Sri Sivasubramaniya Nadar College of Engineering

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Rajiv Gandhi Salai (OMR), Kalavakkam – 603110

Curriculum and Syllabus

Bachelor of Engineering

Electronics and Communication Engineering

Regulations 2018

Choice Based Credit System (CBCS)

(An Autonomous Institution, Affiliated to Anna University, Chennai)

B.E. Electronics and Communication Engineering

REGULATIONS 2018

CHOICE BASED CREDIT SYSTEM

I -VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UEN1176	Communicative English	HS	3	3	0	0	3
2	UMA1176	Algebra and Calculus	BS	5	3	2	0	4
3	UPH1176	Engineering Physics	BS	3	3	0	0	3
4	UCY1176	Engineering Chemistry	BS	3	3	0	0	3
5	UGE1176	Problem Solving and Programming in Python	ES	3	3	0	0	3
6	UGE1177	Engineering Graphics	ES	5	1	0	4	3
PRACTICALS								
7	UGE1197	Programming in Python Lab	ES	3	0	0	3	1.5
8	UGS1197	Physics and Chemistry Lab	BS	3	0	0	3	1.5
			Total	**28**	**16**	**2**	**10**	**22**

SEMESTER II

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UEN1276	Technical English	HS	3	3	0	0	3
2	UMA1276	Complex Functions and Laplace Transforms	BS	5	3	2	0	4
3	UPH1277	Physics for Electronics Engineering	BS	3	3	0	0	3
4	UEE1253	Basic Electrical and Instrumentation Engineering	ES	3	3	0	0	3
5	UEC1201	Circuit Analysis	ES	5	3	2	0	4
6	UEC1202	Electronic Devices	ES	3	3	0	0	3
PRACTICALS								
7	UGE1297	Design Thinking and Engineering Practices Lab	ES	3	0	0	3	1.5
8	UEC1211	Circuits and Devices Lab	ES	3	0	0	3	1.5
			Total	**28**	**18**	**4**	**6**	**23**

SEMESTER III

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UMA1351	Linear Algebra and Numerical Methods	BS	5	3	2	0	4
2	UEC1301	Electronic Circuits I	PC	3	3	0	0	3
3	UEC1302	Digital System Design	PC	3	3	0	0	3
4	UEC1303	Signals and Systems	ES	5	3	2	0	4
5	UCS1351	Object Oriented Programming and Data Structures	PC	3	3	0	0	3
6	UEC1304	Electromagnetic Fields	PC	5	3	2	0	4
PRACTICALS								
7	UCS1371	OOP and Data Structures Lab	PC	3	0	0	3	1.5
8	UEC1311	Analog and Digital Circuits Lab	PC	3	0	0	3	1.5
			Total	**30**	**18**	**6**	**6**	**24**

SEMESTER IV

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UMA1477	Probability Theory and Stochastic Processes	BS	5	3	2	0	4
2	UCY1276	Environmental Science	HS	3	3	0	0	3
3	UEC1401	Electronic Circuits II	PC	3	3	0	0	3
4	UEC1402	Digital Signal Processing	PC	5	3	2	0	4
5	UEC1403	Linear Integrated Circuits	PC	3	3	0	0	3
6	UEC1404	Principles of Communication Systems	PC	3	3	0	0	3
PRACTICALS								
7	UEC1411	Electronic Circuits II and LIC Lab	PC	3	0	0	3	1.5
8	UEC1412	Digital Signal Processing Lab	PC	3	0	0	3	1.5
			Total	**28**	**18**	**4**	**6**	**23**

SEMESTER V

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UEC1501	Digital Communication	PC	3	3	0	0	3
2	UEC1502	Microprocessor, Microcontroller and Interfacing	PC	3	3	0	0	3
3	UEC1503	Transmission Lines and Waveguides	PC	3	3	0	0	3
4	UCS1551	Computer Architecture and Organization	PC	3	3	0	0	3
5	UEE1551	Control Systems Engineering	PC	4	2	2	0	3
6		Professional Elective – I	PE	3	3	0	0	3
PRACTICALS								
7	UEC1511	Analog and Digital Communication Lab	PC	2	0	0	2	1
8	UEC1512	Microprocessor and Microcontroller Lab	PC	2	0	0	2	1
9	UEN1597	Professional Communications Lab	HS	2	0	0	2	1
			Total	**25**	**17**	**4**	**6**	**21**

SEMESTER VI

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UEC1601	Principles of VLSI Design	PC	3	3	0	0	3
2	UEC1602	Wireless Communications	PC	3	3	0	0	3
3	UEC1603	System Design for IoT	PC	3	3	0	0	3
4	UEC1604	Communication Networks	PC	5	3	0	2	4
5	UEC1605	Machine Learning	PC	5	3	0	2	4
6		Professional Elective – II	PE	3	3	0	0	3
PRACTICALS								
7	UEC1611	VLSI Design Lab	PC	2	0	0	2	1
8	UEC1612	System Design for IoT Lab	PC	2	0	0	2	1
			Total	**26**	**18**	**0**	**8**	**22**

SEMESTER VII

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UEC1701	High Frequency Communication Systems	PC	3	3	0	0	3
2	UEC1702	Microwave Engineering and Antennas	PC	3	3	0	0	3
3	UEC1703	Professional Ethics and Management Practices	HS	3	3	0	0	3
4		Professional Elective – III	PE	3	3	0	0	3
5		Professional Elective – IV	PE	3	3	0	0	3
6		Open Elective – I	OE	3	3	0	0	3
PRACTICALS								
7	UEC1711	Wireless Communication Lab	PC	2	0	0	2	1
8	UEC1712	Microwave and Antennas Lab	PC	2	0	0	2	1
9	UEC1718	Project Work Stage – I	EEC	2	0	0	2	1
			Total	**24**	**18**	**0**	**6**	**21**

SEMESTER VIII

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1		Professional Elective – V	PE	3	3	0	0	3
2		Open Elective – II	OE	3	3	0	0	3
PRACTICALS								
3	UEC1818	Project Work Stage – II	EEC	18	0	0	18	9
			Total	**24**	**6**	**0**	**18**	**15**

PROFESSIONAL ELECTIVE – I

SEMESTER V

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC1521	Information Theory and Coding	PE	3	3	0	0	3
2	UEC1522	Advanced Digital Signal Processing	PE	3	3	0	0	3
3	UEC1523	Speech Signal Processing	PE	3	3	0	0	3
4	UEC1524	Soft Computing Techniques	PE	3	3	0	0	3
5	UEC1525	Nano Electronics	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – II

SEMESTER VI

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC1621	Speech Technology	PE	3	3	0	0	3
2	UEC1622	Sensors, Actuators and Interface Electronics	PE	3	3	0	0	3
3	UEC1623	Introduction to MEMS & NEMS	PE	3	3	0	0	3
4	UEC1624	Advanced Microcontrollers	PE	3	3	0	0	3
5	UEC1625	Wireless Adhoc and Sensor Networks	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III

SEMESTER VII

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC1721	CMOS Analog IC Design	PE	3	3	0	0	3
2	UEC1722	Digital Image and Video Processing	PE	3	3	0	0	3
3	UEC1723	Digital Signal Integrity	PE	3	3	0	0	3
4	UEC1724	MIC and RF Systems Design	PE	3	3	0	0	3
5	UEC1725	Embedded and Real Time Operating Systems	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV

SEMESTER VII

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC1726	Electromagnetic Interference and Compatibility	PE	3	3	0	0	3
2	UEC1727	Computer Vision	PE	3	3	0	0	3
3	UEC1728	Cognitive Radio	PE	3	3	0	0	3
4	UEC1729	ASIC and FPGA Based Design	PE	3	3	0	0	3
5	UEC1731	Wireless Technology	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – V

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC1821	Communication Network Security	PE	3	3	0	0	3
2	UEC1822	Mixed Signal Design	PE	3	3	0	0	3
3	UEC1823	Introduction to Radar and Satellite Communication	PE	3	3	0	0	3
4	UEC1824	Optimization in Wireless Communication	PE	3	3	0	0	3
5	UEC1825	Underwater Communication	PE	3	3	0	0	3

OPEN ELECTIVES

(Offered by the Department of ECE to other branches)

ODD SEMESTER

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC1941	A Foundation Course on Digital Signal Processing	OE	3	3	0	0	3
2	UEC1942	Introduction to Communication Systems	OE	3	3	0	0	3
3	UEC1943	Introduction to Microcontrollers	OE	3	3	0	0	3
4	UEC1944	Introduction to Wireless Networks	OE	3	3	0	0	3

EVEN SEMESTER

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC1041	Introduction to Internet of Things	OE	3	3	0	0	3
2	UEC1042	Introduction to Sensors and Actuators	OE	3	3	0	0	3
3	UEC1043	A Foundation Course on Machine Learning	OE	3	3	0	0	3
4	UEC1044	Consumer Electronics	OE	3	3	0	0	3

HUMANITIES AND SOCIAL SCIENCES (HS)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEN1176	Communicative English	HS	3	3	0	0	3
2	UEN1276	Technical English	HS	3	3	0	0	3
3	UCY1276	Environmental Science	HS	3	3	0	0	3
4	UEN1597	Professional Communications Lab	HS	2	0	0	2	1
5	UEC1703	Professional Ethics and Management Practices	HS	3	3	0	0	3

BASIC SCIENCES (BS)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UMA1176	Algebra and Calculus	BS	5	3	2	0	4
2	UPH1176	Engineering Physics	BS	3	3	0	0	3
3	UCY1176	Engineering Chemistry	BS	3	3	0	0	3
4	UGS1197	Physics and Chemistry Lab	BS	3	0	0	3	1.5
5	UMA1276	Complex Functions and Laplace Transforms	BS	5	3	2	0	4
6	UPH1277	Physics for Electronics Engineering	BS	3	3	0	0	3
7	UMA1377	Linear Algebra and Numerical Methods	BS	5	3	2	0	4
8	UMA1477	Probability Theory and Stochastic Processes	BS	5	3	2	0	4

ENGINEERING SCIENCES (ES)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UGE1176	Problem Solving and Programming in Python	ES	3	3	0	0	3
2	UGE1177	Engineering Graphics	ES	5	1	0	4	3
3	UGE1197	Programming in Python Lab	ES	3	0	0	3	1.5
4	UEE1253	Basic Electrical and Instrumentation Engineering	ES	3	3	0	0	3
5	UEC1201	Circuit Analysis	ES	5	3	2	0	4
6	UEC1202	Electronic Devices	ES	3	3	0	0	3
7	UGE1297	Design Thinking and Engineering Practices Lab	ES	3	0	0	3	1.5
8	UEC1211	Circuits and Devices Lab	ES	3	0	0	3	1.5
9	UEC1303	Signals and Systems	ES	5	3	2	0	4

PROFESSIONAL CORE (PC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC1301	Electronic Circuits I	PC	3	3	0	0	3
2	UEC1302	Digital System Design	PC	3	3	0	0	3
3	UCS1351	Object Oriented Programming and Data Structures	PC	3	3	0	0	3
4	UEC1304	Electromagnetic Fields	PC	5	3	2	0	4
5	UCS1371	OOP and Data Structures Lab	PC	3	0	0	3	1.5
6	UEC1311	Analog and Digital Circuits Lab	PC	3	0	0	3	1.5
7	UEC1401	Electronic Circuits II	PC	3	3	0	0	3
8	UEC1402	Digital Signal Processing	PC	5	3	2	0	4
9	UEC1403	Linear Integrated Circuits	PC	3	3	0	0	3
10	UEC1404	Principles of Communication Systems	PC	3	3	0	0	3
11	UEC1411	Electronic Circuits II and LIC Lab	PC	3	0	0	3	1.5
12	UEC1412	Digital Signal Processing Lab	PC	3	0	0	3	1.5
13	UEC1501	Digital Communication	PC	3	3	0	0	3
14	UEC1502	Microprocessor, Microcontroller and Interfacing	PC	3	3	0	0	3
15	UEC1503	Transmission Lines and Waveguides	PC	3	3	0	0	3
16	UCS1551	Computer Architecture and Organization	PC	3	3	0	0	3
17	UEE1551	Control Systems Engineering	PC	4	2	2	0	3

18	UEC1511	Analog and Digital Communication Lab	PC	2	0	0	2	1
19	UEC1512	Microprocessor and Microcontroller Lab	PC	2	0	0	2	1
20	UEC1601	Principles of VLSI Design	PC	3	3	0	0	3
21	UEC1602	Wireless Communications	PC	3	3	0	0	3
22	UEC1603	System Design for IoT	PC	3	3	0	0	3
23	UEC1604	Communication Networks	PC	5	3	0	2	4
24	UEC1605	Machine Learning	PC	5	3	0	2	4
25	UEC1611	VLSI Design Lab	PC	2	0	0	2	1
26	UEC1612	System Design for IoT Lab	PC	2	0	0	2	1
27	UEC1701	High Frequency Communication Systems	PC	3	3	0	0	3
28	UEC1702	Microwave Engineering and Antennas	PC	3	3	0	0	3
29	UEC1711	Wireless Communication Lab	PC	2	0	0	2	1
30	UEC1712	Microwave and Antennas Lab	PC	2	0	0	2	1

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEC1718	Project Work Stage I	EEC	2	0	0	2	1
2	UEC1818	Project Work Stage II	EEC	18	0	0	18	9

SUMMARY

Sl. No.	Category	Credits as per Semester								Total Credits	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HS	3	3		3	1		3		13	7.60
2	BS	11.5	7	4	4					26.5	15.49
3	ES	7.5	13	4						24.5	14.33
4	PC			16	16	17	19	8		76	44.44
5	PE					3	3	6	3	15	8.77
6	OE							3	3	6	3.51
7	EEC							1	9	10	5.85
Total		22	23	24	23	21	22	21	15	171	

COURSE CODE	COURSE TITLE	L	T	P	C
UEN1176	COMMUNICATIVE ENGLISH	3	0	0	3

OBJECTIVES

- To develop the basic reading and writing skills
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions and seeking clarifications
- To help learners develop their speaking skills to enable them speak fluently in real contexts
- To help learners develop general vocabulary through reading pertinent texts

UNIT I LANGUAGE FOR 'SMALL TALK' 9

- Reading: Short comprehension passages, Practice in skimming-scanning and predicting
- Writing: Completing sentences, Developing hints
- Language Development: asking and answering - Wh- Questions and Yes / No questions
- Vocabulary Development: Prefixes and Suffixes, Polite Expressions
- Speaking: Introducing oneself, Exchanging personal information
- Listening: Listening comprehension of short texts

UNIT II DEVELOP WRITING THROUGH READING 9

- Reading: Short narratives and descriptions from newspapers (including dialogues and conversations); Reading Comprehension Texts with varied question types
- Writing: paragraph writing (topic sentence, cohesive devices, organizational pattern)
- Language Development: prepositions, and clauses
- Vocabulary Development: guessing meanings of words in context
- Speaking: informal conversations, chunking at right places
- Listening: Listening to telephone conversations, short presentations and TV News

UNIT III PREPARING FOR A CAREER 9

- Reading: Short texts and longer passages (close reading)
- Writing: Reordering jumbled sentences
- Language Development: Degrees of comparisons, pronouns
- Vocabulary Development: idioms and phrases
- Speaking: short presentations using power point slides
- Listening: Listening to ted talks and long speeches for comprehension

UNIT IV IMPROVING SPEAKING 9

- Reading: Reading different types of texts (literary, journalistic, print media) for comprehension and pleasure
- Writing: letter writing (informal or personal letters) and e-mails etiquette
- Language Development: Tenses: simple present and past, present and past continuous
- Vocabulary Development: single word substitutes, collocations
- Speaking: Role plays (literary and non-literary texts)
- Listening: Listening comprehension (IELTS, TOEFL and others)

UNIT V LISTENING FOR DEEPER UNDERSTANDING 9

- Reading: Reading for comparisons and contrast and other deeper levels of meaning

- Writing: Writing short pieces – developing an outline, identifying main and subordinate ideas
- Language Development: modal verbs, perfect tenses
- Vocabulary Development: phrasal verbs, fixed and semi-fixed expressions (including idioms), fillers
- Speaking: Group Discussions
- Listening: Listening to lectures and making notes

TOTAL PERIODS: 45

OUTCOMES

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

- Apply reading strategies to comprehend articles of a general kind in magazines and newspapers
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English
- Comprehend conversations and short talks delivered in English in both formal and informal contexts
- Write short essays of a general kind and personal letters and emails in English

TEXT BOOK

1. Board of Editors, Using English: A Course book for Undergraduate Engineers and Technologists, Orient BlackSwan Limited, Hyderabad, 2015.

REFERENCE BOOKS

1. Richards C. Jack, Interchange Students' Book-2, New Delhi, Cambridge University Press, 2015.
2. Bailey, Stephen, Academic Writing: A practical guide for students, New York, Rutledge, 2011.
3. Means L. Thomas and Elaine Langlois, English & Communication for Colleges, Cengage Learning, USA, 2007.
4. Redston, Chris & Gillies Cunningham, Face2Face (Pre-intermediate Student's Book & Workbook), Cambridge University Press, New Delhi, 2005.
5. Comfort Jeremy et al., Speaking Effectively: Developing Speaking Skills for Business English, Cambridge University Press, Cambridge, Reprint, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UMA1176	ALGEBRA AND CALCULUS	3	2	0	4

OBJECTIVES

The objective of this course is to enable the student to

- Understand De Moivre's Theorem and use it in finding the expansion of trigonometric functions
- Evaluate the Eigen values and Eigen vectors and diagonalize the given matrix
- Understand the concept of circle of curvature, evolute and envelope of a given curve
- Familiarize the functions of two variables and finding its extreme points
- Understand Beta and Gamma functions and their relations, evaluation of double integrals and triple integrals

UNIT I TRIGONOMETRIC SERIES 12

De Moivre's Theorem (with proof) – Roots of a complex number, expansion of $\sin n\theta, \cos n\theta$ and $\tan n\theta$ in powers of $\sin\theta$, $\cos\theta$ and $\tan\theta$. Addition formulae for any number of angles, Expansion of $\sin^m\theta, \cos^n\theta$ and $\sin^m\theta \cos^n\theta$ in a series of sines or cosines of multiples of θ, Complex function – Exponential function of a complex variable, Hyperbolic functions, Real and imaginary parts of circular functions, Logarithmic function of complex variable.

UNIT II MATRICES 12

Eigen values and Eigen vectors – Properties of Eigen values - Linear dependence and independence of Eigen vectors - Cayley-Hamilton theorem (excluding proof), Reduction to Diagonal form – Similarity transformation, Quadratic form – Reduction of Quadratic form to canonical form, Nature of a Quadratic form, Complex Matrices.

UNIT III DIFFERENTIAL CALCULUS 12

Curvature – Cartesian and parametric coordinates, radius of curvature – Cartesian form (with proof) parametric and polar form, Centre of curvature and circle of curvature in Cartesian form, Evolute and envelope.

UNIT IV FUNCTIONS OF SEVERAL VARIABLES 12

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobians - Taylor's expansion – Maxima and Minima – Lagrangian method of undetermined multipliers, Differentiation under the integral sign.

UNIT V INTEGRAL CALCULUS 12

Beta and Gamma functions – Properties, Transformation of Beta and Gamma functions, Relation between Beta and Gamma functions, Double integrals, Change the order of Integration, Evaluation of double integrals in polar co-ordinations, Triple integrals.

TOTAL PERIODS: 60

OUTCOMES

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

- Obtain the expansion of trigonometric functions using De-Moivre's theorem
- Determine the Eigen values and Eigen vectors and diagonalize the given matrix
- Evaluate the circle of curvature, evolute and envelope of a given curve
- Find Taylor's expansion for functions of two variables, solve problems using Jacobians and find the extreme points of a function of two variables
- Solve problems using beta and gamma functions and evaluate problems in double integral and triple integral

TEXT BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, Forty Third Edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, Inc., Tenth Edition, 2016.

REFERENCE BOOKS

1. Bali N.P, Goyal M, Watkins C, Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. James Stewart, Calculus: Early Transcendental, Cengage Learning, New Delhi, Seventh Edition, 2013.

3. Narayanan S and Manicavachagom Pillai T.K, Calculus Volume I and II, S. Viswanathan (Printers & Publishers), Pvt., Ltd., 1997.
4. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus Early Transcendentals, John Wiley & Sons, Inc., Eleventh Edition, 2016.
5. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
UPH1176	ENGINEERING PHYSICS	3	0	0	3

OBJECTIVES

- Comprehend and identify different crystal structures and their imperfections
- Explain the elastic and thermal properties of materials and understand their significance
- Develop an understanding of quantum mechanical phenomena and their applications
- Provide an overview of the characteristics of sound, architectural acoustics and the production, detection and applications of ultrasound
- Explain the origin of laser action, production of laser, fiber optics and their applications

UNIT I CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials– single crystals - Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal Imperfections – Point, line (Edge and Screw dislocations –Burger vectors) Surface (stacking faults) and Volume defects.

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Properties of matter: Elasticity- Hooke's law - Relationship between three moduli of elasticity– stress -strain diagram– Poisson's ratio –Factors affecting elasticity– Torsional stress & deformations – Twisting couple – Torsion pendulum - theory and experiment–bending of beams -bending moment–cantilever: theory and experiment–uniform and non-uniform bending: theory and experiment-I-shaped girders.

Thermal Physics: Modes of heat transfer – thermal conduction, convection and radiation - thermal conductivity- Linear heat flow (Derivation) – Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel) – Formation of ice on ponds.

UNIT III ACOUSTICS AND ULTRASONICS 9

Acoustics: Classification and characteristics of Sound - decibel - Weber–Fechner law – Sabine's formula - derivation using growth and decay method —factors affecting acoustics of buildings and their remedies - Types of Acoustic absorbers - Methods of determination of Absorption Coefficient.

Ultrasonics: Production of ultrasonics by Magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A, B and C – scan displays.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton Effect. Theory and experimental

verification – Properties of Matter waves – wave particle duality - Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box and extension to three dimensional box – Degeneracy of electron energy states - Scanning electron microscope - Transmission electron microscope.

UNIT V PHOTONICS AND FIBRE OPTICS **9**

Photonics: Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients –Conditions for Laser action - Types of lasers – Nd: YAG, CO_2, Diode lasers- Industrial and Medical Applications. Fibre optics: Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) –Losses in fibers - attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors - pressure and displacement.

TOTAL PERIODS: 45

OUTCOMES

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

- Analyze crystal structures and the influence of imperfections on their properties
- Demonstrate and explain the general concepts of elastic and thermal properties of materials
- Explain quantum mechanical theories to correlate with experimental results and their applications to material diagnostics
- Analyze the applications of acoustics and ultrasonics to engineering and medical disciplines
- Elucidate the principle and working of lasers and optical fibers, and their applications in the field of industry, medicine and telecommunication

TEXT BOOKS

1. Gaur R.K and Gupta, S.L, Engineering Physics, Dhanpat Rai Publishers, 2012.
2. Serway R.A and Jewett J.W, Physics for Scientists and Engineers, Cengage Learning, 2010.

REFERENCE BOOKS

1. Halliday D, Resnick R and Walker J, Principles of Physics, Wiley, 2015.
2. Tipler P.A and Mosca G, Physics for Scientists and Engineers with Modern Physics, WH Freeman, 2007.
3. Avadhanulu M. N and Kshirsagar P. G, A Text Book of Engineering Physics, S. Chand & Co. Ltd., Ninth Revised Edition, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
UCY1176	ENGINEERING CHEMISTRY	3	0	0	3

OBJECTIVES

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques
- To give an overview about Polymers
- To develop an understanding of the basic concepts of phase rule and its application
- To make the students conversant with the types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels
- To provide knowledge on electrochemical cell, measurement of redox potential,

electrochemical corrosion and control, electroplating

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – Alkalinity- boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water- Reverse Osmosis.

UNIT II POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index Preparation, properties and uses of PVC, PE, PS Nylon 6.6, and Epoxy resin. Biodegradable polymers. Effect of polymers on environment.

UNIT III PHASE RULE AND ALLOYS 8

Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process – magnesium-zinc system. Alloys: Introduction- Definition- properties of alloys- significance of alloying – heat treatment of steel.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel.

Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value – theoretical air for combustion (problems) - flue gas analysis (ORSAT Method).

UNIT V ELECTROCHEMISTRY AND CORROSION 10

Electrochemical cell - redox reaction, electrode potential - origin of electrode potential - oxidation potential - reduction potential, measurement and applications – electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion – causes – factors - types chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – electrochemical protection – sacrificial anode method and impressed current cathodic method. Paints - constituents and function. Electroplating of Copper and electrode less plating of nickel.

TOTAL PERIODS: 45

OUTCOMES

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

- The knowledge gained on water treatment techniques, Polymers, Phase rule, Fuels and electrochemistry and Corrosion will facilitate better understanding of engineering processes and applications for further learning

TEXT BOOKS

1. Jain P.C. and Monika Jain, Engineering Chemistry Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.

2. Vairam S, Kalyani P. and Suba Ramesh, Engineering Chemistry, Wiley India Pvt., Ltd., New Delhi, 2013.

REFERENCE BOOKS

1. Dara S.S and Umare S.S, A Textbook of Engineering Chemistry, S. Chand and Company Ltd, New Delhi, 2015.
2. Friedrich Emich, Engineering Chemistry, Scientific International Pvt., Ltd., New Delhi, 2014.
3. Prasanta Rath, Engineering Chemistry, Cengage Learning India Pvt., Ltd, Delhi, 2015.
4. Shikha Agarwal, Engineering Chemistry-Fundamentals and Applications, Cambridge University Press, Delhi, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
UGE1176	PROBLEM SOLVING AND PROGRAMMING IN PYTHON	3	0	0	3

OBJECTIVES

- To solve algorithmic problems
- To abstract and specify problems
- To compose programs in Python using iteration and recursion
- To construct programs in Python using functions

UNITI ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions); Notation (pseudo code, flow chart, programming language); specification, composition, decomposition, iteration, recursion.

UNIT II DATA, EXPRESSION, STATEMENT, CONDITIONAL 9

Data and types: int, float, boolean, string, list; variables, expressions, statements, simultaneous assignment, precedence of operators; comments; in-built modules and functions; Conditional: boolean values and operators, conditional (if), alternative (if-else), case analysis (if-elif-else).

UNIT III ITERATION, FUNCTION, STRINGS 9

Iteration: while, for, break, continue, pass; Functions: function definition, function call, flow of execution, parameters and arguments, return values, local and global scope, recursion; Strings: string slices, immutability, string functions and methods, string module.

UNIT IV LISTS, TUPLES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, l ist parameters, nested lists, list comprehension; Tuples: tuple assignment, tuple as return value, tuple operations.

UNIT V DICTIONARIES, FILES 9

Dictionaries: operations and methods, looping and dictionaries, reverse lookup, dictionaries and lists; Files: Text files, reading and writing files, format operator, file names and paths; command line arguments.

TOTAL PERIODS: 45

OUTCOMES

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

- Think logically to solve programming problems and write solutions in pseudo code
- Understand and develop simple Python programs using conditionals and loops
- Decompose a program into functions
- Represent compound data using Python lists, tuples, dictionaries
- Perform input/output with files

TEXT BOOKS

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Updated for Python 3, Shroff/O'Reilly Publishers, Second Edition, 2016. (http://greenteapress.com/wp/think-python/).
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS

1. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013.
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, Exploring Python, McGraw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.
5. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python 3, Pragmatic Programmers, LLC, Second Edition, 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
UGE1177	ENGINEERING GRAPHICS	1	0	4	3

OBJECTIVES

- To develop the graphic skills for communication of concepts, ideas and design of engineering products
- To expose them to existing national standards related to technical drawings

CONCEPTS AND CONVENTIONS (Not for Examinations)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING 10

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Orthographic projection principles - Principal planes - First angle projection - Layout of views - Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 15

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 20

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of truncated solids (simple position only) – Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC PROJECTION AND BUILDING DRAWING 15

Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions – Building drawing – Plan, Elevation and Sectional View showing Foundation of simple buildings like pump room.

TOTAL PERIODS: 75

OUTCOMES

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

- Familiarize with the fundamentals and standards of Engineering graphics
- Perform freehand sketching of basic geometrical constructions and multiple views of objects
- Project orthographic projections of lines and plane surfaces
- Draw projections and solids and development of surfaces
- Visualize and to project isometric and perspective sections of simple solids
- Read a building drawing

TEXT BOOKS

1. Natarajan K.V, A Text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K and Prabhu Raja V, Engineering Graphics, New Age International (P) Limited, 2008.

REFERENCE BOOKS

1. Bhatt N.D and Panchal V.M, Engineering Drawing, Charotar Publishing House, Fifteenth Edition, 2010.
2. Basant Agarwal and Agarwal C.M, Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R, Engineering Drawing (Vol. I & II Combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren J and Duff John M, Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Prentice Hall of India Pvt. Ltd., New Delhi, Eastern Economy Edition, 2005.
5. Parthasarathy N.S and Vela Murali, Engineering Graphics, Oxford University Press, New Delhi, 2015.

6. Shah M.B and Rana B.C, Engineering Drawing, Pearson, Second Edition, 2009.
7. Bhattacharyya B and Bera, S.C, Engineering Graphics, I.K. International Publishing House Pvt. Ltd., New Delhi.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to End Semester Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

COURSE CODE	COURSE TITLE	L	T	P	C
UGE1197	PROGRAMMING IN PYTHON LAB	0	0	3	1.5

OBJECTIVES

- To solve problems using algorithms and flowcharts
- To write, test and debug simple Python programs
- To develop and execute programs using Python programming constructs

SUGGESTIVE EXERCISES

1. Use Linux shell commands, use Python in interactive mode, and an editor
2. Write simple programs (area of a geometric shape, simple interest, solve quadratic equation, net salary).
3. Write programs using conditional statements (leap year, maximum of 2 numbers, maximum of 3 numbers, simple calculator, grade of the total mark).
4. Develop programs using loops and nested loops (gcd, prime number, integer division, sum of digits of an integer, multiplication table, sum of a series, print patterns, square root using Newton's method).
5. Develop programs using function (sine and cosine series, Pythagorean triplets).
6. Develop programs using recursion (efficient power of a number, factorial, Fibonacci number).
7. Develop programs using strings (palindrome, finding substring) without using in-built functions.
8. Develop programs using list and tuples (linear search, binary search, selection sort, insertion sort, quick sort).
9. Develop programs using nested lists (matrix manipulations).
10. Develop simple programs using dictionaries (frequency histogram, nested dictionary).
11. Develop programs using Files (read and write files).
12. Develop programs to perform any task by reading arguments from command line.

TOTAL PERIODS: 45

OUTCOMES

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

- To write, test, and debug simple Python programs
- To implement Python programs with conditionals and loops
- Use functions for structuring Python programs
- Represent compound data using Python lists, tuples, and dictionaries
- Read and write data from/to files in Python

COURSE CODE	COURSE TITLE	L	T	P	C
UGS1197	PHYSICS AND CHEMISTRY LAB	0	0	3	1.5

PHYSICS LABORATORY

OBJECTIVES

The students will be trained to perform experiments to study the following

- The Properties of Matter
- The Optical properties like Interference and Diffraction.
- Optical Fibre Characteristics
- Characteristics of Lasers.
- Electrical & Thermal properties of Materials

and enable the students to enhance acuracy in experimental measurements.

LIST OF EXPERIMENTS

(A minimum of 8 experiments to be performed from the given list)

1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.
3. Determination of velocity of sound in the given liquid and compressibility of the liquid using Ultrasonic interferometer.
4. Determination of wavelength of mercury spectra using Spectrometer and grating.
5. Determination of dispersive power of prism using Spectrometer.
6. Determination of grating element/wavelength, and particle size/ wavelength using a laser.
7. Determination of Numerical and acceptance angle of an optical fiber.
8. Determination of thickness of a thin wire using interference fringes.
9. Determination of the coefficient of viscosity of the given liquid using Poiseuille's method.
10. Determination of energy band gap of the semiconductor.
11. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.
12. Determination of specific resistance of the material of the given wire using Carey Foster's bridge

OUTCOMES

On successful completion of this course, the student will be able to demonstrate the ability to formulate, conduct, analyse and interpret the results of experiments related to study / determination of

- The physical properties of materials like elasticity, compressibility, and viscosity.
- The optical properties of materials such as diffraction, interference and Numerical aperture.
- Thermal and electrical properties of materials such as conductivity and band gap.

CHEMISTRY LABORATORY
(A minimum of 8 experiments to be performed from the given list)

The chemistry laboratory course consists of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

OBJECTIVES

- Understand and apply the basic techniques involved in quantitative analysis
- Apply the knowledge gained in theory course

LIST OF EXPERIMENTS

1. Estimation of Hardness by EDTA method
2. Estimation of Chloride in water
3. Estimation of Alkalinity of water
4. Estimation of iron by spectrophotometry
5. Determination of the strength of strong acid by pH metry
6. Determination of the strength of strong acid by conductometry
7. Determination of the strength of mixture of strong and weak acids by conductometry
8. Estimation of Na by flame photometry
9. Estimation of Fe^{2+} by potentiometric titration
10. Determination of Degree of Polymerization of a low Molecular weight water soluble polymer
11. Determination of rate of corrosion of mild steel in acidic medium
12. Estimation of Barium chloride by conductometry titration

TOTAL PERIODS: 45

OUTCOMES

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

- Evaluate the quality of water
- Determine the metals and ions present in any given sample using various analytical techniques
- Measure properties such as conductance of solutions, redox potentials

COURSE CODE	COURSE TITLE	L	T	P	C
UEN1276	TECHNICAL ENGLISH	3	0	0	3

OBJECTIVES

- To develop strategies and skills to enhance their ability to read and comprehend texts in engineering and technology
- To improve their ability to write convincing job applications and effective reports

- To develop their speaking skills to make technical presentations, participate in group discussions
- To strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization

UNIT I INTRODUCING TECHNICAL WRITING 9

- Reading: Reading short technical texts from journals, newspapers and checking their comprehension
- Writing: Definitions, instructions, recommendations, checklist.
- Language Development: Subject Verb Agreement, numerical adjectives.
- Vocabulary Development: Avoidance of jargon, Technical vocabulary
- Speaking: Asking for and giving Directions
- Listening: Listening to technical talks with comprehension tasks.

UNIT II INTERPRETING CHARTS AND GRAPHS 9

- Reading: Practice in chunking and speed reading.
- Writing: Interpreting charts, graphs and other kinds of visual information.
- Language Development: Use of passive voice in technical writing
- Vocabulary Development: Important Latin and other foreign expressions in use.
- Speaking: Talking about Processes (Technical and General)
- Listening: Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos).

UNIT III PREPARING FOR A PRESENTATION 9

- Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests)
- Writing: Describing general or technical processes using appropriate flow charts.
- Vocabulary Development: Informal vocabulary and formal substitutes (based on a small grammatically-streamlined sample)
- Language Development: Embedded sentences and Ellipsis (allowed and disallowed types)
- Speaking: 5 minute presentations on technical/general topics
- Listening: Listening Comprehension (IELTS practice tests)

UNIT IV WRITING AND SPEAKING IN FORMAL SITUATIONS 9

- Reading: Technical reports, advertisements and minutes of meeting
- Writing: Writing minutes of a meeting, reports and general essays
- Vocabulary Development: paraphrasing, analogy, collocations
- Language Development: if conditionals and other kinds of complex sentences
- Speaking: Public Speaking (debates, extempore, just a minute)
- Listening: Listening to eminent voices of one's choice (in or outside the class, followed by a discussion in the class)

UNIT V WRITING REPORTS 9

- Reading: Extensive Reading (short stories, novels, poetry and others)
- Writing: reports (accident, issue-/survey-based), minutes of a meeting
- Vocabulary Development: Archaisms and contemporary synonyms, clichés.
- Language Development: Summarising, Elaboration.
- Speaking: Talk to public personalities and share the experience in class.
- Listening: Extensive Listening. (radio plays, rendering of poems, audio books & others)

TOTAL PERIODS: 45

OUTCOMES

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

- Apply reading strategies to comprehend technical texts and write area- specific texts effortlessly
- Listen and comprehend lectures and talks in science and technology
- Speak appropriately and effectively in varied formal and informal contexts
- Write technical documents like reports, emails, resume and winning job applications

TEXT BOOK

1. Board of Editors, Fluency in English: A Course book for Engineering and Technology, Orient Blackswan, Hyderabad, 2016.

REFERENCE BOOKS

1. Sudharshana N.P and Saveetha C, English for Technical Communication, Cambridge University Press, New Delhi, 2016.
2. Raman, Meenakshi, Sharma and Sangeetha, Technical Communication Principles and Practice, Oxford University Press, New Delhi, 2014.
3. Kumar Suresh E, Engineering English, Orient Blackswan, Hyderabad, 2015.
4. Booth L. Diana, Project Work, Oxford University Press, 2014.
5. Grussendorf, Marion, English for Presentations, Oxford University Press, 2007.
6. Means L. Thomas and Elaine Langlois, English & Communication for Colleges, Cengage Learning, USA, 2007.

COURSE CODE	COURSE TITLE	L	T	P	C
UMA1276	COMPLEX FUNCTIONS AND LAPLACE TRANSFORMS	3	2	0	4

OBJECTIVES

The objective of this course is to enable the student to

- Understand C-R equations and use it in the construction of Analytic Functions
- Understand the methods of Complex Integration using Cauchy's Integral Formula and Cauchy Residue theorem, finding Taylor's and Laurent's Series expansions
- Find the Laplace Transforms of standard Functions
- Find the Inverse Laplace Transform of a function and use it in solving Differential Equations
- Understand the concept of Divergence and curl and use it in evaluating Line, Surface and Volume integrals

UNIT I ANALYTIC FUNCTIONS 12

Analytic functions – necessary and sufficient conditions – Cauchy-Riemann equations in Cartesian and polar form (with proof) - Properties-harmonic functions, Construction of analytic function, conformal mapping, some standard transformations - $w = z + c,\ cz,\ \frac{1}{z}, z^2$, bilinear transformation.

UNIT II COMPLEX INTEGRATION 12

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour (except the poles on the real axis).

UNIT III LAPLACE TRANSFORMS 12

Definition, properties, existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Shifting theorems – Transforms of derivatives and integrals – Initial and final value theorems, Evaluation of integrals by Laplace transforms, periodic functions, Inverse transforms – Convolution theorem.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 12

Solution of second and higher order linear differential equation with constant coefficients ($f(x) = e^{mx}, sinmx, cosmx, x^n$), Solving linear second order ordinary differential equations with constant coefficients using Laplace transforms, Simultaneous linear equations with constant coefficients of first order.

UNIT V VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields, Line integral over a plane curve, Surface integral - Area of a curved surface, Volume integral, Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

TOTAL PERIODS: 60

OUTCOMES

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

- Solve problems in Analytic functions and construction of analytic functions using C-R equations
- Evaluate problems using Cauchy's integral formula and Cauchy residue theorem and find Taylor's and Laurent's series expansion of a given function
- Obtain the Laplace Transforms of standard functions
- Solve Differential Equations of Second order and Simultaneous linear equations with constant coefficients of first order using Laplace Transform
- Solve problems using divergence and curl and evaluate line, Surface and Volume integrals

TEXT BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, Forty Third Edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, Inc., Tenth Edition, 2016.

REFERENCE BOOKS

1. Bali N.P, Goya M, Watkins C, Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. Boyce W.E, and DiPrima R.C, Elementary Differential Equations and Boundary Value Problems, Wiley India, 2012.
3. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, Thomas' Calculus: Early Transcendental, Pearson Education, Thirteenth Edition, 2013.
4. O'Neil. P. V, Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd, New Delhi, Seventh Edition, 2011.

5. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus Early Transcendentals, John Wiley and Sons, Inc., Eleventh Edition, 2016.
6. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 2015.
7. Srivastava, A.C, and Srivastava P.K, Engineering Mathematics Volume I and II, PHI Learning Pvt. Ltd, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UPH1277	PHYSICS FOR ELECTRONICS ENGINEERING	3	0	0	3

OBJECTIVES

Enable the students to

- Understand the transport properties of conducting materials and their modeling using classical and quantum theories
- Analyze the physics of semiconductors and relate their microscopic properties to observable bulk phenomena
- Comprehend the origin of magnetic and superconducting properties in different materials and their engineering applications
- Provide an overview of the fundamentals of dielectrics and their applications
- Understand the basics of Opto and Nano electronics and its applications in various domains

UNIT I CONDUCTING MATERIALS 9

Classification of solids - Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum free electron theory – Density of energy states - Fermi distribution function – Effect of temperature on Fermi Function — carrier concentration in metals – Electron in periodic potential – Bloch theorem – Kronig - Penney model (qualitative) – Band theory of solids (qualitative), tight binding approximation, E-k curves and effective mass

UNIT II SEMICONDUCTING MATERIALS 9

Intrinsic semiconductor – Bond and energy band diagrams –Concept of hole - carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – Bond and energy band diagrams - carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – Direct and indirect band semiconductors – Velocity – electric field relations - Hall effect – Determination of Hall coefficient – Applications & Devices – Formation of PN junction –energy band diagram - biased and unbiased conditions.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Origin of magnetic moment – Bohr magneton- magnetic field and induction–magnetization-magnetic permeability and susceptibility– Microscopic and macroscopic classification of magnetic materials – comparison of Dia and para magnetism and Ferro magnetism – Ferromagnetism: origin and exchange interaction–saturation magnetization and Curie temperature - Domain theory – Hysteresis (based on domain theory) – soft and hard magnetic materials – Ferrites – applications Superconductivity - properties – Type I and Type II super conductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS 9

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Clausius – Mossotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – high-k dielectrics – Ferro electricity and applications.

UNIT V OPTO AND NANO ELECTRONIC DEVICES 9

Absorption emissionandscatteringoflightinmetals,insulatorsandSemiconductors(conceptsonly) - Carrier generation and recombination processes in semiconductors–Excitons LED-OLED-Semiconductor Laser diodes (Homo and double hetero junction) – Photo detectors- Photo diodes and Photo Conductors (concepts only) – Solar cell – Electron density in bulk material – Size dependence of Fermi energy – Energy band gap of Nano material – Quantum confinement – Density of states in quantum well, quantum wire and quantum dot structures-Quantum well and Quantum dot lasers– Carbon nanotubes – types, properties and applications.

TOTAL PERIODS: 45

OUTCOMES

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

- Estimate the conducting properties of materials based on classical and quantum theories and understand the formation of energy band structures
- Acquire knowledge on basics of semiconductor physics and its application to simple devices like PN junction devices
- Relate the magnetic and superconducting phenomena to their applications
- Demonstrate an understanding of dielectric materials, their operational limits and applications
- Understand the structure-property relationship of various nano and opto electronic materials and their realization in various domains

TEXT BOOKS

1. Adaptation by Balasubramanian R, Callister's Material Science and Engineering, Wiley India Pvt. Ltd., Second Edition, 2014.
2. Kasap S.O. - Principles of Electronic Materials and Devices, (Special Indian Edition) McGraw-Hill Education, Third Edition, 2017.

REFERENCE BOOKS

1. Umesh K Mishra and Jasprit Singh, Semiconductor Device Physics and Design, Springer, 2008.
2. Wahab M.A, Solid State Physics: Structure and Properties of Materials, Narosa Publishing House, Third Edition, 2015.
3. Pallab Bhattacharya, Semiconductor Optoelectronic Devices–Pearson, Second Edition, 2017.
4. Avadhanulu, M. N, P. G. Shirsagar, A Text Book of Engineering Physics, S. Chand & Co. Ltd., Ninth Revised Edition, 2012.
5. Salivahanan S, Rajalakshmi A, Karthie, S, Rajesh, N.P, Physics for Electronics Engineering and Information Science, McGraw Hill Education, 2018.
6. Charles Kittel, Introduction to Solid State Physics, Wiley Student Edition Publications, Eighth Edition, 2012.
7. Gaur R.K and Gupta S.L, Engineering Physics, Dhanpat Rai Publishers, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1253	BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING	3	0	0	3

OBJECTIVES

To impart knowledge on

- Operation of Three phase electrical circuits and power measurement
- Working principles of Electrical Machines
- Working principle of Various measuring instruments

UNIT I AC CIRCUITS AND POWER SYSTEMS 9

Three phase power supply – Star connection – Delta connection – Balanced and Unbalanced Loads- Power equation – Star Delta Conversion – Three Phase Power Measurement - Transmission & Distribution of electrical energy – Overhead Vs Underground system – Protection of power system – types of tariff – power factor improvement.

UNIT II TRANSFORMER 9

Introduction - Ideal Transformer – Accounting for Finite Permeability and Core Loss – Circuit Model of Transformer – Per Unit System – Determination of Parameters of Circuit Model of Transformer – Voltage Regulation – Name Plate Rating – Efficiency – Three Phase Transformers - Auto Transformers.

UNIT III DC MACHINES 9

Introduction – Constructional Features– Motoring and generation principle – EMF and Torque equation - Circuit Model – Methods of Excitation and magnetisation characteristics – Starting and Speed Control – Universal Motor.

UNIT IV AC MACHINES 9

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit, Single phase Induction motors -Construction– Types–starting and speed control methods. Alternator- working principle–Equation of induced EMF – Voltage regulation, Synchronous motors- working principle-starting methods -– Torque equation – Stepper Motors – Brushless DC Motors.

UNITV MEASUREMENT AND INSTRUMENTATION 9

Type of Electrical and electronic instruments – Classification- Types of indicating Instruments – Principles of Electrical Instruments – Multimeters, Oscilloscopes - Static and Dynamic Characteristics of Measurement – Errors in Measurement – Transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the concept of three phase power circuits and measurement
- Comprehend the concepts in electrical generators, motors and transformers
- Choose appropriate measuring instruments for given application

TEXT BOOKS

1. Kothari D.P and Nagarath, I.J, Basic Electrical and Electronics Engineering, McGraw

Hill Education (India) Private Limited, Third Reprint, 2016.
2. Giorgio Rizzoni, Principles and Applications of Electrical Engineering, McGraw Hill Education (India) Private Limited, 2010.

REFERENCE BOOKS

1. Bhattacharya S.K, Basic Electrical and Electronics Engineering, Pearson India, 2011.
2. Del Toro, Electrical Engineering Fundamentals, Pearson Education, New Delhi, 2015.
3. Leonard S Bobrow, Foundations of Electrical Engineering, Oxford University Press, 2013.
4. Rajendra Prasad, Fundamentals of Electrical Engineering, Prentice Hall of India, 2006.
5. Mittle, N, Basic Electrical Engineering, Tata McGraw Hill Edition, 24th Reprint, 2016.
6. Fitzgerald A.E, David E Higginbotham, and Arvin Grabel, Basic Electrical Engineering, McGraw Hill Education (India) Private Limited, 2009.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1201	CIRCUIT ANALYSIS	3	2	0	4

OBJECTIVES

- To introduce electric circuits and develop the ability to apply circuit analysis to DC and AC circuits
- To impart knowledge on solving circuits using network theorems
- To introduce the phenomenon of resonance in coupled circuits
- To obtain the transient response of circuits using Laplace transform
- To understand the concept of network synthesis

UNIT I BASIC CIRCUIT ANALYSIS 12

Ohm's law – Kirchhoff's laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for DC and AC circuits – Phasor Diagram – Power, Power Factor and Energy.

UNIT II NETWORK REDUCTION & NETWORK THEOREMS FOR DC & AC CIRCUITS 12

Network reduction: voltage and current division, source transformation – star delta conversion – Thevenin's and Norton's theorems – Superposition theorem – Maximum power transfer theorem – Reciprocity theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 12

Resonant tuned circuits – Series and Parallel resonance – frequency response – Quality factor and Bandwidth - Self and Mutual inductance – Coefficient of coupling – Modeling of coupled circuits – Dot convention - Tuned circuits – Single tuned and Double tuned coupled circuits.

UNIT IV TRANSIENT RESPONSE AND TWO PORT NETWORKS 12

Transient response of RL, RC and RLC circuits using Laplace transform for DC excitations and AC with sinusoidal excitations, Characterization of two port networks in terms of Z, Y, ABCD and h-parameters, Interconnection of two port networks – Transfer function of two port network terminated by a resistance.

UNIT V NETWORK SYNTHESIS 12

Causality and stability, Hurwitz polynomials, Positive real functions, Sturm's Theorem – Synthesis of one port network – Properties of driving-point immittance of LC networks – Synthesis of driving-point immittances – Foster and Cauer forms of LC networks – Synthesis of RC impedances and RL admittances in Foster and Cauer forms – Properties of RL impedance and RC admittances.

TOTALPERIODS: 60

OUTCOMES

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

- Learn and understand the basic concepts of circuit analysis such as Kirchoff's laws, mesh current and node voltage method for analysis of DC and AC circuits and network topology
- Apply the basic circuit analysis concepts and network theorems such as, Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem and Maximum power transfer theorem to DC and AC circuits
- Understand and characterize the frequency response of parallel and series resonance circuits, the concept of inductance, coupling and apply it to single and double tuned circuits
- Understand the transient response of RC, RL and RLC circuits and characterize two port networks in terms of *Z*, *Y*, *ABCD* and *h*-parameters
- Understand the concepts of network synthesis of one port network in Foster and Cauer forms

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, Engineering Circuits Analysis, McGraw Hill Science Engineering, 11th Reprint, Eighth Edition, 2016.
2. Van Valkenbarg M.E, Network Analysis, Pearson Education, Third Edition, 2015.

REFERENCE BOOKS

1. Charles K. Alexander, Mathew N.O. Sadiku, Fundamentals of Electric Circuits, McGraw Hill, Fifth Edition, 2015.
2. Franklin Kuo, Network Analysis and Synthesis, Wiley, Second Edition, 2009.
3. Allan H. Robbins, Wilhelm C. Miller, Circuit Analysis: Theory and Practice, Cengage Learning, Fifth Edition, 2013.
4. Salivahanan S, Pravin Kumar S, Circuit Theory, Vikas Publishing House, 2014.
5. Joseph A. Edminister, Mahmood Nahvi, Electric circuits, Schaum's outline series, Tata McGraw-Hill Publishing Company, Fifth Edition, 2016.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1202	ELECTRONIC DEVICES	3	0	0	3

OBJECTIVES

- To examine the behaviour of electrons under the influence of electric and magnetic fields
- To acquaint the semiconductor properties and formation of PN Junction diode and its characteristics
- To explain the operation and applications of BJT and FET
- To study the operation of special diodes and examine their characteristics

- To describe the functionality of power semiconductor devices and classify various types of optoelectronic devices

UNIT I ELECTRON BALLISTICS & SEMICONDUCTOR PROPERTIES 9

Electron Ballistics: Charged particles – Force, Field intensity, Potential and Energy – Two dimensional motion of electron – Force and motion in a magnetic field - parallel and perpendicular electric and magnetic field – electrostatic and magnetic deflection in a CRT – magnetic focusing – comparison between electric and magnetic deflection systems.

Semiconductor Properties: Classification of semiconductors – Conductivity of a semiconductor – Energy distribution of electrons – Carrier concentration in intrinsic and extrinsic semiconductor – Mass action law – Properties of intrinsic semiconductors – Variation in semiconductor properties with temperature – diffusion and drift currents – Carrier lifetime – Continuity equation.

UNIT II PN JUNCTION DIODE AND BJT 9

Theory of PN junction diode – Energy band structure of open-circuited PN junction – Quantitative theory of PN diode currents – Diode current equation– Static and dynamic resistance levels – Transition and diffusion capacitances, Temperature dependence of V-I characteristics of diode – Switching characteristics, Breakdown in PN junction diodes – Diode as a circuit element – Piecewise Linear diode model – PN diode applications.

BJT: Construction of BJT – Transistor biasing – Operation of NPN and PNP transistors–Types of configurations– Transistor as an amplifier - Large signal, dc and small signal CE values of current gain –Breakdown in transistors – Ebers-Moll Model.

UNIT III FIELD EFFECT TRANSISTOR 9

Construction and operation of N-channel JFET – Characteristic parameters of JFET– Expression for saturation drain current – Slope of V-I characteristics – Biasing for zero current drift - Comparison of BJT and JFET – Applications of JFET, Construction and operation of N-Channel and P-Channel MOSFET – Enhancement and depletion type MOSFET –Characteristics – Threshold voltage – Channel length modulation – Comparison of N-channel and P- channel MOSFETs–Comparison of MOSFET with JFET –Applications of MOSFETs in CMOS circuits.

UNIT IV SPECIAL SEMICONDUCTOR DEVICES 9

Construction, Principle of operation, characteristics and applications of Zener diode, Backward diode, Varactor diode, Step Recovery Diode, Point contact diode – Metal-Semiconductor junction – Schottky diode – Tunnel diode – Gunn Diode – Impatt Diode – PIN Diode – PIN Photodiode - Avalanche Photodiode - DUAL GATE MOSFET – FINFET– MESFET.

UNIT V POWER SEMICONDUCTOR & OPTOELECTRONIC DEVICES 9

Power Semiconductor Devices: Construction, Principle of operation, characteristics and applications of UJT, PNPN Diode, SCR, LASCR, DIAC, TRIAC, GTO Thyristors – Power BJT – Power MOSFET – DMOS – VMOS.

Optoelectronic Devices: Photoconductive sensors – Photoconductive cell – Photovoltaic sensors – Photo emissive sensors –Light emitters - LCD, Alpha numeric displays, LCD Panels, Plasma display Panels - Optocoupler, CCD, BBD.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the basics of electron ballistics and semiconductor physics
- Explain the basics of device physics and working principle of PN Junction diode
- Describe the construction, operation and applications of BJT, JFET and MOSFET

- Understand the device physics of metal-semiconductor junctions and working principle of special semiconductor devices
- Explain the construction and working principle of power semiconductor devices and optoelectronic and display devices

TEXT BOOKS

1. Donald A Neaman, Semiconductor Physics and Devices, McGraw Hill, Fourth Edition, 2017.
2. Salivahanan S and Sureshkumar N, Electronic Devices and Circuits, McGraw Hill Education, Fourth Edition, 2017.

REFERENCE BOOKS

1. Ben G Streetman and Sanjay Kumar Banerjee, Solid State Electronic Devices, Pearson, Seventh Edition, 2015.
2. Jacob Millman, Christos C. Halkias and Satyabrata Jit, Electronic Devices and Circuits, McGraw Hill, Fourth Edition, 2015.
3. Robert Boylestad and Louis Nashelsky, Electron Devices and Circuit Theory, Pearson, Eleventh Edition, 2013.
4. Thomas L. Floyd, Electronic Devices, Pearson, Ninth Edition, 2016.
5. Tyagi M.S, Introduction to Semiconductor Materials and Devices, Wiley, 2008.
6. David A Bell, Electric Circuits and Electronic Devices, Oxford University Press, 2010.
7. Robert F Pierret, Semiconductor Device Fundamentals, Pearson, 1996.

COURSE CODE	COURSE TITLE	L	T	P	C
UGE1297	DESIGN THINKING AND ENGINEERING PRACTICES LAB	0	0	3	1.5

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I - CIVIL ENGINEERING PRACTICE

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
(b) Preparation of plumbing line sketches for water supply and sewage works.
(c) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise: Wood work, joints by sawing, planning and cutting.
(a) Wood working - Demonstration of wood working machinery and furniture manufacturing.

II - MECHANICAL ENGINEERING PRACTICE

Basic Machining:
(a) Drilling Practice
Sheet Metal Work:
(a) Forming & Bending: (b) Model making – Trays, dust pan and funnels. (c) Different type of joints.

Machine assembly practice:
(a) Study of centrifugal pump (b) Study of air conditioner
Design Thinking: Students will be trained to dismantle, understand the functional / aesthetic aspects of the product and to assemble the following components like (a) Three jaw Chuck Assembly (b) Iron Box (c) Pedestal Fan (d) Lathe Tailstock.

Demonstration on:
(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt. (b) Foundry operations like mould preparation for gear and step cone pulley. (c) Fitting – Exercises – Preparation of square fitting and V – fitting models. (d) Arc welding and Gas Welding (e) Lathe operations.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipment – Resistor color coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL PERIODS: 45

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1211	CIRCUITS AND DEVICES LAB	0	0	3	1.5

OBJECTIVES

- To learn the characteristics of basic electronic devices such as Diode, BJT, FET, SCR.
- To understand the working of RL, RC and RLC circuits
- To gain hands on experience in Thevenin & Norton theorem, KVL & KCL, and Superposition Theorems

LIST OF EXPERIMENTS

Part I Devices Experiments using Breadboard, Equipment and Devices

1. Characteristics of PN Junction diode
2. Zener diode Characteristics & Regulator using Zener diode
3. Common Emitter input-output Characteristics
4. Common Base input-output Characteristics
5. FET Characteristics
6. SCR Characteristics
7. Clipper and Clamper & Full Wave Rectifier

Part II Circuits Experiments using Breadboard and Measuring Instruments

1. Verifications of Thevenin & Norton theorem
2. Verifications of KVL & KCL
3. Verifications of Superposition theorem
4. Verifications of Maximum Power Transfer & Reciprocity theorem
5. Determination of Resonance Frequency of Series & Parallel RLC Circuits

Part III Circuits and Device Simulations using PSPICE

1. Verification of Thevenin and Norton's theorem
2. Verifications of Superposition theorem
3. Verifications of Maximum Power Transfer theorem
4. Verification of Reciprocity theorem
5. Transient Analysis of RL and RC Circuits

TOTAL PERIODS: 45

OUTCOMES

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

- Analyze the characteristics of basic electronic devices
- Verify KVL & KCL, Thevenin & Norton theorem, Superposition, Maximum power and Reciprocity theorems
- Design RLC and transient RL & RC circuits in PSPICE

COURSE CODE	COURSE TITLE	L	T	P	C
UMA1351	LINEAR ALGEBRA AND NUMERICAL METHODS	3	2	0	4

OBJECTIVES

- To understand the basics of vector spaces, subspaces and linear transformations
- To apply the linear transformation concepts in diagonalization of a matrix
- To study inner product and norms and apply it in Gram-Schmidt procedure and least square approximation
- To evaluate the linear system of equations by using different numerical methods
- To find the numerical solution of Eigen values problems and generalized inverses

UNIT I VECTOR SPACES 12

Vector spaces –Subspaces –Linear combinations and system of Linear equations –Linear independence and Linear dependence –Bases and Dimensions –Linear Transformation –Matrix representation of Linear Transformation-Null space, Range and dimension theorem.

UNIT II LINEAR TRANSFORMATIONS 12

Linear transformations -Null spaces Range -Matrix representation of linear transformation - Eigenvalues -Eigenvectors –Diagonalization.

UNIT III INNER PRODUCT SPACES 12

Inner product and norms -Gram Schmidt orthonormalization process -Orthogonal Complement - Least square approximation.

UNIT IV NUMERICAL SOLUTION OF LINEAR SYSTEM OF EQUATIONS 12

Solution of linear system of equations–Direct method: Gauss elimination method –Pivoting – Gauss-Jordan method -LU decomposition method – Cholesky decomposition method -Iterative methods: Gauss-Jacobi and Gauss-Seidel –SOR Method.

UNIT V NUMERICAL SOLUTION OF EIGENVALUE PROBLEMS AND GENERALISED INVERSES 12

Eigen value Problems: Power method –Jacobi's rotation method–Conjugate gradient method– QR decomposition-Singular value decomposition method.

TOTAL PERIODS: 60

OUTCOMES

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

- Solve the problems using the concepts of vector spaces, subspaces and linear transformation
- Apply linear transformation to diagonalise a given matrix and hence to find the eigen values of the given matrix
- Apply Gram-Schmidt's orthogonalization process to diagonalise a given matrix and to solve the given system of equations by least square approximations
- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to the linear system of equations
- Decompose the matrix using different methods such as QR and singular value decomposition

TEXT BOOKS

1. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Prentice Hall of India, New Delhi, 2004.
2. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002.

REFERENCE BOOKS

1. Kumaresan S, Linear Algebra – A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
2. Strang G, Linear Algebra and its applications, Thomson (Brooks/Cole), New Delhi, 2005.
3. Gerald C.F, and Wheatley P.O, Applied Numerical Analysis, Pearson Education, New Delhi, 2002.
4. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2008.
5. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Education, New Delhi, First Reprint, 2009.
6. Richard Branson, Matrix Operations, Schaum's outline series, 1989.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1301	ELECTRONIC CIRCUITS – I	3	0	0	3

OBJECTIVES

- To understand the concepts of biasing in BJT, JFET and MOSFET

- To design and analyze single stage and multistage amplifier circuits using equivalent circuit
- To analyze the frequency response of small signal amplifiers
- To design, analyze, troubleshoot and fault analysis of regulated power supplies

UNIT I BIASING OF DISCRETE BJT, JFET & MOSFET 9

BJT: Need for biasing - DC load line and bias point - Thermal runaway - Stability factor - Methods of BJT biasing - Design and analysis of transistor circuits - Condition for thermal stability - Bias compensation techniques - JFET: DC load line and bias point - Methods of JFET and MOSFET biasing.

UNIT II BJT AMPLIFIERS 9

Small signal hybrid-π equivalent circuit of BJT - Early effect – Midband analysis of CE, CC and CB amplifiers using hybrid-π equivalent circuit - AC load line analysis - Comparison of CB, CE and CC amplifiers and their applications - Cascade and cascode amplifier - Darlington amplifier - Bootstrapping technique - BJT Differential amplifier - Small signal analysis and CMRR.

UNIT III JFET AND MOSFET AMPLIFIERS 9

Small signal hybrid-π equivalent circuit of FET and MOSFET – Midband analysis of CS, CD and CG amplifiers using hybrid-π equivalent circuit - FET differential amplifier - Small signal analysis and CMRR.

UNIT IV FREQUENCY RESPONSE OF AMPLIFIERS 9

General shape of frequency response of amplifiers - Frequency response of transistor amplifiers with circuit capacitors - High frequency-π model for BJT - CE short-circuit current gain - cut off frequency - f_α, f_β and gain-bandwidth product - Miller effect and Miller capacitance - High frequency analysis of CE amplifier - High frequency-π model for FET - High frequency analysis of CS amplifier.

UNIT V REGULATED POWER SUPPLIES 9

Linear mode power supply - Rectifiers: Half-wave rectifier - Full-wave rectifier - Bridge rectifier - Filters: L, C, LC and CLC filter - Voltage regulators - series and shunt - Over load protection - Switched mode power supply (SMPS) - Power supply performance and testing - Troubleshooting and Fault Analysis.

TOTAL PERIODS: 45

OUTCOMES

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

- Apply the knowledge of biasing on BJT and FET circuits
- Analyze the performance of small-signal BJT and FET in single stage and multi stage amplifiers
- Understand the frequency response characteristics of BJT and FET amplifiers
- Apply the knowledge gained in the design of electronic circuits

TEXT BOOKS

1. Donald A. Neamen, Electronic Circuits Analysis and Design, McGraw Hill Education (India) Private Ltd., Third Edition, 2017.
2. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, Eleventh Edition, 2016.

REFERENCE BOOKS

1. Millman J, Halkias C and Sathyabrada Jit, Electronic Devices and Circuits, McGraw Hill Education (India) Private Ltd., Fourth Edition, 2015.
2. Thomas L. Floyd, Electronic Devices, Pearson Education, Ninth Edition, 2017.
3. Salivahanan S and Suresh Kumar N, Electronic Devices and Circuits, McGraw Hill Education, Fourth Edition, 2017.
4. David A. Bell, Electronic Devices and Circuits, Oxford University Press, Fifth Edition, 2017.
5. Muhammad H. Rashid, Microelectronic Circuits Analysis and Design, Cengage Learning, Second Edition, 2017.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1302	DIGITAL SYSTEM DESIGN	3	0	0	3

OBJECTIVES

- To understand Boolean algebra and implement logic minimization
- To be able to use combinational logic blocks and sequential logic blocks to design a digital system
- To be able to design digital system and verify its functionality using hardware descriptive language (VHDL)

UNIT I DIGITAL FUNDAMENTALS 9

Analog versus Digital, Logic levels (Noise Levels), Fan-In, Fan-Out, propagation delay, power dissipation, Advantages of the digital information processing, Number systems: Binary, Octal, Decimal, Hexadecimal, 1's Complement and 2's Complement, Codes: Binary code, gray code, Binary coded decimal, ASCII, Code conversions, Boolean Algebra: Switching algebra, axioms and theorems, Logic gates: AND, OR, NOT, NAND, NOR, EXOR, EXNOR, Truth tables and logic gates expression: minterms and maxterms, SOP, POS.

UNIT II COMBINATIONAL CIRCUIT DESIGN 9

Logic minimization using Karnaugh's map: 3 variables, 4 variables and 5 variables, Logic minimization using Quine Mc-Cluskey method, Arithmetic operations: Half adder, full adder, ripple carry adder, lookahead adder, subtractor, binary multiplier, Booth's multiplier, Selection logic: Multiplexer, De-multiplexer, decoder, encoder, priority encoder, magnitude comparator.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Mealy machine, Moore machine, Latches and Flip flops: SR, JK, T and D, excitation tables and excitation equations, Setup time, hold time, propagation delay, clock sensitivity, clock skew, timing diagrams and meta-stability, Counters: Ripple counters, ring counters, modulo counters, Shift registers: SISO, SIPO, PISO, PIPO, Universal shift registers, Pipelining: Data path logic design.

UNIT IV FINITE STATE MACHINE: SYNCHRONOUS AND ASYNCHRONOUS 9

Synchronous FSM: State machine analysis: State diagram, state assignment, state minimization, Algorithmic state machine (ASM), Examples: sequence detector, up/down counter, Asynchronous logic design: Essential hazards, cycles and race conditions, Asynchronous FSM: stable and unstable states, state reduction, race free assignment, Pulse mode sequential circuits.

UNIT V HARDWARE DESCRIPTIVE LANGUAGE: VHDL 9

Introduction to Verilog and VHDL, Design entry in VHDL: Entity, architecture, coding style (behavioral and structural), Coding syntax: sequential statement, case, if statement, sensitivity list, Behavioral design of combinational logic blocks: multibit adder, selection logic, encoder,

decoder, comparator, Behavioral design of sequential logic blocks: counters, shift registers, finite state machines and sequence detector, Introduction to test bench.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand Boolean algebra and illustrate logic minimization
- Design combinatorial logic circuits including arithmetic logic, selection logic and code conversion
- Design sequential logic circuits including counters, shift registers and pipeline data path circuits
- Design finite state machines: conceptualization, algorithmic translation, state diagram to sequential logic circuits
- Design combinational and sequential logic circuits using VHDL

TEXT BOOK

1. John F. Wakerly, Digital Design Principles and Practices, Prentice Hall, Fourth Edition, 2005.
2. Salivahanan S and Arivazhagan S, Digital Circuits and Design, Oxford University Press, Fifth Edition, 2017.

REFERENCE BOOKS

1. Morris Mano M and Michael D. Ciletti, Digital Design, Pearson, Fifth Edition, 2015.
2. Charles H. Roth and Larry M. Hanny, Fundamentals of Logic Design, Cengage learning, Sixth Edition, 2010.
3. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated circuits: A design perspective, Pearson, Second Edition, 2016.
4. Kenneth L. Short, VHDL for Engineers, Prentice Hall, 2009.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1303	SIGNALS AND SYSTEMS	3	2	0	4

OBJECTIVES

- To understand the fundamentals of signal & systems and its classification
- To learn Laplace Transform & Fourier Transform and their properties
- To understand Z transform & DTFT and their properties
- To characterize LTI systems in Time and Transform domains

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 12

Continuous-Time signals (CT), Discrete-Time signals (DT) - Step, Ramp, Pulse, Impulse, Exponential, Classification of CT and DT signals - periodic and aperiodic, random signals, CT systems and DT systems - properties of systems.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 12

Fourier series analysis, Parseval's Theorem in Fourier series, Gibb's phenomenon. Fourier Transform and its properties - Linearity, Time shift, Time scaling, Frequency shift, Duality, Convolution, Multiplication and Parseval's Theorem.

Laplace Transform and its properties -Linearity, Time shift, Frequency shift and Convolution.

UNIT III LINEAR TIME INVARIANT –CONTINUOUS TIME SYSTEMS 12

Differential equation, Representing CT system using differential equations -Mechanical and Electrical Systems, Impulse response, Convolution integral, Fourier and Laplace transforms in Analysis of CT systems, Block diagram representation, Direct Form-I and Direct Form-II-Cascade and Parallel forms, Interconnection of system –Cascade and Parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 12

Sampling of CT signals, Frequency domain representation of sampling, Reconstruction of a band-limited signals from its samples- Zero order hold, Z-transform, Pole – Zero analysis, properties of Z-transform -Linearity, Time shift, Time scaling, Time Reversal, Frequency shift, Convolution, and Correlation, Inverse Z-transform- Partial fraction method. Discrete-Time Fourier Transform (DTFT) and properties -Linearity, Time shift, Time scaling, Frequency shift and Convolution.

UNIT V LINEAR TIME INVARIANT - DISCRETE TIME SYSTEMS 12

Difference equations, Impulse response, Convolution sum, Z-transform and DTFT Analysis of Recursive & Non Recursive systems. Block diagram representation, Direct Form-I and Direct Form-II - Cascade and Parallel forms, Interconnection of system – Cascade and Parallel.

TOTAL PERIODS: 60

OUTCOMES

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

- Analyze the properties of signals & systems
- Apply Fourier series, Laplace transform, Fourier transform, Z-transform and DTFT in signal analysis
- Analyze continuous time LTI systems using Fourier and Laplace Transforms
- Analyze discrete time LTI systems using Z-transform and DTFT

TEXT BOOK

1. Oppenheim A.V, Wilsky S and Nawab S.H, Signals and Systems, Prentice-Hall International, Second Edition, 2011.

REFERENCE BOOKS

1. Lathi B.P, Principles of Linear Systems and Signals, Oxford, Second Edition, 2009.
2. Zeimer R.E, Tranter W.H and Fannin R.D, Signals & Systems-Continuous and Discrete, Prentice-Hall, Fourth Edition, 1998.
3. Oktay Alkin**,** Signals and Systems: A MATLAB® Integrated Approach, CRC Press, First Edition, 2017.
4. Salivahanan S, Digital Signal Processing, McGraw Hill Education, Fourth Edition, 2019.
5. Roberts M.J, Signals & Systems Analysis using Transform Methods & MATLAB, Tata-McGraw Hill, First Edition, 2003.

COURSE CODE	COURSE TITLE	L	T	P	C
UCS1351	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES	3	0	0	3

OBJECTIVES

- To understand the object oriented programming concepts, using C++
- To apply object oriented programming to implement data structures
- To use linear and non-linear data structures in applications

UNIT I BASICS 9

Getting Started; Variables and Basic Types: primitive built in types - compound types - header files; Strings Vectors and Arrays: library string type and library vector type – arrays; Expressions: arithmetic - logical – relational - assignment; Statements: conditional - iterative - jump - exception handling.

UNIT II FUNCTIONS AND CLASSES 9

Function basics: argument passing – return types and return statements – overloaded functions – specialized uses – function matching – pointers to functions; Classes: defining abstract data types – access control and encapsulation – additional class features – class scope – constructors revisited – static class members.

UNIT III LINEAR DATA STRUCTURES 10

List ADT: array based implementation – pointer based implementation of singly linked list – applications: polynomial manipulation; Stack ADT: array based implementation – pointer based implementation, application: evaluating arithmetic expressions; Queue ADT: array based implementation and pointer based implementation.

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees: binary trees – traversals – search tree ADT; Graphs: representation of graphs – Dijkstra's algorithm for single source shortest path – depth first search.

UNIT V PRIORITY QUEUES, SORTING 8

Priority Queues: binary heap, implementation; Sorting: insertion sort – quicksort – mergesort.

TOTAL PERIODS: 45

OUTCOMES

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

- Design problem solutions using Object Oriented Techniques
- Apply the concepts of data abstraction, encapsulation and inheritance for problem solutions
- Use the control structures of C++ appropriately
- Critically analyze the various algorithms
- Apply the different data structures to problem solutions

TEXT BOOKS

1. Stanley B. Lippman, Jose Lajoie, and Barbara E. Moo., C++ Primer, Addison-Wesley Professional, Fifth Edition, 2012.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education, Second Edition, 2005.

REFERENCE BOOKS

1. Deitel and Deitel, C++ How to Program, Pearson Education, Fifth Edition, 2005.
2. Bhushan Trivedi, Programming with ANSI C++, A Step-by-Step approach, Oxford University Press, 2010.
3. Goodrich, Michael T, Roberto Tamassia, and David Mount, Data Structures and Algorithms in C++, Wiley, Seventh Edition, 2004.
4. Bjarne Stroustrup, The C++ Programming Language, Pearson Education, Third Edition, 2007.
5. Herbt Schildt, C++*:* The Complete Reference, McGraw-Hill, Inc., New York, NY, USA, Fourth Edition, 2002.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1304	ELECTROMAGNETIC FIELDS	3	2	0	4

OBJECTIVES

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

UNIT I VECTOR ANALYSIS AND ELECTROSTATICS 12

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem, Electric field, Coulomb's law, Gauss's law and applications, Electric potential.

UNIT II STATIC ELECTRIC FIELD IN MATERIALS 12

Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Capacitance of various geometries (parallel plate, cylindrical and spherical) using Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law

UNIT III MAGNETOSTATICS 12

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors (toroid and solenoid), Magnetic energy, Magnetic forces and torques (Hall effect, infinitely long parallel conductors, rectangular loop).

UNIT IV TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS 12

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields.

UNIT V PLANE ELECTROMAGNETIC WAVES 12

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary.

TOTAL PERIODS: 60

OUTCOMES

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

- Demonstrate knowledge and understanding of fundamental electromagnetic laws and concepts
- Display an understanding of the effect of materials on electric and magnetic fields
- Analyze electric and magnetic field quantities from simple charge and current distributions
- Analyze electric and magnetic field from a plane wave normally incident on a metallic dielectric material

TEXT BOOK

1. Cheng D.K., Field and wave electromagnetics, Pearson Education, Second Edition, 1989.

REFERENCE BOOKS

1. Griffiths D.J, Introduction to electrodynamics, Pearson Education, Fourth Edition, 2013.
2. Notaros B.M, Electromagnetics, Pearson, New Jersey, 2011.
3. Hayt W.H and Buck J.A, Engineering electromagnetics, McGraw-Hill (India), Seventh Edition, 2006.
4. Sadiku M.N.O and Kulkarni S.V, Principles of electromagnetics, Oxford (Asian Edition), Sixth Edition, 2015.
5. Salivahanan S and Karthie S, Electromagnetic Field Theory, McGraw Hill Education, Second Edition, 2018.

COURSE CODE	COURSE TITLE	L	T	P	C
UCS1371	OOP AND DATA STRUCTURES LAB	0	0	3	1.5

OBJECTIVES

- To write programs using object oriented programming features, in C++
- To implement data structures using C++
- To write recursive programs

LIST OF EXPERIMENTS

1. Basic programs using classes
2. Programs using exception handling
3. Programs using inheritance
4. Programs using polymorphism & function overloading
5. Stack ADT implementation
6. Linked list implementation
7. Queue ADT implementation
8. Evaluating arithmetic expression
9. Search Tree ADT
10. Single source shortest path: Dijkstra's algorithm
11. Sorting algorithms
12. Binary heaps

TOTAL PERIODS: 45

OUTCOMES

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

- Apply object oriented programming features in program development
- Write recursive functions
- Implement linked lists, stacks, queues

- To use data structures for solving problems

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS

S.NO. EQUIPMENTS

1. Standalone desktops with C++ Compiler - 35 Nos.

(or)

Server with C++ compiler supporting 35 terminals or more.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1311	ANALOG AND DIGITAL CIRCUITS LAB	0	0	3	1.5

OBJECTIVES

- To understand the frequency response of CE, CB and CC amplifier using BJT
- To obtain the bandwidth for multistage amplifiers like cascade and cascode amplifier
- To learn the frequency response of CS amplifier using JFET
- To determine the CMRR for BJT differential amplifier
- To simulate the frequency response of amplifier circuits using PSpice simulation tool
- To design and implement the combinational and sequential logic circuits

LIST OF ANALOG EXPERIMENTS

1. Frequency response of CE and CB amplifiers using self-bias configuration
2. Frequency response of Darlington amplifier
3. Determination of bandwidth for cascode amplifier circuit
4. Frequency response of CS amplifier using JFET
5. BJT differential amplifier – CMRR measurement
6. Analysis of BJT CE amplifier in voltage divider bias using PSpice
7. Analysis of BJT cascade amplifiers using PSpice
8. Analysis of JFET CS amplifier in fixed bias/self-bias/voltage divider bias using PSpice

LIST OF DIGITAL EXPERIMENTS

1. Design and implementation of code converters using logic gates (i) BCD to excess-3 code (ii) Binary to gray
2. Design and implementation of 4-bit binary adder/ subtractor using IC 7483
3. Design and implementation of BCD adder using IC 7483
4. Design and implementation of multiplexer and demultiplexer using logic gates
5. Design and implementation of encoder and decoder using logic gates
6. Construction and verification of 4-bit ripple counter and mod-10 / mod-12 ripple counter
7. Design and implementation of 3-bit synchronous up/down counter

TOTAL PERIODS: 45

OUTCOMES

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

- Design and test BJT/JFET amplifiers
- Differentiate cascode and cascade amplifiers
- Analyze the limitation in bandwidth of single stage and multistage amplifiers
- Measure the CMRR in differential amplifier
- Simulate and analyze amplifier circuits using PSpice

- Design and test the digital logic circuits

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.NO. EQUIPMENT FOR ANALOG LABORATORY

1. CRO/DSO (30MHz) – 15 Nos.
2. Signal Generator /Function Generators (3 MHz) – 15 Nos.
3. Dual Regulated Power Supplies (0 – 30V) – 15 Nos.
4. Standalone desktop PCs with SPICE software – 15 Nos.
5. Transistor/FET (BJT-NPN-PNP and JFET-N type-P type) – 50 Nos.
6. Multimeter – 15 Nos.
7. Components and Accessories: Resistors, Capacitors, Inductors, PN-Junction diodes, Zener diodes and wires
8. Bread Boards, PSpice circuit simulation software: (any public domain or commercial software)

S.NO. EQUIPMENT FOR DIGITAL LABORATORY

1. Dual power supply/ single mode power supply – 15 Nos.
2. IC Trainer Kit – 15 Nos.
3. Bread Boards – 15 Nos.
4. Seven segment display – 15 Nos.
5. IC's each 50 Nos.: 7400 / 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 / 74151 / 74147 / 7445 / 7476 / 7491/ 7494 / 7447 / 74180 / 7485 / 7473 / 74138 / 7411 / 7474
6. IC Tester – 5 Nos.

COURSE CODE	COURSE TITLE	L	T	P	C
UMA1477	PROBABILITY THEORY AND STOCHASTIC PROCESSES (Common to ECE and BME)	3	2	0	4

OBJECTIVES

- To identify the standard distributions and apply them in solving problems
- To understand the concept of two-dimensional random variables and solve problems in finding the Joint probabilities and correlation between them
- To analyze the concept of random processes and solve problems in Stationary process, Poisson process and Markov process
- To calculate the relationship between the Auto correlation function and Power density spectrum using Wiener Khintchine thoerem
- To analyze the response of random inputs to linear time invariant systems

UNIT I RANDOM VARIABLES 15

Probability - Axioms of probability - Conditional probability -Baye's theorem -Discrete and Continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Normal distributions - Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12

Joint distributions - Marginal and Conditional distributions –Covariance - Correlation and Linear regression - Transformation of random variables - Central limit theorem.

UNIT III RANDOM PROCESSES 13

Classification - Stationary process - Poisson process -Markov process - Discrete parameter Markov chain - Chapman Kolmogorov equation - Limiting distributions- Random telegraph process.

UNIT IV POWER SPECTRAL DENSITIES 12

Auto-correlation functions - Cross-correlation functions - Properties - Power spectral density - Cross power spectral density - Properties-Wiener Khintchine thoerem.

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 8

Linear time invariant system - System transfer function - Linear systems with random inputs - Auto-correlation and Cross-correlation functions of input and output.

TOTAL PERIODS: 60

OUTCOMES

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

- Identify standard distributions and apply them
- Solve problems in two dimension random variables and find the correlation between them
- To analyze different types of random processes
- Find the relation between Auto correlation function and Power density spectrum
- Find the response of random inputs to linear time invariant systems

TEXT BOOKS

1. Ibe O.C., Fundamentals of Applied Probability and Random Processes, Elsevier, First Indian Reprint, 2007.
2. Peebles, P.Z., Probability, Random Variables and Random Signal Principles, Tata McGraw Hill, New Delhi, Fourth Edition, 2002.

REFERENCE BOOKS

1. Cooper G.R., McGillem C.D., Probabilistic Methods of Signal and System Analysis, Oxford University Press, New Delhi, Third Indian Edition, 2012.
2. Hwei Hsu, Schaum‘s Outline of Theory and Problems of Probability, Random Variables and Random Processes, Tata McGraw Hill Edition, New Delhi, 2004.
3. Miller. S.L. and Childers. D.G., Probability and Random Processes with Applications to Signal Processing and Communications, Academic Press, 2004.
4. Stark. H. and Woods. J.W., Probability and Random Processes with Applications to Signal Processing, Pearson Education, Asia, Third Edition, 2002.
5. Yates. R.D. and Goodman. D.J., Probability and Stochastic Processes, Wiley India Pvt. Ltd., Bangalore, Second Edition, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
UCY1276	ENVIRONMENTAL SCIENCE	3	0	0	3

OBJECTIVES

- To understand the structure and functions of the ecosystems and biodiversity among life forms within an ecosystem
- To realize the importance of various natural resources and its sustainable use
- To address the various environmental issues related to various types of pollution.
- To address various social issues and the role of various environmental machineries to ensure proper environmental regulations
- To understand the influence of human population on environment issues and role of IT as a tool to minimize the environmental problems

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment– concept, structure and function of an ecosystem – energy flow- food chains, food webs and ecological pyramids – ecological succession Introduction to biodiversity definition and types– values of biodiversity- India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity-endangered and endemic species of India -conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II NATURAL RESOURCES 9

Uses, over-exploitation of natural resources: Forest, Water, Mineral, Food, Energy and Land. Case studies on over exploitation of natural resources -Role of an individual in conservation of natural resources- Equitable use of resources for sustainable lifestyles.

UNIT III ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: Air, Water, Soil, Marine, Noise, and Thermal pollution, Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earth quake, cyclone and landslides.

UNIT IV SOCIAL ISSUES AND ENVIRONMENT 9

From unsustainable to sustainable development – water conservation, rain water harvesting, watershed management – role of non-governmental organization - Social Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, case studies – environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

Population growth, variation among nations – population explosion – family welfare programme –environment and human health – human rights – value education – HIV/AIDS-women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the importance of the environment and describe the structure and functions of an ecosystem
- Identify the value and need for conservation of bio-diversity
- Know the importance of natural resources and its equitable use for sustainable life styles
- Explain the causes, effects and control measures of different types of pollution
- Understand various environmentally related social issues and their solutions

- Recall the tools for environmental regulations
- Relate the role of environment in human population growth and development
- Get knowledge about various techniques used for environmental monitoring and management

TEXT BOOKS

1. Anubha Kaushik and Kaushik C. P, Environmental Science and Engineering, New Age International Publishers, Fourteenth Edition, 2014.
2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2006.

REFERENCE BOOKS

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Pearson Education, Second Edition, 2004.
2. Tyler Miller G, and Scott E. Spoolman, Environmental Science, Cengage Learning India Pvt, Ltd, Delhi, 2014.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1401	ELECTRONIC CIRCUITS II	3	0	0	3

OBJECTIVES

- To introduce the concept of feedback in amplifiers and oscillators
- To study about tuned amplifiers
- To understand the analysis and design of feedback amplifiers, LC and RC oscillators, wave shaping circuits, multivibrators, power amplifiers and DC convertors

UNIT I FEEDBACK AMPLIFIERS 9

Basic concept of feedback - Gain with feedback - Feedback factor - General characteristics of negative feedback amplifiers - Effect of negative feedback on input and output resistance; topologies of feedback amplifiers - Analysis of series-shunt, series-series, shunt-series and shunt-shunt feedback amplifiers - Nyquist criterion for stability of feedback amplifiers - Gain and phase margin.

UNIT II OSCILLATORS 9

Classification of Oscillators - Barkhausen criterion for oscillation - RC phase shift, Wien bridge and Twin-T oscillator - General form of LC oscillator - Hartley, Colpitts and Clapp oscillator - Ring oscillators - Crystal oscillators – Equivalent circuit of crystal - Miller and Pierce crystal oscillator - Frequency stability of oscillator.

UNIT III TUNED AMPLIFIERS 9

Coil losses, Unloaded and loaded *Q* of tank circuits, Small signal tuned amplifiers - Analysis of capacitor coupled single tuned amplifier - Double tuned amplifier - Effect of cascading single tuned and double tuned amplifiers on bandwidth - Stagger tuned amplifiers - Comparison of tuned amplifiers - Stability of tuned amplifiers - Neutralization - Hazeltine neutralization method.

UNIT IV WAVE SHAPING AND MULTIVIBRATOR CIRCUITS 9

RC differentiator and integrator - Diode clippers and clampers - Transistor switching times - Speed-up capacitor - Collector-coupled astable, monostable and bistable multivibrator - Triggering methods for bistable multivibrators - Schmitt trigger - UJT relaxation oscillator.

UNIT V POWER AMPLIFIERS AND DC CONVERTERS 9

BJT Power amplifiers - Class A - Class B - Class AB - Class C - MOSFET Power amplifiers- Temperature Effect - Class AB Power amplifier using MOSFET - DC/DC convertors - Buck, Boost, Buck-Boost analysis and design.

TOTAL PERIODS: 45

OUTCOMES

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

- Acquire knowledge on the concept of feedback in amplifiers and oscillators
- Design and analyze feedback amplifiers and oscillators
- Analyze the performance of tuned amplifiers
- Design and analysis of wave shaping circuits and multivibrators
- Analysis and design of power amplifiers and DC converters

TEXT BOOKS

1. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Oxford University Press, Seventh Edition, 2016.
2. Salivahanan S and Suresh Kumar N, Electronic Devices and Circuits, McGraw Hill Education, Fourth Edition, 2017.

REFERENCE BOOKS

1. Millman J, Halkias C and Chetan D. Parikh, Integrated Electronics, McGraw Hill Education (India) Private Ltd., Second Edition, 2015.
2. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, Eleventh Edition, 2016.
3. Millman J, Taub H and Suryaprakash Rao Mothiki, Pulse Digital and Switching Waveforms, McGraw Hill Education (India) Private Ltd., Third Edition, 2011.
4. David A. Bell, Solid State Pulse Circuits, Prentice Hall of India, Fourth Edition, 1992.
5. David A. Bell, Electronic Devices and Circuits, Oxford University Press, Fifth Edition, 2017.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1402	DIGITAL SIGNAL PROCESSING	3	2	0	4

OBJECTIVES

- To learn the fundamentals of Discrete Fourier transform and its properties
- To understand the design aspects of frequency selective digital filters
- To interpret the implementation issues in designing digital filters
- To understand the concepts of adaptive filters

UNIT I DISCRETE FOURIER TRANSFORM 12

The concept of frequency in discrete time signals. Frequency-domain sampling, the discrete Fourier transform (DFT), DFT as a linear transformation. Properties of DFT - periodicity, linearity, time-reversal, symmetry properties, multiplication property - circular convolution. Linear filtering using DFT - filtering long data sequences - overlap save and overlap add method. Computation of DFT using DIF-FFT and DIT-FFT.

UNIT II DESIGN OF FIR FILTERS 12

Ideal filter characteristics, causality and its implications, characteristics of practical frequency-selective filters. Design of FIR filters - Symmetric and anti-symmetric FIR filters, design of linear-phase FIR filters using windows: rectangular window, Hamming window. Frequency sampling method.

UNIT III DESIGN OF IIR FILTERS 12

Design of analog filters - Chebyshev filter, Butterworth filter. Design of digital IIR lowpass filter from analog filters by approximation of derivatives, impulse invariance method and bilinear transformation.

UNIT IV IMPLEMENTATION OF DISCRETE-TIME SYSTEMS 12

Structures for the realization of discrete-time systems: structures for FIR systems - direct-form, cascade-form, frequency sampling structure and lattice structure. Effects of quantization of FIR filter coefficients. Structures for IIR systems - direct-form, transposed, cascade-form, parallel-form. Round-off effects in IIR filters - limit cycle oscillations, scaling to prevent overflow. Statistical characterization of quantization effects in realization of digital filters.

UNIT V MULTI-RATE PROCESSING & ADAPTIVE FILTERS 12

Multi-rate processing – decimation, interpolation, sampling rate conversion by rational factor. Wiener filter - Discrete Wiener Hoff equations. Basics of adaptive filters, FIR Adaptive filters, Adaptive filters based on steepest descent method, the LMS algorithm - convergence of the LMS algorithm, normalized LMS.

TOTAL PERIODS: 60

OUTCOMES

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

- Apply discrete Fourier transform for the analysis of digital signals and systems
- Design and realize a frequency selective digital IIR filters
- Design and realize FIR filters
- Characterize quantization effects in digital filters
- Apply the concepts of multirate processing, adaptive filtering in engineering applications

TEXT BOOKS

1. John G. Proakis, Dimitris G. Manolakis, Digital signal processing - principles, algorithms and applications, Pearson Education, Fourth Edition, 2007.
2. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, Wiley Publishers, 2011.
3. Salivahanan S, Digital Signal Processing, McGraw Hill Education, Fourth Edition, 2019.

REFERENCE BOOKS

1. Alan V. Oppenheim, Ronald W. Schaffer and John R. Buck, Discrete time signal processing, Prentice Hall, Third Edition, 2009.
2. Vinay K. Ingle and John G. Proakis, Digital Signal Processing using MATLAB, Cengage learning, Third Edition, 2011.
3. Sanjit K. Mitra, Digital Signal Processing: A computer based approach, McGraw Hill, Second Edition, 2000.
4. Ashok Ambardar, Digital Signal Processing: A modern introduction, Cengage Learning, First Edition, 2006.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1403	LINEAR INTEGRATED CIRCUITS	3	0	0	3

OBJECTIVES

- To understand applications of Operational Amplifiers
- To design circuits using analog multiplier and PLL
- To learn the circuits for the realization of ADC and DAC
- To design circuits to generate waveforms and special functions using ICs

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Ideal Operational Amplifier, General operational amplifier stages, DC and AC characteristics, Open and closed loop configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Adder, Subtractor, Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, Instrumentation amplifier, Integrator, Differentiator, Log and Antilog amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass, and band-pass filters.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair, four quadrant Gilbert Multiplier, Variable transconductance technique, analog multiplier ICs and their applications, Operation of PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM and FM detection, FSK MODEM, Frequency synthesizing and clock synchronisation.

UNIT IV ANALOG-TO-DIGITAL AND DIGITAL-TO-ANALOG CONVERTERS 9

A/D Converter, Flash type, Successive Approximation type, Single Slope type and Dual Slope type, Over-sampling A/D Converters, Sigma–Delta converters. D/A converter, weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode, high speed sample-and-hold circuits,

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs 9

Sine wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – fixed and adjustable voltage regulators, Monolithic switching regulator, Switched capacitor filter, Frequency-to-Voltage and Voltage-to-Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier.

TOTAL PERIODS: 45

OUTCOMES

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

- Design linear and nonlinear applications of Op-amps
- Demonstrate applications using analog multiplier and PLL
- Design ADC and DAC using Op-amps
- Synthesize waveforms using Op-amp Circuits
- Design circuits using special function ICs

TEXT BOOKS

1. Roy Choudhry D, Shail Jain, Linear Integrated Circuits, New Age International, Fourth Edition, 2012.
2. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Tata Mc Graw-Hill, Third Edition, 2007.

REFERENCE BOOKS

1. Ramakant A. Gayakwad, OP-AMP and Linear ICs, Prentice Hall, Fourth Edition, 2001.
2. Salivahanan S and Kanchana Bhaaskaran V S, Linear Integrated Circuits, McGraw Hill Education, Third Edition, 2018.
3. Sonde B.S., System design using Integrated Circuits, New Age International, Second Edition, 2001
4. Gray and Meyer, Analysis and Design of Analog Integrated Circuits, Wiley International, Fifth Edition, 2009.
5. William D. Stanley, Operational Amplifiers with Linear Integrated Circuits, Pearson Education, 2004.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1404	PRINCIPLES OF COMMUNICATION SYSTEMS	3	0	0	3

OBJECTIVES

- To introduce the concepts of various analog modulations and their spectral characteristics.
- To understand the properties of random process.
- To know the effect of noise on communication systems.
- To study the limits set by Information Theory.

UNIT I AMPLITUDE MODULATION 9

Amplitude Modulation- DSBSC, DSBFC, SSB, VSB - Modulation index, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, Envelope Detection - DSBSC Generation – Balanced Modulator, Coherent Detection - Hilbert Transform, Pre-envelope & complex envelope – SSB Generation – Filter and Phase Shift Method, Coherent Detection - VSB Generation – Filter Method, Comparison of different AM techniques.

UNIT II ANGLE MODULATION 9

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth - FM –Direct and Indirect methods, FM Demodulation – FM to AM conversion, Foster Seeley Discriminator - PLL as FM Demodulator.

UNIT III RANDOM PROCESS 9

Random Process, Wide Sense Stationary Processes, Mean, Correlation & Covariance functions, Power Spectral Density, Ergodic Processes, Gaussian Process, Transmission of a Random Process through an LTI filter.

UNIT IV NOISE CHARACTERIZATION 9

Noise sources – Thermal and Shot noise – Noise figure, noise temperature and noise bandwidth – Noise in cascaded systems - Representation of Narrow band noise – In-phase and quadrature, Envelope and Phase – Noise performance analysis in AM & FM systems – Threshold effect, Pre-emphasis and de-emphasis for FM.

UNIT V INFORMATION THEORY **9**

Discrete Memoryless source, Information, Entropy, Mutual Information - Discrete Memoryless channels – Binary Symmetric Channel, Channel Capacity - Shannon - Hartley law - Source coding theorem - Shannon – Fano & Huffman codes.

TOTAL PERIODS: 45

OUTCOMES

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

- Design AM communication systems.
- Design Angle modulated communication systems
- Apply the concepts of Random Process to the design of Communication systems
- Analyze the noise performance of AM and FM systems
- Apply the concepts of source coding techniques for the design of Communication systems

TEXT BOOKS

1. Proakis.J.G, Salehi.M, Fundamentals of Communication Systems, Pearson Education, Second Edition, 2006.
2. Haykin.S, Digital Communications, John Wiley, 2005.

REFERENCE BOOKS

1. Lathi B.P, Modern Digital and Analog Communication Systems, Oxford University Press, Third Edition, 2007.
2. Sklar B, Digital Communication Fundamentals and Applications, Pearson Education, Second Edition, 2009.
3. Papoulis A, Probability, Random variables and Stochastic Processes, McGraw Hill, Third Edition, 1991.
4. Hsu H.P, Schaum Outline Series - Analog and Digital Communications, TMH, 2006.
5. Couch L, Modern Communication Systems, Pearson, 2001.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1411	ELECTRONIC CIRCUITS II AND LIC LAB	0	0	3	1.5

OBJECTIVES

- To gain hands on experience in designing electronic circuits like feedback amplifiers and oscillators
- To understand the working of tuned amplifiers, RC circuits, diode clippers and clampers
- To differentiate the operation of various multivibrators
- To understand the characteristics of the operational amplifier
- To apply operational amplifiers in linear and nonlinear applications
- To acquire the basic knowledge of special function ICs
- To use PSpice software for linear integrated circuit design

LIST OF EXPERIMENTS USING DISCRETE COMPONENTS

1. Frequency response of current series and voltage shunt feedback amplifiers
2. RC phase shift oscillator
3. Hartley oscillator and Colpitts oscillator
4. Single tuned amplifier
5. RC integrator and differentiator circuits

6. Astable and monostable multivibrators
7. Diode clippers and clampers

LIST OF EXPERIMENTS USING LINEAR ICs

8. Inverting, Non-inverting amplifiers
9. Integrator and Differentiator
10. Active band-pass filter
11. Schmitt Trigger using op-amp
12. Wien bridge oscillator using op-amp
13. Astable and Monostable multivibrators using NE555 Timer
14. Voltage regulator using LM723

SIMULATION USING PSPICE

1. Integrator/Differentiator using op-amp
2. Active low-pass, high-pass and band-pass filters using op-amp
3. Astable and Monostable multivibrators using NE555 Timer
4. Schmitt trigger using op-amp

TOTAL PERIODS: 45

OUTCOMES

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

- Analyze various types of feedback amplifiers
- Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators
- Design amplifiers and oscillators using operational amplifiers
- Design filters using op-amp and performs an experiment on frequency response
- Design of voltage regulator using ICs
- Analyze the performance of active filters, multivibrators, and Schmitt trigger using PSpice

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

S.NO. EQUIPMENTS FOR EC-II AND LIC LABORATORY

1. CRO (30MHz) – 15 Nos.
2. Signal Generator /Function Generators (3 MHz) – 15 Nos.
3. Pulse Generators – 6 Nos.
4. Dual Regulated Power Supplies (0 – 30V) – 15 Nos.
5. Standalone desktop PCs with SPICE software – 15 Nos.
6. Transistor/FET (BJT-NPN-PNP and JFET-N type-P type) – 50 Nos.
7. Multimeter– 15 Nos.
8. Components and Accessories: Resistors, Capacitors, Inductors, PN-Junction diodes, Zener diodes, Power transistors, Potentiometer, and wires.
9. Op-Amps: uA741, LM301, LM311, LM324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM555, and LM565.
10. Bread Boards, PSPICE circuit simulation software: (any public domain or commercial software).

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1412	DIGITAL SIGNAL PROCESSING LAB	0	0	3	1.5

OBJECTIVES

- To implement DFT and analyze the frequency content of the DT signals
- To implement FIR & IIR filters and understand the impact of finite word length effects
- To study the architecture and programming of DSP processor
- To design and implement adaptive filters and multi-rate systems for signal processing applications

LIST OF EXPERIMENTS

MATLAB / EQUIVALENT SOFTWARE PACKAGE IMPLEMENTATION 15

1. Generation of DT sequences (functional & random)
2. Auto - and Cross - correlation of sequence(s)
3. Linear and Circular convolutions
4. Linear filtering via Overlap – add and Overlap – save methods
5. Spectrum analysis using DFT

DSP PROCESSOR BASED IMPLEMENTATION 30

6. Study of architecture and programming of Digital Signal Processor
7. Design and demonstration of FIR (LP, HP, BP and BS) filtering
8. Design and demonstration of IIR (LP, HP, BP and BS) filtering
9. Demonstration of finite word length effects in FIR and IIR filters
10. Design of adaptive filters for signal processing applications
11. Design of multi-rate systems for signal/audio processing applications

TOTAL PERIODS: 45

OUTCOMES

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

- Carry out simulation of various time-domain operations of DSP systems
- Implement DFT/FFT to analyse the frequency spectrum of the DT signals
- Demonstrate their abilities towards DSP processor based implementation of FIR and IIR filters
- Analyse the impact of finite word length effect on DSP systems
- Design adaptive filters and multi-rate systems for various applications of DSP

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity Required
1	PC with Fixed/Floating point DSP Processor	15
2	MATLAB with Simulink or Other Equivalent Software	15
3	Signal Generator (20 MHz)	15
4	Digital Storage Oscilloscope (50 MHz)	15
5	Analog Discovery Kit (FG + DSO) together	10

TEXT BOOKS

1. Sanjit K. Mitra, Digital Signal Processing - A Computer based approach, McGraw-Hill, Fourth Edition, 2010.
2. Rulph Chassaing and Donald S. Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK, Wiley-IEEE Press, Second Edition, 2008.

REFERENCE BOOKS

1. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing Principles, Algorithms and Applications, Prentice Hall of India, Fourth Edition, 2006.

2. Alan V. Oppenheim and Ronald W. Schafer, Discrete time signal processing, Prentice Hall, Third Edition, 2009.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1501	DIGITAL COMMUNICATION	3	0	0	3

OBJECTIVES

- To understand the digital representation of analog signals through sampling and quantization
- To understand the ISI and derive Nyquist criteria for zero ISI
- To learn the principles of spread spectrum modulation schemes
- To analyze the various digital modulation schemes
- To understand fundamentals of channel coding

UNIT I SAMPLING & QUANTIZATION 11

Sampling–Aliasing–Quantization – Uniform & non-uniform quantization –Quantization noise – companding – PCM –DPCM – Delta modulation – ADPCM & ADM - Linear predictive coding - Line codes and PSD of line codes.

UNIT II BASEBAND TRANSMISSION 9

Nyquist criterion for distortion less transmission – Pulse shaping – Correlative level coding schemes – ISI - Eye pattern – Equalization, correlation receiver, matched filter receiver, detection of signals with unknown phase in noise.

UNIT III DIGITAL MODULATION SCHEMES 9

Signal space representation – Generation, detection, PSD & BER of coherent BPSK, BFSK, QPSK and DPSK – QAM –Detection of binary modulated signals in the presence of noise, BER analysis.

UNIT IV SPREAD SPECTRUM MODULATION 7

Pseudo noise sequences, properties, Generation of PN sequences, direct sequence spread spectrum, processing gain, slow and fast frequency hop spread spectrum, synchronization techniques.

UNIT V ERROR CONTROL CODING 9

Channel coding theorem – Linear block codes – Hamming codes – Cyclic codes – Convolutional codes –Viterbi Decoder.

TOTAL PERIODS: 45

OUTCOMES

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

- Digitally represent analog signals through sampling & quantization
- Apply the knowledge of ISI problems and derive Nyquist Criteria for zero ISI
- Compare error probability of different digital modulation schemes
- Describe spread spectrum modulation scheme and Illustrate both DS and FH systems
- Apply various error control coding schemes over information bits

TEXT BOOKS

1. Haykin S, Digital Communications, John Wiley, 2005.

2. Sklar B, Digital Communication Fundamentals and Applications, Pearson Education, Second Edition, 2009.

REFERENCE BOOKS

1. Proakis J.G, Digital Communication, Tata Mc Graw Hill Company, Fifth Edition, 2018.
2. Lathi B. P, Modern Digital and Analog Communication Systems, Oxford University Press, Third Edition, 2007.
3. Hsu H.P, Schaum's Outline Series – Analog and Digital Communications, Tata Mc Graw Hill Company, Third Edition, 2006.
4. Roody D, Coolen J, Electronic Communications, PHI, Fourth Edition, 2006.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1502	MICROPROCESSOR, MICROCONTROLLER AND INTERFACING	3	0	0	3

OBJECTIVES

- To study the architecture of 8086 microprocessor and 8051 microcontroller
- To learn the development of assembly language programming of 8086 and 8051
- To learn the design aspects of I/O and Memory Interfacing circuits

UNIT I THE 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set – Assembly language programming - Interrupts and interrupt service routines.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

Basic configuration – System Bus Structure - System bus timing – System design using 8086 – Memory interfacing – Interrupt controller (8259A) – DMA controller (8237) - Multiprocessor configurations.

UNIT III 8086 I/O INTERFACING 9

Parallel communication interface (8255) – Serial communication interface (8251) – Timer Interface (8254) – Keyboard / display controller Interface (8279) - Programming and applications - Interfacing ADC and DAC.

UNIT IV 8051 MICROCONTROLLER 9

8051 Microcontroller Architecture – Programming model - Addressing modes - Instruction set - Assembly language programming – Memory Organization.

UNIT V 8051 MICROCONTROLLER INTERFACING 9

I/O Ports – Timer port architecture and programming - Serial port architecture and programming g - Interrupts Handling - LCD & Keyboard Interfacing – ADC & DAC Interfacing – DC & Stepper Motor Interfacing – Introduction to PIC16X Microcontroller.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the architecture of 8086 microprocessor and 8051 microcontroller
- Apply programming techniques in developing the assembly language program for microprocessor applications

- Apply programming techniques in developing the assembly language program for microcontroller applications
- Understand various types of interfacing devices with other peripheral devices
- Design and Construct Microprocessor and Microcontroller based Systems

TEXT BOOKS

1. Walter A Triebel and Avatar Singh, The 8088 and 8086 Microprocessors – Programming, Interfacing, Software, Hardware and Applications, Pearson, Fourth Edition, 2002.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson education, Second Edition, 2013.

REFERENCE BOOKS

1. Doughlas V Hall, Microprocessors and Interfacing, Programming and Hardware, Tata McGraw Hill, 2012.
2. Yu-Cheng Liu, Glenn A. Gibson, Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design, Prentice Hall of India, Second Edition, 2015.
3. Scott MacKenzie, Raphael Chung-Wei Phan, The 8051 Microcontroller, Pearson Education, Fourth Edition, 2007.
4. Martin P Bates, Programming 8 – bit PIC Microcontrollers in C with Interactive Hardware Simulation Newness, 2008.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1503	TRANSMISSION LINES AND WAVEGUIDES	3	0	0	3

OBJECTIVES

- To understand the fundamentals and design of passive filters
- To introduce the types of transmission lines and discuss the associated losses
- To understand impedance transformation and matching techniques
- To use the Smith chart in solving transmission line problems
- To understand the concept of waveguides

UNIT I PASSIVE FILTERS 9

Neper and Decibel-Characteristic impedance of symmetrical networks - propagation constant - filter fundamentals, Design of filters: Constant K - Low Pass, High Pass, Band Pass, Band Elimination, m- derived sections - low pass and high pass filters.

UNIT II TRANSMISSION LINE THEORY 9

Transmission Line Model- Line of Cascaded T sections, General theory of Transmission lines - The infinite line - Input and transfer impedance - Open and short circuited lines - wavelength, velocity of propagation - Waveform distortion, Distortion-less lines - Loading and methods of loading - Reflection coefficient - calculation of current, voltage and power delivered.

UNIT III HIGH FREQUENCY TRANSMISSION LINES 9

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current equations on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance - Open and short circuited lines - Reflection losses on unmatched line.

UNIT IV IMPEDANCE MATCHING IN HIGH FREQUENCY LINES 9

Impedance matching: Quarter-wave line and applications, Half-wave line - Impedance matching by stubs - Single stub and double stub matching - Smith chart –Smith circle equations – Determination of Load impedance, input impedance, Reflection co-efficient, VSWR, V_{min} and V_{max} using Smith chart - Single and double stub matching using Smith chart.

UNIT V WAVE GUIDES 9

Transverse Magnetic waves, Transverse Electric waves and Transverse Electromagnetic waves between parallel plates, TM and TE waves in Rectangular wave guides, Impossibility of TEM in Rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides.

TOTAL PERIODS: 45

OUTCOMES

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

- Construct simple filters using the knowledge of passive filter theory
- Develop a transmission line model
- Comprehend the working of transmission line at radio frequencies
- Analyze the problems in RF line and stub matching using Smith chart
- Characterize the wave propagation in parallel plates and wave guides

TEXT BOOKS

1. John D Ryder, Networks lines and fields, Prentice-Hall of India, Second Edition, 2005.
2. Jordan E.C and Balmain K.G, Electromagnetic Waves and Radiating Systems, Prentice Hall of India, Second Edition, 2011.

REFERENCE BOOKS

1. Raju G S N, Electromagnetic Field Theory and Transmission Lines, Pearson Education, 2006.
2. Cheng D K, Field and Wave Electromagnetics, Pearson Education, Second Edition, 2006.
3. Inan U S and Inan A S, Engineering Electromagnetics, Pearson Education, 2010.
4. Ulaby F.T, Michelson E and Ravaioli U, Fundamentals of Applied Electromagnetics, Pearson Education, Sixth Edition, 2015.
5. Umesh Sinha, Transmission Lines and Networks: Networks, Filters & Transmission Lines, Sathya Prakash, 2010.

COURSE CODE	COURSE TITLE	L	T	P	C
UCS1551	COMPUTER ARCHITECTURE AND ORGANISATION	3	0	0	3

OBJECTIVES

- To learn the basic structure and operations of a computer
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit
- To learn the basics of pipelined execution
- To understand parallelism and multi-core processors
- To understand the memory hierarchies, cache memories and virtual memories
- To learn the different ways of communication with I/O devices

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism.

UNIT III PROCESSOR AND CONTROL UNIT 9

A Basic MIPS implementation – Building a datapath – Control Implementation Scheme – Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions.

UNIT IV PARALLELISM 9

Parallel processing challenges – Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units.

UNIT V MEMORY & I/O SYSTEMS 9

Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits - USB.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the basics structure of computers, operations and instructions
- Design arithmetic and logic unit
- Understand pipelined execution and design control unit
- Understand parallel processing architectures
- Understand the design of various memory systems and I/O communication

TEXT BOOKS

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Morgan Kaufmann / Elsevier, Fifth Edition, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Tata McGraw Hill, Sixth Edition, 2012.

REFERENCE BOOKS

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Pearson Education, Eighth Edition, 2010.
2. John P. Hayes, Computer Architecture and Organization, Tata McGraw Hill, Third Edition, 2012.
3. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1551	CONTROL SYSTEMS ENGINEERING	2	2	0	3

OBJECTIVES

- To understand the concept of transfer function representation for analysis of electrical, mechanical and other physical systems
- To understand the time response of control systems and steady state error analysis
- To understand the frequency responses of control systems
- To analyze the systems for stability and design compensators
- To introduce state variable representation of different systems

UNIT I SYSTEMS AND THEIR REPRESENTATION 9

Basic elements in control systems – Classification of systems - Open and closed loop systems – Transfer function - Mathematical modelling of electrical, mechanical, hydraulic, pneumatic, liquid level and thermal systems – Electrical analogy– Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS 9

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error –- Effects of P, PI, PID modes of feedback control –Time response analysis - Root locus construction.

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency response – Frequency domain specifications- Bode plot – Polar plot – Nyquist plot - Constant M - N circles - Nichols Chart- Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications.

UNIT IV STABILITY AND COMPENSATOR DESIGN 9

Characteristics equation – Routh Hurwitz criterion – Performance criteria – Lag, lead and lag-lead networks – Effect of Lag, lead and lag - lead compensation on frequency response analysis - Design of compensator network using Bode plot.

UNIT V STATE VARIABLE ANALYSIS 9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the importance of mathematical modeling of systems
- Analyze control systems with respect to time domain and frequency domain
- Verify the stability of the system
- Design compensators to meet the desired specifications
- Implement P, PI and PID controllers for a given application

TEXT BOOKS

1. Katsuhiko Ogata, Modern Control Engineering, Pearson India Education, 2015.
2. Nagarath I.J and Gopal M, Control Systems Engineering, New Age International, 2017.

REFERENCE BOOKS

1. Gopal M, Control System: Principle and design, McGraw Hill Education, 2012.
2. Richard C. Dorf and Bishop R.H, Modern Control Systems, Pearson India Education, 2009.

3. John J D'Azzo, Constantine H Houpis and Stuart N Sheldon, Linear Control System Analysis and Design with MATLAB, CRC Taylor & Francis Reprint, 2009.
4. Salivahanan S, Rengaraj R and Venkatakrishnan G R, Control Systems Engineering, Pearson Education, 2015.
5. Rames C. Panda and Thyagarajan T, An Introduction to Process Modelling Identification and Control of Engineers, Narosa Publishing House, 2017.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1511	ANALOG AND DIGITAL COMMUNICATION LAB	0	0	2	1

OBJECTIVES

- To visualize the effects of sampling and TDM
- To implement AM & FM modulation schemes
- To implement and simulate PCM & DM
- To simulate Digital Modulation schemes
- To simulate Error control coding schemes

LIST OF EXPERIMENTS

1. Signal Sampling and Reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator
5. Pulse Code Modulation
6. Delta Modulation
7. Line Coding schemes
8. Simulation of PCM and DM signals
9. Simulation of ASK, FSK, and BPSK generation schemes
10. Simulation of ASK, FSK, and BPSK generation schemes
11. Simulation of DPSK, QPSK and QAM generation schemes
12. Simulation of signal constellations of BPSK, QPSK and QAM
13. Simulation of ASK, FSK and BPSK detection schemes
14. Simulation of Linear Block and Cyclic error control coding schemes
15. Simulation of Convolutional Coding scheme
16. Communication link simulation

TOTAL PERIODS: 30

OUTCOMES

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

- Simulate & validate the various functional modules of a communication system
- Demonstrate their knowledge in baseband signaling schemes through simulation of digital modulation schemes
- Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system
- Simulate end-to-end communication Link

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

i) Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes
ii) CROs/DSOs – 15 Nos, Function Generators – 15 Nos

iii) MATLAB or equivalent software package for simulation experiments
iv) PCs - 15 Nos

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1512	MICROPROCESSOR AND MICROCONTROLLER LAB	0	0	2	1

OBJECTIVES

- To introduce assembly language programming concepts and features
- To write assembly language program for 8086 and 8051
- To interface different I/O interfaces with 8086 microprocessor
- To program the internal resources of 8051 microcontroller

LIST OF EXPERIMENTS

8086 PROGRAMS USING KITS AND MASM

1. Basic arithmetic and Logical operations
2. Code Conversion
3. Searching and sorting
4. String manipulations
5. Matrix operations
6. Floating point operations

8086 PERIPHERALS AND INTERFACING EXPERIMENTS

1. Traffic light control interface
2. Stepper motor control interface
3. ADC and DAC interface
4. Keyboard and display interface

8051 EXPERIMENTS USING KITS

1. Basic arithmetic and logical operations
2. 8051 parallel and serial port programming
3. 8051 Timer / Counter programming
4. LCD interface

TOTAL PERIODS: 30

OUTCOMES

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

- Develop and execute simple assembly language programs using 8086 and 8051 instruction sets
- Interface different I/O interfaces with 8086 and 8051
- Develop assembly language programs to program 8051's internal resources

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

8086 and 8051 Trainer kits – 10 each
Interfacing Units: Traffic light control interface, stepper motor control interface, ADC interface, DAC interface, LCD interface – 3 each
Desktop Computers with MASM (8086) and Simulators (8051) – 10 nos

COURSE CODE	COURSE TITLE	L	T	P	C
UEN1597	PROFESSIONAL COMMUNICATIONS LAB	0	0	2	1

OBJECTIVES

- To enhance the Employability and Career Skills of students
- To orient the students towards grooming as a professional
- To make them Employable Graduates
- To develop their confidence and help them attend interviews successfully

UNIT I SOFT SKILLS FOR EMPLOYABILITY 5

Introduction to Soft Skills– Hard skills & soft skills – employability and career Skills - Grooming as a professional with values—Time Management—General awareness of Current Affairs.

UNIT II SHORT PRESENTATIONS 6

Self-Introduction-organizing the material – Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations.

UNIT III PARTICIPATION IN A GROUP DISCUSSION 8

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics – brainstorming the topic -– questioning and clarifying –GD strategies- activities to improve GD skills.

UNIT IV PREPARATION FOR A JOB INTERVIEW 7

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews.

UNIT V CAREER PLANNING 4

Recognizing differences between groups and teams- managing time-managing stress-networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes.

TOTAL PERIODS: 30

OUTCOMES

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

- Make effective presentations
- Participate confidently in Group Discussions
- Attend job interviews and be successful in them
- Develop adequate Soft Skills required for the workplace

REFERENCE BOOKS

1. Butterfield, Jeff, Soft Skills for Everyone, Cengage Learning, New Delhi, 2015.
2. Suresh Kumar E. et. al. Communication for Professional Success, Orient Black Swan, Hyderabad, 2015.
3. Interact English Lab Manual for Undergraduate Students, Orient Black Swan, Hyderabad, 2016.

4. Raman, Meenakshi and Sangeeta Sharma, Professional Communication. Oxford University Press: Oxford, 2014.
5. Hariharan S. et. al. Soft Skills. MJP Publishers: Chennai, 2010.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1601	PRINCIPLES OF VLSI DESIGN	3	0	0	3

OBJECTIVES

- To understand the principles of VLSI System Design
- To study construction, operation, characteristics, layout and fabrication of MOS Transistor and CMOS Inverter
- To learn the design and construction of CMOS Combinational & Sequential Logic Circuits and Subsystem Design
- To learn the testability of VLSI circuits

UNIT I VLSI SYSTEM DESIGN 9

Introduction to VLSI Design: VLSI Design Problem - VLSI Design Cycle - VLSI Design Domains - Types of IC Design – Hierarchical Design Approach - VLSI Design Principles. Implementation Methodologies: Full Custom Design - Standard Cell Based Design - Gate Array Based Design - Programmable Logic Devices Based Design – Overview of SPLD/CPLD/FPGA Architectures.

UNIT II MOS TRANSISTOR 9

Metal Oxide Semiconductor (MOS) Transistor: Structure, Operation & Characteristics - Threshold Voltage (V_{T0} & V_T), Drain Current (I_D). MOS Capacitances - MOS Scaling - Second Order & Non Ideal Effects - Modeling of MOS Transistor – SPICE Models - Fabrication Cycle, NMOS & PMOS Fabrication Processes. Layout Design Rules, Full-Custom Mask Layout Design, Stick Diagrams.

UNIT III CMOS INVERTER 9

CMOS Inverter: Construction and Operation - Static & Dynamic Characteristics – Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics & Delay. Power Analysis of CMOS Inverter – Low Power Design Principles. Fabrication & Layout of CMOS Inverter: n-well, p-well, twin-tub & triple-well processes. Latch-Up in CMOS Technology. Layout and Stick Diagram of CMOS Inverter.

UNIT IV CMOS LOGIC CIRCUITS 9

Combinational Logic Circuits: Static CMOS Design – Dynamic CMOS Design –Transmission Gates – Design Examples: Basic Gates, Complex Logic Circuits. Sequential Logic Circuits: Static Latches and Registers, Dynamic Latches & Registers, Transmission Gate Based Registers, C^2MOS Registers, True Single-Phase Clocked Register (TSPCR), Register Pipelining, Latch vs Register Based Pipelines, NORA – CMOS

UNIT V DATA PATH SUBSYSTEMS & TESTING 9

Data Path Subsystems: Data Path Architectures. Adders – Subtractor - Multipliers – Dividers - Shifters. Design for Testability: Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Boundary Scan Testing, Built-In Self-Test (BIST) Techniques, Automatic Test Pattern Generation (ATPG), Fault Simulation, Current Monitoring IDDQ Test.

TOTAL PERIODS: 45

OUTCOMES

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

- Learn various design principles and design methodologies of VLSI design
- Understand construction, operation, characteristics, layout and fabrication of MOS Transistor and CMOS Inverter
- Design and develop the layouts for CMOS Combinational & Sequential Logic Circuits and Subsystem Design
- Understand various methods used to test CMOS Combinational & Sequential Logic Circuits and Subsystems

TEXT BOOKS

1. Sung Mo Kang, Yusuf Leblebici and Chulwoo Kim, CMOS Digital Integrated Circuits, Mc Graw Hill India, Fourth Edition, 2016.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, Pearson Education India, Second Edition, 2016.

REFERENCE BOOKS

1. David Money Harris, Neil Weste and Ayan Banerjee, CMOS VLSI Design: A Circuits and Systems Perspective. Pearson Education India, Fourth Edition, 2016.
2. Jacob Baker R, CMOS Circuit Design Layout and Simulation, Wiley Student Edition, 2018.
3. Uyemura J. P, Introduction to VLSI Circuits and Systems, Wiley Student Edition, 2015.
4. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design, Prentice Hall, Third Edition, 2016.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1602	WIRELESS COMMUNICATIONS	3	0	0	3

OBJECTIVES

- To gain knowledge about wireless channel models
- To understand the concepts and benefits of multiple access, modulation and equalization techniques
- To learn multicarrier transmission techniques
- To comprehend the concepts of diversity in communication and MIMO systems

UNIT I PROPAGATION IN WIRELESS CHANNELS 9

Challenges of Wireless Communications-Propagation Mechanisms (Qualitative treatment), Statistical Description of the Wireless Channel –Two ray -Path Model, Small-Scale Fading with and without a Dominant Component, Doppler Spectra and Temporal Channel Variations, Temporal Dependence of Fading, Large-Scale Fading Channel Models- Narrowband Channel Models.

UNIT II MULIPLE ACCESS AND MODULATION TECHNIQUES 9

Cellular Concepts: Overview and evolution of 2g/3G/4G/5G, – Frequency reuse, Co channel and Adjacent Channel Interference, C/I, Handoff; Multiple access - FDMA, TDMA, SSMA and SDMA, Packet Radio Access Reception. Modulation techniques- QPSK, offset QPSK, pi/4 QPSK, MSK and GMSK.

UNIT III EQUALIZATION TECHNIQUES 9

Equalizers-Linear Equalizers, Decision Feedback Equalizers, Maximum Likelihood Sequence Estimation – Viterbi Detector, Comparison of Equalizer Structures.

UNIT IV ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM) 9

Introduction-Principle of OFDM, Implementation of Transceivers, Channel Estimation, Peak-to-Average Power Ratio, Inter Carrier Interference, Adaptive Modulation and Capacity, Multiple Access – OFDMA, Multicarrier Code Division Multiple Access, Single-Carrier Modulation with Frequency Domain Equalization.

UNIT V DIVERSITY TECHNIQUES 9

Introduction-Principle of Diversity, Transmit Diversity, Definition of the Correlation Coefficient, Micro diversity, Macro diversity and Simulcast, Combining Diversity, Error Probability in Fading Channels with Diversity Reception. Multi antenna systems, Multiple Input Multiple Output Systems, Multiuser MIMO.

TOTAL PERIODS: 45

OUTCOMES

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

- Determine the types and appropriate fading channel models based on the design parameters
- Analyze and design multiple access and modulation techniques for wireless systems
- Analyze and design equalization techniques
- Understand the modulation and coding in the design of multi-carrier systems
- Determine the transceiver techniques including multi antenna systems

TEXT BOOKS

1. Andreas F. Molisch, Wireless Communications, John Wiley India, Second Edition, 2013.
2. Rappaport T.S, Wireless communications, Pearson Education, Second Edition, 2014.

REFERENCES BOOKS

1. Gordon L. Stuber, Principles of Mobile Communication, Springer International Ltd., Fourth Edition, 2017.
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
3. Simon Haykin & Michael Moher, adapted by David Kovilpillai, Modern Wireless Communications, Pearson Education, 2011.
4. David Tse and Pramod Vishwanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1603	SYSTEM DESIGN FOR IoT	3	0	0	3

OBJECTIVES

- To learn the fundamentals of Internet of Things
- To understand IoT Reference Model and IoT Reference Architecture
- To learn about the basics of IoT protocols
- To understand the security issues possible with IoT
- To build a small low cost IoT system and to apply the concept of Internet of Things in the real world scenario

UNIT I FUNDAMENTAL CONCEPTS OF IoT 9

Internet of Things - Physical Design- Logical Design - IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology.

UNIT II IoT ARCHITECTURES 9

Introduction – Reference Model and Architecture – IoT Reference Model - Domain model - Information model - Functional model - Communication model – Security Model, IoT Reference Architecture – Functional View – Information View – Deployment and Operational View – Other relevant architectural views.

UNIT III IoT PROTOCOLS 9

IoT Protocol Standardization Efforts – Issues with IoT Standardization – Unified Data Standards Challenges – Protocols – IEEE 802.15.4 – Zigbee – BACNet – Modbus – 6LowPAN – CoAP.

UNIT IV SECURITY ISSUES OVERVIEW 9

Introduction – Phases of IoT System – Internet of Things as Interconnection of Threats – Phase attacks: Data leakage or breach, data sovereignty, data loss, data authentication, attack on availability, modification of sensitive data – Attacks as per architecture – Attacks based on components.

UNIT V BUILDING IoT SYSTEM & CASE STUDIES ` 9

IoT Physical Devices & Endpoints - Basic building blocks of an IoT Device - Raspberry Pi - Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Real world design constraints – IoT use cases – Case Study: Commercial building automation today and in the future: Background, Technology overview, and Evolved value chain for commercial building automation – Case Study: Smart cities: The need, working definition, some examples, Roles – actors – engagement, Transport and logistics – an IoT perspective.

TOTAL PERIODS: 45

OUTCOMES

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

- Interpret the fundamental concepts of IoT
- Develop IoT Architecture for a particular application scenario
- Identify the correct protocol for a specific application
- Identify the security issues possible with IoT systems
- Design a portable IoT using Raspberry Pi, Analyze applications of IoT in real time scenario

TEXT BOOKS

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things – A hands-on approach, Universities Press, 2015.
2. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things – Key applications and Protocols, Wiley, 2012.

REFERENCE BOOKS

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand and David Boyle, From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Elsevier, 2014.
2. Fei Hu, Security and Privacy in Internet of Things (IoTs): Models, Algorithms & Implementations, CRC Press, Taylor & Francis group, 2016.
3. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.
4. Dieter Uckelmann, Mark Harrison and Michahelles Florian (Eds), Architecting the Internet of Things, Springer, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1604	COMMUNICATION NETWORKS	3	0	2	4

OBJECTIVES

- To understand the underlying concept of computer network
- To learn the flow control and congestion control algorithms
- To introduce multiple access techniques, network protocols and QoS protocols
- To understand the performance of internetworking and emerging trends in networking technologies

UNIT I FUNDAMENTALS AND LINK LAYER 9

Building a network – Requirements - Layering and protocols, Performance; Link layer Services OSI model, TCP/IP model - Framing - Flow control – stop and wait protocol, sliding window protocol - Error control – CRC, checksum.

UNIT II MEDIA ACCESS AND NETWORK DEVICES 9

Topologies: Bus, star, Ring, Mesh. LAN – Ethernet - Encoding, Physical properties, CSMA/CD (IEEE 802.3). WAN – Circuit switching, Packet switching. WLAN – spread spectrum, distribution systems, CSMA/CA (IEEE 802.11n). Internetworking devices – hub, repeater, bridge- Spanning tree algorithm, switch, router Interfaces and connectors.

UNIT III INTERNETWORKING AND ROUTING 9

IP Addressing-IPv4, Datagram Forwarding in IP, Address Translation: Address Resolution Protocol (ARP), Host Configuration: Dynamic Host Configuration Protocol (DHCP), Error Reporting: Internet Control Message Protocol (ICMP), Routing- Network as a Graph, Distance Vector: Routing Information Protocol (RIP), Link State: Open Shortest Path Find (OSPF), Metrics, Global Internet - subnetting, classless routing, IPv6, Mobile IP.

UNIT IV TRANSPORT AND APPLICATION LAYER 9

UDP, TCP-end-to-end issues, 3-way handshaking algorithm, Congestion control Algorithms – Adaptive Retransmission. Congestion avoidance (DECbit, RED) – Traditional applications - Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP.

UNIT V PROTOCOLS FOR QoS SUPPORT 9

QoS – Application requirements. Integrated Services, Differentiated Services, RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details - RTP – Protocol Architecture.

PRACTICAL EXPERIMENTS 15

1. Implementation of CSMA/CA MAC protocol
2. Implementation of Stop and Wait Protocol
3. Implementation of sliding window Protocol
4. Implementation of distance vector routing algorithm
5. Implementation of Link state routing algorithm

TOTAL PERIODS: 60

OUTCOMES

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

- Identify various networking components and their respective roles in a communication system
- Choose the required functionality at each layer for given application
- Trace the flow of information from one node to another node in the network
- Design, calculate and apply subnet masks and addresses and identify routing mechanisms to fulfill networking requirements
- Analyze the features and operations of various application layer protocols such as HTTP and Email

TEXT BOOKS

1. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, Morgan Kaufmann Publishers, Fifth Edition, 2011.
2. William Stallings, High Speed Networks and Internet, Pearson Education, Second Edition, 2002.

REFERENCE BOOKS

1. Kurose J.F and Ross K.W, Computer Networking- A top down approach featuring the internet, Pearson, Second Edition, 2012.
2. Behrouz A. Forouzan, Data communication and Networking, Tata McGraw – Hill, Fourth Edition, 2013.
3. Andrew S. Tanenbaum, Computer Networks, PHI, Fourth Edition, 2011.
4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, Mc Graw Hill Publisher, First edition, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1605	MACHINE LEARNING	3	0	2	4

OBJECTIVES

- To introduce the concepts of machine learning
- To introduce learning methods such as supervised, unsupervised and reinforcement learning techniques
- To study various probability based learning methods
- To understand graphical models for machine learning

UNIT I FUNDAMENTALS OF MACHINE LEARNING 9

Learning -the brain and the neuron - types of machine learning: supervised, unsupervised and reinforcement learning. Perspectives and issues in machine learning. concept learning task - concept learning as search - finding a maximally specific hypothesis - version space and candidate elimination algorithm.

UNIT II CLASSIFICATION 9

Supervised learning - Bayes decision theory, Minimum-error-rate classification, Classifiers and discriminant functions for the normal density. Parameter estimation methods: Maximum likelihood estimation, Maximum a posteriori estimation. Pattern classification by distance functions - minimum distance classifier.

UNIT II CLUSTERING AND DIMENSIONALITY REDUCTION 9

Probability and learning - K-means clustering and vector quantization, Expectation Maximization algorithm, Gaussian mixture model, k-nearest-neighbor method. The curse of

dimensionality, dimensionality reduction, factor analysis, principal component analysis, Independent component analysis.

UNIT IV GRAPHICAL MODELS 9

Directed graphical models - Bayesian network, Markov Random fields-inference in graphical models - Markov model - Hidden Markov Models (HMMs). Decision trees - Classification and regression tree. Combining models - Ensemble learning: boosting and bagging.

UNIT V ARTIFICIAL NEURAL NETWORKS AND DEEP LEARNING 9

Models of a neuron - feed-forward neural networks - Perceptron learning, Multi-layer feed-forward neural network, Gradient descent, back propagation algorithm - network pruning, limitations and convergence of back-propagation learning. Cover's theorem on the separability of patterns, Generalized radial-basis function networks, Auto encoder networks - auto-association neural network - convolutional neural network

Mini project: 15

Students can be assessed based on a mini project that involves application of various machine learning algorithms on a given text/speech/image/video dataset. A written report on the results and a presentation can be included as a part of assessment.

TOTAL PERIODS: 60

OUTCOMES

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

- Distinguish between various learning methods
- Implement machine learning algorithms for a given application
- Suggest a learning algorithm for a given problem and modify machine learning algorithms
- Apply graphical models appropriately
- Understand and apply neural network-based learning algorithm

TEXT BOOKS

1. Bishop C.M, Pattern Recognition and Machine Learning, Springer, 2006.
2. Stephen Marsland - Machine learning - an algorithmic perspective, Chapman and Hall / CRC machine learning and Pattern recognition series, Second Edition, 2014.
3. Simon Haykin, Neural networks - a comprehensive foundation, Pearson Education, Second Edition, 2008.

REFERENCE BOOKS

1. Duda R.O., Hart P.E. and Stork D.G., Pattern Classification, John Wiley, 2001.
2. Tom. M. Mitchell - Machine learning, McGraw Hill education, First Edition,2013.
3. Ian Good Fellow, Yoshua Bengio and Aaron Courville, Deep learning, MIT Press, 2016.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1611	VLSI DESIGN LAB	0	0	2	1

OBJECTIVES

- To learn Hardware Descriptive Language (Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To familiarize fusing of logical modules on FPGAs

- To provide hands on design experience with professional design (EDA) platforms

LIST OF EXPERIMENTS

DIGITAL SUBSYSTEM DESIGN USING HDL

1. Design of 4-Bit Ripple Carry Adder & 4-Bit Carry Look Ahead Adder
2. Design of 4-Bit Array Multiplier & 4-Bit Booth Multiplier
3. Design of 4-Bit ALU
4. Design of 4-Bit Synchronous Up/Down Counter & 4-Bit Ripple Counter
5. Design of 4-Bit Universal Shift Register
6. Design of Moore and Mealy FSMs

For the experiments 1 – 6,

- Use VHDL/Verilog to model either in structural and/or behavioral domains
- Simulate it using by Xilinx/Altera Software
- Implement by Xilinx/Altera FPGA
- Verify the functionality using Xilinx/Altera FPGA Trainer Kit

CMOS DIGITAL CIRCUIT DESIGN

7. Basic CMOS gates
8. CMOS Latches & Flip Flops using the Cells developed in Expt. No. 7
9. Half Adder, Full Adder, Half Subtractor & Full Subtractor using the Cells developed in Expt. No. 7
10. 4-Bit Synchronous Up/Down Counter using the Cells developed in Expt. No. 8

For the experiments 7 – 10,

- Design & Construct at circuit level
- Perform Post Layout Simulation to perform static and dynamic analysis
- CAD Tools: Cadence/mentor Graphics/Mentor Graphics/Tanner

TOTAL PERIODS: 30

OUTCOMES:

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

- Write HDL code for basic as well as advanced digital integrated circuits.
- Import and verify the functionality the logic modules into FPGA Trainer.
- Design, Simulate and Extract the layouts of Digital Building Blocks using EDA tools.

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

SL.NO.	EQUIPMENT	REQUIRED
1.	Xilinx/Altera FPGA Synthesis Software with Trainer Kits	15 nos.
2.	Tanner/Mentor Graphics / Cadence Tools/equivalent	15 User License
3.	Personal Computer	15 nos.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1612	SYSTEM DESIGN FOR IoT LAB	0	0	2	1

OBJECTIVES

- To understand about the different boards available to develop IoT system
- To build an IoT system and connect to the cloud
- To apply the concept of Internet of Things in the real world scenario
- To implement actuator control in the IoT system

LIST OF EXPERIMENTS

PART I

1. Getting familiar with Raspberry Pi
2. Blinking LED using Raspberry Pi
3. Calibrating and accessing real time sensors data
4. Realtime IoT sensor measurement of temperature and humidity on PC
5. Generating an alarm for any physical parameter exceeding threshold

PART II

Mini project on building IoT system for specific applications

1. IoT based intelligent traffic management system
2. Smart irrigation system using IoT
3. IoT based smart waste management system for smart city
4. IoT based weather reporting system
5. IoT based water management system

TOTAL PERIODS: 30

OUTCOMES

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

- Use Raspberry Pi for IoT systems
- Apply IoT principles and design tools for developing IoT systems
- Comprehensively record and report the measured data
- Establish connectivity between IoT system and cloud
- Implement control applications using IoT

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

SL.NO.	EQUIPMENT	REQUIRED
1.	Raspberry Pi 3 model B with accessories (SD card, power adapter HDMI to VGA connector, USB mouse, Keyboard)	15 Nos.
2.	Personal Computer	15 Nos.
3.	Sensors and interfaces based on the application to be build	5 Nos. each
4.	Freeware available for installation of OS - SD card formatter, Win32 disk images, Operating system - Raspbian Jessie/stretch OS, Cloud platform –Thingspeak	

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1701	HIGH FREQUENCY COMMUNICATION SYSTEMS	3	0	0	3

OBJECTIVES

- To understand the mechanism of light propagation for signal transmission within a fiber
- To understand the components of fiber optic networking
- To understand the free space communication system model
- To understand the fundamentals of mmWave propagation
- To appreciate the design requirements for mmWave Communications system

UNIT I MILLIMETER WAVE PROPAGATION 9

Radio Wave Propagation for mmWave, Large-Scale and small scale Propagation Effects of mmwaves, Outdoor Channel Models, Indoor Channel Models, Vehicle-to-Vehicle Models, Spatial Characterization of Multipath and Beam Combining, Angle Spread and Multipath Angle of Arrival.

UNIT II MILLIMETER WAVE COMMUNICATION 9

Arrays and antenna topologies for mmWave Communications, Adaptive Antenna Arrays — Beam Steering and Beamforming, ESPRIT and MUSIC, Emerging Applications of mmWave Communications.

UNIT III LIGHT PROPAGATION IN FIBER 9

Transmission Characteristics of Fibres: Attenuation, material absorption and scattering loss, bending loss, intra-modal and inter-modal dispersion in step and graded fibres, FOC System description and design considerations.

UNIT IV FIBER OPTIC NETWORKS 9

Principles of WDM, DWDM, telecommunications & broadband application, wavelength-routed networks - SONET/SDH, MUX, Analog & Digital broadband transmission, optical switching.

UNIT V FREE SPACE OPTICAL COMMUNICATION 9

Propagation of light in unguided media, LASER beam characteristics, atmospheric effects on optical signals, FSO transceiver design, Point-to-Point FSO systems, point-to-point with transponder nodes, Hybrid FSO and RF, FSO applications, LIDAR.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the fiber optic communications system and the components of networking
- Explain the merits of fiber optic networks and multiplexing of light signals
- Design free space light communication against atmospheric effects
- Appraise the need for mmWave communications systems
- Design applications involving mmWave systems for high bit rate communications

TEXT BOOKS

1. Gerd Keiser, Optical Fiber Communications, Mcgraw -Hill, Second Edition, 2007.
2. Theodore S. Rappaport, Robert W. Heath, Robert C. Daniels, and James N. Murdock Millimeter Wave Wireless Communications, Prentice Hall of India, 2018.

REFERENCE BOOKS

1. Stamatios V. Kartalopoulos, Free Space Optical Networks for Ultra-Broad Band Services, John Wiley & Sons, Inc., First Edition, 2011.
2. John M. Senior, Optical Fiber Communication, PHI/Pearson.
3. Agrawal G, Fiber optic Communication Systems John Wiley and sons.
4. Rajiv Ramaswami, Kumar Sivarajan and Galen Sasaki, Optical Networks: A Practical Perspective, Morgan Kaufman Publishers, Third Edition, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1702	MICROWAVE ENGINEERING AND ANTENNAS	3	0	0	3

OBJECTIVES

- To introduce the various microwave sources, microwave passive and active devices
- To understand antenna parameters and the radiation principles of wire antennas
- To understand the design and operation of array and aperture antennas
- To understand the antenna and microwave measurement techniques

UNIT I MICROWAVE GENERATORS AND DEVICES 9

Microwave Sources: Theory and operation of two cavity Klystron amplifier, Reflex Klystron, TWT amplifier, Magnetron amplifier.

Microwave devices: Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Gunn diode oscillator, IMPATT diode oscillator and amplifier.

UNIT II ANTENNA FUNDAMENTALS 9

Antenna parameters - Gain, Directivity, Effective aperture, Radiation Resistance, Bandwidth, Beam width; Impedance matching: BALUNS, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, half wave dipole and folded dipole.

UNIT III ARRAY AND APERTURE ANTENNAS 9

Antenna Arrays: N-element linear array, Pattern multiplication, Broadside and end fire array, Array synthesis: Binomial array.

Aperture Antennas: Horn antennas, Reflector antennas, Slot antennas.

UNIT IV SPECIAL ANTENNAS 9

Microstrip patch antenna, Yagi array, Spiral antennas, Helical antennas, log periodic antenna, Lens antennas, Fractal Antennas, Smart antennas and antenna beam forming.

UNIT V INSTRUMENTATION AND MEASUREMENTS 9

Instrumentation: VSWR meter, Power meter, Spectrum Analyzer, Network analyzer, Anechoic chamber.

Measurements: Measurement of frequency, power, VSWR, dielectric constant, S-parameters, Antenna Gain, Radiation pattern and polarization.

TOTAL PERIODS: 45

OUTCOMES

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

- Explain the radiation mechanism of simple antennas to complex antenna structures
- Perform array synthesis
- Identify and explain the operation of microwave sources and devices
- Understand antenna and microwave measurement systems and techniques.

TEXT BOOKS

1. Balanis CA, Antenna Theory: Analysis and Design, A John Wiley & Sons Inc. publications, Third Edition, 2005.
2. Samuel Y. Liao, Microwave Devices and Circuits, Pearson, Third Edition, 2003.

REFERENCE BOOKS

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, Antennas and Wave Propagation, Tata McGraw-Hill, Fourth Edition, 2006.
2. David M. Pozar, Microwave Engineering, Wiley India, Fourth Edition, 2012.
3. Collin RE, Foundations for Microwave Engineering, IEEE Press, Second Edition, 2001
4. Annapurna Das and Sisir K Das, Microwave Engineering, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2005.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1703	PROFESSIONAL ETHICS AND MANAGEMENT PRACTICES	3	0	0	3

OBJECTIVES

- To develop an understanding of the importance of ethics in professional sphere
- To gain an understanding of the fundamental aspects of management
- To critically reflect on aspects such as organizational culture, employee motivation and organizational strategy
- To understand the relationship between personal and organizational management

UNIT I ETHICS, PROFESSIONALISM AND TECHNOLOGY 9

Scope of engineering ethics - Accepting and sharing responsibility - Responsible professionals and ethical corporations - Truthfulness and trustworthiness - Research integrity - Engineers and technological progress - Cautious optimism - Moral leadership.

UNIT II INTRODUCTION TO MANAGEMENT 9

Managers, management and organizations - Views on manager's impact on organizations - Organizational culture - Organizational culture issues - Social responsibility - Encouraging ethical behaviour - Reflections on ethical dimensions.

UNIT III PLANNING 9

Managers as decision makers - Styles of decision making - Fundamentals of planning - Strategic management and its process - Corporate strategies - Reflections on ethical dimensions.

UNIT IV ORGANIZING 9

Managing human resources - Employee selection, training and retention - Managing teams - Turning groups into effective groups - Reflections on ethical dimensions.

UNIT V LEADING 9

Understanding individual behaviour - Attitudes and job performance - Perception - Motivating employees - Early and contemporary theories of motivation - Managers as leaders - Reflections on ethical dimensions.

TOTAL PERIODS: 45

OUTCOMES

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

- Reflect on the importance of ethics in professional sphere
- Display an understanding of the fundamental aspects of management
- Critically reflect on aspects such as organizational culture, employee motivation and organizational strategy

TEXT BOOKS

1. Martin M.W, and Schinzinger, R., Ethics in Engineering, McGraw Hill Education (India), New Delhi, Fourth Edition, 2014.
2. Robbins S.P, Coulter M., and Vohra, N., Management, Pearson (India), Tenth Edition, 2016.

REFERENCE BOOKS

1. J A F Stoner, Freeman R.E and Daniel R Gilbert, Management, Pearson Education, Sixth Edition, 2004.

2. Harold Koontz and Heinz Weihrich, Essentials of management, Tata Mc Graw Hill, 1998.
3. Ennals Richard, Responsible management: Corporate responsibility and working life, Springer, 2014.
4. Tripathy P C & Reddy P N, Principles of Management, Tata McGraw Hill, 1999.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1711	WIRELESS COMMUNICATION LAB	0	0	2	1

OBJECTIVES

- To gain indepth knowledge on various advanced communication techniques with hardware and software platforms
- To understand various wireless channel impairments and their impact on the performance
- To comprehend the different channel impairments mitigation techniques

LIST OF EXPERIMENTS

Using NI USRP

1. Performance analysis of Digital Modulation and Detection techniques
2. Pulse Shaping and Matched Filtering Analysis
3. Demonstration of Synchronization
4. Implementation of Channel Estimation & Equalization
5. Implementation of Frame Detection & Frequency Offset Correction Techniques
6. Implementation of OFDM Modulation
7. Channel Coding in OFDM Systems

Simulation Using IT++ or Matlab

1. Study of Small scale fading, large scale fading and link budgets
2. Study of diversity Concepts
   - ✓ Receive diversity
   - ✓ Selection diversity
   - ✓ Maximum ratio combining
   - ✓ Transmit diversity (Alamouti - STBC)
3. Implementation of MIMO including spatial multiplexing
4. Simulation study of Interference mitigation in MIMO
5. Implementation of IEEE 802.11n standard (PHY layer)

TOTAL PERIODS: 30

OUTCOMES

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

- Implement various digital modulation, detection schemes using NI Hardware platform
- Design multicarrier systems based on NI USRP platform
- Perform simulation and interpret results for fading models and diversity techniques
- Construct simulation model for advanced wireless transmission techniques

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

1. USRP Software Defined Radio Reconfigurable Device - 3 sets of the transceiver
2. LabVIEW programming module

3. 2 x 2 MIMO antenna - 3 pairs
4. IT++ or Matlab Simulation Software Installed PCs - 10 Nos.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1712	MICROWAVE AND ANTENNAS LAB	0	0	2	1

OBJECTIVES

- To introduce the various microwave sources, microwave passive and active devices
- To understand the antenna and microwave measurement techniques
- To understand antenna parameters and the radiation principles of wire antennas
- To understand the design and operation of array and aperture antennas

-

LIST OF EXPERIMENTS

1. Mode Characteristics of Reflex Klystron
2. VI Characteristics of Gunn diode and attenuation measurement
3. Measurement of VSWR, frequency and wavelength using Reflex Klystron
4. S parameter analysis of E plane Tee, H plane Tee and Magic Tee
5. S parameter analysis of Isolator and circulator
6. S parameter analysis of Directional Coupler
7. Characterization of two port networks using vector network analyzer
8. Design and characterization of a printed monopole antenna
9. Design and characterization of a microstrip patch antenna
10. Design of a horn antenna and analysis using 3D electromagnetic tool
11. Radiation pattern and gain measurement of X band horn antenna
12. Design of a two/four element microstrip antenna array

TOTAL PERIODS: 30

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS (3 STUDENTS / EXPERIMENT)

1. Microwave Test Bench at X band - 6 nos.
2. PC loaded with CST Microwave Studio Suite - minimum 4 nos.
3. Vector Network Analyzer - 1 no.
4. MIC trainer kit - 1 no.

OUTCOMES

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

- Characterize microwave components using S parameters
- Handle vector network analyzer for microwave measurements
- Design antennas and analyze its characteristics
- Perform real time measurement of antenna parameters

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1521	INFORMATION THEORY AND CODING	3	0	0	3

OBJECTIVES

- To know the principles of information measure
- To know the fundamentals of source coding

- To study various coding techniques
- To learn the concepts of information channel
- To understand rate distortion theory

UNIT I INFORMATION MEASURE 9

Introduction to information theory – Definition of information measure and entropy – Entropy, relative entropy and mutual Information – Properties of joint and conditional information measures a-Markov source – Asymptotic properties of entropy and problem solving in entropy.

UNIT II INTRODUCTION TO SOURCE CODING 9

Block code and its properties – Instantaneous code and its properties – Kraft-Mcmillan Equality and compact codes – Shannon's first theorem.

UNIT III CODING TECHNIQUES 9

Source coding techniques: Arithmetic code – Lempel Ziv code, Channel coding techniques: Low density parity code, Turbo code.

UNIT IV INFORMATION CHANNEL 9

Introduction to information channel – Binary symmetric channel – Binary erasure channel – Channel capacity – Calculation of channel capacity for different information channel.

UNIT V RATE DISTORTION THEORY 9

Introduction to rate distortion – Introduction to quantization – Lloyd-max quantizer – Companded quantizer – Vector quantizer.

TOTAL PERIODS: 45

OUTCOMES

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

- Design source coding systems
- Design and implement coding techniques
- Evaluate the information capacity of discrete memoryless channels and determine the capacity
- Analyze rate distortion theory

TEXT BOOKS

1. Cover T M and Thomas J A, Elements of Information Theory, John Wiley & Sons, 1991.
2. Sklar B, Digital Communication Fundamentals and Applications, Pearson Education, Second Edition, 2009.

REFERENCE BOOKS

1. Yeung R W, A First Course in Information Theory, Kluwer Academic, 2002.
2. Ranjan Bose, ITC and Cryptography, Tata Mc Graw Hill Company, Second Edition, 2007.
3. Muralidhar Kulkarni and Shivaprakasha K.S, Information Theory and Coding, Wiley India Pvt. Ltd, 2015.
4. Morelos-Zaragoza R H, The Art of Error Correcting Coding, John Wiley & Sons, 2006.
5. Khalid Syaood, Introduction to Data Compression, Elsevier, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1522	ADVANCED DIGITAL SIGNAL PROCESSING	3	0	0	3

OBJECTIVES

- To introduce the basics of discrete time random signal processing
- To learn the concept of signal modeling, estimation and prediction theory
- To know about linear and adaptive filtering and its applications
- To understand the spectrum estimation techniques
- To learn the concepts of compressed sensing

UNIT I DISCRETE TIME STOCHASTIC PROCESSES 9

Review of Discrete Stochastic Processes - Stationary processes, Autocorrelation, Autocovariance, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes.

UNIT II SPECTRAL ESTIMATION 9

Nonparametric methods of spectrum estimation - Periodogram, Modified periodogram, Bartlett, Welch and Blackman Tukey methods, Performance Comparison, Parametric methods - Special types of Random Processes – MA, AR, ARMA – Yule-Walker equations and spectral estimation.

UNIT III SIGNAL MODELING AND LINEAR PREDICTION 9

Least square method, Prony's pole-zero model – Prony's all pole model, Iterative Prefiltering, Finite Data Records – Linear Prediction of Signals -The Autocorrelation and Covariance Method, Levinson Durbin Algorithm, Forward and Backward Predictions.

UNIT IV OPTIMUM FILTERS 9

Linear Minimum Mean - Square Error (LMMSE) Filtering, Wiener Hopf Equation, FIR Wiener filter, Noise Cancellation Application, Causal and Noncausal IIR Wiener filter, Discrete Kalman Filter.

UNIT V COMPRESSED SENSING 9

Traditional Sampling system and its drawback- Compressed sensing process - Mathematical background- Sparse filtering - Signal Representation: Basis vectors -Restricted Isometric Property- Coherence- Stable recovery- Number of measurements- Sensing matrix-Sparse Recovery Algorithms: Basis Pursuit algorithm- L1 minimization- Matching pursuit- Orthogonal Matching Pursuit(OMP).

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the power spectral density and apply to discrete random signals and systems
- Analyze non- parametric methods and parametric methods for spectral estimation
- Analyze signal modeling techniques to discrete random signals
- Apply linear estimation and prediction techniques to discrete random signals for signal separation, detection and estimation
- Apply optimum filtering techniques for discrete random signals
- Apply the concepts of compressed sensing for signal processing applications

TEXT BOOKS

1. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, Inc, Singapore, 2002.

2. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson Education India; Fourth Edition, 2007.

REFERENCE BOOKS

1. Sanjit K. Mitra, Fundamentals Digital Signal Processing: A Computer - Based Approach, McGraw Hill Education, 2013.
2. Dimitris G. Manolakis and Vinay K. Ingle, Applied Digital Signal Processing, Cambridge University Press, 2011.
3. Radha Sankararajan, Hemalatha Rajendran and Aasha Nandhini Sukumaran, Compressive Sensing for Wireless Communication: Challenges and Opportunities, River Publications, 2016.
4. Carmi Avishy Y, Compressed Sensing & Sparse Filtering, Edited by Lyudmila Mihaylova, and Simon J. Godsill. Springer, 2014.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1523	SPEECH SIGNAL PROCESSING	3	0	0	3

OBJECTIVES

- To learn the fundamentals of speech production mechanism and perception
- To understand time and frequency domain characteristics of speech signal and to model speech using digital systems
- To familiarize fundamentals of speech enhancement methods

UNIT I BASIC CONCEPTS 9

Fundamentals of speech: articulatory phonetics - Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; discrete time model of speech, Speech perception - human auditory system, critical bands, threshold of hearing, auditory masking - simultaneous and non-simultaneous masking.

UNIT II TIME AND FREQUENCY DOMAIN ANALYSIS 9

Time-dependent processing of speech - short-time energy, short-time autocorrelation, short-time zero-crossing rate, speech vs. silence discrimination using time-domain processing. Frequency domain processing - Short-time Fourier analysis, time-frequency resolution, spectrogram - wideband and narrowband.

UNIT III HOMOMORPHIC SIGNAL PROCESSING 9

Principles of homomorphic systems. Homomorphic systems for convolution. Complex cepstrum - sequences with rational z-transform and impulse train, homomorphic filtering, discrete complex cepstrum - phase unwrapping. Pitch and formant estimation using cepstrum.

UNIT IV LINEAR PREDICTIVE ANALYSIS 9

Basics principles of linear predictive analysis, formulation of linear prediction analysis equation - the autocorrelation method and the Levinson Durbin recursive solution, the covariance method and Cholesky decomposition solution. Prediction error signal, frequency domain interpretation of prediction error. Applications of LPC parameters - pitch detection, formant estimation using LPC parameters.

UNIT V SPEECH ENHANCEMENT 9

Sources of speech degradation, nature of interfering sounds. Speech enhancement techniques - short-term spectral amplitude techniques - spectral subtraction. Adaptive noise canceling techniques - MMSE, log MMSE-based speech enhancement. Performance evaluation, Quality versus intelligibility, Subjective and objective measures of speech quality and intelligibility - PESQ, SEGSNR, STOI, CSII.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the fundamentals of speech production and apply the same in building spoken language systems
- Apply time and frequency domain properties in speech-based applications
- Understand the significance of non-parametric spectrum estimation technique
- Apply linear prediction in extracting speech features
- Apply signal processing techniques for building robust speech-based systems

TEXT BOOKS

1. Thomas F Quatieri, Discrete-time speech signal processing - Principles and Practice, Pearson, 2012.
2. John R. Deller Jr, John H. L. Hansen, and John G. Proakis, Discrete-time processing of speech signals, IEEE Press, 2000.

REFERENCE BOOKS

1. Douglas O' Shaughnessy, Speech communications - human and machine, Universities Press, Second Edition, 2004.
2. Rabiner L. R and Schaffer R. W, Digital Processing of speech signals, Pearson Education, 2004.
3. John Makhoul, Linear Prediction - a tutorial review, Proceedings of the IEEE, 1975.
4. Ephraim Y, Statistical model -based speech enhancement techniques, Proceedings of the IEEE, 1992.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1524	SOFT COMPUTING TECHNIQUES	3	0	0	3

OBJECTIVES

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems
- To introduce hybrid soft computing systems
- To apply soft computing techniques to solve problems

UNIT I INTRODUCTION 9

Artificial Neural Network: Introduction, Characteristics, Learning Methods, Evolution of Neural Networks, Basic Models – Fuzzy Logic: Introduction, Crisp Sets, Fuzzy Sets, Fuzzy Relations, Non-Iterative Fuzzy Sets – Genetic Algorithm: Introduction, Biological Background, Traditional Optimization and Search Techniques – Swarm Intelligent Systems.

UNIT II NEURAL NETWORKS 9

Mcculloch-Pitts Neuron – Linear Separability – Hebb Network – Supervised Learning Network: Perceptron Networks – Adaptive Linear Neuron, Multiple Adaptive Linear Neuron, BPN, RBF, Associative Memory Network, BAM, Hopfield Networks – Unsupervised Learning Networks, Kohonen Self-Organizing Feature Maps, LVQ – CP Networks, ART Network.

UNIT III FUZZY LOGIC 9

Membership Functions: Features, Fuzzification, Methods of Membership Value Assignments – Defuzzification: Lambda Cuts – Methods – Fuzzy Arithmetic and Fuzzy Measures – Extension Principle – Fuzzy Integrals – Fuzzy Rule Base and Approximate Reasoning: Truth Values and Tables, Formation oif Rules – Decomposition and Aggregation of Fuzzy Rules, Fuzzy Reasoning – Fuzzy Inference Systems – Overview of Fuzzy Expert System – Fuzzy Decision Making.

UNIT IV GENETIC ALGORITHM 9

Basic Concepts – Working Principles – Encoding – Fitness Function – Reproduction – Inheritance Operators – Cross Over – Inversion and Deletion – Mutation Operator – Bit-Wise Operators – Convergence of Genetic Algorithm.

UNIT V HYBRID SYSTEMS **9**

Hybrid Systems – Neural Networks, Fuzzy Logic and Genetic – GA Based Weight Determination – LR-Type Fuzzy Numbers – Fuzzy Neuron – Fuzzy BP Architecture – Learning in Fuzzy BP – Inference by Fuzzy BP – Fuzzy ARTMAP – GA in Fuzzy Logic Controller Design.

TOTAL PERIODS: 45

OUTCOMES

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

- Choose suitable soft computing techniques for various applications
- Design learning algorithms for neural network in pattern classification and regression problems
- Use fuzzy logic in decision making systems
- Apply Genetic Algorithms for optimization of engineering problems
- Integrate various soft computing techniques for complex engineering problems

TEXT BOOKS

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun and Eiji Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Prentice-Hall of India, 2004.
2. Sivanandam S N and Deepa S N, Principles of Soft Computing, Wiley India Pvt. Ltd., Second Edition, 2011.

REFERENCE BOOKS

1. Timothy J Ross, Fuzzy Logic with Engineering Applications, Wiley Publishers, Third Edition, 2010.
2. George J Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, 1995.
3. James A Freeman and David M Skapura, Neural Networks: Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.
4. Davis E Goldberg, Genetic Algorithms: in Search, Optimization and Machine Learning, Addison Wesley, 1989.
5. Padhy N P and Simon S P, Soft Computing: With MATLAB Programming, Oxford University Press, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1525	NANO ELECTRONICS	3	0	0	3

OBJECTIVES

- To understand the concepts of nano electronics and quantum electronics
- To understand the concepts of nano electronic devices, transistors, tunneling devices and superconducting devices
- To understand the basics of nanotube devices

UNIT I ELECTRONICS TO NANO ELECTRONICS **9**

Scaling to nano - Light as a wave and particle- Electrons as waves and particles- origin of quantum mechanics - General postulates of quantum mechanics - Time independent Schrodinger wave equation- Electron confinement - Quantum dots, wires and well-Spin and angular momentum-Wave packets and uncertainty.

UNIT II QUANTUM ELECTRONIC DEVICES 9

Quantum electronic devices - Short channel MOS transistor - Split gate transistor - Electron wave transistor - Electron wave transistor - Electron spin transistor - Quantum cellular automata -Quantum dot array, Quantum memory.

UNIT III NANO ELECTRONIC TRANSISTORS 9

Coulomb blockade - Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions - Single electron transistors, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics - Memory cell.

UNIT IV NANOELECTRONIC TUNNELING AND SUPER CONDUCTING DEVICES 9

Tunnel effect -Tunneling element -Tunneling diode - Resonant tunneling diode - Three terminal resonant tunneling devices- Superconducting switching devices- Cryotron- Josephson tunneling device.

UNIT V NANOTUBES AND NANOSTRUCTURE DEVICES 9

Carbon Nanotube - Fullerenes - Types of nanotubes – Formation of nanotubes –Assemblies – Purification of carbon nanotubes – Electronic properties – Synthesis of carbon nanotubes – Carbon nanotube interconnects – Carbon nanotube FETs and SETs –Nanotube for memory applications- Nano structures and nano structured devices.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the basics of nano electronics including quantum wires, dots and wells
- Use the mechanism behind quantum electronic devices
- Analyze the key performance aspects of tunneling and superconducting nano electronic devices
- Apply the knowledge in the development of nanotubes and nanostructure devices

TEXT BOOKS

1. Hanson, Fundamentals of Nanoelectronics, Pearson education, 2009.
2. Jan Dienstuhl, Karl Goser, and Peter Glösekötter, Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices, Springer-Verlag, 2004.

REFERENCE BOOKS

1. Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009.
2. Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017.
3. Brajesh Kumar Kaushik, Nanoelectronics: Devices, Circuits and Systems, Elsevier science, 2018.
4. Murty B S, Shankar P, Baldev Raj, Rath B B and James Murday, Textbook of Nanoscience and Nanotechnology, Springer, Universities press, 2012

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1621	SPEECH TECHNOLOGY	3	0	0	3

OBJECTIVES

- To learn the fundamentals of speech processing
- To introduce various features required to build speech-based systems
- To understand statistical modeling techniques and its application in building speech-based systems

UNIT I BASIC CONCEPTS 9

Fundamentals of speech: articulatory phonetics - Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; discrete time model of speech, Speech perception - human auditory system, critical bands. Short-time Fourier transform, spectrogram, pitch and formant estimation using cepstrum. Linear prediction - autocorrelation method, Levinson Durbin recursion, Pitch and formant estimation using linear prediction.

UNIT II FEATURE EXTRACTION 9

Fundamentals of pattern recognition and significance of feature selection. Feature Extraction - MFCC, LPCC and PLP. Speech distortion measures– mathematical and perceptual – Log–spectral distance, cepstral distances, weighted cepstral distances, likelihood distortions. Time alignment and normalization - dynamic time warping, multiple time-alignment paths.

UNIT III SPEECH MODELING 9

k-means clustering and vector quantization. Statistical modeling of speech - Gaussian mixture modeling, Hiddeinn Markov models - Markov processes. HMMs - Probability Evaluation, optimal state sequence - Viterbi search, Baum-Welch parameter re-estimation.

UNIT IV SPEECH AND SPEAKER RECOGNITION SYSTEMS 9

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-gram statistics, context dependent sub-word units. Speaker recognition - speaker identification and verification - acoustic models; Applications and current status.

UNIT V TEXT-TO-SPEECH SYNTHESIS 9

Text-to-speech synthesis: Text and phonetic analysis, role of prosody in TTS, concatenative and waveform synthesis, prosody modification of speech - PSOLA, TD-PSOLA. HMM-based text-to-speech synthesis. Evaluation of TTS systems - quality and intelligibility.

TOTAL PERIODS: 45

OUTCOMES

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

- Model speech production system and describe the fundamentals of speech
- Extract and compare different speech parameters
- Choose an appropriate statistical speech model for a given application
- Build a speech and speaker recognition system
- Build a text-to-speech synthesis system

TEXT BOOKS

1. Thomas F. Quatieri, Discrete-time speech signal processing - Principles and practice, Pearson, 2012.

2. Huang X, Acero A. and Hon H. W., Spoken language processing- a guide to theory, algorithm and system development, Prentice Hall, 2001.

REFERENCE BOOKS

1. Rabiner L. R. and Schaffer R. W, Digital Processing of speech signals, Pearson Education, 2004.
2. John Makhoul, Linear Prediction - a tutorial review, Proceedings of the IEEE, 1975.
3. Rabiner L. R. and Juang B. H, Fundamentals of speech recognition, Pearson Education, 2003.
4. Zen H, Tokuda K. and Black A. W, Statistical parametric speech synthesis, Speech communication, Vol. 51, No. 11, pp. 1039 - 1064, 2009.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1622	SENSORS, ACTUATORS, AND INTERFACE ELECTRONICS	3	0	0	3

OBJECTIVES

- To study different types of sensors and actuators
- To gain knowledge on type of sensors to be used for practical applications
- To study and understand interfacing electronic sensors for various applications

UNIT I STRAIN, PRESSURE AND TEMPERATURE 9

Introduction, Stress & Pressure sensors: Resistance strain gauge, piezoelectric strain gauge, characteristics. Fiber-optic sensor, Pressure gauges. Temperature Sensors: Bimetallic strip, thermocouples, Resistance thermometers, thermistors, bolometer, Pyroelectric detector.

UNIT II MOTION SENSORS 9

Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors drag cup devices, piezoelectric devices, Rotary encoders.

UNIT III OPTICAL SENSORS 9

Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber optic sensors, electro optic sensors & fiber-optic applications, light transducer, solid-state transducers and liquid crystal devices.

UNIT IV ACTUATORS 9

Relays, Solenoid drive, Stepper Motors, Voice-Coil actuators, Hydraulic actuators – Variable transformers: synchros, resolvers, Inductosyn.

UNIT V INTERFACING ELECTRONIC SENSORS 9

Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, smoke sensors. Direct Sensor-Microcontroller Interfacing, intelligent sensors.

TOTAL PERIODS: 45

OUTCOMES

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

- Select sensors for the measurement of physical variables for real time applications
- Use sensors for optoelectronic applications
- Understand and apply actuators for engineering applications
- Interface different sensors for engineering applications

TEXTBOOKS

1. Doebelin E O, Measurement Systems, Application and Design, McGraw Hill, Fifth Edition, 2004.
2. Ian R Sinclair, Sensors and Transducers, Newnes publishers, Third Edition, 2001.

REFERENCE BOOKS

1. Ramon Pallás Areny, John G. Webster, Sensors and Signal conditioning, John Wiley and Sons, Second Edition, 2000.
2. Jack P Holman, Experimental Methods for Engineers, McGraw Hill, USA, Seventh Edition, 2001.
3. Patranabis D, Sensors and Transducers, Tata McGraw Hill, Seventh Edition, 2003.
4. Jon Wilson, Sensor Technology Handbook, Newnes, First Edition, 2004.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1623	INTRODUCTION TO MEMS AND NEMS	3	0	0	3

OBJECTIVES

- To understand the concepts of micro electromechanical devices and quantum mechanics
- To learn the fabrication process of Microsystems
- To understand the design concepts of micro sensors and micro actuators
- To understand the packaging and characterization of MEMS/NEMS

UNIT I INTRODUCTION TO MEMS AND NEMS 9

Introduction to micro systems, Advantages of MEMS, Materials for MEMS. Potential applications of MEMS and NEMS.

Introduction to NEMS, Issues of nano scaling, Giant magneto resistance and multilayer structures, Nano structured materials, Atomic structures and Quantum mechanics, Schrodinger Equation and Wave function Theory.

UNIT II FABRICATION OF MEMS AND NEMS 9

Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, LIGA, SOI MUMPS.

UNIT III MICRO AND NANO SENSORS 9

Acoustic sensor – Quartz crystal microbalance, surface acoustic wave, Flextural plate wave, shear horizontal; Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors, Nano gas sensor.

UNIT IV MICRO AND NANO ACTUATORS 9

Electrostatic actuators – parallel plate capacitor, Interdigitated finger capacitor, piezoelectric actuators, Thermal actuators, Actuators using shape memory alloys; Microgrippers, Micromotors, Microvalves, Micropumps, Nano energy harvester.

UNIT V PACKAGING AND CHARACTERIZATION OF MEMS AND NEMS 9

Micro / nano systems packaging, Essential packaging technologies, Selection of packaging materials; SEM, TEM, AFM, STM, Spectroscopic techniques for Nano characterization.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the basics of micro/nano electromechanical structures, devices and systems including their theoretical foundations, applications and advantages
- Recognize the use of materials in micro/nano fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA
- Analyze the key performance aspects of micro/nano electromechanical transducers including sensors and actuators
- Understand the techniques for characterization and packaging requirements of MEMS/NEMS

TEXT BOOKS

1. Sergey Edward Lyshevski, MEMS and NEMS: Systems, Devices, and Structures, CRC Press, 2002.
2. Chang Liu, Foundations of MEMS, Pearson education India limited, 2006.

REFERENCE BOOKS

1. Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press, 2012.
2. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcgraw Hill, 2002.
3. Mahalik N P, MEMS, Tata McGraw Hill, 2007.
4. Manouchehr E Motamedi, MOEMS: Micro-Opto-Electro-Mechanical Systems, SPIE press, First Edition, 2005.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1624	ADVANCED MICROCONTROLLERS	3	0	0	3

OBJECTIVES

- To familiarize the features, specification of modern microprocessors
- To gain knowledge on the architecture of Intel 32 and 64 bit microprocessors and salient features associated with them
- To familiarize the features, specification of modern microcontrollers
- To gain knowledge on the 32 bit microcontrollers based ARM architectures

UNIT I ADVANCED FEATURES OF MICROPROCESSORS 9

Evolution of microprocessors - Data and Address buses – clock speed – memory interface - multi-core architectures – cache memory hierarchy – operating modes – super scaler execution – dynamic execution – over-clocking – integrated graphics processing - performance benchmarks.

UNIT II HIGH PERFORMANCE CISC ARCHITECTURES 9

Introduction to IA-32 architecture – Intel Pentium Processors family tree – Memory Management – Branch prediction logic - Superscalar architecture – Hyper threading technology – 64 bit extension technology – Intel 64 bit architecture - Intel Core processor family tree – Turbo boost technology – Smart cache - features of Nehalem microarchitecture.

UNIT III HIGH PERFORMANCE RISC ARCHITECTURE – ARM 9

RISC architecture merits and demerits – The programmer's model of ARM Architecture – 3-

stage pipeline ARM organization - 3-stage pipeline ARM organization – ARM instruction execution – Salient features of ARM instruction set - ARM architecture profiles (A, R and M profiles).

UNIT IV ARM CORTEX PROCESSORS 9

Introduction to the Cortex-M Processor Family - ARM 'Cortex-M3' architecture for microcontrollers – Thumb 2 instruction technology – Internal Registers - Nested Vectored Interrupt controller - Memory map - Interrupts and exception handling – Applications of Cortex-M3 architecture.

UNIT V MSP430 MICROCONTROLLERS 9

Functional Block diagram of MSP430F2003 - Memory Mapped CPU, Exceptions, Architecture of MSP430 - Processor Addressing Modes - Instruction Set, Interrupts, Digital in-outs, Timer, Communication interfaces.

TOTAL PERIODS: 45

OUTCOMES:

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

- Explain the features and important specifications of modern microprocessors
- Explain the salient features of CISC microprocessors based on IA-32 bit and IA-64 bit architectures
- Explain the salient features of RISC processors based on ARM architecture and different application profiles of ARM core
- Explain the features and important specifications of modern microcontrollers
- Explain about ARM – M3 architecture and its salient features
- Implement designs using MSP430 and ARM processors

TEXT BOOKS

1. Barry B Breg, The Intel Microprocessors, PHI, 2008.
2. Steve Furber, ARM System – On – Chip architecture, Addision Wesley, 2000.

REFERENCE BOOKS

1. Intel Inc, Intel 64 and IA-32 Architectures Developers Manual, Volume-I, 2016.
2. Joseph Yiu, The Definitive Guide to the ARM ® Cortex-M3, Newnes, 2010.
3. John H Davies, MSP430 Microcontroller Basics, Elsevier, 2008.
4. Trevor Martin, The Designers Guide to the Cortex-M Processor Family, Newnes,2013.
5. Manuel Jimenez, Rogelio Palomera and Isidoro Convertier, Introduction to Embedded systems using Microcontrollers and the MSP430, Springer 2014.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1625	WIRELESS ADHOC AND SENSOR NETWORKS	3	0	0	3

OBJECTIVES

- To learn Ad Hoc network and Sensor Network fundamentals
- To understand the different MAC and routing protocols
- To have an in-depth knowledge on sensor network architecture, design issues and networking concepts
- To understand the transport layer and security issues possible in Ad Hoc and Sensor networks

- To have an exposure to mote programming platforms and tools

UNIT I AD HOC NETWORKS – INTRODUCTION & MAC PROTOCOLS 9

Design Issues in Ad Hoc Networks - MAC Protocols – Issues, Classifications of MAC protocols: Contention Based Protocols, Contention Based Protocols with reservation mechanisms, Contention Based Protocols with Scheduling Mechanism – MAC protocol with Directional Antenna - Multi channel MAC & Power control MAC protocol.

UNIT II AD HOC ROUTING PROTOCOLS AND TRANSPORT LAYER 9

Issues in designing a routing protocol for Ad Hoc Wireless Networks – Classifications of routing protocols: Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), On–Demand Routing protocols – AODV, Dynamic Source Routing (DSR), Location Aided Routing (LAR), Hierarchical – Cluster based routing protocol, Power Aware Routing (PAR), Ad Hoc Transport Layer Issues, TCP Over Ad Hoc – Feedback based, TCP with explicit link, TCP-Bus, Ad Hoc and Split TCP.

UNIT III WSN ARCHITECTURES 9

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles, service interfaces and Gateway Concepts, Protocol Architecture.

UNIT IV WSN NETWORKING CONCEPTS 9

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols - PAMAS, Schedule based protocols – LEACH, SMACS, TRAMA, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Geographic Routing, Transport layer issues and security issues.

UNIT V SENSOR NETWORKS PLATFORM & TOOLS 9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, Node-level Simulators – The NS2 and its sensor network extensions, TOSSIM, Programming beyond individual nodes – State centric programming.

TOTAL PERIODS: 45

OUTCOMES

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

- Identify the necessity of Ad Hoc networks and Wireless Sensor Networks
- Examine the MAC issues in Ad Hoc and Wireless Sensor Networks
- Describe the sensor node architecture, network and protocol architectures
- Identify the suitable routing algorithm based on the network and user requirement
- Understand the transport layer and security issues possible in Ad Hoc and sensor networks
- Understand the OS used in Wireless Sensor Networks and build basic modules using NesC

TEXT BOOKS

1. Siva Ram Murthy C and Manoj B S, Ad Hoc Wireless Networks Architectures and Protocols, Prentice Hall, PTR, 2004.
2. Holger Karl, Andreas Willig, Protocol and Architecture for Wireless Sensor Networks, John wiley publication, Jan 2006.

REFERENCE BOOKS

1. Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: an information processing approach, Elsevier publication, 2004.
2. Charles E. Perkins, Ad Hoc Networking, Addison Wesley, 2000.
3. Jun Zheng and Abbas Jamalipour, Wireless Sensor Network A Networking Perspective, A John Wiley & Sons, Inc., Publication, 2009.
4. KazemSohraby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks: Technology, Protocols and Applications, A John Wiley & Sons, Inc., Publication, 2007.
5. Carlos de Morais Cordeiro, Dharma Prakash Agrawal, Ad Hoc and Sensor Networks, Theory and Applications, World Scientific 2006.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1721	CMOS ANALOG IC DESIGN	3	0	0	3

OBJECTIVES

- To study the construction, operation, characteristics and analysis of analog CMOS circuits such as current sources/sinks, current mirrors/reference, voltage references
- To familiarize with the construction, operation, characteristics and analysis of CMOS single stage and differential amplifiers
- To learn the construction, operation, characteristics and analysis of single stage and two stage CMOS operational amplifiers
- To understand the construction, operation, characteristics and analysis of CMOS data converters

UNIT I CMOS ANALOG SUBCIRCUITS 9

Introduction to Analog Integrated Circuit Design – Analog Switches - Active Resistors - Current Sources & Sinks – Passive and Active Current Mirrors: Basic Current Mirrors, Cascode Current Mirrors and Active Current Mirrors – Voltage & Current References – Bandgap References: General Considerations, Supply Independent Biasing, Temperature Independent, PTAT Current Generation, Constant Gm Boosting, Speed and Noise issues.

UNIT II SINGLE STAGE AMPLIFIERS 9

Basic Concepts - Common Source Stage - Common Gate Stage - Source Follower - Cascode & Folded Cascode Stages. Frequency Response & Noise Analysis.

UNIT III DIFFERENTIAL AMPLIFIERS 9

Single Ended & Differential Operation - Basic Differential Pair – Qualitative & Quantitative Analysis - Common Mode Response, Differential Pair with MOS Loads - Gilbert Cell. Frequency Response & Noise Analysis.

UNIT IV OPERATIONAL AMPLIFIERS 9

General Considerations - One Stage Op Amps - Two Stage Op Amps – Gain Boosting – Common Mode Feedback- Input Range Limitations – Slew Rate – Power Supple Rejection – Frequency Response of One Stage and Two Stage Op Amps - Noise in OpAmps.

UNIT V DATA CONVERTERS 9

Data Converter Fundamentals: Characterization of ADC & DAC – Specifications of ADC & DAC – DAC Architectures: Digital Input Code, Resistor String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DACs & Pipeline DAC – ADC Architectures: Flash,

Two Step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC, Oversampling ADC.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the fundamentals of analog IC design
- Design CMOS single stage amplifiers, differential and operational amplifiers for the desired specifications
- Analyze various performance parameters such as gain, bandwidth and noise figure of CMOS single stage amplifiers, differential and operational amplifiers
- Understand the fundamentals and architectures of CMOS data converters

TEXT BOOKS

1. Behzad Razavi, Design of CMOS Analog Integrated Circuits, McGraw Hill Publications, Second Edition, 2016.
2. Jacob Baker R, CMOS: Circuit Design, Layout and Simulation, Wiley Publications, Third Edition, 2018.

REFERENCE BOOKS

1. Philip E Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Oxford University Press, Third Edition, 2012.
2. Hurst, Gray and Lewis Meyer, Analysis and Design of Analog Integrated Circuits, Wiley Publications, Fifth Edition, 2014.
3. Randall L. Geiger, Philip E.Allen and Noel R. Strader, VLSI Design Techniques for Analog and Digital Circuits, Tata McGraw-Hill Education, 2012.
4. Tony Chan Carusone, David Johns and Kenneth Martin, Analog Integrated Circuit Design, John Wiley and Sons Inc., Second Edition, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1722	DIGITAL IMAGE AND VIDEO PROCESSING	3	0	0	3

OBJECTIVES

- To mathematically represent the image signal and develop a theoretical foundation of fundamental Digital Image Processing concepts
- To understand practical techniques for image transforms
- To understand digital manipulation of images for restoration and object segmentation
- To develop algorithms for image feature extraction and classification
- To understand motion estimation in video signals

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Image Representation and Formation, Image sampling and quantization, pixel distribution - histogram equalization and matching, Enhancement, color image processing.

UNIT II IMAGE TRANSFORMS 8

2D convolution and correlation. 2D - DFT, DCT, Hadamard, Haar, KL and Wavelet transform.

UNIT III IMAGE RESTORATION AND SEGMENTATION 9

Filtering for noise removal and edge detection, Wiener filtering Constrained Least squares restoration Blind deconvolution. Segmentation based on thresholding, region based segmentation and watershed transform, Morphological Processing.

UNIT IV IMAGE FEATURES AND CLASSIFICATION 9

Shape, texture and statistical features, principle component analysis, Classification using Minimum distance criteria, Linear discriminant functions, Bayesian classifiers, K - means clustering.

UNIT V VIDEO PROCESSING 10

Analog video, Digital Video, Video sampling, filtering operations. 2-D Motion Estimation - Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation,

TOTAL PERIODS: 45

OUTCOMES

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

- Process images for better understanding of the information present
- Apply image transforms to develop further understanding on frequency domain
- Apply image processing techniques for restoration and object segmentation
- Develop algorithms for image feature extraction and classification
- Estimate motion components for video processing

TEXT BOOKS

1. Chris Solomon and Toby Breckon, Fundamentals of Digital Image Processing - A Practical Approach with Examples in Matlab, John Wiley & Sons.
2. Yao wang, Joem Ostarmann and Yaquin Zhang, Video processing and communication, PHI, First Edition.

REFERENCE BOOKS

1. Aner ozdemi R, Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms, John Wiley & Sons.
2. Gonzalez R. E. Woods, Eddins S. L, Digital Image Processing using Matlab, Pearson-Prentice-Hall, 2004.
3. Gonzalez and Woods, Digital Image Processing, Pearson, Third Edition, 2008.
4. Anil. K. Jain, Fundamentals of Digital Image Processing, PHI, Second Edition, 2004.
5. Alberto S. Aguado and Mark S. Nixon, Feature extraction and image processing, Academic Press, Third Edition, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1723	DIGITAL SIGNAL INTEGRITY	3	0	0	3

OBJECTIVES

- To learn the fundamental concepts of signal integrity
- To analyze and minimize cross talk in unbounded conductive media
- To understand different types of dielectric materials
- To provide an insight into differential cross talk and CMOS based I/O circuit models

UNIT I FUNDAMENTALS 9

The importance of signal integrity: The Basics - Electromagnetic fundamentals for signal integrity: Maxwell's Equations, Common Vector Operators - Wave Propagations-Electrostatics – Magnetostatics - Power flow and the Poynting Vector - Reflections of Electromagnetic Waves.

UNIT II CROSS TALK AND ITS MITIGATION 9

Mutual Inductance and Capacitance - Coupled Wave Equations - Coupled Line Analysis - Modal Analysis - Crosstalk Minimization - Signals Propagation in Unbounded Conductive Media - Classic Conductor Model for Transmission models.

UNIT III DIELECTRIC MATERIALS 9

Polarization of Dielectrics - Classification of Dielectric Materials - Frequency Dependent Dielectric Behavior - Fiber Weave Effect - Environmental Variation in Dielectric Behavior Transmission Line Parameters for Lossy Dielectrics and Realistic Conductors.

UNIT IV DIFFERENTIAL SIGNALING 9

Removal of Common Mode Noise - Differential Crosstalk - Virtual Reference Plane - Propagation of Modal Voltages - Common Terminology - Drawbacks of Differential Signaling.

UNIT V CHANNEL AND I/O CIRCUITS MODELLING 9

Creating a Physical Transmission Line Model - I/O Design Considerations - Push-Pull Transmitters - CMOS Receivers - ESD Protection Circuits - On Chip Termination - Bergeron Diagrams.

TOTAL PERIODS: 45

OUTCOMES

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

- Apply the fundamental concepts of signal integrity in high speed PCBs
- Identify and resolve crosstalk
- Interpret the frequency dependence of dielectrics
- Design a system with reduced interference effects

TEXT BOOKS

1. Stephen H. Hall and Howard L. Heck, Advanced Signal Integrity for High-Speed Digital Designs, John Wiley and Sons, Second Edition, 2009.
2. James Edgar Buchanan, Signal and power integrity in digital systems: TTL, CMOS, and BiCMOS, McGraw-Hill, Second Edition,1996.

REFERENCE BOOKS

1. Mike Peng Li, Jitter, Noise, and Signal Integrity at High-Speed, Prentice Hall, First Edition, 2007.
2. Eric Bogatin, Signal and Power Integrity – Simplified, Prentice Hall, Second Edition, 2004.
3. Samuel H Russ, Signal Integrity: Applied Electromagnetics and Professional Practice, Springer International publishing, 2016.
4. Stephen C. Thierauf, Understanding Signal Integrity, Artech House, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1724	MIC AND RF SYSTEMS DESIGN	3	0	0	3

OBJECTIVES

- To study the transmission lines used in microwave frequencies
- To know the concepts of impedance matching using lumped and distributed elements
- To study various microwave components and their characteristics
- To study various microwave systems

UNIT I PLANAR TRANSMISSION LINES 9

Microstrip lines: Structure, Waves in Microstrip, Quasi-TEM approximation, Effective Dielectric Constant and Characteristic Impedance Coupled lines: Even mode and odd mode analysis – Discontinuities and Components: Microstrip Discontinuities – Other Types of Microstrip lines– Coplanar waveguide– Slot lines.

UNIT II IMPEDANCE MATCHING 9

Matching with lumped elements, Stub matching - Single and double stub using smith chart solutions, Quarter wave transformer, Tapered Lines – Exponential and Triangular Taper.

UNIT III POWER DIVIDERS, COUPLERS AND FILTERS 9

Power Dividers - T Junction Power Dividers, Wilkinson power divider, Couplers - Wave guide and Coupled Line Directional Coupler, 90˚ Hybrid Coupler, Lange Coupler, 180˚ Hybrid coupler, Filters - Filter Design by the Insertion Loss Method.

UNIT IV AMPLIFIERS, OSCILLATORS AND MIXERS 9

Characteristics of Amplifiers, Stability Considerations, Broadband, High-Power and Multistage Amplifiers, Basic Oscillator Model, High Frequency Oscillator Configuration, Basic Characteristics of Mixers.

UNIT V MICROWAVE SYSTEMS 9

Radar Systems - Radar equation, pulse radar, Doppler radar, Radar Cross Section; Radiometer Systems - Theory and Applications of Radiometry; Microwave Heating and Power Transfer.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the concepts of transmission lines at microwave frequencies
- Design impedance matching circuits using lumped and distributed elements
- Design active and passive microwave components
- Understand the application of microwave components in systems

TEXT BOOKS

1. David M. Pozar, Microwave Engineering, John Wiley & Sons, Fourth Edition, 2012.
2. Reinhold Ludwig and Pavel Bretchko, RF Circuit Design: Theory and Applications, Prentice Hall, First Edition, 2000.

REFERENCE BOOKS

1. Jia Sheng Hong and M. J. Lancaster, Microstrip Filters for RF/Microwave Applications, John Wiley & Sons, Second Edition, 2011.

2. Gupta K C and Amarjit Singh, Microwave Integrated Circuits, John Wiley, New York, 1975.
3. Hoffman R K, Handbook of Microwave Integrated Circuits, Artech House, Boston, 1987.
4. Annapurna Das and Sisir K Das, Microwave Engineering, McGraw Hill Education, Third Edition, 2015.
5. Guillermo Gonzalez, Microwave Transistor Amplifiers – Analysis and Design, Prentice Hall, New Jersy, Second Edition, 1997.
6. Thomas H. Lee, Planar Microwave Engineering - Planar Microwave Engineering: A Practical Guide to Theory, Measurement, and Circuits, Cambridge University Press, 2004.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1725	EMBEDDED AND REAL TIME OPERATING SYSTEMS	3	0	0	3

OBJECTIVES

- To understand the concepts of embedded system design process
- To explore the architecture features of ARM processor
- To understand the fundamentals of RTOS and its various scheduling policies
- To design and develop an application using RTOS

UNIT I BASICS OF EMBEDDED SYSTEMS 9

Complex systems and microprocessors– Embedded system design process –Design example; Model train controller- Instruction sets preliminaries - ARM Processor – CPU, programming input and output- supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption.

UNIT II EMBEDDED COMPUTING PLATFORM 9

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis - Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

UNIT III BASICS OF RTOS 9

Processors and resources, Parameters of real time workload, Periodic task Model, Aperiodic and Sporadic Tasks, Precedence Constraints and data dependency, Other types of dependencies, Functional Parameters, resource parameters of jobs and parameters of resources.

UNIT IV SCHEDULING ALGORITHMS 9

Clock-driven approach, weighted round-robin approach, priority driven approach, Dynamic versus Static system, Effective release Times and deadlines, optimality of the EDF and LST Algorithms, Non-optimality of the EDF and the LST Algorithms, Challenges in validating timing constraints in priority-driven systems, off-line versus on-line scheduling.

UNIT V RTOS BASED EMBEDDED SYSTEM DESIGN 9

Resources and Resource Access Control: Resource contention and resource access control, Basic Priority- Inheritance Protocol, Basic Priority ceiling Protocol. Real time operating system

design: The kernel, time service and scheduling mechanisms, other basic operating system functions, operating system architecture, capabilities of commercial real-time operating systems. Example POSIX-Windows CE.

TOTAL PERIODS: 45

OUTCOMES

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

- Acquire knowledge on basic components of embedded system design
- Understand the architectural strength of ARM processor
- Acquire knowledge on fundamentals of RTOS and its various scheduling policies
- Apply the features of RTOS in the process of application development

TEXT BOOKS

1. Marilyn Wolf, Computers as Components - Principles of Embedded Computing System Design, Morgan Kaufmann Publisher, Third Edition, 2012.
2. Raj Kamal, Embedded system: Architecture Programming and Design, TMH Publication, Second Edition, 2008.

REFERENCE BOOKS

1. David E Simon, An Embedded Software Primer, Pearson Education Asia Publication, First Edition, 2001.
2. Krishna C M and Kang G Shin, Real Time Systems, TMH Publication, First Edition, 1997.
3. Chowdary Venkateswara Penumuchu, Simple Real-time Operating System, Trafford Publishing, First Edition, 2008.
4. Jane W S Liu, Real Time System, Pearson Education, Sixth Edition, 2001.
5. Phillip A Laplante, Real-Time Systems Design and Analysis, Wiley Publishers, Fourth Edition, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1726	**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY**	**3**	**0**	**0**	**3**

OBJECTIVES

- To gain broad conceptual understanding of the various aspects of electromagnetic interference and compatibility
- To develop a theoretical understanding of electromagnetic shielding effectiveness
- To understand ways of mitigating EMI by using shielding, grounding and filtering
- To understand the need for standards and to appreciate measurement methods
- To understand how EMI impacts wireless and broadband technologies

UNIT I INTRODUCTION, AND SOURCES OF ELECTROMAGNETIC INTERFERENCE **9**

Introduction - Classification of sources - Natural sources - Man-made sources - Surveys of the electromagnetic environment.

UNIT II SHIELDING **9**

Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures.

UNIT III INTERFERENCE CONTROL TECHNIQUES 9

Equipment screening - Cable screening - grounding - Power-line filters - Isolation - Balancing - Signal-line filters - Nonlinear protective devices.

UNIT IV EMC STANDARDS, MEASUREMENTS AND TESTING 9

Need for standards - The international framework - Human exposure limits to EM fields -EMC measurement techniques - Measurement tools - Test environments.

UNIT V EMC CONSIDERATIONS IN WIRELESS AND BROADBAND TECHNOLOGIES 9

Efficient use of frequency spectrum - EMC, interoperability and coexistence - Specifications and alliances - Transmission of high-frequency signals over telephone and power networks - EMC and digital subscriber lines - EMC and power line telecommunications.

TOTAL PERIODS: 45

OUTCOMES

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

- Demonstrate knowledge of the various sources of electromagnetic interference
- Display an understanding of the effect of how electromagnetic fields couple through apertures, and solve simple problems based on that understanding
- Explain the EMI mitigation techniques of shielding and grounding
- Explain the need for standards and EMC measurement methods
- Discuss the impact of EMC on wireless and broadband technologies

TEXT BOOKS

1. Christopoulos C, Principles and Techniques of Electromagnetic Compatibility, CRC Press, Second Edition, Indian Edition, 2013.
2. Paul C R, Introduction to Electromagnetic Compatibility, Wiley India, Second Edition, 2008.

REFERENCE BOOKS

1. Kodali V P, Engineering Electromagnetic Compatibility, Wiley India, Second Edition, 2010.
2. Bemhard Keiser, Principles of Electromagnetic Compatibility, Artech house, Norwood, Third Edition, 1986.
3. Henry W Ott, Electromagnetic Compatibility Engineering, John Wiley & Sons Inc, Newyork, 2009.
4. Scott Bennett W, Control and Measurement of Unintentional Electromagnetic Radiation, John Wiley & Sons Inc., Wiley Interscience Series, 1997.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1727	COMPUTER VISION	3	0	0	3

OBJECTIVES

- To review image processing techniques for computer vision
- To understand shape and region analysis
- To understand Hough Transform and its applications to detect lines, circles, ellipses
- To understand the models for stereo vision
- To understand deep learning techniques for computer vision
- To study some applications of computer vision algorithms

UNIT I FUNDAMENTALS OF COMPUTER VISION 9

Images and Imaging Operations- Basic Image Filtering Operations – Thresholding Techniques - Edge Detection - Corner and Interest Point Detection - Textures - Binary Shape Analysis - Boundary Pattern Analysis - Line Detection - Circle and Ellipse Detection- The Hough Transform - Pattern Matching Techniques.

UNIT II HIGH-LEVEL VISION 9

Image Stitching- Motion Models, Global Alignment, Compositing; Stereo Correspondence: Epipolar geometry- Sparse correspondence- Dense correspondence- Local methods- Global optimization; Multi-view stereo - 3D reconstruction.

UNIT III 3-D VISION AND MOTION 9

The Three-Dimensional World: Tackling the Perspective n-point Problem - Invariants and Perspective - Image Transformations and Camera Calibration – Motion.

UNIT IV DEEP LEARNING FOR COMPUTER VISION 9

Neural networks Fundamentals - Convolutional Neural Network - CNN building blocks - Training - Dropout - Case study - Smile detection.

UNIT V COMPUTER VISION APPLICATIONS 9

Surveillance: Introduction - Surveillance - The Basic Geometry - Foreground—Background Separation - Particle Filters - Use of Color Histograms for Tracking - Implementation of Particle Filters – Chamfer Matching - Tracking and Occlusion - Combining Views from Multiple Cameras.

TOTAL PERIODS: 45

OUTCOMES

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

- Implement fundamental image processing techniques required for computer vision
- Perform shape analysis and Implement boundary tracking techniques
- Apply 3D vision techniques
- Apply Deep learning for computer vision applications
- Develop applications using computer vision techniques

TEXT BOOKS

1. Davies E R, Computer & Machine Vision, Academic Press, Fourth Edition, 2012.
2. Adrian Rosebrock, Deep Learning for Computer Vision with Python Starter Bundle, Pyimagesearch, First Edition, 2017.

REFERENCE BOOKS

1. Szeliski R, Computer Vision: Algorithms and Applications, Springer 2011.
2. Rafael C Gonzalez and Richard E Woods, Digital Image Processing, Pearson Education, Third Edition, 2008.
3. Mark Nixon and Alberto S Aquado, Feature Extraction & Image Processing for Computer Vision, Academic Press, Third Edition, 2012.
4. John C Russ, The Image Processing Handbook, CRC Press, 2007.
5. Baggio D L et al., Mastering OpenCV with Practical Computer Vision Projects, Packt Publishing, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1728	COGNITIVE RADIO	3	0	0	3

OBJECTIVES

- To understand the concepts and architecture of cognitive radio
- To learn spectrum sensing and dynamic spectrum access
- To understand the MAC and Network layer design for cognitive radio
- To describe the advancements and applications of cognitive radio

UNIT I INTRODUCTION TO COGNITIVE RADIO 9

Evolution of Software Defined Radio and Cognitive radio - key applications, regulatory issues of cognitive access, spectrum measurements and usage, Applications for spectrum occupancy data.

UNIT II COGNITIVE RADIO ARCHITECTURE 9

Cognitive Radio – functions, Cognition cycle – orient, plan, decide and act phases, SDR as a platform for Cognitive Radio Architecture, Cognitive Radio Standards - Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

UNIT III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS 9

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing.

UNIT IV MAC AND NETWORK LAYER DESIGN 9

MAC for cognitive radios – Random Access, Time Slotted and Hybrid Protocols, Network layer design, flow control and error control techniques.

UNIT V ADVANCED TOPICS IN COGNITIVE RADIO 9

Spectrum Management and agility, Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.

TOTAL: 45 PERIODS

OUTCOMES

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

- Understand fundamental concepts and challenges of cognitive radio.
- Describe the spectrum regulation and standardization activities of cognitive radio.
- Apply detection techniques for cognitive radio spectrum sensing.
- Implement MAC and Network layer protocols for dynamic spectrum access in cognitive radio.
- Understand the applicability of cognitive radio for public safety, spectrum markers Internet of Things.

TEXT BOOKS

1. Alexander M Wyglinski, Maziar Nekovee and Thomas Hou, Cognitive Radio Communications and Networks, Academic Press, Elsevier, 2010.
2. Huseyin Arslan (Ed.), Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.

REFERENCE BOOKS

1. Kwang-Cheng Chen and Ramjee Prasad, Cognitive Radio Networks, John Wiley and Sons, 2009.
2. Joseph Mitola III, Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering, John Wiley & Sons, 2000.
3. Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein H. Vincent Poor and Narayan B. Mandayam, Principles of Cognitive Radio, Cambridge University Press, 2013.
4. Bruce Fette, Cognitive Radio Technology, Newnes, 2006.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1729	ASIC AND FPGA BASED DESIGN	3	0	0	3

OBJECTIVES

- To study the design flow of different types of ASIC.
- To familiarize the different types of programming technologies and logic devices and FPGA architectures
- To explore on the methods of partitioning, floor planning, placement and routing including circuit extraction of ASIC

UNIT I INTRODUCTION TO ASICS, ASIC LIBRARY DESIGN AND PROGRAMMING TECHNOLOGY 9

Introduction to ASICs: ASIC Design Flow, Types of ASIC - Full Custom, Semi-Custom – Standard Cell Based ASIC and Gate Array ASIC, Programmable ASIC – PROM, PLA, PAL, CPLD, FPGA.

ASIC Cell Library Design: Combinational Logic Cell – Sequential Logic Cell - Data Path Logic Cell - Library Cell Design - Library Architecture

Programming Technology**:** Antifuse, SRAM, EPROM, EEPROM, ASIC construction.

UNIT II PROGRAMMABLE ASIC LOGIC CELLS, I/O CELLS AND INTERCONNECT 9

Programmable ASIC Logic Cells: Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX, Vertex and Spartan FPGAs, Cyclone FPGAs.

Programmable ASIC I/O Cells: DC & AC Inputs and Outputs - Clock & Power Inputs - Xilinx I/O Bocks.

Programmable ASIC Interconnect: Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX, Vertex and Spartan FPGAs, Cyclone FPGAs.

UNIT III LOGIC SYNTHESIS, SIMULATION & TEST 9

Logic Synthesis: Logic Synthesis – FPGA Synthesis - Verilog and Logic Synthesis -VHDL and Logic Synthesis.

Simulation: Types of Simulation, Logic Simulation – Cell Models & Delay Models, Static Timing Analysis, Formal Verification, Switch Level Simulation, Transistor Level Simulation.

Test: Importance of Test, Boundary Scan Test, Faults, Fault Simulation, ATPG, Scan Test, BIST.

UNIT IV SYSTEM PARTITIONING, FLOORPLANNING AND PLACEMENT 9

System Partitioning: Measurement of Partitioning, Partitioning Algorithms – Constructive Partitioning, Iterative Partitioning Improvement Algorithms - K-L Algorithm, FM algorithm, Ratio-Cut Algorithm, Look-Ahead Algorithm, Simulated Annealing, FPGA Partitioning, Power Dissipation.

Floor planning and Placement: Floor Planning Measurement and tools, I/O, Power and clock planning, Measurement of Placement, Placement Algorithms – Min-cut Placement, Eigen value Placement, Iterative Placement Improvement and Timing driven Placement algorithms.

UNIT V ROUTING AND CIRCUIT EXTRACTION 9

Routing and Circuit Extraction: Global Routing Measurement – Measurement of Interconnect Delay using Elmore's constant, Global routing for CBIC and GA, Detailed Routing Measurement - Measurement of Channel Density, Detailed routing Algorithms – LEA, Lee Maze and High tower Algorithms, Circuit extraction process, Layout Design Rules and Technology related issues.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the basics of ASIC Design, various ASIC Design Methodologies
- Understand the construction of combinational and sequential logic cells
- Learn the different types of programming technologies the architectures of Xilinx, Altera and Actel FPGA families
- Learn the steps involved in sequential and combinational logic synthesis, structural, static timing analysis, and gate level Simulation and testing methods
- Comprehend various steps involved in ASIC physical design partitioning; floor planning, and placements and routing

TEXT BOOK

1. Michael John Sebastian Smith, Applications Specific Integrated Circuits, Pearson Education, Ninth Indian Reprint, Thirteenth Edition, 2004.

REFERENCE BOOKS

1. Trimberger S, Edr. Field Programmable Gate Array Technology, Kluwer Academic Publishers, 1994.
2. Old Field J and Dorf R, Field Programmable Gate Arrays, John Wiley& Sons, New York, 1995.
3. Chan P K and Mourad S, Digital Design using Field Programmable Gate Array, Prentice Hall, 1994.
4. Sherwani N A, Algorithms for VLSI Physical Design Automation, Kluwer Academic Publishers, 2002.
5. Gerez H, Algorithms for VLSI Design Automation, John Wiley, 1999.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1731	WIRELESS TECHNOLOGY	3	0	0	3

OBJECTIVES

- To gain knowledge about the digital cellular systems
- To build an understanding of the concepts and performance of IEEE 802.16standard
- To build knowledge on LTE specific signaling protocols and procedures
- To understand Wireless local and personal area network setup & its security
- To comprehend the concepts of cognitive radio technologies

UNIT I 3G MOBILE CELLULAR TECHNOLOGIES 9

CDMA2000-Operational Advantages, General Architecture, Airlink Design, Data Throughput, Forward Link Scheduling, Reverse Link, CDMA2000 1xEV Signaling, Handoffs, CDMA2000 1xEV-DO, CDMA2000 1xEV-DV.

WCDMA-ETSI UMTS versus ARIB WCDMA, UMTS Cell and Network Structure, UMTS Radio Interface, UMTS, UTRA Channels, UTRA Multiplexing and Frame Structure, Spreading and Carrier Modulations, Packet Data, Power Control Handovers.

UNIT II WiMAX 9

Background on IEEE 802.16 and WiMAX, Salient Features of WiMAX, WiMAX Physical Layer, MAC-Layer Overview, Advanced Features for Performance Enhancements, Reference Network Architecture, Performance Characterization.

UNIT III LTE AND LTE-ADVANCED NETWORKS 9

Overview of LTE Networks, The Radio Protocol Architecture, The Interfaces, Support for Home eNBs (Femtocells), Air Interface, Frame Structure, UE States and State Transitions, Quality of Service and Bandwidth Reservation, Mobility Management, Security, Frame-Structure in LTE, Frame-Structure in LTE-Advanced, LTE Identification, Naming and Addressing.

UNIT IV WIRELESS DATA NETWORKS 9

IEEE 802.11 Standards for Wireless Networks, IEEE 802.11a Supplement to 802.11 Standards, IEEE 802.11 Security, IEEE 802.15 WPAN Standards, ETSI HIPERLAN and ETSI HIPERLAN/2 Standards, Bluetooth Technologies.

UNIT V COGNITIVE RADIO TECHNOLOGY & 5G 9

Definitions of Cognitive Radio, Basic Cognitive Algorithms, Conceptual Classifications of Cognitive Radios, Cognitive Radio for WPANs, Cognitive Radio for WLANs, Cognitive Radio for WMANs, Cognitive Radio for WWANs, Cognitive Radio for WRANs: IEEE 802.22, Challenges to Implement Cognitive Radio.

5G system concept, Concept overview, Extreme mobile broadband, Massive machine-type communication, Ultra-reliable machine-type communication-The 5G architecture-NFV and SDN-Basics about RAN architecture, D2D standardization: 4G LTE D2D, New relaying techniques for 5G.

TOTAL PERIODS: 45

OUTCOMES

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

- Apply Digital cellular concepts in the design of Cellular networks
- Build and Design the wireless networks based on the IEEE 802.16 standard
- Explain the LTE related components and its functions
- Demonstrate advanced knowledge of networking and performance of data networks and define performance metrics
- Explain the concepts behind the cognitive wireless networks and next generation networks

TEXT BOOK

1. Hsiao-Hwa Chen and Mohsen Guizani**,** Next Generation Wireless Systems and Networks, John Wiley & Sons Ltd, 2006.

REFERENCE BOOKS

1. Abd-Elhamid M Taha, Hossam S Hassanein and Najah Abu Ali, LTE, LTE-Advanced and WiMAX towards IMT-Advanced Networks, John Wiley & Sons, Ltd, 2012.
2. Jeffrey G Andrews, Arunabha Ghosha and Rias Muhamed, Fundamentals of WiMAX Understanding Broadband Wireless Networking, Pearson Education, 2007.
3. Fazel K and Kaiser S, Multi-Carrier and Spread Spectrum Systems-From OFDM and MC-CDMA to LTE and WiMAX, John Wiley & Sons, Second Edition, 2008.
4. Steve Rackley, Wireless Networking Technology from Principles to Successful Implementation, Elsevier, 2007.
5. Afif Osseiran Jose F, Monserrat and Patrick Marsch, 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1821	COMMUNICATION NETWORK SECURITY	3	0	0	3

OBJECTIVES

- To understand the classical ciphers, and public key cryptography
- To study block ciphers for practical implementation
- To study Hash functions and MAC functions
- To understand and study the security issues and challenges in various networks
- To have knowledge about the current technology in the area of cryptography

UNIT I CLASSICAL CIPHERS 9

Services – Mechanisms and Attacks – OSI security Architecture – Model for Network Security – Classical Encryption Techniques – Symmetric Cipher Model – Substitution Techniques – Transposition Techniques – Rotor Machines– Stenography.

UNIT II PUBLIC KEY ENCRYPTION 9

Block Ciphers and Data Encryption Standard: Simplified DES – Block Cipher Principles, Block Cipher Design Principles – Block Cipher Modes of Operation. Principles of Public Key Cryptosystems – RSA Algorithm, Key Management and other public key cryptosystems– Diffie–Hellman Key Exchange. Basics of ECC algorithm.

UNIT III HASH & MAC FUNCTIONS 9

Message Authentication and Hash Functions – Authentication Requirements– Authentication Functions – Message Authentication Codes – Hash Functions and MACs; Hash Algorithms – MD5 Message Digest Algorithm, Digital Signatures and Authentication Protocols.

UNIT IV WIRELESS NETWORK SECURITY ATTACKS 9

Security Attack issues specific to Wireless systems: Brute force attack- Denial of Service attack- DDoS-Worm hole attack. Other attacks- Tunneling, Grayhole and Man-in-the-middle attack. Security issues & challenges in VANETs, Ad Hoc & Sensor networks, and IoT.

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UNIT V SECURITY PRACTICE 9

Introduction to hardware security, side channel attacks – counters measures, Application of simple cryptographic algorithms in FPGA, Web Security -Secure Electronic Transaction, Introduction to Quantum cryptography and introduction to block chaining technology.

TOTAL PERIODS: 45

OUTCOMES

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

- Learn different types of classical cipher and public key cryptographic algorithms
- Understand and learn to use block ciphers for both software and hardware applications
- Understand and apply the MAC and Hash authentication algorithms for wireless network applications
- Analyze different types of attacks existing in wireless networks and learn to mitigate them
- Understand and apply cryptographic algorithms in FPGA
- Understand quantum cryptography and block chaining technology

TEXT BOOKS

1. William Stallings, Cryptography and Network Security, Prentice Hall of India, New Delhi, Sixth Edition, 2004.
2. Charlie Kaufman, Network Security Private Communication in Public World, Prentice Hall of India New Delhi, Second Edition, 2004.

REFERENCE BOOKS

1. William Stallings, Network Security Essentials, Prentice Hall of India, New Delhi, Second Edition, 2004.
2. Nichols R K and P C Lekkas, Wireless Security: Models, Threats, and Solutions Mc Graw - Hill, First Edition, 2002.
3. Fatih Sakiz and Sevil Sen, A survey of attacks and detection mechanisms on intelligent transportation systems: VANETs and IoV, Ad Hoc Networks, 61, 2017, pp 33–50.
4. Gilles Van Assche, Quantum Cryptography and Secret-Key Distillation, Cambridge University Press, First Edition, 2006.
5. Shanti Bruyn A, Blockchain an introduction, Research paper, August 26, 2017, pp 1-43.
6. Internet of things security A top - down survey. https://doi.org/10.1016/j.comnet.2018.03.012.
7. Introduction to side channel attack http://gauss.ececs.uc.edu/Courses/c653/lectures/SideC/intro.pdf.
8. Bhunia Swarup, Hardware security: A Hands-on Learning Approach, published by Morgan Kaufmann, First edition, 2018.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1822	MIXED SIGNAL DESIGN	3	0	0	3

OBJECTIVES

- To be able to understand and design Sample/hold circuits, and analog Comparators
- To be able to understand and design Digital to Analog converters
- To be able to understand and design Analog to Digital Converters
- To be able to understand and design Power Amplifiers and data converter interfaces

UNIT I SAMPLE AND HOLD CIRCUITS 9

Analog versus Discrete time signals, analog to digital signal conversion, Sampling switches: Impulse sampling, decimation, sample and hold, track and hold, interpolation, sample and hold

gain, aperture error, Analog integrator, Issues in data converters: sampling, quantization and reconstruction, oversampling and aliasing.

UNIT II SWITCHED CAPACITOR CIRCUITS AND COMPARATORS 9

Switched capacitor architecture: Switched capacitor integrator, Current mode architecture, Basic comparator, characteristics of comparator, clock comparator, Comparator: Single stage amplifier, cascaded amplifier, Latched comparator.

UNIT III DIGITAL TO ANALOG CONVERTERS 9

Differential non-linearity (DNL), Integral non-linearity (INL), Offset, Gain Error, Signal to noise ratio, dynamic range, Reference multiplication and division: voltage, current and charge division, Resistor ladder DAC: switching functions, architecture with switched sub divider, Current steering DAC: R-2R network switching functions, R-2R network architecture, Binary to thermometer code conversion, Design challenges: Current element matching, clock feed through, zero order hold.

UNIT IV ANALOG TO DIGITAL CONVERTERS 9

Quantization error, Differential non-linearity (DNL), Integral non-linearity (INL), Offset, Gain Error, Signal to noise ratio, aliasing, ADC architecture: Successive approximation register(SAR) ADC, Pipelined ADC, Flash ADC, Performance metrics: Slew in sampling point, input capacitance non-linearity, charge redistribution in DAC, comparator offset cancellation.

UNIT V POWER AMPLIFIERS AND INTERFACING FOR DATA CONVERTERS 9

MOSFET power amplifier, MOSFET based: Class A, Class B, Class AB, Class D power amplifiers, Parallel and serial protocols.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand and design sample/hold circuits, and analog Comparators
- Understand and analyze Digital to Analog converters
- Understand and analyze Analog to Digital converters
- Understand and analyze Power Amplifiers and data converter interfaces

TEXT BOOKS

1. Franco Maloberti, Data converters, Springer, 2007.
2. David A John and Kenmarti, Analog integrated circuit design, Wiley India, 1997.
3. Behzad Razavi, Principles of data conversion system design, Wiley-Blackwell, First Edition, 1994.

REFERENCE BOOKS

1. Analog divisors inc. edited by Walt Kester, The data conversion handbook, Newness, Elsevier, 2005.
2. Jacob Baker R, CMOS: Circuit design, layout and simulation, Wiley Interscience, Second Edition, 2008.
3. Rudy Van De Plassche, CMOS integrated Analog-to-Digital and Digital-to-Analog Converters, Springer, Second Edition, 2005.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1823	INTRODUCTION TO RADAR AND SATELLITE COMMUNICATION	3	0	0	3

OBJECTIVES

- To understand the design and operation of radar systems for a variety of applications
- To learn various radars like MTI, Doppler and tracking radars and their comparison
- To study the various segments in satellite communication with broadcast and access techniques
- To understand the design of radar transmitters and receivers

UNIT I PRINCIPLES OF RADAR AND RADAR EQUATION 9

Basics of Radar: Simple form of Radar Equation, Radar Operation, Radar Frequencies and Applications. Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Radar Equation: SNR, Envelope Detector — Integration of Radar Pulses, Radar Cross Section of Targets Transmitter Power, PRF and Range Ambiguities, System Losses.

UNIT II TYPES OF RADAR SYSTEMS 9

CW and Frequency Modulated Radar: Doppler Effect, CW Radar — Block Diagram, Receiver Bandwidth Requirements, Applications of CW radar.

FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter, Multiple Frequency CW Radar.

MTI and Pulse Doppler Radar: MTI Radar with – Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancelers — Filter Characteristics, Blind Speeds, Double Cancellation, MTI versus Pulse Doppler Radar.

UNIT III TRACKING RADARS AND RADAR RECEIVER 9

Tracking Radar: Sequential Lobing, Conical Scan, Monopulse Tracking Radar — Amplitude Comparison Monopulse, Phase Comparison Monopulse, Acquisition and Scanning Patterns, Comparison of Trackers.

Radar Receivers: Duplexers — Circulators as Duptexers. Phased Array Antennas – Radiation Pattern, Beam Steering and Beam Width changes, Applications and Limitations.

UNIT IV SATELLITE ORBITS AND SATELLITE LINK DESIGN 9

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, geo stationary and non-Geo-stationary orbits, Satellite uplink and downlink Analysis and Design, E/N calculate ion-performance impairments, Modulation and Multiplexing – digital transmission system, multiple access: FDMA, TDMA, CDMA, Assignment Methods, encryption.

UNIT V SATELLITE APPLICATIONS AND GPS 9

Satellite Applications - INTELSAT Series, INSAT, VSAT, Mobile satellite services: GPS, Global Navigation Satellite Systems - Basic concepts of GPS. Space segment, Control segment, user segment, GPS constellation, GPS measurement characteristics, Selective availability (AS), Anti spoofing (AS)., Applications of Satellite and GPS for 3D position, Velocity, determination as function of time, Interdisciplinary application.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the radar fundamentals and analysis of the radar signals
- Understand design of radar transmitters and receivers

- To learn various radars like MTI, Doppler and tracking radars and their comparison
- Demonstrate a clear understanding of the satellite communication
- Study the various segments in satellite communication with broadcast and access techniques
- Understand the GPS system and its operation with applications.

TEXT BOOKS

1. Mark A Richards, James A Scheer and William A Holm Yesdee, Principles of Modern Radar: Basic Principles, Scitech Publishing Inc, First Edition, 2013.
2. Dennis Roddy, Satellite Communication, McGraw-Hill International, Fourth Edition, 2006.

REFERENCE BOOKS

1. Men I Skolnik, Introduction to Radar Systems, TMH Special Indian Edition, Second Edition, 2007.
2. Byron Edde, Radar Principles, Technology Applications, Pearson Education, 2004.
3. Wilbur L Pritchard, Hendri G Suyderhoud and Robert A Nelson, Satellite Communication Systems Engineering, Prentice Hall/Pearson, 2007.
4. Madhavendra Richharia, Satellite Systems for Personal Applications, John Wiley and Sons, Ltd.
5. Mohinder S Grewal, Lawerence R, Weill and Angus P Andrews, Global Positioning Systems, Inertial Navigation, and Integration., A John Wiley & Sons, Inc. Publication, Second Edition, 2007.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1824	OPTIMIZATION IN WIRELESS COMMUNICATION	3	0	0	3

OBJECTIVES

- To review the important concepts of linear algebra
- To understand the fundamentals of convex optimization
- To apply optimization techniques to wireless systems

UNIT I LINEAR ALGEBRA REVIEW 9

Properties of Vectors and Matrices – Linear dependence and rank - Eigen values and Eigen vectors of matrices, positive semidefinite and positive definite matrices and their properties – inner product space and its properties, properties of norm, gauss elimination and echelon form of matrices, Gram Schmidt orthogonalization, Null space and trace of matrices, Eigen value decomposition of Hermitian Matrices, Woodbury Identity.

UNIT II CONVEX OPTIMIZATION FUNDAMENTALS 9

Introduction to Convex Optimization – Norm, Ellipsoid and Polyhedron - Convex sets and properties - Affine sets - convex and concave functions - properties and conditions for convexity - Jensen’s inequality.

UNIT III PRACTICAL APPLICATIONS: WIRELESS SYSTEMS 9

Application of norm ball, ellipsoid and polyhedron in wireless systems - Cooperative cellular transmission - Maximal ratio combiner for wireless systems - MIMO receiver design as a least squares problem - Multiantenna channel estimation.

UNIT IV PRACTICAL APPLICATIONS: BEAMFORMING IN MIMO WIRELESS SYSTEMS 9

Beamforming in multiantenna wireless communication, Multiantenna beamforming with interfering user - Zero forcing beamforming with interfering user - robust beamforming with channel uncertainty for wireless systems, MIMO beamforming.

UNIT V PRACTICAL APPLICATIONS: COOPERATIVE COMMUNICATIONS 9

Cooperative communications - overview and protocols used - probability of error for cooperative communication - optimum power allocation for cooperative communication.

TOTAL PERIODS: 45

OUTCOMES

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

- Apply the basic concepts of vector and matrix algebra, including linear dependence / independence, basis and dimension of a subspace, rank and nullity, for the analysis of wireless systems
- Recognise problems in wireless systems that can be formulated as convex optimization
- Explain the role of convex optimization in MIMO and cooperative communications
- Develop a research project in the area of wireless communications

TEXT BOOKS

1. Aditya K Jaganatham, Principles of Modern Wireless Communication Systems, Tata McGraw Hill, 2015.
2. Prof Stephen Boyd, Convex Optimization, Cambridge University Press, 2009.

REFERENCE BOOKS

1. David Tse, Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005.
2. Ezio Biglieri**,** Robert Calderbank**,** Anthony Constantinides**,** Andrea Goldsmith**,** Arogyaswami Paulraj and Vincent Poor H, MIMO Wireless Communications, Cambridge University Press, 2007.
3. Peter Hong Y W, Wan-Jen Huang and Jay Kuo C C, Cooperative Communications and Networking: Technologies and System Design, Springer, 2010.
4. Theodore S. Rappaport, Wireless Communication, Principles and Practice, Pearson Education India, 2009.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1825	UNDERWATER COMMUNICATION	3	0	0	3

OBJECTIVES

- To understand the properties of underwater acoustic signal
- To understand the characteristics of noises in sea
- To understand the principles of SONAR and acoustic modem
- To understand the challenges in underwater signal processing and sensor networks

UNIT I FUNDAMENTALS OF UNDERWATER ACOUSTICS 9

The Ocean acoustic environment, measuring sound level, Sources and receivers, relevant units, sound velocity in sea water, typical vertical profiles of sound velocity, Sound propagation in the

Ocean, Sound attenuation in sea water, Bottom Loss, Surface bottom and volume scattering, Snell's law for range dependent ocean.

UNIT II AMBIENT NOISE IN THE SEA 9

Sources of ambient noise-introduction, different frequency bands of ambient noise, spatial coherence of ambient noise, directional characteristics of ambient noise, intermittent sources of noise- biological & non biological (rain, earthquakes, explosions and valcanos).

UNIT III CHARACTERISTICS OF SONAR SYSTEMS 9

Sonar systems, active and passive sonar equations, transducers and their directivities, Sensor array characteristics-array gain, receiving directivity index, beam patterns, adaptive beamforming.

UNIT IV ADAPTIVE SIGNAL PROCESSING 9

Adaptive Systems, Open Loop and Closed loop Adaptations, Adaptive Linear Combiner, Adaptive Algorithms and Structures, Acoustic Modem.

UNIT V UNDERWATER SENSOR NETWORK 9

Underwater Networking- Ocean Sampling Networks, Pollution Monitoring, Environmental Monitoring and Tactical surveillance systems, Major challenges in the design of Underwater Sensor Networks, Factors that affect the UWSN.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the properties of underwater acoustic signal
- Understand the characteristics of noises in sea
- Understand the principles of SONAR and acoustic modem
- Understand the challenges in underwater signal processing and sensor networks

TEXT BOOKS

1. Robert J Urick, Principles of Underwater Sound, Peninsula Pub, Third Edition, 1983.
2. William S Burdic, Underwater Acoustic Systems, Prentice Hall Inc., 2002.

REFERENCE BOOKS

1. Robert S H Istepanian and MilicaStojanovic, Underwater Acoustic Digital signal processing & communication system, Kluwer academic Publisher, 2002.
2. Robert J Urick, Ambient noise in the sea, Peninsula Pub, Second Edition, 1986.
3. Clay Medwin, Acoustical Oceanography: Principles and Applications, Physics Today, 1978.
4. Brekhovskikh L M and Lysanov Yu P, Fundamental of ocean acoustics, Springer, Third Edition, 2003.
5. Richard O Nielsen, Sonar signal processing, Artech House Publishers, 1991.

OPEN ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1941	A FOUNDATION COURSE ON DIGITAL SIGNAL PROCESSING	3	0	0	3

OBJECTIVES

- To introduce basic concepts of signals and systems
- To introduce LTI systems and its properties
- To understand frequency domain analysis of signals using Z-transform and Fourier transform
- To introduce design concepts of digital filters

UNIT I BASICS OF SIGNALS AND SYSTEMS 9

Elementary discrete-time signals. Classification of signals - continuous & discrete-time, periodic & aperiodic, deterministic & random, Causal & non-causal signals. Discrete-time systems: classification - time-invariant & time-variant, linear &non-linear, causal & non-causal, stable and unstable systems.

UNIT II LINEAR TIME-INVARIANT SYSTEMS 9

Analysis of LTI systems: response of an LTI system - convolution sum, causality and stability of an LTI system. LTI systems characterized by constant-coefficient difference equation. Impulse response of an LTI system. Structures of an LTI system - recursive and non-recursive.

UNIT III Z-TRANSFORM 9

Concept of frequency in continuous-time and discrete-time signals, sampling theorem, aliasing. Z-transform, ROC, convolution property. Pole-zero systems - Pole-zero analysis - pole locations and time-domain behavior of causal signals. Analysis of LTI systems in z-domain - causality and stability, pole-zero cancellations.

UNIT IV DISCRETE-FOURIER TRANSFORM 9

An overview of Discrete-time Fourier transform - frequency domain sampling. Discrete Fourier transform - Properties - periodicity, linearity, multiplication property, circular convolution. Frequency analysis of signals using DFT - magnitude and phase spectrum representation.

UNIT V DESIGN OF DIGITAL FILTERS 9

General considerations in filter designs, characteristics of frequency-selective filters. Linear-phase property. Design of FIR filters - linear-phase FIR filter design using Hamming window. Design of IIR filters using Bilinear transformation, properties of IIR filters.

TOTAL PERIODS :45

OUTCOMES

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

- Understand the fundamental concepts of signals and systems
- Understand and apply the properties of LTI systems in digital system design
- Apply and analyze digital signals using Fourier transform and Z-transforms
- Design digital filters

TEXT BOOKS

1. John G. Proakis, Dimitris G. Manolakis, Digital signal processing - Principles, algorithms and applications, Pearson Education, Thirteenth edition, 2013.
2. Alan V. Oppenheim, Wilsky S. and Nawab S. H, Signals and Systems, Pearson, 2015.

REFERENCE BOOKS

1. Oppenheim A V, Schaffer R W and Buck J R, Discrete-time signal processing, Pearson, Eighth Indian Reprint, 2014.
2. Vinay K Ingle and John G Proakis, Digital Signal Processing using MATLAB, Cengage learning, Third Edition, 2011.
3. Sanjit K Mitra, Digital Signal Processing: A computer based approach, McGraw Hill, Second Edition, 2000.
4. Ashok Ambardar, Digital Signal Processing: A modern introduction, Cengage Learning, First Edition, 2006.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1942	INTRODUCTION TO COMMUNICATION SYSTEMS	3	0	0	3

OBJECTIVES

- To introduce concept of basic analog and digital communication systems
- To understand the various modulation techniques for analog and digital communication systems
- To study the wired channel on communication systems

UNIT I ANALOG COMMUNICATION 9

Amplitude modulation - DSBFC, square law modulator, envelope detection, Hilbert transform, SSB -frequency and phase shift methods of SSB generation-coherent detection.

UNIT II ANGLE MODULATION 9

Frequency Modulation, narrowband and wideband signals, Bessel functions, Carson's rule - bandwidth, Direct and indirect FM generation, demodulation using Phase-locked loop.

UNIT III DIGITAL COMMUNICATION 9

Nyquist sampling theorem - Pulse amplitude modulation, Pulse code modulation – Quantization - quantization noise, delta modulation, DPCM, Multiplexing and Multiple Access Techniques - FDM and FDMA, TDM and TDMA, CDMA.

UNIT IV DIGITAL MODULATION TECHNIQUES 9

Binary Phase Shift Keying - Binary Frequency Shift Keying, On - Off Keying. Optimum receiver structures for digital communication - matched filtering, correlation detection, probability of error.

UNIT V MOBILE CELLULAR COMMUNICATION 9

Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G, 4G - Cellular network components - Components of a mobile phone - setting up a call process - Making a call process - Receiving a call process - Spectrum allocation: Policies and strategies, Role of TRAI.

TOTAL PERIODS: 45

OUTCOMES

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

- Understand the basic concepts of communication systems
- Use the modulation techniques for analog and digital communication
- Analyse the performance of wireless channels

TEXT BOOKS

1. Haykin S, Communication Systems, John Wiley, Third Edition, 2007.
2. Theodore S Rappaport, Wireless Communications: Principles and Practice, Pearson education, India, Second Edition, 2009.

REFERENCE BOOKS

1. Lathi B P, Modern Digital and Analog Communication systems, Oxford university press, Third Edition, 2007.
2. Sklar B, Digital Communications Fundamentals and Applications, Pearson education, Second Edition, 2016.
3. David Tse and Pramod Viswanath, Fundamentals of Wireless Communications, Wiley series in Telecommunications, cambridge university press, 2005.
4. Proakis J G, Salehi M, Fundamentals of Communication Systems, Pearson education 2006.
5. Hsu H P, Schaum outline series - Analog and Digital Communications, TMH, 2006.
6. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1943	INTRODUCTION TO MICROCONTROLLERS	3	0	0	3

OBJECTIVES

- To study the architecture of 8051 and PIC microcontroller
- To study the addressing modes & instruction set of 8051 and PIC
- To introduce the need & use of Interrupt structure 8051 and PIC
- To develop skill in interfacing peripherals with 8051 and PIC

UNIT I INTRODUCTION 9

Introduction to Microcontrollers and Embedded Processors - Microcontrollers survey-four bit, eight bit, sixteen bit, thirty-two bit Microcontrollers - Comparing Microprocessors and Microcontrollers-The 8051 Architecture- Hardware modules - data pointer-registers-stack and stack pointer-special function registers- memory organization -Input / Output Ports –counter and timer-serial data Input / output-Interrupts.

UNIT II 8051 PROGRAMMING 9

8051 Assembly Language Programming-Structure of Assembly language-Assembling and running an 8051 program- Addressing modes-Accessing memory using various addressing modes- Instruction set- 8051 Serial Communication -Connection to RS-232- Serial Communication Programming- Interrupts Programming.

UNIT III INTRODUCTION TO PIC ARCHITECTURE 9

PIC16F877 Architecture - Program and Data memory organization - Special Function Registers - Addressing modes, Instruction set. MPLAB Integrated Development Environment – Introduction to Assembly language and Embedded C programming – Stack – Subroutines - Interrupt structure – Peripherals – Input/Output Ports.

UNIT IV PIC PERIPHERALS 9

Timers/Counters - Watchdog Timer – Capture/Compare/PWM (CCP) - Analog to Digital Converter(ADC) – EEPROM - Serial Communication – USART.

UNIT V CASE STUDY 9

Simple programming exercises-LED-LCD interfaces – Interfacing with relays and opto isolators - Closed loop control of servo motor- stepper motor control – Washing Machine Control.

TOTAL PERIODS: 45

OUTCOMES

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

- Ability to understand and analyze, architectural features of 8051 and PIC microcontroller
- Ability to design and develop an application using 8051 and PIC computing platform for engineering problems

TEXT BOOKS

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Prentice Hall, Second Edition, 2005.
2. John B Peatman, Design with PIC microcontrollers, Prentice Hall, 1998.

REFERENCE BOOKS

1. Martin P Bates, Programming 8 bit PIC Microcontrollers in C with Interactive Hardware Simulation, Newnes, 2008.
2. PIC Micro Mid-Range MCU Family Reference Manual, Micro Chip Technology Inc.
3. Han-Way Huang, Leo Chartrand, PIC Microcontroller: An Introduction to Software & Hardware Interfacing 1st Edition, Thomson Learaning Series, 2004.
4. Muhammad Ali Mazidi, Danny Causey and Rolin McKinlay, PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18, Pearson, Second edition, 2016.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1944	INTRODUCTION TO WIRELESS NETWORKS	3	0	0	3

OBJECTIVES

- To gain knowledge about Wireless Wide-Area Network
- To understand the concepts of network architecture of UMTS
- To learn about various WLAN standards
- To comprehend the concepts of WPLAN

UNIT I ARCHITECTURE OF A WIRELESS WIDE-AREA NETWORK (WWAN) 9

Introduction-First- and Second-Generation Cellular Systems-Cellular Communications from 1G to 3G-Road Map for Higher Data Rate Capability in 3G-Wireless 4G Systems-Future Wireless Networks-GSM Public Land Mobile Network Services.

UNIT II WIDE-AREA WIRELESS NETWORKS (WANs) — GSM EVOLUTION 9

Introduction-GSM Evolution for Data-Third-Generation (3G) Wireless Systems-UMTS Network Reference Architecture, UMTS Terrestrial Radio Access Network Overview-IEEE 802.16-World Interoperability for MicroAccess, Inc. (WiMAX).

UNIT III UMTS CORE NETWORK ARCHITECTURE 9

3G-MSC-3G-SGSN-3G-GGSN-SMS-GMSC/SMS-IWMSC, Quality of Service in UMTS-High-Speed Downlink Packet Access (HSDPA)- Freedom of Mobile multimedia Access (FOMA).

UNIT IV WIRELESS LOCAL AREA NETWORKS 9

Introduction-WLAN Equipment-WLAN Topologies-WLAN Technologies-IEEE 802.11 WLAN-Joining an Existing Basic Service Set-Security of IEEE 802.11 Systems-Power Management-IEEE 802.11b — High Rate DSSS-IEEE 802.11n-Other WLAN Standards (Quantitative).

UNIT V WIRELESS PERSONAL AREA NETWORK 9

Introduction- The Wireless Personal Area Network-Bluetooth (IEEE 802.15.1)-ZigBee Technology-IEEE 802.15.4 LR-WPAN Device Architecture-Wireless Sensor Network-Usage of Wireless Sensor Networks-Wireless Sensor Network Model.

TOTAL PERIODS: 45

OUTCOMES

On successful completion of this course, the student will be

- Conversant with the various WWAN
- Able to understand the operation of UMTS core network architectures
- Familiar with the various WLAN technologies
- Able to comprehend various low and high rate WPAN

TEXT BOOK

1. Vijay Garg, Wireless Communications and networking, Elsevier, First Edition, 2007.

REFERENCE BOOKS

1. Jochen Schiller, Mobile Communications, Pearson Education, Second Edition, 2012.
2. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, 3G Evolution HSPA and LTE for Mobile Broadband, Academic Press, Second Edition, 2008.
3. Anurag Kumar, Manjunath D and Joy kuri, Wireless Networking, Elsevier, First Edition, 2011.
4. Simon Haykin, Michael Moher and David Koilpillai, Modern Wireless Communications, Pearson Education India, 2011.
5. Cory Beard and William Stallings, Wireless Communication Networks and Systems, First Edition, Pearson, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1041	INTRODUCTION TO INTERNET OF THINGS	3	0	0	3

OBJECTIVES

- To understand the fundamentals of Internet of Things
- To understand the concept of Internet of Things in the real world scenario
- To know various case study of IoT systems

UNIT I INTRODUCTION AND APPLICATIONS 9

Introduction to IoT–Definition, Characteristics, functional requirements, motivation, Physical design-things in IoT, IoT protocols, Logical Design-functional blocks, communication models, Communication APIs, Applications–Home Automation, Cities, Environment, Energy, Agriculture, Health, Industry.

UNIT II M2M AND SYSTEM MANAGEMENT 9

Introduction-M2M, Difference between M2M and IoT, SDN and NFV for IoT, System Management–need, SNMP, NETCONF, YANG.

UNIT III DEVELOPING INTERNET OF THINGS 9

IoT Methodology-Purpose & Requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specifications.

UNIT IV USAGE OF PYTHON 9

IoT systems logical design using python-python data types & data structures, control flow, functions or modules, remote access enablement using cloud.

UNIT V CASE STUDY ON IoT SYSTEM 9

Case study for weather monitoring system-modules & package of python, python packages of interest for IoT-JSON, XML, HTTP & URLLib, SMTPLib. Exemplary device-Rasberry pi, Linux on Rasberry pi.

TOTAL PERIODS: 45

OUTCOMES

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

- Design a portable IoT using Arduino/ equivalent boards and relevant protocols.
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario.

TEXT BOOKS

1. Arhdeep Bahga and Madisetti, Internet of Things A hands-on approach, Universities Press(India) Private Limited, 2014.
2. Olivier Hersent, Omar Elloumi, and David Boswarthick, The Internet of Things: Applications to the smart grid and building automation, Wiley 2012.

REFERENCE BOOKS

1. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things - Key Applications and Protocols, Wiley 2012.
2. Manoel Carlos Ramon, Intel® Galileo and Intel® Galileo Gen API Features and Arduino Projects for Linux Programmers, Apress, 2014.
3. Marco Schwartz, Internet of Things with the Arduino Yun, Packt Publishing, 2014.
4. Dieter Uckelmann, Mark Harrison and Florian Michahelles, Architecting the Internet of Things, Springer, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1042	INTRODUCTION TO SENSORS AND ACTUATORS	3	0	0	3

OBJECTIVES

- To study different types of sensors and actuators
- To gain knowledge on type of optical sensors to be used for practical applications
- To understand the design concepts of micro sensors and micro actuators
- To understand the packaging and characterization of MEMS/NEMS

UNIT I STRAIN, PRESSURE AND TEMPERATURE 9

Introduction, Stress & Pressure sensors: Resistance strain gauge, piezoelectric strain gauge, characteristics. Fiber-optic sensor, Pressure gauges. Temperature Sensors: Bimetallic strip, thermocouples, Resistance thermometers, thermistors, bolometer, Pyroelectric detector.

UNIT II OPTICAL SENSORS 9

Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber optic sensors, electro optic sensors & fiber-optic applications, light transducer, solid-state transducers and liquid crystal devices.

UNIT III MICRO SENSORS 9

Acoustic sensor – Quartz crystal microbalance, surface acoustic wave, Flextural plate wave, shear horizontal; Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors.

UNIT IV MICRO ACTUATORS 9

Electrostatic actuators – parallel plate capacitor, Interdigitated finger capacitor, piezoelectric actuators, Thermal actuators, Actuators using shape memory alloys; Microgrippers, Micromotors, Microvalves, Micropumps

UNIT V PACKAGING AND CHARACTERIZATION 9

Micro / nano systems packaging, Essential packaging technologies, Selection of packaging materials; SEM, TEM, AFM, STM, Spectroscopic techniques for Nano characterization.

TOTAL PERIODS: 45

OUTCOMES

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

- Select sensors for the measurement of physical variables for real time applications
- Use sensors for optoelectronic applications
- Understand and apply actuators for engineering applications
- Understand the packaging and characterization requirements

TEXTBOOKS

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata McGraw Hill, First Edition, 2002.
2. Ian R Sinclair, Sensors and Transducers, Newnes publishers, Third Edition, 2001.

REFERENCE BOOKS

1. Doebelin E O, Measurement Systems, Application and Design, McGraw Hill, Fifth Edition, 2004.
2. Vinod Kumar Khanna, Nanosensors: Physical, Chemical, and Biological, CRC press, First Edition, 2012.
3. Chang Liu, Foundations of MEMS, Pearson education India limited, Second Edition, 2006.
4. Ramon Pallás Areny and John G. Webster, Sensors and Signal conditioning, John Wiley and Sons, Second Edition, 2000.
5. Jack P Holman, Experimental Methods for Engineers, McGraw Hill, USA, Seventh Edition, 2001.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1043	A FOUNDATION COURSE ON MACHINE LEARNING	3	0	0	3

OBJECTIVES

- To review foundations on applied mathematics for machine learning

- To introduce basics of machine learning algorithms
- To introduce the fundamentals of artificial neural networks
- To understand the concepts of deep learning algorithms

UNIT I MATHEMATICAL FOUNDATIONS 9

Linear algebra: Properties of vectors, matrices - non-negative matrices, linear dependence and rank of a matrix, Eigen values and Eigen vectors. Singular value decomposition, the Moore-Penrose pseudoinverse, Probability theory: Conditional probability - the chain rule. Gaussian distribution - multivariate, multimodal normal distribution.

UNIT II MACHINE LEARNING BASICS 9

Learning algorithms - supervised, unsupervised and reinforcement learning. Capacity, overfitting, underfitting and generalization - The no free lunch theorem - Bayesian decision theory, maximum likelihood estimation, maximum aposteriori estimation - Basic concepts of gradient descent optimization and Lagrange method.

UNIT III CONVENTIONAL MACHINE LEARNING ALGORITHMS 9

Feature extraction - MFCC, LPCC, PLP. spectral distortion measures - log-spectral distance, likelihood distortions – Expectation - Maximization algorithm - An overview of Gaussian mixture modeling, hidden Markov modeling, support vector machines for speech enabled systems.

UNIT IV ARTIFICIAL NEURAL NETWORKS 9

Models of a neuron - feed-forward neural networks - Perceptron learning, Multi-layer feed-forward neural network, back propagation algorithm - Cover's theorem on the separability of patterns, Generalized radial - basis function networks.

UNIT V DEEP NEURAL NETWORKS 9

Convolution neural network - the convolution operation, sparse interactions, parameter sharing. Pooling - max pooling - Case study - CNN based speech enabled system - Sequence modeling - recurrent neural networks - The long short-term memory (LSTM) model.

TOTAL PERIODS: 45

OUTCOMES

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

- Apply the properties of matrices and vector algebra
- Understand and apply the concepts of statistics and optimization methods
- Choose an appropriate pattern recognition algorithm for the given data
- Apply neural networks for suitable pattern recognition problems

TEXT BOOKS

1. Duda R O, Hart P E. and Stork D G, Pattern Classification, John Wiley, 2001.
2. Bishop C M, Pattern Recognition and Machine Learning, Springer, 2006.
3. Ian Good Fellow, Yoshua Bengio and Aaron Courville, Deep learning, MIT Press, 2016.

REFERENCE BOOKS

1. Simon Haykin, Neural networks - A Comprehensive Foundation, Pearson Education, Second Edition, 2008.
2. Andrew Webb, Statistical Pattern Recognition, Arnold Publishers, London, 1999.
3. Robert J Schalkoff, Pattern Recognition Statistical, Structural and Neural Approaches, John Wiley and Sons. Inc, New York, 1992.

COURSE CODE	COURSE TITLE	L	T	P	C
UEC1044	CONSUMER ELECTRONICS	3	0	0	3

OBJECTIVES

- To fundamentals of Consumer Electronics
- To operation of various Audio, Video & Recording systems
- To basics and operations of Home appliances
- To advance consumer electronic gadgets used in our day-today activities

UNIT I CONSUMER ELECTRONICS FUNDAMENTALS 9

History of Electronic Devices, Semiconductor Devices, Diodes, Rectifiers, Transistors, Integrated Circuits, Logic Gates, Combinational Circuits, ADC, DAC and Microprocessors, Microcontrollers in consumer electronics, Energy management, Intelligent Building Perspective.

UNIT II ENTERTAINMENT ELECTRONICS 9

Audio systems - Construction and working principle of Microphone, Loud speaker, AM and FM receiver, Stereo, 2.1 home theatre, 5.1 home theatre.
Display systems - CRT, LCD, LED, Graphics displays, Video Players, DVD, Blue RAY
Recording Systems – Digital Cameras and Camcorders.

UNIT III SMART HOME 9

Technology involved in Smart home, Home Virtual Assistants-Alexa and Google Home, Home Security Systems - Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.

UNIT IV HOME APPLIANCES 9

Home Enablement Systems - RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Microwave Owen, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart toilet, Smart floor, Smart locks.

UNIT V COMMUNICATION SYSTEMS 9

Cordless Telephones, Fax Machines, PDAs-Tablets, Smart Phones and Smart Watches, Introduction to Smart OS-Android and iOS, Video Conferencing Systems-Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems.

TOTAL PERIODS: 45

OUTCOMES

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

- Apply the fundamentals of electronics to construct the audio and video systems
- Identify and explain working of various color Television system
- Analyze and make use of the technology for smart home
- Define the working principles of various home appliances
- Describe the basic functional blocks of home based communication systems

TEXT BOOKS

1. Bali S P, Consumer Electronics, Pearson Education Asia Pvt. Ltd., 2008.
2. Mitchel E Schultz, Basic Electronics, McGraw Hill Publishers, Tenth Edition, 2017.

REFERENCE BOOKS

1. Thomas L Floyd, Electronic Devices, Pearson Education Asia, Tenth Edition, 2018.
2. Philp Hoff, Consumer Electronics for Engineers, Cambridge University Press, 1998.
3. Jordan Frith, Smartphones as Locative Media, John Wiley, 2014.
4. Dennis C Brewer, Home Automation Made Easy, Que Publishing, 2013.
5. Thomas M Coughlin, Digital Storage in Consumer Electronics, Springer, 2017.