to improve the system performance

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

Contents:

Review of control system components, Open loop and closed loop systems, mathematical modeling and representation of physical systems, transfer functions for different type of systems, block diagram reduction, Signal flow graphs and Mason's gain formula reduction.

Time response characteristics, transient response of first order, second order and higher order systems, Steady state errors, Performance analysis for P, PI and PID controllers

Introduction to stability, Routh Hurwitz stability criterion, Root locus plots, stability margins

Frequency response analysis: Nyquist stability criterion, Bode plots and stability margins in frequency domain. Basics of control design, the proportional, derivative and integral actions. Design using Root locus ad bode plots, effect of zeros, minimum and non-minimum phase systems.

Compensation Techniques: Introduction of compensation techniques, lag, lead and lag-lead networks, design of compensation network using time response and frequency response of the system Feedback compensation using P, PI, PID controllers

State model of linear time invariant (LTI) systems, transfer function from ordinary differential equations, canonical variable diagonalization, system analysis by transfer function and state space methods for continuous and discrete time systems convolution integral; State transition matrices and solution of state equations for continuous and discrete time systems.

Concept of controllability and observability, definitions, state and output controllability and observability tests for discrete systems. Effect of state feedback on controllability and observability, design via state feedback full order observer, reduced order observers design of state observers and controllers.

Text Books

1. Nagrath I. J. and Gopal M., “Control System Engineering”, 5th Ed, 2008
2. Private Ltd. Kuo B. C., “Automatic Control Systems”, 8th Ed., Wiley India. 2008.
3. Ogata K., “Modern Control Engineering”, 4th Ed., Pearson Education. 2008.
4. Dorf R. C. and Bishop R. H., “Modern Control Systems” Pearson Education. 2008.
5. Norman S. N., “Control Systems Engineering”, 4th Ed., Wiley India. 2008.

ECP312 Control Engineering [(0-0-2); Credits: 1] Top

Course Outcomes:

Student will

1. Be familiar with various components used in building control systems.
2. Analyze any transient response and frequency response of different order systems.
3. Check for stability.
4. Learn simulation of control system using software tools.
5. Study the lead and lag networks using discrete components.

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

List of Experiments:

1. Control system simulation using MATLAB and Simulink
   (a) To study the command on control system toolbox in MATLAB and solve nonlinear differential equation using the ODE command in MATLAB
2. To study the characteristics of Potentiometer as an error detector.
3. To Study transient response of second order R-L-C Circuit using discrete components.
4. To study the effect of addition of pole to the second order closed loop control discrete components.
5. Experimental determination of transfer function of lead and lag network
   To draw the Bode plot and obtain the transfer function of lead and lag networks and compare the results with theoretical plots.
6. To Study the effect of PID controller using a Kit.
7. To study the level control system and tune the PID parameters.

ECL403 Embedded Systems [(3-0-0); Credits: 3] Top

Pre-requisite:ECL203

Course Outcomes

Students will

1. understand importance of Embedded Systems in Real life, Engineering and Industrial applications and also to observe importance of embedded processors over general systems, consolidate theoretical concepts of Embedded Systems and microcontrollers architecture.
2. learn, practice and implement programming using concepts of microcontroller.
3. learn peripherals, interfacing and their programming to solve prototype problems.
4. design Real life/ Engineering and Industry problems using Embedded Systems.
5. learn, understand concepts of ARM (Advance RISK machine) and RTOS (Real Time Operating System)

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

Contents:

Introduction to embedded systems, microcontrollers 8051 family, architecture, register set, instruction set, programming, interrupts, stack, timers on-chip and off chip peripherals interfacing and programming, Keys, keyboards, LEDs, 7Seg multiplexed display interfacing, ADC,DAC, Stepper motor LCD dot matrix interfacing, Serial communication, sensors and actuators, instrumentation amplifier, Design examples , introduction to ARM, features, architecture, instruction set features, Concepts of RTOS.

Books

1. M A Mazidi, J G Mazidi, R D McKinlay, The 8051 Microcontroller and Embedded Systems Using Assemble and C, Pearson/Prentice Hall, 2nd Ed
2. Kenneth Ayala, The 8051 Microcontroller, Cengage learning, India, 2004 3rd Ed
3. Lyla B Das; Embedded Systems and Integrated Approach, Pearson, India, 2013, first edition,
4. K M Bhurchandi, A K Ray, Advanced microprocessors and Peripherals, McGraw Hill Education India, 2012, 3rd ed

5. Rajkamal, Microcontrollers, Archi, Progr, interfacing and Sys design, Pearson, India, 2nd ed, 2012

6. K V Shibu, Introduction to Embedded Systems, Tata McGraw Hill Education, India, 2009

ECP403 Embedded Systems [(0-0-2); Credits: 1] Top

Course Outcomes:

1. implement and test numerical programs on Keil 8051 and the hardware platform.
2. interface simple peripherals like Keys, LED's, etc. with 8051 with loading considerations.
3. interface higher level peripherals like 7-Segment Displays, MUX Displays, Keyboards, etc. also DAC, ADC and understand the timing and loading considerations.
4. Form a simple but complete Embedded System product with LCD, and with other peripherals.
5. Understand any five embedded system products using internet knowledge survey.

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

List of Experiments:

1. Write an assembly language program to find largest and smallest number in an array using Keil software.
2. Write an assembly language program to find Least Common Multiple (LCM) and Greatest Common Divisor (GCD) of two given numbers using Keil software.
3. Write an assembly language program to find HCF of five numbers in an array using Keil software.
4. Write an assembly language program to generate Fibonacci Series using Keil software.
5. Write an assembly language program to sort an array in ascending and descending order using Keil software.
6. Write an assembly language program to find sum and count of numbers divisible by 4 using Keil software.
7. Write an assembly language program to find the given number is prime using Keil software.
8. Write an assembly language program to interface LED with 8051 microcontroller using Keil software.
9. Write an assembly language program to interface 7 segment LED display with 8051 microcontroller using Keil software.

10. Write an assembly language program to interface HEX Keypad with 8051 microcontroller using Keil software.
11. Write an assembly language program to interface Digital to Analog Convertor (DAC) with 8051 microcontroller
    i. To generate Square Wave
    ii. To generate Triangular Wave
    iii. To generate Saw-tooth Wave
12. Write an assembly language program to interface stepper motor with 8051 microcontroller.
13. Write an assembly language program to interface servo motor with 8051 microcontroller.
14. Write an assembly language program to interface DC motor with 8051 microcontroller.
15. Write an assembly language program to interface LCD module with 8051 microcontroller.
16. Write an assembly language program to generate PWM signal.
17. Programming with Embedded Boards: ATMEGA / PIC / ARDUINO / Beagle Board.
18. Projects with Embedded Boards: ATMEGA / PIC / ARDUINO / Beagle Board.

ECL301 Analog Communication [(3-1-0); Credits: 4] Top

Pre-requisite: ECL 211

Course outcomes

Students will

1. understand issues related to transmission of signals through communication channels
2. understand analog communication systems using amplitude modulation and demodulation.
3. understand analog communication systems using angle modulation and demodulation.
4. Be familiar with analog radio transmitters and receivers.
5. be familiar with analog pulse communication systems.

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

Contents:

Signal Analysis: Fourier Series representation of periodic signals, Fourier transform, Properties of Fourier transform, Convolution, Analysis of Linear time invariant system.

Transmission of signals through systems: Criteria for distortion less transmission, ideal filters, distortions in practical systems, power and energy of signals.

Amplitude modulation: Need of modulation, AM DSB-SC, SSB-SC and vestigial side band modulation and demodulation, AM transmitter (broadcast and low power), FDM.

Angle modulation: FM and PM, reactance FET modulator Armstrong method, Foster- Seely discriminator, PLL detector, Stereophonic FM, Spectrum of FM, Narrow band and wide band FM, FM transmitter (broadcast and low power).

Radio receivers : TRF and super-heterodyne receiver, AGC, FM receiver, sensitivity, selectivity, image frequency rejection measurements, block schematic of communication receiver and its special features. Transceivers for wireless mobile communication devices.

Analog pulse modulation: Sampling theorem, PAM, PWM, PPM, generation & detection of these pulse modulated signals, TDM, Noise in communication systems.

Books

1. Haykin Simon; Introduction to Analog & Digital Communication Systems; John Wiley

2. Lathi B.P.; Modern Analog & Digital Communication Systems; John Wiley

3. Kennedy; Electronic Communication Systems; TMH

4. Frenzel Louis; Communication Electronics (3e); TMH

5. Gandhi Abhay; Analog and Digital Communication, Theory and Lab Work, Cengage Learning

6. Schoenbeck, “Electronic Communication Modulation and Transmission”, PHI

ECP301 Analog Communications [(0-0-2); Credits: 1] Top

Course Outcomes:

Students will

1. be able to use laboratory instruments such as analog & digital oscilloscopes and spectrum analyzer.
2. verify the spectra of commonly used test signals and transfer functions (magnitude) of various analog filters.
3. be able to characterize modulated signals such as AM, FM, PAM, PPM and PWM.
4. gain working knowledge of various modulators and demodulators.
5. Gain working knowledge of radio transmission and reception

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

List of Assignments in Analog Communication

Assignments No. 1

Testing of Analog oscilloscope & function generator

Objectives

- Probe checking using ‘calib’ o/p of scope.
- Difference between ALT and CHOP mode.
- Observing various triggering modes.
- Observing waveforms of function generator.

Assignments No. 2

Testing of digital oscilloscope & function generator

- Probe checking and calibration/adjustment/compensation.
- Study of trigger menu/auto setting
- Observing waveforms of function generator O/P.

Assignments No. 3

Testing of Spectrum analyzer

- Observing 48 MHz test signal.
- Testing of cable using tracking generator.
- Harmonics of sine, square & triangular waves.

Assignments No. 4

To perform different parameter measurement using Spectrum Analyzer HM-5014.

- To measure frequency and level of a given unknown signal.
- To measure frequency of TV transmission signal.
- To measure harmonics of sine wave.
- To measure harmonics of square wave.
- To measure harmonics of triangular wave.

Assignments No. 5

To analyze responses of various filters for estimation of cut off frequencies using Spectrum Analyzer.

- To check frequency response of a 'LOW PASS' Filter.
- To check frequency response of a 'HIGH PASS' Filter.
- To check frequency response of a 'BAND REJECT' Filter.
- To check frequency response of a 'BAND PASS' Filter.
- To check frequency response of a 'High Frequency DC coupled Amplifier'.

Assignments No. 6

To perform channel parameter measurement for an A-V signal using Spectrum Analyzer.

- To observe channel Modulator output on Spectrum Analyzer.
- To observe Mixer output on Spectrum Analyzer.

Assignments No. 7

DSB/SSB Transmitter-Receiver Trainer ST 2201 & 2202

To formulate full AM generation and study technique of AGC also to study working of AM detector and DSB-SC generator of estimate modulation index for different settings.

- Double Sideband AM Generation.
- To calculate modulation index of DSB wave by trapezoidal pattern.
- Double Sideband AM Reception.
- Study of Diode Detector .

Assignments No. 8

DSB/SSB Transmitter-Receiver Trainer ST 2201 & 2202

To estimate performance improvement because of SSB AM generation and to study it's demodulation.

- Single Sideband AM generation.
- Single Sideband AM reception.
- Operation of the Automatic Gain Control (AGC) circuit.

Assignments No. 9

Frequency Modulation and Demodulation Trainer ST2203

To study different FM generation techniques under direct category.

- To study frequency modulation using Varactor modulator.
- To study frequency modulation using Reactance modulator.

Assignments No. 10

Frequency Modulation and Demodulation Trainer ST2203

To analyze and compare working of different FM detectors.

- To study operation of Detuned resonant circuit.
- To study operation of Quadrature detector.
- To study operation of Phase-Locked Loop detector.
- To study operation of Foster –Seeleye detector.
- To study operation of Radio detector.

Assignments No. 11

DSB/SSB Transmitter-Receiver Trainer ST 2202

To estimate three basic parameters of an AM receiver by studying it's working.

- To plot selectivity curve for radio receiver.
- To plot sensitivity curve for radio receiver.
- To plot fidelity curve for radio receiver.

Assignments No. 12

PAM, PPM, PWM, Modulation Trainer ST 2110

To verify sampling theorem and study PAM with different styles of sampling.

- To study Pulse Amplitude Modulation (PAM) using Natural and Flat top sampling.
- To study PAM using sample and hold sampling.
- To study PAM and Demodulation with sample ,sample and hold and flat top.

Assignments No. 13

PAM, PPM, PWM, Modulation Trainer ST 2210

To study PPM (time modulation) and demodulation for various signals.

- To study PPM using DC input.
- To study PPM using Sine wave input.
- To study PPM Demodulation.

Assignments No.14

PAM, PPM, PWM, Modulation Trainer ST 2210

To analyze (time modulation) PWM and demodulation.

- To study PWM using different sampling frequency.
- To study Pulse Width Demodulation.

Assignments No. 15

PAM, PPM, PWM, Modulation Trainer ST 2210

To formulate voice transmission using all types of Pulse modulation technique.

- To study Voice Link using Pulse Amplitude Modulation.
- To study Voice Link using Pulse Position Modulation.
- To study Voice Link using Pulse Width Modulation.

ECL204 Measurement and Instrumentation [(3-0-0); Credits: 3] Top

Pre-requisite:

Course Outcomes :

1. Understand and respond to the need for rigorous and formal metrology concepts in designing measurement system.

2. Underastand the errors in measurements and their rectification.

3. Apply the knowledge to select and identify specific sensors (or complete instruments) for controlling machines and processes.

4. Understand the operating principles of a range of widely used instruments.

5. Design of signal conditioning circuit for measurement systems.

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

Contents:

Accuracy and precision, Significant figures, Types of errors, statistical, Probability of errors, Limiting errors. Functional elements of an instrument, Active and Passive transducers, Analog and Digital mode of operation, Null deflection methods,

Input and output configuration of measuring instrument and instrument system. Wheat stone bridge : Basic operation, measurement errors, Thevenin's equivalent circuit, Guarded Wheat-stone bridge, Kelvin bridge: Effects of connecting leads, Kelvin double Bridge. AC Bridges and their application: Condition and application of the balance equation. Maxwell's bridge, Hay Bridge, Schering Bridge, Wein Bridge unbalanced condition. PMMC galvanometer, DC ammeters , Ohmmeter: Series and shunt type, VOM, watt hour meter,

instrument transformers power factor meter, Q- meter. Transducers as input elementsto instrumentation system. Basic methods of Force measurement, Torque measurement of rotating shafts, shaft power measurement (Dynamometers)

Pressure and Sound Measurement : Standards and calibration, Basic methods of pressure measurement, high pressure and low-pressure measurement, sound measurement. Temperature and Heat Measurement: Standards and calibration, Thermal expansion methods, Thermocouples

(Thermoelectric sensors), Resistance thermometers Junction semiconductors sensors, Digital thermometers. Heat-flux sensors, Radiation types. Strain Measurement: Bonded and un-bonded electrical strain gauges, gauge factor, temperature compensation methods.

Introduction, Amplified DC meter, AC voltmeter using rectifiers, Electronic multi-meter, Digital voltmeters, Q meter. Oscilloscope : Introduction, Oscilloscope block Diagram, Cathode Ray tube (CRT), CRT circuits, Deflection systems, Delay line. Multiple trace , Simple frequency counters. Strip XY recorder, CRO, signal conditioning Techniques used in various transducers, Gain clipping, filtering, amplification, data logger.IEEE488Bus: Principles of operation, protocols

Text Books

1. Albert.D. Helfrick and William. D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques ", Pearson education

2. Earnest .O Doeblin, "Measurement Systems Application and Design", McGraw Hill International editions, the edition, 1990.

Reference books

1. R1. John P. Bentley, Principles of Measurement Systems, Third edition, Addison Wesley Longman Ltd., UK, 2000

2. R2. A.K.Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanapat Rai & Sons, 2000.

3. R3. A.J.Bouwens, "Digital Instrumentation", McGraw Hill, 1986.

4. R4. Geroge C. Barney, "Intelligent Instrumentation",IEEE, 1992.

5. R5. H. S. Kalsi, "Electronic Instrumentation", Tata McGraw Hill Publishing Company Ltd., 1995

ECP204 Measurement and Instrumentation [(0-0-2); Credits: 1] Top

Course Outcomes:

1. Design and validation of DC and AC bridges.
2. Study the dynamic response and the calibration of few instruments
3. Learn about various measurement devices, their characteristics, their operation and their limitations
4. An understanding of statistical data analysis for instruments
5. An understanding of computerized data acquisition for instrument design.

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

List of Experiments:

1. Study the Characteristics of LVDT.
2. Study the Characteristics of Pressure Cell.
3. Torque Measurement.
4. Strain Measurement.
5. Linear regression (basic fitting) using MATLAB
6. Design filtering algorithms for noise measurement
7. Study Characteristics of Thermistor and design signal conditioning circuit.
8. Capacitance measurement using Differentiator Circuit.
9. Design of R-2R Digital to Analog Conversion.
10. Mini Project: Traffic Control System using Piezo Electric Sensor.

ECL405 Waveguides and Antennas [(3-0-0); Credits: 3] Top

Pre-requisite:ECL305

Course Outcomes

1. Be able to understand and analyse guided wave propagation.

2. Be able to analyze and design transmission line based systems and components.

3. Be familiar with radiation theory, antenna theory and terminology.

4. Be able to achieve proficiency of antenna array analysis and design.

5. Be conversant with various types of antennas and related technologies for different applications.

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

Contents:

Revision of Maxwell's equations for time varying fields and physical significance of Curl, Divergence and Gradient. Waves between parallel planes, TE, TM,& TEM and their characteristics. Attenuation in parallel plane guides wave impedances. TE, TM waves and impossibility of TEM mode in Rectangular waveguide. Different characteristics like group velocity, phase velocity, guide wavelength and wave impedances.

Transmission line equations and their solutions. Transmission line parameters, Characteristic impedances, Propagation constant, Attenuation constant, Phase constant, Waveform distortion, Distortion less transmission lines, Loading of transmission lines, Reflection coefficient and VSWR. Equivalent circuits of transmission lines, Transmission lines at radio frequency. Open circuited and Short circuited lines, Smith Chart, Stub matching.

Scalar and vector potentials related potentials, field due to a current element, power radiated and radiation resistance for field due to a dipole, power radiated and radiated resistance. Reciprocity theorem applied to antennas. Antenna terminology: Gain, Aperture, Radiation intensity, Directivity, Directive gain, Beam width, Radiation patterns, FBR, Antenna bandwidth etc.

Concept of antenna arrays, Two element arrays and their directional characteristics, Linear array analysis, Broadside and end fire arrays, Principles of pattern multiplication & their application.

Polynomial representation, Binomial arrays, Design of broadcast array for a specific pattern, Chebyshev array synthesis.

Analysis of power patterns of various antennas like Parabolic reflectors, Lens antenna, folded dipole, Turnstile antenna, Yagi antenna, Log-periodic antenna, Horn antenna & feeding, Traveling wave antenna, Printed antennas, Case grain antenna, Patch & Micro strip antennas, Superconducting antenna, Rhombic, Helical, Open ended waveguide radiator, Small design problems & applications.

Signal processing antennas or smart antenna, DOA, Principle beam formation & Digital beam formatting, Switched beam systems, Adaptive antennas, introduction to concepts of various signal processing algorithms, Principle of special filtering, Antenna diversity, TRB, SRB and Nulling of interference. Introduction to antenna measurement methods: measurement of Gain, Radiation pattern, Time domain gating, Antenna noise temperature & G/T, Impedance & Bandwidth. Introduction to measurement of cellular radio handset antenna.

Text Books

1. “Antennas and Wave Propagation”, K.D.Prasad, Khanna or Satya Publications
2. “Electromagneting waves and radiating systems”, Jhordan & Balmin, Pearson

Reference Books

1. “Electromagnetic field theory and transmission lines”, Raju, Pearson
2. “Antennas and wave propagation”, Raju, Pearson
3. “Antennas for all applications”, Kraus,TMH
4. “Elements of electromagnetism”, Sadiku, Oxford
1. “Electromagnetic Waves”, Shevgaonkar,TMH

PHL208 Physics of Semiconductor Devices [(3-0-0); Credits: 3] Top

Pre-requisite:-

Course Outcomes

Students will

1. Understand the physics and properties of various semiconductor devices.

2. Understand device operation with more emphasis than circuit properties.

3. Know the physics of semiconductor junctions, metal-semiconductor junctions and metal-insulator semiconductor junctions.

4. Understand the fundamental principles and applications of modern electronic and optoelectronic semiconductor devices.

5. Gain updated knowledge in the most advanced development of low dimensional semiconductor hetero-structures and their applications.

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

Contents:

Physics and properties of semiconductors: Crystal structure energy bands, carrier concentration at thermal equilibrium, carrier transport phenomenon, phonon spectra, optical thermal and high field properties of semiconductors. Basic equation for device operation. P-n junction diode, basic device technology, depletion region and depletion capacitance, current voltage characteristics, junction breakdown, heterojunctions. Schrodinger wave equation for a finite potential step, metal semiconductor contacts, energy band relations, depletion layer, Schottky effect, current transport processes, thermionic emission, diffusion, tunneling current, minority carrier injection ratio, characterization of barrier height, measurement of barrier height, device structures, ohmic contact. Photonic devices: radiative transitions, LED and semiconductor lasers, photoconductor, photodiode, solar cells.

References

1. Physics of semiconductor devices, S.M. Sze, John Wiley and Sons, 2001.

2. Semiconductor physics and devices, S.S. Islam, Oxford University press.

CSL311 Computer Architecture and Organization [(3-0-0); Credits: 3] Top

Pre-requisite:ECL203

Course Outcomes

Students will

1. help to learn how computers work

2. know in depth principles of computer's working

3. be able to analyze the performance of computers

4. know how computers are designed and built

5. have understanding of issues affecting modern processors (caches, pipelines etc.).

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

Contents:

Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines.

Processor organisation, Information representation, number formats.

multiplication & division ALU design, Floating Point arithmetic, IEEE 754 floating point formats

Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit

Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory,.

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces

Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network

Books

1. Computer Organisation,V.Carl Hammacher,Fifth Edition.

2. Structured Computer Organisation,A.S.Tanenbum,PHI,Third edition

3. Computer Organisation and Microprogramming,"Y.Chu, II, Englewood Chiffs, N.J.",Prentice Hall,Edition

4. Computer System Architecture,M.M.Mano,Edition

5. Computer Organisation and Programming,C.W.Gear,"McGraw Hill, N.V",Edition

6. Computer Architecture and Organisation,Hayes J.P,PHI,Second edition

ECL310 CMOS Design [(3-0-0); Credits: 3] Top

Pre-requisite:ECL201

Course Outcomes

Students will

1. know fundamental principles of VLSI (Very Large Scale Integrated) circuit design and layout.

2. have an overview of CMOS fabrication technologies, physical VLSI design issues (bottom-up design), basic CMOS logic gates,

3. be familiar with architectural building blocks and system design (top-down design), with a stronger emphasis on physical design principles.

4. know building blocks of large-scale CMOS digital integrated circuits

5. have hands-on design experience using a professional IC design platform.

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

Contents:

CMOS Design Introduction: Flow of circuit design, Fabrication Process Flow: Basic Steps, Layout Design Rules

CMOS Digital Circuits: Inverters, Static logic gates, Transmission gates and Flip-Flops, Dynamic logic Gate. Memory Circuits.

CMOS Analog Circuits: MOS Analog models, Current Sources and sinks, References, amplifiers, Differential Amplifiers, Operational Amplifiers.

CMOS Mixed- Signal Circuits:

Data converter: Fundamentals and Converter architectures.

Reference Books

1. Behzad Razavi, “Fundamentals of Microelectronics”, 2nd Edition, March 2014.

2. Behzad Razavi. 2000. Design of Analog CMOS Integrated Circuits (1ed.). McGraw-Hill, Inc., New York, NY, USA.

3. “CMOS Circuit design, Layout and Simulation”, R. J. Baker, H W Li, D. E. Boyce, PHI EEE

4. “Principles of CMOS VLSI Design”, Neil H. E. Weste, Kamran Eshraghian, Addison Wesley

5. “Basics of CMOS Cell Design”, Etienne Sicard

6. “Circuit Design for CMOS VLSI”, John P. Uyemura

7. “CMOS Circuit Design, Layout, and Simulation”, R. Jacob Baker, 3E.

8. “CMOS Digital Integrated Circuits: Analysis and Design,” Sung- Mo (Steve) Kang and Yusuf Leblebici

ECL311 Automotive Electronics [(3-0-0); Credits: 3] Top

Pre-requisite:ECL308 and ECL203

Course Outcomes

Students will

1. be able to identify various systems and sub-systems in automobiles
2. describe applications of electronics in various systems in automobiles
3. be conversant with various industry standards in automotive industry
4. be able to design embedded systems for automobiles
5. be familiar with advancements taking place in the field of automobiles

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

Contents:

Fundamentals:- Engines, Fuel systems, Steering, Suspension & braking system, Transmission system, passenger amenities like air conditioning ,anti theft & safety systems.

Electrical systems in automobiles:- Charging , Alternators & motors &their applications ,wiring technology components , lightning systems ,dash board instruments.

Engine Control systems: - Microcomputer instrumentation &control, basics of electronic engine control, sensors, actuators, digital engine control systems, engine mapping for optimum performance.

Vehicle motion control:- Antilock braking ,electronic power steering, advanced suspension automatic transmission, cruise control.

Integration of control systems:- Embedded real time controllers ,diagnostics, ISO 9141-2,vehicle networks CAN bus ,LIN,TTCAN & FTTCAN, hardware design using embedded controllers ,microprocessors and FPGA's.

Advances in automobile technology :- Navigation aids, driver information systems, anti-collision systems, intelligent transport systems, hybrid engine vehicles, alternative fuel technologies, emission control systems & regulations onboard diagnostics.

Books

1) William Ribbens, “Understanding Automotive Electronics” (6E)- Elsevier.

2) Bolton, “Mechatronics (3E)” Pearson.

3) Necsulescu, “Mechatronics” Pearson.

4) Crouse & Anglin, “Automotive Mechanics”,

ECL414 Electronic Product Design and Reliability [(3-0-0); Credits: 3] Top

Pre-requisite:-

Course Outcomes

Students will

1. Be familiar with process of defining product specifications
2. Be familiar with impact of various technical and non-technical aspects on product design
3. Be able to define goals of product design
4. Be able to identify factors affecting reliability of the product
5. Be conversant with data analysis methods for reliability improvement

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

Contents:

An introduction to electronic product design: Product development management, establishing needs and specifications, Exploiting the market opportunity

System design, costs and product development, Packaging, noise and heat management, Fundamentals of PCB and PCB design, Hardware design and testing methods, Product documentation

Introduction to design for manufacture, design for testing

Design for reliability, Generic stress factors and de-rating, Selection and application of components Failure mode and effects analysis, failure data management and analysis Reliability evaluation of equipment

Books

1.V. S. Bangad, "Electronic Product Design",Technical Publications Pune

2.James Angus, Anthony Ward,"Electronic Product Design",CRC Press

3.R.G. Kaduskar, V.B. Baru,"Electronic Product Design",Wiley

4.Natarajan, Dhanasekharan, "Reliable Design of Electronic Equipment,An Engineering Guide",Springer

5.Norman B. Fuqua,"Reliability Engineering for Electronic Design",Jenson Books Inc.

ECL415 Electronics System Design [(3-0-0); Credits: 3] Top

Pre-requisite:ECL201 and ECL308

Course Outcomes

1. Understand the basic principles and operations of devices such as Bipolar Junction Transistors, Operational Amplifiers, Filters, Data converters (D/A, A/D), Timer and Power Supply Systems
2. Analysis and modelling of circuits for the given specifications
3. Understand the complex behavior of the circuits using mathematical techniques
4. Understand various applications of the analog integrated circuits
5. Study and analyze the function generators and oscillators

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

Contents:

Design of Power supply system: Unregulated D.C. power supply system with rectifiers and filters. Design of emitter follower regulator, series regulators, overload protection circuits for regulators. Design of SMPS: Step up and step down.

Design of class A small signal amplifiers: Emitter follower, Darlington pair amplifiers with and without Bootstrapping, Two stage direct coupled amplifier. Design of class A, Class AB, audio power amplifier with drivers.

Design of sinusoidal oscillators: OPAMP based Wein bridge and Phase Shift oscillators with AGC circuits, Transistor based Hartley, Colpittsand Crystal oscillators, Evaluation of figure of merit for all above oscillator circuits.

Design of constant current sources, Design of function generators, Design of tuned amplifiers. Design of A/D and D/A converters.

Design of Butterworth, Chebyshev filters upto sixth order with VCVS and IGMF configuration.

Text Books

1 Regulated Power supply Handbook, Texas Instruments

2. Angelo, Electronics: BJT's, FETS and Microcircuits, 1969 edition, Mcgraw-Hill

Reference Books

1. Goyal&Khetan, Monograph on Electronic circuit Design,Fifth edition, Khanna publishers

2. Tobey, Grame, Huelsman, Operational Amplifiers, 1971 edition, McGraw-Hill

ECL307 Statistical Signal Processing [3-0-0; Credits: 3] Top

Pre-requisite:ECL211 and MAL205

Course outcomes

1. After completing this course, the student must demonstrate the knowledge and ability to:
2. Understand the concepts of random signal processes.
3. Model the random processes.
4. Apply the concepts of random signals to Signal Processing and Digital Communications.
5. Develop simulation model for the random signals and processes.

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

Contents:

Representation of random signal processes, Random variables and expectations, Random processes, Concept of Stationarity, Correlation and Covariances, Frequency domain representation of random signals, Weiner-Khinchin theorem, Ergodicity, Finite Dimensional representation of random processes.

Signal space Representation: Vector space concepts, Eigenvectors, Inner product spaces, Signal space representation, Discrete signal representation, Complete orthonormal sets.

Simulation methods for random processes, Monte-Carlo Simulations.

Text Books

1. L. E. Franks , “Signal Theory”, Prentice Hall.
2. Haykin, “Adaptive Filter Theory”, Pearson Education
3. Papoulis, ‘”Probability Theory and Random Variables”, Mc Graw Hill

Reference Books

1. Oppenheim, “Signals Systems, and Inference” , Pearson
2. Gallager, “Stochastic Processes” , Cambridge

ENL302 Device Modeling [(3-0-0); Credits: 3] Top

Pre-requisite:ECL201

Course outcomes

Students will

1. Have an introduction to numerical modeling of semiconductor devices

2. Understand the physical, electrical, and optical properties of semiconductor materials and their use in microelectronic circuits.

3. Be able to analyze the relation of atomic and physical properties of semiconductor materials to device and circuit performance issues.

4. Understand the connection between device-level and circuit-level performance of microelectronic systems.

5. Perform analysis of device structures and behaviors using modeling software.

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

Contents:

Introduction to SPICE Simulation, Analysis of complex electronic circuits, simulation and analysis using SPICE, AC/DC operation, DC sweep transfer function, frequency response, feedback control analysis, transient response, device models, simulation and analysis of electronic circuits and systems.

Review of semiconductor physics, The pn junction, , The built-in voltage, Depletion width and junction capacitance, Diode current/voltage characteristic, Minority carrier charge storage.

MOS transistors, Threshold voltage and the body effect, Current/voltage characteristics, Subthreshold current, Short channel effect and narrow width effect, Drain induced barrier lowering Channel length modulation, Hot carrier effects, Effective mobility and velocity saturation

SPICE models, MOS inverter circuits

Bipolar transistors, Current gain, Gummel plots and output characteristics, Recombination in the emitter/base depletion region, Charge storage and forward transit time, Cut-off frequency, TTL gates.

Basic SPICE Models, Ebers-Moll and basic Gummel-Poon model, Small-signal model, Parameter extraction

References

1. “Solid State Electronic Devices”, “B. G. Streetman and S. Banerjee”, Prentice Hall India

2. “Analysis and Design of Digital Integrated circuits”, “D. A. Hodges, and H. G. Jackson” , McGrraw-Hill International

3. “Introduction to VLSI circuit and systems”, “J.P.Uyemura”, John Wiley and Sons

4. “Fundamentals of Modern VLSI devices”, “Y.Taur, T.H.Ning”, Cambridge University Press

5. “Principles of CMOS VLSI design , A systems perspective”, “Eshraghian K”, Addison Wesley.

ENP302 Device Modeling [(0-0-2); Credits: 1] Top

Course Outcomes:

Students will

1. Have an introduction to designing and modeling of semiconductor devices

2. Understand modeling of semiconductor devices and deal with the advanced concepts in semiconductor electronic devices.

3. Understand the physical and electrical properties of semiconductor devices and their use in microelectronic circuits through simulations.

4. Understand the device/circuit co-design issues for the implementation of microelectronic systems.

5. Perform analysis of device structures and behaviors using modeling software.

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

List of Experiments:

1. Design and simulation of rectifiers. a) Half-wave rectifier b) Half-wave rectifier with capacitor filter. c) Full-wave rectifier d) Bridge rectifier.

2. Plot the output response of clipper and clamper circuits a) Positive clipper. b) Negative clipper c) Combination clipper d) Clamper

3. Design and simulation of RC phase shift oscillator

4. Plot output response of following op-amp based circuits a) inverting and non-inverting amplifier. b) integrator. c) differentiator.

5. Design and simulation of static CMOS logic circuits a) Inverter b) NAND gate c) NOR gate

6. Realize a 1-bit full adder using half adder and NAND gates as sub-circuits.

7. Realize a 4-bit Full adder using four 1-bit full adder as sub-circuits.

8. Plot the output response of a level triggered and edge triggered D- Flip-Flops.

9. Extract parasitic capacitances of NMOS and PMOS transistors.

10. Study the impact of channel length, width and power supply variations on rise time and fall time of an inverter. Further, investigate the impact of these parameters on static and dynamic power.

11. Perform transient and ac analysis of CE amplifier and plot the magnitude and phase response.

ECL303 Digital Communication [(3-0-0); Credits: 3] Top

Pre-requisite:ECL301

Course outcomes

Students will

1. be able to describe concepts of information theory and their applications to efficient coding of speech, audio, image and video signals.

2. be able to describe applications of information theory in efficient coding of data sources.

3. be able to critically think and solve problems related to digital transmission and reception in baseband format.

4. be able to critically think and solve problems related to digital transmission and reception in modulated format

5. be able to describe applications of information theory to error control coding.

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	2	-	-	-	-	-	-	-	1
CO4	3	3	2	2	-	-	-	-	-	-	-	1
CO5	3	3	1	1	-	1	-	-	-	-	-	1

Contents:

Introduction to digital communication. Comparison of analog and digital communication. Advantages and disadvantages of digital communication.

Source Coding of Analog Sources: PCM-TDM, Practical PCM-30 system, Delta modulation, Adaptive DM, DPCM, ADPCM.

Source coding of digital sources: Information, entropy, Shannon's source coding theorem, Huffman algorithm, prefix codes.

Generalized digital communication system, geometric interpretation of signals, performance of matched filter receiver and correlator receive in the presence of white noise. Threshold setting and error probability.

Base band transmission: Line coding fundamentals, transmission formats, spectral requirements.

Media used for digital communication; storage and transmission, guided and unguided. types of noise and other impairments. Inter-symbol interference, Nyquist's results for ISI, Eye pattern and adaptive equalization.

Pass-band transmission methods: Binary ASK, PSK and FSK, Quadrature multiplexing, QPSK and QAM methods. Geometric interpretation of signals, performance of matched filter receiver and correlator receive in the presence of white noise.

Spread spectrum methods: Properties of PN sequences, DSSS system, slow and fast FHSS. Block diagrams and performance analysis, carrier and symbol synchronization.

Case studies of transmission methods in telecommunications and computer networking. For example XDSL, 802.3 LANs, WiFi LANs, GSM, CDMA and OFDM based mobile wireless networks.

Error control coding: Shannon's channel capacity theorem, significance of the theorem. Linear block codes generation and decoding, Hamming distance considerations, Cyclic codes and their applications, Convolutional codes and Viterbi decoding algorithm.

Data link layer protocols; ARQ and sliding window protocols; flow control methods; elementary analysis of protocol correctness and performance; Case studies of HDLC and PPP.

Books

1. Abhay Gandhi, "Analog and Digital Communication, Theory and Lab Work", Cengage Learning

2. Haykin Simon; "Introduction to Analog & Digital Communication Systems";John Wiley,Edition

3. Lathi B.P, "Modern Analog & Digital Communication Systems", John WileyEdition

4. Haykin Simon, "Digital communication" ,WileyEdition

5. Haykin, Simon, "Communication systems ",Wiley,(4e)

6. Proakis John, "Digital communication", Tata- McGraw-Hill,(3e)

ECP303 Digital Communication [(0-0-2); Credits: 1] Top

Course Outcomes:

Students will

1. Be able to analyse simple systems for digital representation of analog signals.
2. Be able to characterize digital transmission in baseband and modulated format
3. Understand receiver design issues in baseband and modulated format.
4. Understand error control coding applied in digital communication
5. Be able to simulate working of digital communication systems through software tools such as Matlab or Scilab.

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

List of Experiments:

1. To perform following experiment on Kit No. ST 2101

a) To observe signal sampling and reconstruction techniques, also verify Nyquist Criteria and aliasing.

b) Analyze the effect of SAMPLE/HOLD circuitry on reconstructed waveform. Also verify effect of sampling pulse duty cycle on the reconstructed waveform in sample and sample hold output.

2. To perform following experiment on Kit No. ST 2101 (Experiment No. 3 of St 2101)

a) To compare the frequency response of 2nd order and 4th order Butterworth Low Pass Filter

3. To perform following experiment 1,2,3 on Kit No. ST 2103 & ST 2104

a) To observe Working of Error Check Code.

b) To Study Analog to Digital conversion.

c) To observe control signal and their timing.

4. To perform following experiment 4,5,6 on Kit No. ST 2103 & ST 2104

a) To perform Time Division Multiplexing.

b) To verify the use of Pseudo Random Sync. Code Generator.

c) To verify the three mode of transmission.

5. To perform following experiment 5,6,7 on Kit No. ST 2103 & ST 2104

a) To verify and use Computer communication using RS 232 interface via ST 2103 & ST 2104.

b) To verify working of multipoint to multipoint Communication using RS 232 interface via 2103 & ST 2104.

c) To verify working of point to multipoint Communication using RS 232 interface via 2103 & ST 2104.

6. To perform following experiment 1,2,3 on Kit No. ST 2105

a) To perform delta modulation and demodulation.

b) To perform and study Adaptive Delta Modulation and Demodulation.

c) To perform Delta Sigma Modulation and Demodulation.

7. To perform following experiment 1 To 7 on Kit No. ST 2106 & ST 2107

a) To Study NRZ (L) Code

b) To verify NRZ (M) Code and it's detection

c) To Observe RZ code and it's detection.

d) To observe Biphase (Manchester) Code and it's detection.

e) To observe Biphase (Mark) Code and it's detection.

f) To study RB Code and it's detection.

g) To study AMI Code and it's detection.

8. To perform following experiment 8 & 9 on Kit No. ST 2106 & ST 2107

a) To study ASK modulation and demodulation.

b) To study FSK modulation and demodulation.

9. To perform following experiment 8 & 9 on Kit No. ST 2106 & ST 2107

a) To study PSK & DPSK.

b) To Study QPSK modulation and demodulation.

10. To Observe the Eye diagram (Expt. No. 12 of ST 2106 & ST 2107)

Four experiments on MATLAB simulator & OCTAVE.

ECL313 Digital Hardware Design [(3-0-0); Credits: 3] Top

Pre-requisite:ECL203

Course Outcomes

1. Students will be able to conceptualize combinatorial circuits and sequential circuits.
2. Students will know about design of state machines and memory cell design.
3. The students will get familiar with the process of digital integrated circuit synthesis, together with place and route, starting from HDL code to silicon/gate array level.
4. Students will learn about various hardware descriptive languages such as VHDL and Verilog.
5. Students will be able to develop applications related to digital communication processors

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

Contents:

Review of Combinational circuit design and optimization, fault detection in combinational circuits

Synthesis of synchronous Sequential circuits. Finite state machine, state transition diagrams and state transition tables, ASM charts.

Asynchronous sequential Logic. Memory elements: ROM, PROM, RAM-SRAM, DRAM.

Introduction to Hardware Description Language, Analysis and Synthesis , Array based logic elements (Memory, PLA, FPGA),Special Topics (such as processor design, testing and verification, special digital systems, asynchronous state machines etc.)

Case studies using VHDL: design of DSP processor, Any Digital communication perspective design

Books:

1. Morris mano: Digital Design, Pearson Education
2. Charles H Roth: Digital Systems Design using VHDL, Thomson Learning, 1998
3. H.Taub and D. Schilling, Digital Integrated Electronics, McGraw Hill, 1977
4. D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill, 1983.

5. F.J. Hill and G.L. Peterson, Switching Theory and Logic Design, John Wiley, 1981.
6. Z. Kohavi, Switching and Finite Automata Theory, McGraw Hill, 1970.

ECP313 Digital Hardware Design [(0-0-2); Credits: 1] Top

Course Outcomes:

Students will

1. Gain knowledge about hardware description languages.

2. will learn about VHDL and Verilog syntax.

3. Be able to design digital systems using FPGAs.

4. Will learn simulation and synthesis concept.

5. know about features of HDL desirable by Industry.

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	3	-	-	-	4	1	1	1
CO2	1	-	1	-	3	-	-	-	2	2	2	1
CO3	2	-	-	-	3	-	-	-	2	2	1	1
CO4	1	-	1		2	-	-	-	1	1	1	1
CO5	2	-	2	1	2	1	-	1	1	2	1	1

List of assignments

Development of programs based on

1. dataflow style

2. if-else construct

3. case construct

4. for loops

5. structural style

6. functions and procedures

7. testbench

8. file related operations

ECL404 RF & Microwave Engineering [(3-0-0); Credits: 3] Top

Pre-requisite: ECL305

Course Outcomes

Students will have

1. Familiarity with basic concepts and theory of RF & Microwave Engineering.
2. Ability to demonstrate waveguide components, assemble them.
3. Ability to solve problems on microwave communication system.
4. Ability to design, implement, analyze and maintain a high frequency communication system
5. Ability to get idea about different microwave network circuit.

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

Contents:

Introduction: RF & Microwave spectrum, Historical Background, Typical application of RF & Microwaves,

Microwave Tubes: Limitation of conventional tubes in microwaves, Two cavity and multicavity Klystron, Reflex Klystron, Magnetron, Travelling wave tube, Backward wave oscillator – working principles, characteristics.

Semiconductor Microwave Device: Tunnel diode, Gunn diode, IMPATT diode, TRAPATT diode, Microwave bipolar transistor, hetero-junction bipolar transistor, parametric amplifier

Passive Components: S- matrix, Directional coupler, Bethe-hole coupler, Magic tee, Hybrid ring, Circulator, Isolator.

Microwave Measurement: Measurement of VSWR-Low, Medium and High, Measurement of power, Bolometer, Frequency measurement, Impedance measurement. Application of Microwaves: Introduction to satellite communication, Radar, Industrial application of microwaves.

Books

1. Microwave Devices & Circuits S.Y.Liao Pearson Education/PHI
2. Microwave Engineering ,Monojit Mitra ,Dhanpath Rai New Delhi
3. Microwaves ,K.C.Gupta ,New Age Publishers
4. Microwave Engineering , Kulkarni , Dhanpat Rai New Delhi

CSL312 Concepts in Operating Systems [(3-0-0); Credits: 3] Top

Pre-requisite:-

Course Outcomes

Students will

1. know models of Operating Systems from the uni-processor and multiprocessor perspectives.

2. Know frame of reference on which the existing designs have emerged and the future design possibilities are likely to evolve.

3. Know paradigm that views an Operating System environment in the collective interplay of processes requiring economic resources.

4. gain knowledge about the Operating Systems concepts such as process, main memory management, secondary memory management, CPU and disk scheduling etc.

5. be aware of security issues in operating systems.

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

Contents:

Introduction to Operating Systems, simple batch Systems, time sharing systems etc., computer system structures, I/O structure, storage structure, operating system structures, operating system services, system calls

Process management, Concept of a process, operations on a process, interprocess communication, CPU scheduling, scheduling criteria, scheduling algorithms, process synchronization, critical section problem, synchronization primitives, semaphores, monitors, deadlocks, deadlock prevention, avoidance and detection

Storage Management, memory management, logical vs. physical address space, paging and segmentation, virtual memory, demand paging, page replacement algorithms, thrashing

File system interface, file concept, access methods, directory structure, protection, file-system implementation, allocation methods, free-space management

I/O Systems, I/O hardware, secondary-storage structure, disk structure, disk scheduling, disk management

Protection and security, goals of protection, domain of protection, access matrix, capability based systems, security issues, authentication, encryption

Books

1. Operating System Concepts,"Galvin P.B., Silberchatz A",Wesley

2. Operating Systems,Stallings W,"PHI, New Delhi"

3. Modern Operating Systems,Tanenbaum A.S,"PHI, New Delhi"

ECL420 Smart Antennas [(3-0-0); Credits: 3] Top

Pre-requisite:ECL405

Course Outcomes

Students will

1. Be acquainted with fundamentals and terminology of antenna arrays.
2. Be familiar with working of smart arrays.
3. Be able to utilize various signal processing techniques for smart arrays.
4. Be conversant with smart array implementation for different communication technologies and standards.
5. Be able to assess impact of channel characteristics on antenna arrays.

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

Contents:

Array Antenna Fundamentals: Linear Arrays , Array Weighting, Beamsteered Arrays , Circular Arrays ,Fixed Beam and Sectorized Arrays. Sidelobe Cancellors , Retrodirective Arrays. Smart Antennas, benefits of smart antennas, Adaptive Algorithm Basics , Gradient Based Methods, Howells Applebaum Processor , Adaptive Beamforming Elimination of the Effects of Mutual Coupling on Adaptive Antennas. Adaptive Arrays for CDMA , Waveform Diversity Methods, MIMO ExamplesAngle-of-Arrival Estimation, Array Correlation Matrix ,Bartlett AOA Estimation method ,Capon AOA Estimation method , Spectral Estimation Methods .Channel Characterization ,Channel Impulse Response, Slow Fading; Fast Fading; Fast Fading Modeling ,Spreading , Channel Equalization. Methods for Optimizing the Location of Base Stations for Indoor Wireless Communication, Identification and Elimination of Multipath Effects, Signal Enhancement in Multiuser Communication.

Books

1. Smart Antennas for Wireless Communications By Frank Gross, McGraw hill
2. Smart Antennas, Tapan A. Sarkar ,M. C. Wicks, M. Salazar-Palma, R. J. Bonneau , Wiley
3. Introduction to Smart Antennas , Balanis, Constantine A. , Morgan & Claypool

ECL411 Digital Image Processing [(3-0-0); Credits: 3] Top

Pre-requisite:ECL304

Course Outcomes

1. To understand and explore importance of Digital Image Processing.

2. To extend the theory concepts of Digital Signal Processing further to Digital Image Processing.

3. To physically understand concepts of digital image enhancement and filtering in spatial domain.

4. To implement frequency domain filters for image processing applications.

5. To visualize basic computer vision algorithms using the learned Image Processing concepts.

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

Contents:

Elements of visual perception, Digital Image fundamentals, Basic image processing steps, Image Transforms, Image enhancement in spatial and frequeny domain, linear gray level transformations, Histogram equalization and specification ,smoothing & sharpening spatial filters, Image degradation models ,image restoration, inverse filtering, Wiener filtering. Image reconstructions from projections, radon transform, projection theorem of computerized tomography Morphological image processing ,dilation ,erosion, Basic morphological algorithms ,thinning algorithms Edge detection ,Edge linking & Boundary Detection ,watershed segmentation algorithm , Introduction to object recognition., colour image processing ,RGB and HSI color models, Gray level to color transformations

Books

1. Digital Image Processing Gonzalez R.C. and Woods R.E., Pearson, Second

2. Digital Image Processing Pratt W.K., Wiley, Third

3. Fundamentals of Digital Image Processing, A.K.Jain, PHI

ECL412 Advanced Digital Signal Processing [(3-0-0); Credits: 3] Top

Pre-requisite:ECL304

Course Outcomes

1. Study about the 2-Dimensional representation of signal and their operations

2. Understand the different 2-D transformation methods and their properties

3. Gain the knowledge about the application of multirate signal processing and different algorithms of filter design.

4. Consolidate the theoretical and mathematical formulation of different transformation methods (DCT, STFT, DWT).

5. Know role of adaptive filtering technique and implement the filtering concept using MATLAB and Simulink and research applications.

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

Contents:

Representation of 2-dimensional signals and systems, 2-D extensions of DTFT, DFT, and Z-transform, Linear filtering of using DFT/FFT, Chirp Z-transform

Multirate signal processing, Decimation and Interpolation, Upsampling and Downsampling in Z-domain, Polyphase structure, Filter Design for Interpolator and Decimator, Multistage Decimator and Interpolator, Filter Banks, Uniform DFT filter Bank, and its polyphase realization, Two channel QMF filter Bank

Discrete Cosine transform, Short time Fourier Transform and its application on speech signals, Discrete Wavelet Transform, Multiresolution properties, implementation of DWT, wavelet packets, Application of DWT for signal and image denoising.

Introduction to Adaptive filter Design, Correlation and basic of linear Algebra, Wiener Filtering, Least mean square (LMS) algorithm, Block LMS, frequency domain adaptive filtering, linear prediction theory. Adaptive lattice filter design.

Books

1. S. K. Mitra *"*Digital Signal Processing: A Computer based Approach*"* 4th edition TMH

2. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education 3rd Edition

3. Tamal Bose, Digital Signal and Image Processing, John Wlley & Sons, Inc

4. S. Haykin, *"*Adaptive Filter Theory", 4th edition Prentice Hall

ECL314 Power Electronic Devices and Circuits [(3-0-0); Credits: 3] Top

Pre-requisite:ECL308

Course Outcomes

1. Know concepts of power electronic devices as switches
2. Understand operation and applications of converters
3. Comprehend operation of inverters and commutation methods
4. Learn techniques of PWM inverters
5. Understand operation of choppers

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

Contents:

Semiconductor devices used in power electronics: SCR, ASCR, RCT , LASCR, TRIAC, IGBT, Power MOSFET, GTO, Triggering devices: UJT, PUT, construction characteristics, ratings,

Thyristor as power controller, phase angle control, Extinction angle control, Symmetrical angle control, time ratio control, pulse width modulation, Turn on methods: Circuits for single phase line communicated converter, single phase converter , single phase inverter Turn off (commutation) Methods: type A, B, C, D, E and F.

Uncontrolled Rectifiers: single phase: (M-2), (B-2),(M-3), B-6; Single phase/three phase half control(one quadrant operation); Single phase full wave converter, Three phase converter, three pulse, six pulse, (Bridge & midpoint type), Semi converter, Dual converter operation, Single phase bridge, three phase bridge (circulating & non circulating).

Invertors : Types-series, parallel, bridge, PWM voltage source inverter (CSI), Current source inverters (CSI), Filters-Types, calculation. Commutations methods,

Text Books

1. Sen P. C. ; Morden Power Electronics; Wheeler Publishers,1998
2. Singh. M. G., K.B. Khanchandani; Power Electronics; Tata MaGraw Hill, 2000.

Reference Books

1. Bose. B. K.; Modern Power Electronics and AC Drives; Pearson education India, Indian Reprint, 2003.

2. Ned Mohan, etal; Power Electronics; John Willey, 2000. Lander C. Y; Power Electronics: McGraw Hill International, 1993

ECP412 Advanced Digital Signal Processing [(0-0-2); Credits: 1] Top

Course outcomes:

1. To implement basic digital signal processing techniques for different applications related to communication
2. To study different systems related to advanced digital signal processing
3. To implement STFT for different applications
4. To implement DWT for different applications
5. To implement basic digital processing algorithms in dedicated DSP platforms

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

Contents:

1. Study of interpolation and Decimation
2. Implement all four different types of filter for a multiple sinusoidal signal having three different frequencies, amplitudes and phases corrupted with random noise.
3. Synthesis & Analysis of signal using STFT
4. Synthesis & Analysis of signal using DWT.
5. Implement using software tools to compute the DCT coefficients for a given signal.
6. Implement Least mean square algorithm using software tools
7. Implement using software tools to optimize the filter coefficients using steepest decent algorithm.

Text Books:

1. S. Haykin Adaptive Filter Theory 4^{th} edition Prentice Hall
2. Khalid Sayood Introduction to Data Compression 2^{nd} edition Morgan Kaufmann Publishers
3. R. M. Rao and A. S. Bopardikar Wavelet Transforms: Introduction to theory and Application 4^{th} edition Pearson Edition

Reference Books:

1. S. K. Mitra *Digital Signal Processing: A Computer Based Approach* 4th edition TMH
2. www. ti.com

ECP404 RF and Microwave Engineering [(0-0-2); Credits: 1] Top

Course outcomes:

1.Be able to analyze different microwave circuits and network.

2.Be able to design different microwave Circuits.

3.Will able to measure different parameters to characterize microwave network.

4.Will be able to evaluate the performance of a microwave circuit.

5.Be able to design a microwave communication link.

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

List of Experiments:

Phase I: Basic experiments

1.V-I characteristics of Gunn diode

2.Study of different characteristics of klystron amplifier

3.Study of different characteristics of reflex klystron amplifier

Phase II: Measurements

1. Frequency measurements
2. VSWR measurements
3. Attenuation measurement
4. Impedance measurement

Phase III: Advance experiments

1.Determination of S matrix

2.Magic Tee E plane Tee H plane Tee

Phase IV: Mini project

ECP411 Digital Image Processing [(0-0-2); Credits: 1] Top

Course outcomes:

1. To implement basic concepts of Image processing.

2. To implement given task/manipulations/transformations on digital images.

3. To implement filters on digital images.

4. To implement enhancement algorithms on digital images.

5. To visualize, design, and implement real life problems like image denoising, morphological operations, color image processing task on digital images.

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

List of Experiments:

1. Write a program for some basic affine transform on images.
   a. Rotation with 45 degree angle
   b. Translation
   c. Vertical shearing
   d. Horizontal shearing

2. Write a program for
   a. Take an image and insert alternate zeros in every row
   b. Alternate rows should have shifted zeros and do averaging

3. Write a program capable of zooming and shrinking an image by pixel replication. Assume that the desired zoom/shrink factors are integers. Take any image and use your program to shrink the image by a factor of 10. Use your program to zoom the image back to the resolution of the original. Explain the reasons for their differences.

4. Enhance the image 'spine.tiff' (available in MATLAB), using
   a. The log transformation
   b. The power-law transformation

In (a) the only free parameter is c, but in (b) there are two parameters, c and r for which values have to be selected. By experimentation, obtain the best visual enhancement possible with the methods in (a) and (b). Once (according to your judgment) you have the best visual result for each transformation, explain the reasons for the major differences between them.

5. Write a function to generate the histogram of an image. The function should take an image data array (with pixel values in the range 0 – 255) as its only parameter and return an array containing the histogram of the image. The histogram can be displayed using the built in plotting function.

6. Write a function to implement histogram equalization. Use it to enhance the images. Compare the output of your implementation with any built-in library function.

7. Load an image and then perform a simple spatial 3x3 average of image pixels. In other words, replace the value of every pixel by the average of the values in its 3x3 neighborhood. Be careful with pixels at the image boundaries. Repeat the process for a 10x10 neighborhood and again for a 20x20 neighborhood. Observe what happens to the image and give explanation for it.

8. (a) Write a program to add Gaussian noise to an image. You must be able to specify the noise mean and variance.
(b) Write a program to add salt-and-pepper (impulse) noise to an image. You must be able to specify the probabilities of each of the two noise components.

9. In given image there is a disturbing pattern, which should be removed. The pattern is a sinusoidal component. Remove the disturbance by looking in the frequency domain for the spike corresponding to the disturbing frequency and try to remove it from there. (Hint: The disturbing frequency can be found in the FFT by considering the orientation and frequency of the disturbance.)

10. Write your own code for some basic functions that work on binary images.
    a. dilation
    b. erosion
    c. opening
    d. closing

You are not allowed to use standard functions such as "BWMORPH".

ECL408 Biomedical Engineering [(3-0-0); Credits: 3] Top

Pre-requisite:-

Course Outcomes

Students will

1. Study the human body functioning for the purpose of biomedical measurements
2. Understand the cardiovascular system, ECG, PCG signal acquisition and blood pressure measurement
3. Learn about the Nervous system and EEG, ERPs and EMG signal measurement and its characteristics.
4. Gain the knowledge about the medical imaging instruments and modalities
5. Learn the signal processing aspects of acquiring biomedical signal and images.

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

Contents:

Anatomy and physiology, Sources of bioelectric potential (resting and action potential, Propagation of action potential, Bioelectric potential)

Biomedical signals and Electrodes: Nature of biomedical signal, Example of biomedical signals with the functioning of the organs, ENG, EMG, ECG, EEG, ERp, EGG, PCG, CP, Speech Signal, VMG, VAG Objective of Biomedial Signal analysis, Difficulties in analysis, Electrodes

Cardiovascular System, Heart anatomy, Cardiovascular measurement, Blood flow, Blood pressure measurement, Plethysmography, Heart sound, heart rate and pulse rate measurement, Nervous system, Anatomy, Measurement,Respiratory System, Measurement

Medical Imaging System, X-ray, CT, US, MR, SPECT, PET imaging

Therapeutic Equipment: Cardiac pacemaker. Defibrillators, Diathermy, Ventilators, Lithotriptors.

Books

1. “Biomedical Inst. & Measurement”, Cromwell, McGraw Hill
2. “Biomedical Phenomenon”, Plonsay Robert, McGraw Hill
3. “Biomedical Engg”, Khandpur, Tata McGraw Hill

ECD401 Project Phase - I [(0-0-4); Credits: 2] Top

Course Outcomes

Students will

1. Students will get an opportunity to apply knowledge of several courses in developing a new algorithm or circuit or a larger system.

2. Students will implement innovative ideas and publish them as a research paper or file a patent.

3. Students will learn working as a team.

4. Students will acquire additional skills otherwise not covered in the curriculum

5. Students will gain practical knowledge about the topic including social, commercial, manufacturing, testing, measurements, simulation, marketing and legal issues (as applicable).

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

ECL429 Communication Networks [(3-0-0); Credits: 3] Top

Pre-requisite:-

Course Outcomes

Students will

1. Be able to distinguish between various network topologies and types of switching
2. Be knowing various medium access protocols and network hardware components
3. Be knowing details of network layer protocols IPv4 and IPv6
4. Be familiar with various protocols used for network control, management and testing.
5. Be conversant with application layer of internet (web technology)

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

Contents:

Networks and services; network topologies; switching methods; network evolution; concept of layered architecture; the OSI model; the TCP/IP model; standardization and standards organizations. Study of telephone network; PCM-TDM based IDN; circuit switching; space and time division switching; signaling methods; store-and-forward switching. ISDN fundamentals; SS#7; Frame relay and ATM networks; SONET and SDH;

LANs and MAC protocols; ALOHA, slotted ALOHA, CSMA and CSMA-CD protocols; IEEE 802.3 protocol and MAC frame format. Details of 802.3 hardware options; 100 Mbps and 1000 Mbps Ethernet LANs, switches, bridges and VPN; Wireless LANs; LAN applications; client-server architecture;

Network Layer: services offered to the transport layer, internal organization as datagram or virtual circuit subnets; routing algorithms; congestion control; internetworking; Study of IPv4 and IP v6, DNS and Internet routing protocols. 20 Transport Layer: Design issues; study of TCP; connection setup and removal; flow control; reliable and efficient delivery, timer management. The TCP/IP protocol stack: ICMP, IGMP, UDP, BOOTP, DHCP etc.

Network applications: World Wide Web and HTTP; Web servers and browsers, Content Engines; FTP and TFTP; SMTP and MIME; DNS.

Books

1. Communication Networks ; Leon-Garcia and Widjaja TMH 3e

2. Computer Networks, a systems approach Peterson and Davie- Morgan Kauffman, Harcourt India

3. Computer Networks , Tanenbaum A. S.; PHI, 4e,

4. Data Comuncation and Networking , B. Forouzan, TMH ,4e

5. Data and Computer Communication, Stallings William, PHI, 6e

6. Computer Networking, a top-down approach featuring the Internet; Kurose and Ross ; Addison Wesley, (Low Price Edition)

7. Communications and Networking Technologies- Gallo and Hancock ;Thomson Learning 2e

ECP429 Communication Networks [(0-0-2); Credits: 1] Top

Course Outcomes

Students will

1. Be able to configure user machines, switches and routers
2. Perform network functioning analysis tools using packet sniffer tools such as WireShark.
3. Be able to gather information on status, configuration and settings of various equipment on the network.
4. Be able to use the network for file sharing, printer sharing etc.
5. Be able to understand working of higher layer protocols.

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

List of experiments:

1. Using utilities such as ‘net help’, ‘netstart’, ‘netview’ etc.
2. Study of networking devices, topologies and IEEE 802 series standards
3. Gathering information about NIC of a PC.
4. TCP/IP diagnostics and configuration using ‘ping’, ‘ipconfig’ etc.
5. Files sharing in LANs
6. WireShark or similar open source packet sniffers and their use
7. Network protocol analyzer equipment.
8. Routing protocols using Netsim tool.

ECL407 Radar Engineering [(3-0-0); Credits: 3] Top

Pre-requisite:ECL305

Course Outcomes

1. To understand the basic concepts related with radar technology.
2. To understand various components and various antenna mechanism used for radar technology.
3. To know specific use of technology for various requirement.
4. Ability to design radar transmitter and receiver system
5. Ability to design, implements and analyse a radar system.

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

Contents:

Radar range equation, CW and EM modulated radar.

Moving target, Indicated and pulse Doppler radar, Tracking radar.

Transmitters, Magnetron Oscillator, Modulators, Line Pulsing modulator.

Radar receiver, Receiver noise, Extraction of information from radar.

Radar Antennas, Parabolic reflector, Scanning feed, Reflector cassegrain, Lens Antennas.

Radar Clutter and interference-Radar Indicators.

Text / Reference Books

1. Introduction to Radar System,Skolink,McGraw HillEdition
2. Principles of Radar,Heities & Coates,McGraw HillEdition
3. Introduction to Radar System,Kingsley,McGraw HillEdition

ECL410 Satellite Communication [(3-0-0); Credits: 3] Top

Pre-requisite:ECL303

Course Outcomes

Students will

1. Be conversant with orbital aspects of satellite communication
2. Be able to design satellite link
3. Be knowing about digital satellite links
4. Be familiar with multi-access schemes
5. Be familiar with earth station technology

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

Contents:

Orbital aspects of satellite communication, Orbit mechanisms, Equation of orbit, Locating satellite in orbit, Orbital elements, Orbital area coverage, Look angles, Slant range,

Space craft subsystems, Attitude and orbit control system, Telemetry tracking and command system (TTC), Power subsystems, Antennas, Reliability

Satellite link design, System noise temperature, G/T ratio, Down link design, Uplink design, Link for specified (C/N) base-band noise signal.

Digital Satellite Links, Frequencies and channel allocations, Modulation techniques, QPSK, QAM, BER analysis, medium access methods for satellite communication.

Earth station technology, Earth station design for low system noise temperature. Equipment for earth stations, LNA and HPA.

VSAT systems- overview of VSAT systems, Access control protocols, multiple access selection, modulation, coding and interference issues .

Books

1. Satellite communication , Timothy Pratt, Charles Bostian, Jeremy Allnut, John Willey and Sons Inc. Second edition

2. Satellite Communication Systems Engineering, W. L. Pritchard, H.G. Suyderhoud, R.A. Nelson, Pearson Education Second edition

3. Advanced Electronic communications, Wayne Tomasi, Prentice Hall of India Pvt. Ltd Fifth edition

4. Electronic Communication Systems Frank.R. Dungan, International Thomson Publishing Company Third edition.

5. Satellite Communication, Roddy Second edition .

6. Satellite Communication Technology , Dr. K. Miya, Second edition

ECL430 Biomedical Signal Processing [3-0-0; Credits: 3] Top

Pre-requisite:-

Course Outcomes

1. Gain the knowledge about the origin of bio-potentials.

2. Understand the basic research challenges involve in different biomedical signals monitoring and their analysis

3. Realize the different filter design concepts required for biomedical data

4. Study the applications of different signal processing methods on biomedical field. .

5. Carry out the spectral analysis to evaluate the electroencephalographic biosignals and heart rate variability.

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

Contents:

Preliminaries, Biomedical Signal Origin and dynamics of ECG, EEG, EMG, PCG, VMG, VAG, etc., Challenges in Physiological signals monitoring and analysis

Cardiological Signal Processing: ECG parameters and their estimation; Use of multi-scale analysis for parameters estimation of ECG waveforms, Adaptive noise canceller, Event Detection.

Correlation and coherence analysis of EEG channels, Detection of EEG spike and wave complexes, Morphological analysis of ECG waves, Time domain filters, Frequency domain Filters, Principles of adaptive filters, Wiener Filtering- Steepest Descent algorithms, Least mean square adaptive algorithms, Adaptive noise canceller- Interference cancellation in Electrocardiography- noise cancellation in electro surgery.

HRV and Arrhythmia analysis, Time domain and spectral domain parameters of short term recording.

Neurological Signal Processing: Brain and its potentials, Electrophysiology origin of brain waves, EEG Signal and its characteristics, EEG analysis, Linear prediction theory, The autoregressive (AR) method, Transient detection and elimination-the case of epileptic patients

Books

1. Reddy D C. “Modern Biomedical Signal Processing – Principles and Techniques”, TMH, New Delhi, 2005

2. Tompkins W J “Biomedical Signal Processing”, PHI

3. Rangaraj M. Rangayyan, “Biomedical Signal Analysis: A case study Approach”, Wiley

4. Akay M. “Biomedical Signal Processing”, Academic press

5. Bronzino J D “The Biomedical Engineering handbook”, CRC and Free press, Florida, 1995.

6. Arnon Cohen “Biomedical Signal Processing” CRC Press.

ECL436 Optimal Systems [(3-0-0); Credits: 3] Top

Pre-requisite: ECL312

Course Outcomes

1. To familiarize with the concept of optimal control of continuous time and discrete time systems.

2. Transform systems into state-space equation and apply the required optimality conditions.

3. Solve the optimal control problems using the vibrational approach.

4. Able to model and solve linear regulator problem.

5. Use the dynamic programming and the associated Hamilton-Jacobi-Bellman equation to solve linear quadratic control problems

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

Contents:

Definitions of Optimal Control, plant, Performance Index, constraints, formulation of optimal control problem, selection of a performance index

Formulation of Optimal control problem, the characteristic of the plant, minimum time problem, minimum energy problem, minimum fuel problem, state regulator problem, tracking problem

Calculus of variations, Optimum of a Function and a Functional, The Basic variational Problem, Fixed-End Time and Fixed-End State System, Euler Lagrange Equation, Different Cases for Euler-Lagrange Equation, Hamiltonian method, Steepest Descent method

Finite-Time Linear Quadratic Regulator, LQR System for General Performance Index, Analytical Solution to the Matrix Differential Riccati Equation, Infinite-Time LQR System, Stability Issues of Time-Invariant Regulator, Linear Quadratic Tracking System: Finite Time Case, LQT System: Infinite-Time Case.

Variational Calculus for Discrete-Time, Discrete-Time Optimal Systems, Discrete-Time Linear State Regulator, Closed-Loop Optimal Control: Matrix Difference Riccati Equation

Pontryagin Minimum Principle, Dynamic Programming, Optimal Control of Discrete-Time Systems, Optimal Control of Continuous-Time Systems, The Hamilton-Jacobi-Bellman Equation, LQR System Using H-J-B Equation

Books

1. Kirk Donald E.,"Optimal Control Theory An Introduction", Dover Publication Inc, Mineola, New York. 2004

2. Naidu Desineni Subbaram,"OPTIMAL CONTROL SYSTEMS", CRC PRESS, Boca Raton London New York Washington, D.C. 2002

3. Sage A. P. and White C. C,"Optimum Systems Control", PranticeHall,Englewood Cliffs, N.J.

ECL437 Fundamentals of Information Theory [3-0-0; Credits: 3] Top

Pre-requisite:

Course outcomes

After completing this course, the student must demonstrate the knowledge and ability to:

1. analyze the self and mutual information.

2. evaluate the information rate of various information sources.

3. design lossless data compression codes for discrete memory-less sources.

4. evaluate the information capacity of discrete memory-less channels and determine possible code rates achievable on such channels.and design simple linear block codes.

5. select or design simple convolutional codes.

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

Contents:

Communication channel, Channel matrix, Probability relation in a channel, the measure of information, Entropy function – Properties of entropy function, relative entropy, differential entropy, Mutual Information, Symmetry of information, Jensen's Inequality, Fano's Inequality.

Channel capacity; Special types of channels and their capacity, Noiseless channels symmetric channel, erasure channels, continuous channels, Shannon's theorem, Shannon Hartley theorem for AWGN channels.

Source and Channel Coding Methods, Block code, Binary code, Binary Huffman code, Shannon–Fano Encoding procedure, Noiseless coding theorem. Error – correcting codes such as linear block codes an convolutional codes.

Introduction to advanced codes like LDPC, Turbo codes etc.

Text Books

1. T.M.Cover and J.A Thomas, "Elements of information theory", John Wiley and Sons.
2. S .Haykins, " Communication Systems" John Wiley and Sons.
3. A.S. Gandhi, "Analog and Digital Communication", CRC Press.

Reference Books:

1. G. A. Jones et. Al, "Information and Coding Theory", Springer – Verlag.
2. J. H. van Lint, " Introduction to Coding Theory", Springer –Verlag.

ECL421 Advanced Sensors and Instrumentation [(3-0-0); Credits: 3] Top

Pre-requisite:-

Course Outcomes

Students will

1. Understand basics and operating principle of a few advanced sensors.

2. Understand the behaviour of various physical systems and model them using some advanced technology.

3. learn charteristics of different controllers.

4. have fundamental and some special knowledge in process automation in industries using PLC\SCADA.

5. know basic process parameters that are applied in most processing industries for both measurement and control applications.

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

Contents:

Smart sensors : Definitions, Comparisons, Smart Sensor Interface Standards. Recent / Advanced trends in sensor technology MEMS Sensors Comparison with Past technologies. , Fabrication Techniques, Case study of MEMS Sensors.

Sensors and their applications. Basics of computer aided process control systems. Microcomputer based process control. i) A programmable logic controller ii) A distributed control system

Controllers : - On-off controllers , Analog controllers, Digital controllers, Fuzzy controllers, Working Principle, Merits- Demerits, Typical Application Areas and comparisons.

Controller tuning and system design, Optimal control theory, Case study of Temperature controller, Case study of position controller, Case study of fuzzy controller.

Study of PLC and Microcontroller based instrumentation Systems.

Text Books

1. D. Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw-Hill Publishing Co., New Delhi, 1999

2. A.K.Sawhney, “A course in Electrical and Electronic Measurement and Instrumentation”, Dhanpat Raj and Sons, New Delhi, 1999

3. Stephanopoulis, G, “Chemical Process Control”, Prentice Hall of India, New Delhi, 1990.

Reference Books

1. Ernest O.Doebelin, Measurement systems application and design international student 4th Edition, Tata McGraw Hill Publishing Co., New Delhi, 1999.

2. Frank D. Petruzella, Programmable Logic Controllers, Glencoe McGraw Hill Second Edition,

3. M.Elwenspoek, R.Wiegerink, Mechanical Microsensors, Springer-Verlag Berlin Heidelberg, 2001

4. Eckman D.P.M, Industrial Instrumentation, Wiley Eastern Limited, 1990.

5. Donald E. Kirk, Optimal Control Theory: An Introduction, Prentice-Hall networks series, 1970

ECL438 Project Design Course [3-0-0; Credits: 3] Top

Pre-requisite:-

Course Outcomes

After completion of the course, the students will learn

1. Basics of solid state cameras.
2. Back end electronics for operating the solid state cameras for astronomical purpose.
3. How to assemble a solid state [CCD] camera system.
4. How to operate the assembled solid state camera for astronomical purpose.
5. How to characterize the assembled solid state camera.

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

Content

Basics of CCD: Theory of charge coupled device, Operation and performance of CCD, Performance metrics, Photon transfer, Charge generation, , CCD clocking: how and why, Analog Output Circuitry, Peltier Cooling.

Evaluation Criteria and metrics for CCD performance: Quantum efficiency [QE], Backside illumination, frontside illumination, charge collection, charge transfer, charge transfer mechanisms, charge transfer efficiency [CTE], Measurement techniques of CTE, traps, charge measurement, output amplifier characteristics,

Different types of noise in CCD: Jhonson noise, white noise, shot noise, flicker noise, reset noise, On chip noise sources, of chip noise sources

Laboratory Exercise:

1. Assembly of the complete CCD camera unit including the CCD chip, camera shutter, thermoelectric cooler, fan, PC interface, required electronics and the mechanical parts.
2. Testing the assembled camera with lens system.
3. Measurement of the dark current, gain, linearity and residual image of the camera.
4. Measurement of Quantum efficiency.
5. Measurement of Charge transfer efficiency.

6. Measurement of Modulation Transfer function.

7. Capturing images of friends and classmates with the assembled camera unit.

Books

1. Scientific Charge Coupled Devices. James R Janesick.

2. Solid-State Imaging With Charge-Coupled Devices, A.J.Theuwissen

ECL439 Wireless Communications [3-0-0; Credits: 3] Top

Pre-requisite:ECL303

Course outcomes

Students will be able to

1. choose appropriate propagation model for a given environment
2. make a radio network plan for a given system
3. describe the interplay of system parameters of wireless communication methods
4. describe the interplay of system parameters of medium access methods
5. describe the trade-off of system parameters of diversity techniques

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

Contents:

Introduction to wireless digital communication systems; block diagram of a typical RF transceiver, radio propagation and cellular engineering concepts; frequency reuse, frequency management and channel assignment, handoff and handoff strategies, trunking theory, coverage and capacity improvements

Wireless Mobile Communication channel characterization:

large scale path loss, free space propagation model, propagation effects such as reflection, diffraction, scattering etc. Outdoor and indoor propagation models, ray tracing and coverage prediction.

Small scale fading effects: time-variant impulse response model, channel correlation functions and spectral densities, coherence time, coherence bandwidth, channel models for Rayleigh, Ricean and Nakagami fading.

Modulation methods:

Review of binary modulation methods; ASK, PSK and FSK; Quadrature modulation methods QPSK, QAM, MSK, GMSK, applications of differential coding, OFDM, MIMO, massive MIMO

Spread Spectrum methods: basics; generation and properties of PN sequences, DS-SS system analysis; slow and fast FH-SS system; performance analysis.

Medium access techniques, FDMA, TDMA, CDMA, SDMA. Introduction to non-orthogonal multiple access.

Books

1. Wireless Communication: Principles and Practices (2e) – Theodore Rappaport- Pearson Education.

2. Wireless Digital Communication- Feher- PHI

3. Digital communication (4e)- John Proakis, Tata- McGraw-Hill

4. Communication systems (4e) – Simon Haykin, Wiley

ECL426 Advanced Microprocessor & Interfacing [(3-0-0); Credits: 3] Top

Pre-requisite:ECL203

Course Outcomes

Students will

1. Understanding the 8086/8088 µProcessor Architecture.
2. Introduction to the idea of instruction set programming (8086/8088 µProcessor).
3. Knowledge of segmentation of memory and Interfacing peripherals
4. knowledge of improvements in the architecture of 80386 µProcessor.
5. familiarity with Multimedia Extension (MMX) in Pentium class of µProcessor.

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

Contents:

8086/8088 Architecture, register set, memory organization, signal descriptions, basic memory read/write operations, minimum and maximum mode systems.

Addressing modes, Instruction formats, Instruction set, Assembler directives, pseudo ops assembly language programming,

Stack, Interrupts, Interfacing peripherals: 8255 and applications,8254,8279,8251, Study of 8237, 8272, 8275. Architecture and interfacing of 8087.

80386 Architecture, Register set, flag Register, Real address mode, Protected Virtual address mode, Paging unit, Implementation of Virtual memory concept in advanced microprocessors, Virtual 8086 mode

Pentium Superscalar architecture and special features of Pentium, MMX, Data types, MMX Instructions, Introduction to P IV architecture, Branch prediction, TLB,

Hyperthreading, concept of multi core processors, Advantages and feature of RISC Architectures.

Books

1. D V Hall, “Microprocessors and Interfacing”, MGH
2. Kenneth Ayala, “The 8086 microprocessor: programming and interfacing”, IE India edition
3. K M Bhurchandi, AK Ray, “Advanced Microprocessors and Peripherals”, MGH

ECP426 Advanced Microprocessors and Interfacing [(0-0-2); Credits: 1] Top

Course Outcomes:

Student will

1. Able to interface 8086 microprocessor with various peripherals
2. Able to write ALPs using 8086/88 instruction set.
3. Able to use 8087 instructions in ALP for hardware interfaces
4. Able to write ALPs for hardware interfaces
5. Knowing details of interfacing with PIV machine

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

Interfacing under following guidelines

1. ALPs using 8086/8088 instruction set, ALPs using 8087 instructions
2. ALPs for hardware interfaces with either kit or PIV machine

List of Experiments:

1. Addition of two 8-bit numbers and store result in memory location
2. Multiplication of two 8-bit numbers and store result in memory location
3. Division of two 8-bit numbers and store result in memory location
4. Addition of two 16-bit numbers and store result in consecutive memory locations
5. Addition / Subtraction of two arrays
6. Arrange array elements in Ascending / Descending order
7. Perform the following:
    a. Values for net current for a given circuit are recorded in an array. Find out how many times the net current is positive or negative.

b. In a given array, count the even and odd numbers and find the sum of even numbers and sum of odd numbers

8. Add two matrices of size 2x2 using subroutines
9. Perform matrix multiplication using subroutines
10. Element recognition in array and display “FF” if not found else display “01”
11. Addition of numbers with subroutine display – “Enter 1st number: “ , “Enter 2nd number: “
12. Generate first n elements of an arithmetic series where a=2 and d=3. Store elements from 6500H onwards
13. Find area of right-angled triangle with length and height stored at memory location 6001H and 6002H respectively
14. Interfacing experiments with 8255
15. Interfacing experiments with 8253
16. Projects:
    a. Display “Your Name” Left to Right
    b. Attendance recording of this batch
    c. Billing system for Supermarket
    d. Voting machine to count votes for a particular candidate
    e. Area Calculator for different shapes e.g. Circle, Square, Triangle

ECL413 Adaptive Signal Processing [(3-0-0); Credits: 3] Top

Pre-requisite:ECL211

Course Outcomes

1. To review the basic concepts related to vector space and Eigen analysis
2. To review the basic concepts of stochastic signals and statistics of stationary signal
3. To implement Wiener filter using different LMS algorithms
4. To introduce RLS algorithm
5. To design adaptive filters for different applications

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

Contents:

Vectors, Matrices and Eigen Analysis. Application to adaptive signal processing. Stochastic Processes, Ensemble average, mean, average power, auto and cross correlation functions, stationarity and white noise, Auto-regressive process. Least Squares and LMS algorithms, Normal equations, properties. Eigen System decomposition. Gradient search technique, convergence properties of LMS. Normalized LMS algorithm. Recursive solution techniques, RLS algorithm. Application to noise cancellation, modeling of physical processes, communications.

Text Books

1 S. Haykin Adaptive Filter Theory Fourth Edition Prentice Hall

2. B. Widrow and S. D. Sterns Adaptive Signal Processing Pearson Education

Reference Books

1. M. J. Larrimore, C. R. Johnson and J. R. Treichler Theory and Design of Adaptive Filters publisher

ECP413 Adaptive Signal Processing [(0-0-2); Credits: 1] Top

Course outcomes:

1. To measure statistical parameters of stochastic process
2. To model AR and MA stochastic process
3. To implement Wiener filter using pure LMS algorithm
4. To implement Wiener filter using block LMS algorithm
5. To design adaptive filters for different applications

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

Contents:

1. Computation of mean, standard deviation, correlation function, correlation matrix, covariance matrix and power spectral density of a stochastic process
2. Computation of frequency and amplitude of a noisy sinusoidal signal
3. Modeling AR process of different orders
4. Modeling MA process of different orders
5. Realization of different AR process using pure LMS algorithm
6. Investigation of the role of step size on convergence and mean square error for pure LMS algorithm
7. Investigation of the role of step size on convergence and mean square error for pure LMS algorithm
8. Implementation of Fast block LMS algorithm
9. Implementation of RLS algorithm

10. Performing predictive deconvolution using LMS algorithm

11. Performing adaptive noise cancelling using LMS algorithm

Text Books

1. S. Hyken Adaptive Filter Theory Fourth Edition Prentice Hall
2. B. Widrow and S. D. Sterns Adaptive Signal Processing Pearson Education.

Reference Books

1. M. J. Larrimore, C. R. Johnson and J. R. Treichler Theory and Design of Adaptive Filters.

ECD402 Project Phase - II [(0-0-8); Credits: 4] Top

Course Outcomes

Students will

1. get an opportunity to apply knowledge of several courses in developing a new algorithm or circuit or a larger system.

2. implement innovative ideas and publish them as a research paper or file a patent.

3. learn working as a team.

4. acquire additional skills otherwise not covered in the curriculum

5. gain practical knowledge about the topic including social, commercial, manufacturing, testing, measurements, simulation, marketing and legal issues (as applicable).

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

MAL408 Statistical Analysis & Queuing Theory [(3-0-0); Credits: 3] Top

Pre-requisite:MAL205

Course Outcomes

Students will

1. be exposed to importance of statistical analysis.
2. Be aware of waiting time models.
3. Be able to use Markov chains for analysis.
4. Be able to apply queuing theory models to real life situations
5. Be able to use curve fitting methods

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

Contents:

Testing of Hypotheses: Neyman Pearson theory of testing of Hypotheses: Some fundamental notions of hypotheses testing, Neyman Pearson lemma, unbiased and invariant tests, generalized likelihood ratio tests, Chi – Square test, t – tests, F – tests, Bayes and minimax procedures, methods of finding confidence intervals, unbiased and equivariant confidence intervals.

Stochastic Processes: Introduction, classification of stochastic processes, the Bernoulli process, the Poisson process, Renewal process, availability analysis, random incidence, renewal model of program behavior.

Discrete-Parameter Markov Chains: Introduction, computation of n- step transition probabilities, state classification and limiting distributions, distribution of times between state changes, irreducible finite change with A periodic states, the M/G/1 Queuing system, discrete parameter Birth-Death processes, finite Markov chains with absorbing states.

Continuous – Parameter Markov Chains: Introduction, the Birth and death process, other special cases of Birth –death Model, non Birth-Death processes, Markov chains with absorbing states.

Networks of Queues: Introduction, open queuing networks, closed queuing networks, non exponential service-time distributions and multiple job types, Non – product- Form Networks.

Regression , correlation and Analysis of Variance: Introduction, Least squares curve fitting, the coefficient of determination, confidence intervals in linear regression, correlation analysis, simple non linear regression, higher dimensional least squares fit, analysis of variance.

Books

1. Vijay K. Rohatgi& A.K. Md. EhsanesSaleh: "An Introduction to Probability and statistics" , John Wiley & Sons Inc., New York, 1976.

2. Kishor S. Trivedi : "Probability & Statistics with reliability, Queuing and computer Science applications", PHI private Ltd, 2009.

ECL440 Cellular Systems [(3-0-0); Credits: 3] Top

Pre-requisite:ECL303

Course Outcomes

Students will

1. Understand generations of wireless mobile communication technologies
2. Be conversant with how various decisions were made while evolving the mobile communication system standards.
3. Be aware of functioning of mobile communication network
4. To Understand features of wireless LAN technologies
5. Learn principles of Bluetooth communication technology

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

Contents:

The second generation (2G) systems

GSM: services, features, architecture, radio link, channel types, frames, call handling

CDMA IS95: forward and reverse channels, system architecture, call handling.

2.5G systems

GPRS: data rates, basic services, system architecture, protocols, coding schemes, mobility management, hardware and software components

EDGE: evolution, advanced modulation methods, radio transmission and data rates, services and protocols.

The 3G systems: Introduction, evolution of 3G networks, ITU IMT 2000,

CDMA 2000: bandwidth, chip rate, channels, spreading and modulation, power control, soft handoff, EV-DO, EV-DV

UMTS: radio access network, spreading and modulation, channels, core network.

Wireless LANs

IEEE 802.11 system and protocol architecture, physical layer and MAC, options like 802.11b, a g etc. and their purpose.

Bluetooth: User scenarios, layered architecture, link management, L2CAP, SDP, IEEE 802.15Mobile Communication

Books

1. Jochen Schiller Addison Wesley 2nd Edition

2. Wireless Communication: Principles and Practices

3. Theodre S. Rappaport, Pearson Education

4. Wireless and Mobile Network Architecture Yi-Bing Lin and Imrich Chlamtac Wiley Publication.

5. Principles of Mobile Communication Gordon L., Stuber Kluwer Academic Publishers, Norwell, Ma, USA 1st Edition

6. 3G Mobile Network: Architecture, Protocol and Procedures Kasera Sumit, Narang Nishit Tata McGraw Hill.

ECL409 Radio Frequency Circuit Design [(3-0-0); Credits: 3] Top

Pre-requisite:ENL302

Course Outcomes

Students will

1. be able to design passive matching networks.
2. describe RF amplifier design process in general
3. be able to design LNA, PA for a specified application.
4. design other circuits such as mixer, oscillator and phase locked loops
5. be able to select A/D and D/A converters for RF applications

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

Contents:

Characteristics of passive components for RF circuits. Passive RLC networks. Transmission lines. Two-port network modeling. S-parameter model. The Smith Chart and its applications.

Active devices for RF circuits: SiGe MOSFET, GaAs pHEMT, HBT and MESFET. PIN diode. Device parameters and their impact on circuit performance.

RF Amplifier design: single and multi-stage amplifiers. Review of analog filter design. Low-pass, high-pass, band-pass and band-reject filters. Bandwidth estimation methods. Voltage references and biasing.

Low Noise Amplifier design: noise types and their characterization, LNA topologies, power match vs noise match. Linearity and large-signal performance.

RF Power amplifiers: General properties. Class A, AB and C PAs. Class D, E and F amplifiers. Modulation of power amplifiers. Analog communication circuits: Mixers, phase-locked loops, oscillators and synthesizers. Design and performance characterization. Transceiver design. A/D and D/A convertors for RF applications.

Text Books

1. The Design of CMOS Radio Frequency Integrated Circuits, Lee Thomas H, Cambridge University Press.
2. Design of Analog CMOS integrated circuits, Razavi Behzad, McGraw Hill
3. VLSI for wireless communication Bosco Leung, Pearson Education
4. Ludwig and Bogdanov, RF Circuit Design Theory And Application.

ECP409 Radio Frequency Circuit Design [(0-0-2); Credit: 1] Top

Course Outcomes

Students will

1. be able to analyze an impedance transformation network using a software tool and use the circuit in their design.
2. be able to design physical lay-out of a passive component and evaluate its performance with software tools such as ADS or Microwave Office.
3. will be able to characterize an RF component or circuit using S-parameter matrix
4. be able to design RF amplifier and related circuits and evaluate the performance using software tools.
5. Be able to design mixers and oscillators and evaluate performance using software tools

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

Contents:

Phase-I: Simulation of impedance transformation passive networks

1. L- section upward transformation
2. L-section, downward transformation
3. π- circuit
4. T-circuit
5. Tapped capacitor resonator
6. Tapped inductor resonator
7. Double tapped resonator

For every network, plot the Z_{in} as function of frequency and load resistance R_s.

Phase-II: Simulation of passive RF components.

(Layout design and simulation, circuit models and parameter extraction, circuit simulation)

1. Design of resistor using poly-silicon over field oxide.
2. Parallel plate capacitor using poly-insulator-poly and metal-insulator-metal layers.

3. Lateral flux capacitors (inter-digitated, simple fractal)
4. Spiral inductor and transformer. (Use of Razavi's formula and Lee's formula)
5. Active resistor and MOS capacitor using MOSFETs

Phase-III: S parameter characterization of passive and active components

Using the advanced micro-strip trainer, find the S-parameters of the following components

1. Patch antenna (transformer feed and inset feed)
2. Low-pass filter
3. Band-pass filter
4. Band-reject filter
5. Ring resonator
6. Power divider (with and without isolation resistor)
7. Rat race hybrid ring coupler
8. Parallel line coupler
9. Branched line coupler
10. Amplifier

Phase-IV Design and simulation of active circuits

1. Common Source and Common Gate CMOS amplifier
2. Differential amplifier
3. Single ended LNA
4. Double ended LNA
5. Power amplifiers class A, B, C
6. Power amplifiers class D, E and F
7. Gilbert mixer
8. Colpitt and Hartley oscillators
9. Negative frequency oscillators

ECL423 Image Analysis and Computer Vision [(3-0-0); Credits: 3] Top

Pre-requisite:ECL304

Course Outcomes

Students will

1. Learn about the difficulties associated with automated image content recognition and understand the imaging issues from the perspective of quantitative image analysis.

2. Know a broad range of computer vision techniques and apply methods that are most relevant to their research.

3. Know computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving.

4. Have in-depth understanding of human vision system with its usefulness in development of machine vision algorithms by looking at stereoscopic(3D) vision systems.

5. Be able to apply the knowledge imparted to develop a computer vision system.

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

Contents:

Review of basics of Digital image processing, Introduction about computer vision: What is computer vision, advantages and disadvantages of computer vision, general applications of computer vision. Feature detection and matching: Points and patches, edges, lines, Segmentations: Feature based alignment: 2D and 3D feature based alignments algorithms and applications, Pose estimation algorithms. Motion estimation: Differential motion analysis methods, optical flow, detection of specific motion patterns, image stitching, motion models for tracking, alignments, compositing. Image and video Compression techniques. Computational imaging: super resolution, blur removal, image matting and compositing, texture analysis and synthesis, stereo imaging, basic concepts, and applications.3D image processing techniques: basics of 3D images, 3D sensing, camera calibrations, and reconstructions, 3D from 2D image, surface based representations, point based representations, and volumetric based representations,

and model based reconstruction, recovering textures from 3D images and applications of 3D imaging techniques, 3D shape recognition.

Object Recognition techniques Basics Color image processing: Color fundamentals, color models, color transformation, color segmentation, smoothing, and sharpening. Case studies of computer vision projects such as content-based image retrieval face recognition etc.

Text Books

1. Richard Szeliski Springer, “Computer Vision: Algorithms and Applications”, 2010

2. Shapiro and Stockman, “Computer Vision”, Prentice Hall, 2001

3. Sonka, Hlavac, and Boyle Cengage Learning, “Image Processing, Analysis, and Machine Vision”, 2009.

Reference Books

1. Harley R. Myler, “Fundamentals Of Machine Vision”, PHI Learning (2003)

2. Forsyth, David A., Ponce, “Computer Vision: A Modern Approach”, Jean PHI Learning (2009)

3. Earl Gose Steve Jost and Richard Johnsonbaugh, “Pattern Recognition and Image Analysis”, PHI (2009)

4. Anil K. Jain, “Fundamentals of Digital image processing”, PHI, 2010

5. Rafael C. Gonzalez and Richard E. Woods, “Digital image processing”, Pearson Education 3rd Edition.

ECP423 Image Analysis and Computer Vision [(0-0-2); Credits: 1] Top

Course Outcomes

Students will

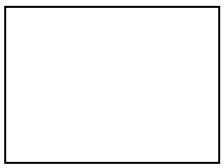
1. Be able to implement basic image processing and evaluation methods
2. Be able to implement different feature detector algorithms for images
3. Implement basic segmentation algorithms on grayscale images
4. Implement basic clustering & dimensionality reduction techniques
5. Implement compression and 3D reconstruction using 2D images

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

List of Experiments

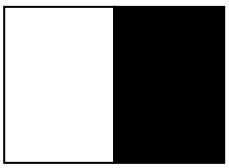
Phase-I:

1. Understanding **basics of images** and understanding of **2D signal handling** by generation of various patterns

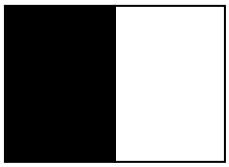


Pattern – 1

Pattern – 2



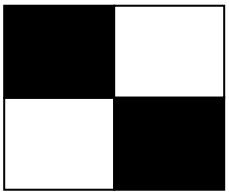
Pattern – 3



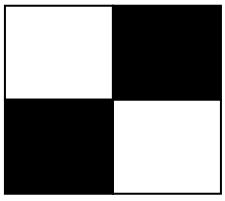
Pattern – 4

Pattern – 5

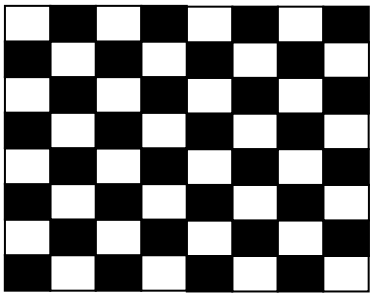
Pattern – 6



Pattern – 7



Pattern – 8



Pattern – 9

2. Performing simple **arithmetic operations** on images (Take Lena and Cameraman images)
    i) Add a constant
    ii) Subtract a constant
    iii) Multiply a constant
    iv) Divide a constant
    v) Addition of two images
    vi) Subtraction of two images
    vii) Multiplication of two images
    viii) Division of two images.

3. Perform **specific intensity search** operations on images (Take Lena and Cameraman Image)

4. Perform **Edge, point and line detection** operations on images.

5. **Image fusion** in spatial domain (Take Lena and cameraman image and perform the operation).

6. **Image Thresholding:** Apply the following thresholds on Lena and cameraman images and compare the results

7. **Image segmentation**: Understanding and implementation of various Image segmentation methods.

Phase-II:

8. **DCT**: Apply Discrete Cosine Transform (DCT) on two the images. (Take cameramen and Lena images)

9. **IDCT:** Apply Inverse Discrete Cosine Transform (IDCT) on the image. (Take cameramen and Lena images)

10. **Image Compression and Decompression:** Perform image compression and decompression using JPEG.

11. **DWT:** Apply Discrete Wavelet Transform (DWT) on two the images. (Take cameramen and Lena images)

12. **IDWT:** Apply Inverse Discrete Wavelet Transform (IDWT) on the image. (Take cameramen and Lena images)

13. **EZW:** Implement Embedded Zero Wavelet (EZW) algorithm on Images.

14. **Image Compression and Decompression:** Perform image compression and decompression using DWT (JPEG 2000).

15. **Color Image Processing:** Perform the following operations on color images (Take RGB color images)
    i) Color Replacement
    ii) Color Detection
    iii) Change of planes
    iv) Color Space Transformations

Phase-III:

16. **Video Processing:** Operations on gray scale videos
    i) Extracting frames from videos
    ii) Playing video in reverse
    iii) Applying background subtraction, frame differencing algorithm. (Take Video traffic Video)

17. **Video Processing:** Operations on Color videos
    i) Extracting frames from videos and dealing with color video frames
    ii) Playing video in reverse
    iii) Applying background subtraction, frame differencing algorithm.

18. **Motion Estimation:** Understanding and implementation of motion estimation techniques used in videos.

19. **Video Compression and decompression:** Perform video compression and decompression mechanisms.

20. **MRA:** Perform Multi Resolution Analysis (MRA) on images and videos.

21. **Image Sharpening:** Understanding and implement Image Sharpening algorithms.

22. **Image and Video Watermarking:** Study and Implement any one of the watermarking algorithm on image and video.

23. **Image Stitching:** Understanding and implement Image Stitching algorithms.

Phase-IV:

24. **Image Matting:** Understanding and implement Image matting algorithms.

25. **Object Detection:** Study and Implement the object detection method on videos for detecting the stationary and moving objects.

26. **SIFT/SURF:** Study about SIFT/SURF and implement any one of the method.

27. **Stereo Imaging:** Understanding and implement Stereo Imaging.

28. **Computer Vision Applications:** Study and implement at least one method for Content based image retrieval.

29. **Computer Vision Applications:** Karhunen – Loeve Transform (KLT) based face representation and recognition system.

30. **Computer Vision Applications:** Study and implement at least one method for video surveillance, human tracking, vehicle tracking, etc.

ECL417 Multimedia Networks [(3-0-0); Credits: 3] Top

Pre-requisite:ECL303

Course Outcomes

Students will

1. Understand functioning of circuit switched and packet switched networks
2. Be familiar with reasons for emergence of converged communication networks
3. Applications of various media coding algorithms
4. Be conversant with transport and signaling protocols
5. To learn with emerging trends in multimedia networks.

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

Contents:

Review of circuit switched digital telephony, signaling and transmission, ISDN, SS7. Evolution of packet switched networks, Internet and LANs. The TCP/IP protocol stack.

Introduction to XoIP, network convergence, Needs of individual users, enterprises and network operators. How XoIP is expected to meet all these concerns. Source coding (speech, audio and video coding) PCM, ADPCM, LP coding, CELP, RPE-LTP, adaptive sub-band coding, MPEG standards for audio and video coding. Signaling protocols: Review of H.323, MEGACO protocols, Session Initiation Protocol (SIP), detailed study of SIP, implementation of SIP through Java. Media Transport: Need of special media transport protocols, RTP, RTCP, RTSP, QoS issues, routing, security etc.

Modern network technologies: mobile communication 3G, 4G, IMS, wireless LANs, wired networks. New services like IP-TV, multimedia conference calls, presence management, device and access independent services. VXML based applications

Books

1. O. Hersent, D. Gurle and JP Petit- “IP Telephony”, Pearson Education Asia
2. J. D. Gibson (Editor) “Multimedia Communications” – Harcourt India
3. Bill Douskalis “IP Telephony”, Prentice Hall
4. R. Wittman, M.Zitterbart-Morgan Kaufman, “Multicast Communication”.

ECL418 Network Planning and Management [(3-0-0); Credits: 3] Top

Pre-requisite:-

Course outcomes

Students will be able to

1. do traffic analysis for network planning
2. describe various procurement and installation procedures.
3. describe operation and maintenance systems for telecom networks
4. design an enterprise network based on the requirements of an organisation.
5. select appropriate protocols and applications for enterprise network management and diagnosis

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

Contents:

Network traffic data analysis and forecasting, resource planning, procurement and installation

Telecom network operation and maintenance system. Case studies of telecom, XoIP, MPLS, GSM, CDMA, LTE, VoLTE networks.

Enterprise need analysis and LAN design, component selection, procurement and installation.

Network management issues such as configuration management, fault and maintenance management, security and access management.

Management protocols such as SNMP, web based management tools such as Netconf, management protocol issues such as scalability, efficiency, effectiveness etc.

Books

1. Subramanian ; “Network Management” ; Addison Wesley (Low Price Edition)
2. McCabe J.D., “Network analysis, architecture and design”, Elsevier
3. FitzGerald J., Dennis A., “Business Data Communications and networking”.

ECL419 Wireless Sensor Networks [(3-0-0); Credits: 3] Top

Pre-requisite:

Course Outcomes

1. This course provides an introduction to fundamentals of wireless sensors.
2. Students will know about software platforms required for WSN.
3. Students can know about various MAC protocols for different communication standards used in WSN.
4. Students can explore new protocols for WSN.
5. Students will know about data gathering, data fusion etc. techniques.

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

Contents:

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

Mobile Adhoc NETworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee,

Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Design Principles for WSNs ,Gateway Concepts Need for gateway ,WSN to Internet Communication, Internet to WSN Communication.

Single-node architecture, Hardware components & design constraints,

Operating systems and execution environments, introduction to TinyOS and nesC.

Text Books

1 Waltenegus Dargie , Christian Poellabauer, Fundamentals Of Wireless Sensor Networks Theory And Practice By John Wiley & Sons Publications

Reference Books

1. Sabrie Soloman, SENSORS HANDBOOK by Mc Graw Hill publication.

2. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks, Elsevier Publications.

3. Kazem Sohrby, Daniel Minoli, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley-Inderscience

4. Philip Levis, And David Gay Tinyos Programming by Cambridge University Press.

ECP419 Wireless Sensor Networks [(0-0-2); Credits: 1] Top

Course Outcomes:

Students will

1. Know wireless sensors which have applications in many fields.

2. design wireless sensor networks for an application

3. know about various simulators

4. know about various protocols used for different communication standards used in WSN

5. explore sensor hardware for WSN

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

List of experiments:

1. Introduction to various sensor networks simulators

2. Compiling and building an application onto a mote

3. Using XCTU tool

4. Experiments based on different routing protocols using Netsim

5. Experiments on sensor boards such as Advanced technology sensor board, crossbow etc.

6. Configuring gateway devices

ECL427 Broadband Communication [(3-0-0); Credits: 3] Top

Pre-requisite:ECL303

Course Outcomes

Students will

1. Be conversant with orbital aspects of satellite communication
2. Be able to design satellite link
3. Be knowing about digital satellite links
4. Be familiar with multi-access schemes
5. Be familiar with multi-carrier communication systems

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

Contents:

Satellite Communication Systems

Orbital aspects of satellite communication, Attitude and orbit control system, Telemetry tracking and command system (TTC), Power subsystems, Antennas, Reliability

Satellite link design, System noise temperature, G/T ratio, Down link design, Uplink design, Link for specified (C/N) base-band noise signal.

Digital Satellite Links, Frequencies and channel allocations, Modulation techniques, QPSK, QAM, BER analysis, medium access methods for satellite communication.

Multicarrier communication systems:

DMT, OFDM, MIMO systems, space-time coding, WiFi, WiMax, UWB systems

Books

1. Timothy Pratt, Charles Bostian, Jeremy Allnut ,"Satellite communication" John Willey and Sons Inc. Second edition
2. W. L. Pritchard, H.G. Suyderhoud, R.A. Nelson, "Satellite Communication Systems Engineering" Pearson Education Second edition
3. Wayne Tomasi "Advanced Electronic communications" PHI Learning, Fifth edition
4. Frank.R. Dungan," Electronic Communication Systems" International Thomson Publishing Company Third edition
5. J. Proakis, "Digital Communication" 4e, TMH
6. Simon Haykin, "Communication Systems", 4e, John Wiley

ECL424 Optical Communication [(3-0-0); Credits: 3] Top

Pre-requisite:

Course Outcomes

1. Familiarity with basic concepts and theory of Optical Communication.

2. Ability to demonstrate OPCOMM components, assemble them and solve problems on Optical Communication system.

3. Ability to design, implements, analyzes and maintains optical communication system

4. Knowledge of different source of light as well as receiver nd their comparative study

5. To get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain

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

Contents:

Optical Fiber: Basic concepts of optical communication. The nature of light. Light as an Electromagnetic Wave, Polarisation, Interference. Transmitting light on a Fibre Refractive index, Fibre refractive index profiles, Modes of propagation. Light Propagation in Multimode Fibre, Snell's Law Critical Angle, Numerical aperture.

Optical Sources: Light Emitting Diodes (LEDS), The Semiconductor Junction Diode, Construction and Operation of LED's , Heterojunctions (Practical LED's) , Characteristics of LED'S, Lasers, Principle of the LASER, Semiconductor Laser Diodes.

Optical Detectors: Photoconductors, Photodiodes, P-N Diodes, P-I-N Diodes, Schottky-Barrier Photodiodes, Avalanche Photodiodes (APDS), Hetero-interface Photodetectors, Travelling Wave photo detectors, Phototransistors.

Optical Communication Systems: Point-to-point Transmission Systems, Modulation techniques, On-off key, Multi state coding, Forward Error correction, Receiving the signal, Timing recovery, Bandwidth Occupancy.

Text Books:

1. Optical Fibre Communication Practice and Principles, J. Senior

2. Fibre Optic Communication , D. C. Agrawal

3. Optical Communication, Keiser

Reference Books:

1. “Optical Fibre Communication Practice and Principles”, Senior

2. “Fibre Optic Communication”, D. C. Agrawal

3. “Optical Communication”, Keiser

ECP424 Optical Communication [(0-0-2); Credits: 1] Top

Course outcomes:

1.Practical concepts of different parameters associated with optical communication.

2.Ability to implement and analyses optical communication

3.Realization of different light source as well as detection

4.Practical concept of different modelling scheme in optical domain

5.Ability to design an optical communication system

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

List of Experiments:

1. Measurement of propagation losses in an Optical Fiber
2. Measurement of Numerical Aperture of an Optical Fiber using 660 nm LED
3. Study of V-I , I-P characteristics of laser and V-I characteristics of 660 nm LED
4. (a). Study of Fiber optic transmission sensor
5. (b). Study of Fiber optic reflection sensor
6. (c). Transmission of light through fiber with gaps
7. Setting up of Fiber optic digital link
8. Setting up of Fiber optic analog link
9. Study and measurement of Bit Error Rate (BER)
10. Study of Pulse width modulation and demodulation
11. Study of Pulse amplitude modulation and demodulation
12. Study of Pulse position modulation and demodulation