SEMESTER I							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1	16EN001	Communication Skills	3/0/2	5	4	40/60	HS
2	16MA101	Linear Algebra, Calculus and its Applications	3/1/0	4	4	60/40	BS
3	16PH103	Engineering Physics	3/0/0	3	3	60/40	BS
4	16CH003	Environmental Science	3/0/0	3	3	60/40	HS
5	16EC301	Fundamentals of Electrical and Electronics Engineering	3/0/0	3	3	60/40	PC
6	16CS201	Problem solving techniques and C programming	3/0/3	6	5	40/60	ES
7	16ES204	Engineering Practices Laboratory	0/0/3	3	2	40/60	ES
8	16PH104	Physics Laboratory	0/0/3	3	2	40/60	BS
			Total	**30**	**26**	**800**	

SEMESTER II							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1.	16MA102	Integral Calculus and Laplace Transform	3/1/0	4	4	60/40	BS
2.	16CH101	Engineering Chemistry	3/0/2	5	4	40/60	BS
3.	16CS212	LINUX and Programming in C++	3/0/2	5	4	40/60	ES
4.	16EC201	Electric Circuits	4/0/0	4	4	60/40	ES
5.	16EC302	Electron Devices	3/0/0	3	3	60/40	PC
6.	16EC303	Electron Devices and Electric Circuits Laboratory	0/0/3	3	2	40/60	PC
7.	16ME205	Engineering Graphics laboratory	0/0/3	3	2	40/60	ES
			Total	**27**	**23**	**700**	

SEMESTER III							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1.	16MA104	Discrete Transforms and Fourier Analysis	3/1/0	4	4	60/40	BS
2.	16CS213	Data Structures and Algorithms	3/0/2	5	4	40/60	ES
3.	16EC304	Electronic Circuits	4/0/0	4	4	60/40	PC
4.	16EC305	Digital Electronics	4/0/0	4	4	60/40	PC
5.	16EC306	Electromagnetics	4/0/0	4	4	60/40	PC
6.	16EC307	Digital Electronics Laboratory	0/0/3	3	2	40/60	PC
7.	16EC308	Electronic Circuits Laboratory	0/0/3	3	2	40/60	PC
8.	16MC001	Mandatory Course-I Business Communication		3	1	0/100	MC
			Total	30	25	**800**	

SEMESTER IV							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1.	16MA108	Probability and Random Process	3/1/0	4	4	60/40	BS
2.	16EC309	Analog Integrated Circuits	3/0/0	3	3	60/40	PC
3.	16EC310	Analog and Pulse Communication	3/0/0	3	3	60/40	PC
4.	16EC311	Signals and Systems	3/0/2	5	4	40/60	PC
5.	16EC312	Transmission Lines and Waveguides	3/0/0	3	3	60/40	PC
6.	16EC313	Analog Integrated Circuits Laboratory	0/0/3	3	2	40/60	PC
7.	16EC314	Analog and Pulse Communication Laboratory	0/0/3	3	2	40/60	PC
8.	16EC601	Mini Project-I	-	-	2	40/60	PW
9.	16MC002	Mandatory Course-II Life Skills		3	1	0/100	MC
			Total	27	24	**900**	

SEMESTER V							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1.	16EC315	Microcontrollers and Interfacing	3/0/0	3	3	60/40	PC
2.	16EC316	Digital Signal Processing	3/0/2	5	4	40/60	PC
3.	16EC317	Digital Communication	3/0/0	3	3	60/40	PC
4.	16EC318	Computer Networks and Interfacing	3/0/0	3	3	60/40	PC
5.	16EC208	Electrical Machines and Control Systems	3/0/0	3	3	60/40	ES
6.	16EC4XX	Program Elective-I	3/0/0	3	3	60/40	PE
7.	16EC319	Microcontrollers Laboratory	0/0/3	3	2	40/60	PC
8.	16EC320	Digital Communication and Networks Laboratory	0/0/3	3	2	40/60	PC
9.	16MC003	Mandatory Course-III Language		3	1	0/100	MC
		Total		**29**	**24**	**900**	

SEMESTER VI							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1.	16EC321	Embedded Systems	3/0/0	3	3	60/40	PC
2.	16EC322	VLSI Circuits	3/0/0	3	3	60/40	PC
3.	16EC323	Antennas and Wave Propagation	3/0/0	3	3	60/40	PC
4.	16XX5XX	Open Elective	3/0/0	3	3	60/40	OE
5.	16EC4XX	Program Elective-II	3/0/0	3	3	60/40	PE
6.	16EC4XX	Program Elective-III	3/0/0	3	3	60/40	PE
7.	16EC324	VLSI Circuits Laboratory	0/0/3	3	2	40/60	PC
8.	16EC325	Embedded Systems Laboratory	0/0/3	3	2	40/60	PC
9.	16EN003	Business Communication Skills Laboratory	0/0/3	3	2	40/60	HS
10.	16EC602	Mini Project-II	-	-	2	40/60	PW
11.	16MC004	Mandatory Course – IV Certification Course			1	0/100	MC
		Total		**27**	**27**	**1100**	

SEMESTER VII							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1.	16MG003	Principles of Management	2/0/0	2	2	60/40	HS
2.	16EC326	Microwave and Optical Communication	4/0/0	4	4	60/40	PC
3.	16EC4XX	Program Elective-IV	3/0/0	3	3	60/40	PE
4.	16EC4XX	Program Elective-V	3/0/0	3	3	60/40	PE
5.	16EC4XX	Program Elective-VI	3/0/0	3	3	60/40	PE
6.	16EC327	Wireless Communication and Networks	3/0/0	3	3	60/40	PC
7.	16EC328	Microwave and Optical Communication Laboratory	0/0/3	3	2	40/60	PC
		Total		**21**	**20**	**700**	

SEMESTER VIII							
S No.	Course Code	Course	L/T/P	Contact hrs/week	Credits	Ext/Int	Category
1.	16EC603	Project Work	0/0/24	24	12	40/60	PW
		Total		**24**	**12**	**100**	

HUMANITIES SCIENCES (11 credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	16EN001	Communication Skills	3/0/2	5	4	HS
2.	16CH003	Environmental Science	3/0/0	3	3	HS
3.	16EN003	Business Communication skills Laboratory	0/0/3	3	2	HS
4.	16MG003	Principles of Management	2/0/0	2	2	HS

BASIC SCIENCES (25 Credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	16MA101	Linear Algebra, Calculus and its Applications	3/1/0	4	4	BS
2.	16PH103	Engineering Physics	3/0/0	3	3	BS
3.	16PH104	Physics Laboratory	0/0/3	3	2	BS
4.	16MA102	Integral Calculus and Laplace Transform	3/1/0	4	4	BS
5.	16CH101	Engineering Chemistry	3/0/2	5	4	BS
6.	16MA104	Discrete Transforms and Fourier Analysis	3/2/0	5	4	BS
7.	16MA108	Probability and Random Process	3/2/0	5	4	BS

ENGINEERING SCIENCES (24 Credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	16CS201	Problem Solving Techniques and C Programming	3/0/3	6	5	ES
2.	16ES204	Engineering Practices Laboratory	0/0/3	3	2	ES
3.	16CS212	LINUX and Programming in C++	3/0/2	5	4	ES
4.	16ME205	Engineering Graphics laboratory	0/0/3	3	2	ES
5.	16CS213	Data Structures and Algorithms	3/0/2	5	4	ES
6.	16EC201	Electric Circuits	4/0/0	4	4	ES
7	16EC208	Electrical Machines and Control Systems	3/0/0	3	3	ES

PROGRAM CORE (80 credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	16EC301	Fundamentals of Electrical and Electronics Engineering	3/0/0	3	3	PC
2.	16EC302	Electron Devices	3/0/0	3	3	PC
3.	16EC303	Electron Devices and Electric Circuits Laboratory	0/0/3	3	2	PC
4.	16EC304	Electronic Circuits	4/0/0	4	4	PC
5.	16EC305	Digital Electronics	4/0/0	4	4	PC
6.	16EC306	Electromagnetics	4/0/0	4	4	PC
7.	16EC307	Digital Electronics Laboratory	0/0/3	3	2	PC
8.	16EC308	Electronic Circuits Laboratory	0/0/3	3	2	PC
9.	16EC309	Analog Integrated Circuits	3/0/0	3	3	PC
10.	16EC310	Analog and Pulse Communication	3/0/0	3	3	PC
11.	16EC311	Signals and Systems	3/0/2	5	4	PC
12.	16EC312	Transmission Lines and Waveguides	3/0/0	3	3	PC
13.	16EC313	Analog Integrated Circuits Laboratory	0/0/3	3	2	PC
14.	16EC314	Analog and Pulse Communication Laboratory	0/0/3	3	2	PC
15.	16EC315	Microcontrollers and Interfacing	3/0/0	3	3	PC
16.	16EC316	Digital Signal Processing	3/0/2	5	4	PC
17.	16EC317	Digital Communication	3/0/0	3	3	PC
18.	16EC318	Computer Networks and Interfacing	3/0/0	3	3	PC
19.	16EC319	Microcontrollers Laboratory	0/0/3	3	2	PC

20.	16EC320	Digital Communication and Networks Laboratory	0/0/3	3	2	PC
21.	16EC321	Embedded Systems	3/0/0	3	3	PC
22.	16EC322	VLSI Circuits	3/0/0	3	3	PC
23.	16EC323	Antennas and Wave Propagation	3/0/0	3	3	PC
24.	16EC324	VLSI Circuits Laboratory	0/0/3	3	2	PC
25.	16EC325	Embedded Systems Laboratory	0/0/3	3	2	PC
26.	16EC326	Microwave and Optical Communication	4/0/0	4	4	PC
27.	16EC327	Wireless Communication and Networks	3/0/0	3	3	PC
28.	16EC328	Microwave and Optical Communication Laboratory	0/0/3	3	2	PC

PROGRAM ELECTIVE COURSES (18 Credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
PROGRAM ELECTIVES						
COMMON ELECTIVES						
1	16EC401	Digital Image Processing	3/0/0	3	3	PE
2	16EC402	Internet of Everything	3/0/0	3	3	PE
3	16EC403	Television and Video Engineering	3/0/0	3	3	PE
4	16EC404	Nano Electronics	3/0/0	3	3	PE
5	16EC405	Robotics	3/0/0	3	3	PE
6	16EC406	Information Theory and Coding Techniques	3/0/0	3	3	PE
7	16EC407	Soft Computing	3/0/0	3	3	PE
Elective Stream I-VLSI Design						
1.	16EC408	Hardware Description Languages	3/0/0	3	3	PE
2.	16EC409	ASIC and FPGA Design	3/0/0	3	3	PE
3.	16EC410	Testing and Verification of VLSI circuits	3/0/0	3	3	PE
4.	16EC411	Digital Low Power VLSI Design	3/0/0	3	3	PE
5.	16EC412	Analog CMOS Circuit Design	3/0/0	3	3	PE
6.	16EC413	CAD for VLSI Circuits	3/0/0	3	3	PE
7.	16EC414	SOC Design	3/0/0	3	3	PE
Elective Stream II – Embedded Systems						
1.	16EC415	Computer Architecture	3/0/0	3	3	PE
2.	16EC416	ARM Processor Architecture and Programming	3/0/0	3	3	PE
3.	16EC417	Sensors for Industrial Applications	3/0/0	3	3	PE
4.	16EC418	Automotive Electronics	3/0/0	3	3	PE
5.	16EC419	Real-Time Operating Systems	3/0/0	3	3	PE
6.	16EC420	Advanced Microprocessor and Microcontroller	3/0/0	3	3	PE
7.	16EC421	Embedded Linux	3/0/0	3	3	PE
Elective Stream III – Communication & Networking						
1.	16EC422	Next Generation Networks	3/0/0	3	3	PE
2.	16EC423	Wireless Sensor Networks	3/0/0	3	3	PE
3.	16EC424	Body Area Networks	3/0/0	3	3	PE
4.	16EC425	Smart Antenna	3/0/0	3	3	PE
5.	16EC426	RF System Design and MEMS	3/0/0	3	3	PE
6.	16EC427	High Speed Networks	3/0/0	3	3	PE
7.	16EC428	Cognitive Radio Communication	3/0/0	3	3	PE
Open Elective Courses offered by ECE						
1.	16EC501	Introduction to VLSI and Embedded Systems	3/0/0	3	3	OE
2.	16EC502	Microcontrollers for Industrial applications	3/0/0	3	3	OE
3.	16EC503	Computer Communication and Networks	3/0/0	3	3	OE

MANDATORY COURSES (4 Credits)

S.No	Course Code	Course Title	Category	Contact Hrs/Wk	Credits	Category
1.	16MC001	Business Communication 1. Business English Communication	MC	3	1	MC
2.	16MC002	Life Skills 1. Environmental awareness 2. Quantitative aptitude 3. Yoga 4. Professional Ethics 5. Industrial psychology	MC	3	1	MC
3.	16MC003	Language 1. Spoken Hindi 2. Foreign language	MC	3	1	MC
4.	16MC004	Certification Course 1. NPTEL courses 2. Domain specific certification	MC		1	MC

SUGGESTED ONE CREDIT COURSES

S. No	Course Code	Course Title	Credits
1.	16EC901	Simulation Program with Integrated Circuit Emphasis	1
2.	16EC902	PCB design	1
3.	16EC903	PLC and SCADA	1
4.	16EC904	CCNA/ CCSP Networking	1
5.	16EC905	4G Core Network Operations, Administration & Maintenance	1
6.	16EC906	IPv6 Fundamental & Deployment	1
7.	16EC907	Advance Mobile communication Technologies	1
8.	16EC908	Timing issues in Digital Circuits	1
9.	16EC909	Embedded RTOS design	1
10.	16EC910	LINUX/ C programming	1
11	16EC911	Embedded Controllers	1
12	16EC912	Measurement System Analysis	1

ADDITIONAL CREDIT COURSES

S. No	Course Code	Course Title	Credits
1	16AC001	Business Communication	1
2	16AC002	Life skills	1
3	16AC003	Language	1
4	16AC004	Certification Course	As per recommendation
5	16AC005	Industry offered One credit courses	1 per course
6	16AC006	SCI/Scopus Indexed Publications	1 per publication
7	16AC007	Value Added Courses	1 per course
8	16AC008	Representation in National/International Software/ Hardware Contest	1 per participation
9	16AC009	Audit/Self Study Courses	3 per course

INDUSTRIAL PRACTICE

S. No	Course Code	Course Title	Credits
1	16IP001	Industrial Practice 1. 2 weeks Internship 2. Any two one credit courses	2

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

S. No	Stream	Credits/Semester								Credits	%	AICTE %
		I	II	III	IV	V	VI	VII	VIII			
1.	Humanities (HS)	7					2	2		11	**6.0**	5-10
2.	Basic Sciences(BS)	9	8	4	4					25	**13.7**	15-20
3.	Engineering Sciences(ES)	7	10	4		3				24	**13.1**	15-20
4.	Program Core(PC)	3	5	16	17	17	16	6		80	**43.7**	30-40
5.	Program Electives(PE)					3	6	9		18	**9.8**	10-15
6.	Open Electives(OE)							3		3	**1.7**	5-10
7.	Project Work(PW)				2		2		12	16	**8.7**	10-15
8.	Mandatory Course			1	1	1	1			4	**2.2**	-
9.	Employability Skills									2	**1.1**	-
	Total	**26**	**23**	**25**	**24**	**24**	**26**	**21**	**12**	**183**	**100**	

16EN001 COMMUNICATION SKILLS 3/0/2/4

COMMON TO ALL BE/ B TECH PROGRAMMES

PREREQUISITES: Language Skills

COURSE OBJECTIVES

1.To equip the students with the LSRW skills

2.To develop communication skills and soft skills

3.To facilitate the students to use the Language in practical mode.

4.To prepare the students for all competitive program like BEC/ IELTS/ TOEFL

COURSE OUTCOMES

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

1. Gain comprehensive knowledge of LSRW Skills
2. Communicate effectively in Corporate Environment
3. Enhance fluency over language with self confidence
4. Use language with ease

COURSE CONTENTS

UNIT NO.	TOPICS	TEXT BOOK	PAGES	LECTURE HOURS
I	Getting to know people- Self introduction-Introducing others- Presenting about job - Presenting about working conditions- Presenting about company history and structure – Presenting about company activities-	T1	8-24	3
	Instructions, Recommendations	T3	217-221	3
	Present simple, Adverb of frequency, Past Simple, Prepositions of time, Connectors of addition and contrast, Present Continuous, Parts of Speech, Gerunds and Infinitives.	T3	97-111	3
II	Vocabulary practice- Business Vocabulary- Telephonic Conversation and Etiquette - Requests and obligation- Describing trends- Presenting about company performance- Reasons and consequences through reading practices-	T1	28-56	4
	Describing products Dimensions, Process description - Presenting about product development - Synonyms-Antonyms- Jumbled sentences- Compare and contrast	T3	90-96	2
	Adjectives and adverbs, Present perfect and past simple, Reasons and Consequences, Comparatives and superlatives, Question formation, Sequencing words, Present continuous, Articles, Prepositions.	T3	17-37	3
III	Presenting about business equipment- Letter Phrases- Writing Test Practice- Presenting about hotel facilities – Presenting about traffic and transport, Making Predictions	T1	48-68	3
	Report writing-Writing proposals	T2	12-17	3
	Tenses- Present-Past-Future-Forms of verbs, Prefixes-Suffixes, Word Techniques- Formation.	T3	45-63	3
IV	Presenting about conference arrangement- Presenting about a conference arrangement –Checking and confirming details- Presentation about a conference before, after, when, until, etc. Listening Test Practice- Presenting about production processes- Presenting about quality control	TI	72-96	3
	Itinerary- Paragraph Writing - Essay Writing- Check list	T3	337-351 365-369	4
	Passive forms and If- Conditionals	T3	57-71	2

V	Language use in call centers, insurance and changes in working practices(Future possibility/ Probability- Presenting about banking- Speaking Test Practice- Presenting about delivery services - Presenting about trading - Presenting about recruitment -Presenting about job applications (Indirect questions)- Reading, Writing and Listening Test)	T1	100-128	3
	Job Application Letter and Resume Writing	T2	391-411	3
	Prepositions of time, Tense review, indirect questions, Conditional 2 (hypothetical	T3	57-71	3
		TOTAL LECTURE HOURS: 45		

LABORATORY COMPONENTS

EXP NO.	NAME OF EXPERIMENT	TEXT BOOK	PAGES	LAB HOURS
1	LISTENING COMPREHENSION	T2	59-67	4
2	SELF INTRODUCTION	T2	117-131	4
3	ORAL PRESENTATION	T2	195-213	4
4	TELEPHONIC CONVERSATION	T1	32-56	4
5	CONFERENCE ARRANGEMENY	T1	80-84	4

TEXT BOOKS:

1 Wood, Ian,Paul Sanderson, Anne Williams with Marjorie Rosenberg, Pass Cambridge BECVantage, Cengage learning. Second Edition. 2014.

2 Rizvi Ashraf M , "Effective Technical Communication", McGraw Hill Education (India) PrivateLimited , 2016

3 Dr Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited 2015

REFERENCE BOOKS:

1 Whitby, Norman. Cambridge University Press- Students Book. 2013.

2 Jawahar, Jewelcy, Rathna P. English Work book, VRB Publications Pvt Ltd,2016.

WEB REFERENCES:

1. http://www.cambridgeindia.org
2. http://www.cambridgeenglish.org/exams/business-certificates/business-vantage

16MA101 **LINEAR ALGEBRA, CALCULUS AND ITS APPLICATIONS** 3/1/0/4
(Common to all branches of B.E / B. Tech courses)

PREREQUISITES : Higher Secondary Mathematics

COURSE OBJECTIVES

1. To develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.
2. To familiarize with functions of several variables which are needed in many branches of engineering.
3. To find the solution of ordinary differential equations as most of the engineering problems are characterized in this form.
4. To acquire sound knowledge of techniques in solving ordinary differential equations by numerical methods.

COURSE OUTCOMES

At the end of this course student would be able to

1. Identify and solve algebraic Eigen value problems and find the extreme values of the given function.
2. Apply the knowledge of differential equation in order to solve the engineering problems like electric circuits and bending of beams.
3. Apply numerical method techniques to find the solution of ordinary differential equations.

UNIT I MATRICES 9

Introduction with Applications- Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties (excluding proof)- Cayley Hamilton Theorem–Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form –Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 9

Total derivatives – Differentiation of implicit functions – Jacobians – Taylor series expansion- Maxima and Minima of functions of two variables – constrained Maxima and Minima- Method of Lagrangian multipliers.

UNIT III ORDINARY DIFFERENTIAL EQUATIONS 9

Second and higher order linear differential equations with constant coefficients- Cauchy's linear differential equations –Transformation of differential equations with variable coefficients to constant coefficients - Legendre's linear differential equations - Method of variation of parameters.

UNIT IV APPLICATIONS OF SECOND ORDER DIFFERENTIAL EQUATIONS 9

Modelling - Free oscillations – Undamped system – Damped system - Solution of specified differential equations connected with electric circuits and bending of beams (Differential equations and associated conditions need to be given).

UNIT V NUMERICAL SOLUTION TO FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 9

Single step methods: Taylor series method - Euler's Method - Modified Euler's Method – Runge - Kutta Method of fourth order.

SELF STUDY:

Multistep methods: Milne's Predictor and Corrector Method - Adam's Predictor and Corrector Method.

TOTAL LECTURE HOURS:45
TUTORIALS:15
TOTAL:60

TEXT BOOKS:

1. Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2014.
2. Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2014.

REFERENCE BOOKS:

1. Venkataraman. M.K, "Engineering Mathematics, Volume I Revised Enlarged, Fourth Edition", The National Pub. Co., Chennai, Sep 2011.
2. Veerarajan. T, "Engineering Mathematics for first year", 3rd edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2011.
3. Kandasamy.P , Thilagavathy.K, Gunavathy.K, " Numerical Methods" ,3rd edition, S Chand & Company Pvt. Ltd, 2013.

WEB REFERENCES:

1. http://www.nptel.ac.in/courses/111105035
2. http://www.nptel.ac.in/courses/122104017
3. http://nptel.ac.in/courses/122102009
4. http://nptel.ac.in/courses/111107063

16PH103 **ENGINEERING PHYSICS** **3 0 0 3**

(Common to B.E ECE , EEE /B.Tech IT programmes)

COURSE OBJECTIVES

1. To gain knowledge on fundamental principle and applications of ultrasonic and LASER
2. To understand the concepts of optical fiber and fiber optic communication system
3. To acquire knowledge about the basic concepts of quantum mechanics and the various types of microscopes
4. To get exposure on vacuum pumps, gauges and nano science

OUTCOMES

Upon successful completion of the course, students shall have ability to

1. demonstrate the uses of ultrasonic , laser and fiber optics in medicine and various engineering applications
2. gain knowledge about quantum mechanics
3. understand the concepts of nano science and vacuum systems

UNIT I ULTRASONICS **9**

Introduction – production methods –magnetostriction generator – piezoelectric generator – properties –Detection of ultrasonic waves – cavitation – velocity measurement – acoustic grating – Industrial applications – drilling, welding, soldering and cleaning –Non Destructive testing – pulse echo system through transmission – medical applications - sonogram, ultrasonic imaging.

UNIT II LASERS **9**

Introduction – principle of absorption and emission, population inversion – pumping mechanisms - Einstein's A and B coefficients. Types of laser –CO_2, Nd-YAG, semiconductor laser. Industrial applications – heat treatment, welding, and cutting – medical applications. Holography -construction and reconstruction of hologram.

UNIT III FIBER OPTICS AND SENSORS **9**

Principle and propagation of light through an optical fiber – numerical aperture, acceptance angle and fractional index change – classification of optical fibers based on material, mode of propagation and refractive index profile– fabrication technique: double crucible method – splicing- losses in optical fiber – fiber optic communication system (Block diagram) – light source for fiber optics (LED) – PIN detector – fiber optic sensors – temperature and displacement – Endoscope.

UNIT IV QUANTUM PHYSICS 9

Quantum theory – Introduction, de-Broglie concept on matter waves, uncertainty principle – Schrödinger's wave equation – time independent and time dependent equations - physical significance of wave function-applications of Schrödinger's equation-particle in a one dimensional potential box.

Scanning electron microscope, transmission electron microscope, scanning transmission electron microscope – applications of microscope.

UNIT V VACUUM AND NANO SCIENCE 9

Vacuum Science: Introduction-concepts of vacuum-throughput, pumping speed, effective pumping speed. Types of pump- rotary pump, diffusion pump. Pressure gauges – Pirani gauge, Penning gauge- working of vacuum system -applications.

Nano science: Introduction – top down and bottom up approach- Synthesis techniques–chemical vapour deposition, sol-gel method, ball milling – properties and applications of nanomaterial.

TOTAL: 45

TEXT BOOKS:

1. R. K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications (P) Ltd, New Delhi, 2014.
2. M.N. Avadhanulu and PG Kshirsagar, 'A Text book of Engineering Physics', S.Chand and company, Ltd., New Delhi, 2014.
3. Rajendran, V 'Engineering Physics' Mc Graw Hill Publications ltd, New Delhi, 2014.

REFERENCE BOOKS:

1. Serway and Jewett, 'Physics for Scientists and Engineers with Modern Physics', 6th Edition, Thomson Brooks/Cole, Indian reprint (9 th Edition) 2013.
2. Dr. S. Jayakumar, 'Engineering Physics' R.K Publishers, Coimbatore 2013.

16EC301 FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING **4/0/0/4**

Nature of Course : G (Theory Analytical)
Pre requisites : 16PH103-Engineering Physics

Course Objectives:

1 To introduce physical and electrical properties of semiconductor.
2 To familiarise various electronic circuit components and number systems.
3 To understand the concepts of measuring instruments and working of transducer.
4 To understand the working of Electrical machines and power generation systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C105.1 Understand physical and electrical properties of semiconductors [U]
C105.2 Apply knowledge on choosing the electrical circuit components [AP]
C105.3 Understand the working of measuring instruments and transducers [U]
C105.4 Analyze and understand the working of electrical machines and power generation systems. [AN]

Course Contents:

SEMICONDUCTOR THEORY Introduction to Semiconductor theory: Classification and conductivity of semiconductors – Energy band structures and conduction in insulators, semiconductors and conductors – practical semiconductor materials – electron emission from conductors – energy distribution of electrons – carrier concentration in intrinsic semiconductors – Mass action law – properties of intrinsic semiconductors – variation in semiconductor parameters with temperature – drift and diffusion currents – continuity equation. **ELECTRONIC CIRCUIT COMPONENTS AND NUMBER SYSTEMS** Physical Properties of elements – Passive Circuit Components: Resistors, Capacitors, Inductors – Number system – Binary arithmetic – 1's and 2's complements – Binary coded decimal – Introduction to Boolean algebra and Logic gates. **INSTRUMENTS AND TRANSDUCERS** Classification of Instruments – Basic Principles of Indicating instruments – Moving Iron instruments: Attraction and Repulsion type, Moving coil instruments: Permanent magnet and dynamometer type – Transducers: Thermistor, Thermocouple SELF STUDY: Piezoelectric and Photoelectric transducers. **ELECTRICAL MACHINES** Construction, Principle and working of DC generator – EMF equation – Construction, Principle and working of DC motor – Torque equation and speed control – Single phase transformer: Construction, working and losses, Construction and working of Single phase Induction motor and Three phase Induction motor. **POWER GENERATION SYSTEMS** Basic structure of power systems – sources of electrical energy – Basic principles: Steam power, hydroelectric power, nuclear, Gas and Diesel engine – Transmission line: Introduction, Types of conductors, representation.

Total Hours: 60

Text Books:

1 R. Muthusubramanian, S. Salivahanan, 'Basic Electrical and Electronics Engineering' McGraw Hill education (India) Private limited, 2012.
2 S.N. Singh, 'Electric power generation, transmission and distribution', Second edition, Prentice Hall, 2008.
3 Donald A Neaman, 'Semiconductor Physics and Devices', 3e., McGraw Hill Education India Private Ltd., 2012

Reference Books:

1 Soumitra Kumar Mandal, 'Basic Electronics' McGraw Hill education (India) private limited, 2013.
2 Millman, Hackias, Jit, 'Electronic Devices and Circuits', 4e., McGraw Hill Education

India Private Ltd., 2013

3 S. Salivahanan, N. Sureshkumar, 'Electron Devices and Circuits', 4e., McGraw Hill Education(India)Private Ltd., 2016 2

Web References:

1 www.allaboutcircuits.com
2 www.circuitstoday.com
3 www.electrcal4u.com
4 www.technologystudent.com

Online Resources:

1 https: //www.edx.org/course/circuits-electronics-1-basic-circuit

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C105.1	Understanding	Writing Skills	5
C105.2	Applying	Group Assignment	5
C105.3	Understanding	Class Presentation	5
C105.4	Analysing	Quiz	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	30	30	30	30
Understanding	40	40	40	40
Applying	20	30	30	20
Analysing	10	-	-	10
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16ES204 **ENGINEERING PRACTICES LABORATORY** **0/0/3/2**

(Common to IT, CSE & ECE)

Nature of Course :M (Practical application)

Co requisites :Engineering Drawing/Graphics

Course Objectives:

1. To learn the use of basic hand tools and to know the need for safety in work place and to gain hands on experience on Carpentry, Fitting, Sheet metal, Plumbing, welding and Foundry.
2. To learn about basic electrical devices, meters and Electronics devices and meters and to gain knowledge about the fundamentals of various electrical and electronic gadgets, basic electronic instruments, their working and trouble shooting.
3. To gain knowledge about the basics of computer hardware and various operating systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C204.1	Identify, formulate and solve the basic engineering problems at home and in workplace	[R,U,AP]
C204.2	Develop the surfaces and make simple components like tray, cylinder, funnel etc.	[C]
C204.3	Make simple metal joints using welding equipment and wooden joints using carpentry tools.	[AP]
C204.4	Prepare pipe connections and sand moulds	[AP]
C204.5	Examine and troubleshoot electrical and electronics circuits	[A]
C204.6	Identify various computer parts and learn to operate the various operating systems in computers.	[E]

Course Contents:

1. Fabrication of rectangular tray, cylindrical container and cone
2. Preparation of butt, lap and T joint using welding (Arc, MIG,TIG)
3. Preparation of Cross lap joint and T joint using carpentry tools
4. Preparation of connection of basic pipe lines
5. Preparation of Sand mould (Solid and Split Pattern)
6. Troubleshooting of electrical and electronics components
7. Preparation of Residential wiring.
8. Soldering of electronic circuits
9. Operation of Cathode Ray Oscilloscope
10. PC Repair Fundamentals
11. Hard disk Partitioning, Installing Windows OS, Linux & Maintaining Windows OS, Linux and Disk De fragmentation.
12. Upgrading Memory and Hard Drives, Securing the PC and LAN.

Total Hours: 45

Reference Books:

1. S. Suyambazhahan "Engineering Practices Laboratory Manual" PHI Learning, Second Edition, 2011.
2. Sekhar Dash &K.Vijayakumar, "Electrical Engineering Practice Lab Manual". Vijay Nicole Imprints Private Ltd., First Edition, 2013.
3. Scott Mueller "Upgrading and Repairing PCs", 22nd Edition, QUE, Pearson Education, New Delhi, 2015.

Course Coordinator BoS/Incharge HoD/Mech

Web References:

1. http://www.allaboutcircuits.com/education/
2. http://www.nptel.ac.in/courses/112107090/
3. nptel.ac.in/courses/112101005/14

Online Resources:

1 http://www.electrical4u.com/
2 http://www.electrical4u.com/

Assessment Methods & Levels (based on Bloom'sTaxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	10	10
Understand	10	10
Apply	40	40
Analyse	20	20
Evaluate	10	10
Create	10	10

Course Coordinator BoS/Incharge HoD/Mech

16MA102 INTEGRAL CALCULUS AND LAPLACE TRANSFORMS 3/2/0/4

(COMMON TO ALL BRANCHES)

Nature of Course J (Problem analytical)

Pre requisites Basics of integration

Course Objectives:

1 To gain knowledge in improper integrals, Gamma and Beta functions which are needed in engineering applications

2 To develop logical thinking and analytical skills in evaluating multiple integrals

3 To acquaint with the concepts of vector calculus needed for problems in all engineering disciplines

4 To apply numerical methods to evaluate integrals when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information

5 Solve the differential equations using Laplace transform technique

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Recall basic integration formulae, scalar and vector point function concepts	[R]
C102.2	Differentiate and integrate vector point functions	[U]
C102.3	Evaluate integrals using Beta and Gamma functions	[AP]
C102.4	Evaluate double integral and triple integral to compute area, volume for two dimensional and three dimensional solid structure	[AP]
C102.5	Find the gradient, divergence and curl of vector point functions and related theorems useful for evaluation of engineering problems	[AP]
C102.6	Apply the Laplace transform technique to solve ordinary differential equations	[AP]

Course Contents:

Definite integrals-Evaluation of definite integrals using Bernoulli's formula-Beta and Gamma Integrals- Relation between Beta and Gamma Functions-Evaluation of Integrals using Beta and Gamma Functions-**Multiple integrals** - Double integration in Cartesian coordinates –Area as double integral –Change the order of integration-Triple integration in Cartesian co-ordinates – Volume as triple integral-**Vector calculus** - Vector differential operator- Gradient of a scalar point function - Directional derivatives –Divergence and Curl of a vector point function – Irrotational and solenoidal vector fields –Simple problems– Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem(statements)– Simple applications involving cubes and rectangular parallelopipeds-**Numerical integration** - Trapezoidal rule – Simpson's 1/3 and 3/8 rules – Two and three point Gaussian Quadrature formulae –Trapezoidal rule and Simpson's rule to evaluate double integrals-**Laplace transform** –Conditions for existence – Transform of elementary functions – Basic properties (without proof) – Derivatives and integrals of Laplace transform -Transforms of derivatives and integrals - Periodic functions - **Inverse Laplace transform**-Partial fraction method - convolution theorem , Initial and Final value theorems (statements)– Problems - Solution of second order differential equations with constant coefficients.

Total Hours: 60

Text Books:

1 Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2014

2 Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2014

3 N.P.Bali and Dr.Manish Goyal,"A Text book of Engineering Mathematics" 8th edition Laxmi publications ltd, 2011

Reference Books:

1 Veerarajan. T, "Engineering Mathematics for first year", 3rd edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2011
2 Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012
3 Jain M.K. Iyengar, K & Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, Publishers 2013

Web References:

1 http://nptel.ac.in/video.php?subjectId=122107037
2 http://nptel.ac.in/courses/122107036/
3 http://nptel.ac.in/video.php?subjectId=117102060

Online Resources:

1 https://www.coursera.org/learn/pre-calculus
2 https://www.coursera.org/learn/linearalgebra1
3 https://alison.com/courses/Advanced-Mathematics-1
4 https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x.
5 https://www.edx.org/course?search_query=laplace+transform

Assessment Methods & Levels (based on Blooms'Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C102.1	Remember	Classroom or Online Quiz	2
C102.2	Understand	Class Presentation/Power point presentation	4
C102.3, C102.4	Apply	Group Assignment	7
C102.5,C102.6	Apply	Group activities	7

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination
	CIA1	CIA2	Term End Assessment	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

16PH101	ENGINEERING PHYSICS Common to MECH,CIVIL,ICE & CSE	3/0/2/4

Nature of Course	: E (Theory skill based)
Pre requisites	: Nil

Course Objectives:

1	To learn the basic concepts of physics needed for all branches of engineering
2	To understand the concepts and working principles of laser, fibre optics, quantum physics and crystal physics.
3	To identify suitable materials to be used in the engineering field.
4	To implement and visualize theoretical aspects in the laboratory
5	To familiarize the students to handle various instruments and equipment

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the basic concepts of laser, fibre optics and quantum physics used in various engineering applications	[R]
C101.2	Understand the crystal structure of the various materials	[U]
C101.3	Understand the fundamental concepts of electrical and magnetic properties of materials.	[U]
C101.4	Interpret the behaviour of nanomaterials and shape memory alloys	[U]
C101.5	Apply the gained knowledge to solve the problems related to their field of study	[AP]

Course Contents:

Laser: Principle of absorption and emission - Types of laser: CO_2, Nd-YAG, semiconductor laser - Industrial applications - Holography. Fiber optics: Principle and propagation–numerical aperture and acceptance angle – classification of optical fibers - splicing - fiber optic communication system - light source - PIN detector – fiber optic sensors: temperature and displacement. Quantum mechanics Matter waves, de-Broglie wavelength, uncertainty principle – Schrödinger's wave equation – time independent and time dependent - physical significance - particle in a one dimensional potential box. Conducting materials: Classical free electron theory of metals - Electrical and thermal conductivity- Wiedemann-Franz law - Band theory of solids- Fermi distribution function –Effect of temperature on Fermi function. Semiconducting materials: Intrinsic and extrinsic semiconductors – carrier concentration derivation – Fermi level – variation of Fermi level with temperature in intrinsic – electrical conductivity for intrinsic semiconductor – Band gap determination – Hall effect. Magnetic materials: Origin of magnetic moment –ferro magnetic material – domain theory – hysteresis – soft and hard magnetic materials – Ferrites. Dielectric materials: properties- Electronic and ionic polarisation – frequency and temperature dependence – internal field-Claussius-Mosotti relation-dielectric loss –dielectric breakdown mechanisms - ferro electric materials – piezo electric materials -

insulating materials - applications. Crystallography: Atomic packing factor for SC, BCC, FCC and HCP structures – miller indices. Advanced materials: Shape memory alloys-characteristics - properties of Ni-Ti alloy. Characterisation techniques: SEM, TEM and X-ray diffraction. Nanomaterials: Properties – synthesis techniques: ball milling, chemical vapour deposition and sol-gel method. Carbon nanotubes: structure - properties and applications.

Lab Component

1	Laser and optical fiber parameters (Wavelength , angle of divergence, Numerical aperture and acceptance angle)	[E]
2	Lattice constant using x-ray diffraction pattern	[E]
3	Specific resistance-Carey Foster's Bridge	[E]
4	Band gap of a semiconductor	[E]
5	Characteristics of a solar cell /Photo diode	[E]
6	Thermal conductivity of a bad conductor	[E]
7	Young's modulus	[E]
8	Rigidity modulus	[E]
9	Thickness of a thin material using air wedge	[E]
10	Coefficient of viscosity for a liquid	[E]
	Total Hours:	**75**

Text Books:

1	R. K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications (P) Ltd, New Delhi, 2014.
2	Rajendran, V 'Engineering Physics' Mc Graw Hill Publications ltd, New Delhi, 2014.

Reference Books:

1	Serway and Jewett, 'Physics for Scientists and Engineers with Modern Physics', 6th Edition, Thomson Brooks/Cole, Indian reprint (9 th Edition) 2013.
2	M.N. Avadhanulu, P.G. Kshirshagar – A Text Book of Engineering Physics- S.Chand & Co Ltd, 2016.
3	P.K. Mittal – Applied Physics – I.K. International Publishing House pvt.Ltd.

Web References:

1	http://www.nanotech-now.com/Nanomat-Preso2.pdf
2	http://nptel.ac.in/courses/108106073
3	https://www.corning.com/in/en/products/communication-networks/.../fiber.html
4	https://physics.stanford.edu/node/201
5	*https://www.amazon.com/*Semiconductor-Materials-Physical...References/.../0849389...
6	*https://books.google.co.in/books?isbn=1482238888*

Online Resources:

1	https://www.coursera.org/learn/ap-physics-1
2	https://www.edx.org/course/electricity-magnetism-part-1-ricex-phys102-1x-0

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [6 marks]	CIA-II [6 marks]	Term End Examination [8 marks]	Rubric based CIA [40 Marks]	
Remember	30	20	30	10	20
Understand	60	60	60	20	60
Apply	10	20	10	40	20
Analyse	-	-	-	30	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

16EC201 **ELECTRIC CIRCUITS** **4/0/0/4**

Nature of Course : G (Theory Analytical)
Pre requisites : 16PH102-Engineering Physics
Course Objectives:

1 To introduce the various circuit components of an electrical network.
2 To enable the students to understand and simplify circuits using network theorems.
3 To impart knowledge on DC transient circuits
4 To enable the students to design and develop series and parallel resonance
5 To demonstrate the knowledge of graph theory

Course Outcomes:

Upon completion of the course, students shall have ability to

C204.1	Demonstrate the knowledge on recalling basic circuits laws the basic concepts of DC circuits	[R]
C204.2	Understand the basic principles of network theorems	[U]
C204.3	Understand the concepts and performance of transients, resonance and coupling	[U]
C204.4	Identify component of Graph topology, understand and apply for simplification of electrical networks.	[AP]
C204.5	Apply network theorems and analyse the possibilities of deriving the equivalent circuits	[AN]

Course Contents:

Basic Concepts: Ohm's law - Kirchhoff's current law - Kirchhoff's voltage law - series and parallel Connected sources - resistors in series and parallel - voltage and current division - Nodal analysis - mesh analysis - source Transformation - delta wye conversion - **Network Theorems:** Thevenin and Norton theorem, Maximum power transfer, Superposition theorem, Reciprocity theorem, Compensation theorem. Millman and Tellegans Theorem. **Transients:** Capacitor - Inductor - energy storage - RL, RC, RLC circuits, dc transient and steady state response - Introduction to Laplace Transform - Laplace Transforms in solving differential equations for complete response in RL, RC and RLC circuits. **Resonance and coupled circuits:** Phasor relationship for R, L and C – Impedance - admittance, series resonance - parallel resonance - their Phasor relationship for R, L and C - Impedance - admittance, series resonance - parallel resonance - their frequency response, bandwidth and quality factor - self-inductance - mutual inductance - coupling Coefficient. **Graph Topology:** Concept of duality, dual network, Graph's of a network, trees, chords and branches, tie set and cutest of a Graph.

Total Hours: 60

Text Books:

1 Sudhakar. A and Shyam Mohan. SP, "Circuits and Network Analysis & Synthesis" 5th edition, Tata McGraw Hill, 2015.
2 William H.Hayt, JV Jack E.Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill India, 8h edition, 2014.

Reference Books:

1 Schaum's Series, "Basic Circuit Analysis" ,2nd Edition, McGraw Hill India Private Ltd., 2011(Reprint)
2 Chakrabati A, "Circuit Theory Analysis and Synthesis", Dhanpath Rai & Sons, New Delhi 2014
3 **Web References:**

Web References:

1 http://nptel.ac.in/courses/117106101/

2 http://www.thelearningpoint.net/home/electrical-science-and-engineering/circuit-theory

3 http://www.tina.com/course/coursex

Online Resources:

1 https: //www.edx.org/course/circuits-electronics-1-basic-circuit

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)					
Formative assessment based on Capstone Model (Max. Marks:20)					
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**			**Marks**
C204.1	Remember	Quiz			4
C204.2	Understand	Technical presentation			4
C204.3	Understand	Group discussion			4
C204.4	Apply	Problem solving			4
C204.5	Analyse	Simulation exercise			4
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**		
Remember	40	20	20		20
Understand	60	60	40		40
Apply	-	20	20		20
Analyse	-	-	20		20
Evaluate	-	-	-		-
Create	-	-	-		-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC302 **ELECTRON DEVICES** **3/0/0/3**

Nature of Course : C (Theory Concept)
Pre requisites : 16PH103- Engineering Physics

Course Objectives:

1. To provide an insight to basic electronic devices such as PN junction diodes, BJT, MOSFETs.
2. To enable the students to understand the change in physical and electrical properties of electron devices under various biasing conditions
3. To introduce advanced electron devices such as Thin-body MOSFETs and FinFETs
4. To enable the students to be aware of the application areas for these devices

Course Outcomes:

Upon completion of the course, students shall have ability to

C205.1	Demonstrate knowledge on recalling the Semiconductor Theory concepts	[R]
C205.2	Understand the change in physical and electrical properties of electron devices under the influence of various biasing conditions	[U]
C205.3	Apply the electrical properties of electron devices for achieving various applications	[AP]
C205.4	Analyse the change in electrical characteristics due to change in size and shape of the terminals	[AN]

Course Contents:

SEMICONDUCTOR THEORY - Energy band structures – Classification - carrier concentration – continuity equation - Hall effect. Passive Circuit Components: Resistors, Capacitors, Inductors **P-N Junction:** depletion region, forward and reverse-bias, depletion and diffusion capacitances, switching characteristics; breakdown mechanisms; Zener diode, Tunnel diode. **BJT:** carrier distribution; current gain, transit time. Metal-semiconductor junctions: rectifying and ohmic contacts, BJT as inverter. **MOSFET:** MOS capacitor; Cv-Iv characteristics; threshold voltage. Single stage amplifiers: CE-CB-CC and CG-CD-CS modes of operation. Fundamentals for thin-body MOSFETs, impacts of substrate; fin shape tuning; gate stack process FinFET's source/drain process. **Thyristors:** DIAC, TRIAC, SCR, UJT, **Applications of devices:** Rectifier, Filters, Clipper, Clamper, Voltage Doubler, Voltage Dividers.

Total Hours: 45

Text Books:

1. Jacob Millman, Chritos C Halkias, SatyabrataJit, "Electronic Devices and Circuits", 4th edition (SIE), McGraw Hill Education India Private Ltd., 2015.
2. S.Salivahanan, "Electron Devices and Circuits", 4th edition, McGraw Hill Education India Private Ltd., 2016.

Reference Books:

1. Donald A Neaman, "Semiconductor Physics and Devices", 4th edition, McGraw Hill Education India Private Ltd., 2011.
2. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory", 11th edition, Pearson New International Edition , 2013.

Web References:

1. www.allaboutcircuits.com
2. www.circuitstoday.com

Online Resources:

1. http://www.electronics-tutorials.ws

Web References:

1 www.allaboutcircuits.com
2 www.circuitstoday.com

Online Resources:

1 http://www.electronics-tutorials.ws

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C105.1	Remember	Quiz	5
C105.2	Understand	Writing Skills	5
C105.3	Apply	Group Assignment	5
C105.4	Analyse	Class Presentation	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	40	20	20	20
Understand	60	60	40	40
Apply	-	20	20	20
Analyse	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC303 ELECTRON DEVICES AND ELECTRIC CIRCUITS LABORATORY 0/0/3/2

Nature of Course : M (Practical application)
Co requisites : 16EC301 Electric Circuits, 16EC302 Electron Devices

Course Objectives:

1 Enable the students to realize circuits to verify KVL, KCL, and various network theorems used for analysing an electrical circuit.
2 Developing skills to design RL and LC circuits for given specification
3 To construct circuits and verify electrical characteristics of forward, reverse bias diodes, current & voltage controlled devices.

Course Outcomes:

Upon completion of the course, students shall have ability to

C206.1	Understand and solve the circuits using basic circuit laws.	[U]
C206.2	Construct circuits by applying the theoretical knowledge gained in electron devices	[AP]
C206.3	Design RL and RC circuits and analyse the frequency response.	[AN]
C206.4	Verify and apply network theorems for analyzing electrical circuit behavior.	[AN]
C206.5	Analyse the electrical characteristics of unipolar and bipolar devices with the constructed circuits	[AN]
C206.6	Observe and analyse the thyristor characteristics	[AN]
C206.7	Create simple applications using electron devices and evaluate the obtained results	[C]

Course Contents:

1. Verification and application of basic circuits' law
2. Verification and application of Network Theorems
3. Analysis of Frequency response of RL,RC and RLC circuits
4. Q factor extraction in Tank circuits
5. Characteristic analysis of JFET devices
6. Breakdown Characteristics analysis of PN Junction Diode
7. Analysis of Capacitance -Voltage Characteristics in PN Junction
8. Negative resistance characteristics of UJT
9. SCR, DIAC and TRIAC Characteristics
10. Characteristic analysis of BJT
11. Clipper, Clamper
12. Rectifiers

Total Hours: 45

Reference Books:

1 Sudhakar.A and ShyamMohan.Sp "Circuits and Network Analysis & Synthesis" Tata McGraw Hill, 2015.
2 William H.Hayt, Jv Jack E.Kemmerly and Steven M. Durbin," Engineering Circuits Analysis", Tata Mc.Graw Hill , 6th edition , 2012Thomas L. Floyd, Digital Fundamentals, 10th Edition, Pearson Education, New Delhi, 2011
3 Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory", 11th edition, Pearson New International Edition, 2013.
4 S.Salivahanan, "Electron Devices and Circuits", 4edition, McGraw Hill Education (India) Private Ltd., 2016.

Web References:

1 www.electrical4u.com/electric-circuit-and-electrical-circuit-element/
2 www.allaboutcircuits.com › ... › Basic Concepts Of Electricity

Online Resources:

1 https://www.edx.org/course/circuits-electronics-1-basic-circuit

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	10	10
Understand	20	20
Apply	30	30
Analyse	20	20
Evaluate	10	10
Create	10	10

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16MA104 **DISCRETE TRANSFORMS AND FOURIER ANALYSIS (ECE,EEE,ICE)** **3/2/0/4**

Nature of Course J (Problem analytical)
Pre requisites 16MA102-Integral Calculus and Laplace Transform

Course Objectives:

1. To acquaint the student with Fourier transform techniques which are used in variety of engineering fields
2. To understand the different possible forms of Fourier series and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data
3. To study the concept of mathematical formulation of certain practical problems in terms of partial differential equations and solving for physical interpretation
4. To solve boundary value problems encountered in engineering practices using Fourier series
5. To solve difference equations using Z-transform technique

Course Outcomes:

Upon completion of the course, students shall have ability to

C104.1	Recall concepts of partial derivatives and summation of series	[R]
C104.2	Formulate and solve the partial differential equations	[U]
C104.3	Interpret Fourier series solutions to the engineering problems	[AP]
C104.4	Use Fourier transform techniques to evaluate the integrals	[AP]
C104.5	Apply the basics of Z transform techniques to solve difference equations	[AP]

Course Contents:

Fourier Transforms - Complex form of Fourier Transforms -Fourier sine and cosine transforms-Properties(excluding proof)-Transforms of simple functions-Convolution theorem and Parseval's Identity (Statement) – Evaluation of integrals using Parseval's Identity - **Fourier series** - Dirichlet's conditions- General Fourier Series – Odd and Even Functions- Half range sine series and cosine series –Parseval's Identity- Harmonic analysis- **Partial Differential Equations** - Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions- Lagrange's linear equations –Linear homogeneous partial differential equations of second and higher order with constant coefficients - **Applications of Partial Differential Equations** - One dimensional wave equation – One dimensional equation of heat conduction –Fourier series solutions in Cartesian coordinates - **Z- Transforms** - Definition - Z-transform of Standard functions-Properties (excluding proof) – **Inverse Z- transform-** Convolution theorem(Statement)-Formation of difference equations- Solution of difference equations using Z-transform Techniques

Total Hours: **60**

Text Books:

1. Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2014
2. Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2014

Reference Books:

1. Veerarajan. T, "Transforms and Partial differential equations", 2nd edition, Tata McGraw-Hill Publishing Company Ltd., reprint,2015

2 N.P.Bali and Dr.ManishGoyal, "A Text book of Engineering Mathematics Sem-III/IV" 4th edition Laxmi publications ltd, reprint 2012
3 Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th edition, 2012

Web References:

1 http://nptel.ac.in/video.php?subjectId=122107037
2 http://nptel.ac.in/courses/122107036/
3 http://nptel.ac.in/video.php?subjectId=117102060

Online Resources:

1 https://www.edx.org/course/calculo-diferencial-galileox-cmath001rx
2 https://www.edx.org/course/pre-university-calculus-delftx-calc001x-1
3 https://www.edx.org/course/calculus-1a-differentiation-mitx-18-01-1x
4 https://alison.com/courses/Advanced-Mathematics-1
5 https://ocw.mit.edu/courses/.../18-335j-introduction-to-numerical-methods-fall-2010 /ocw.usu.edu › Electrical and Computer Engineering › Signals and Systems

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Tentative Assessment Component	Marks
C104.1	Remember	Classroom or Online Quiz	2
C104.2	Understand	Class Presentation/Power point presentation	4
C104.3	Apply	Group Assignment	6
C104.4& C104.5	Apply	Group activities	8

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination
	CIA1	CIA2	Term End Assessment	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

16EC304 **ELECTRONIC CIRCUITS** **4/0/0/4**

Nature of Course :G (Theory analytical)
Pre requisites : 16EC302 Electron Devices

Course Objectives:

1 To introduce the concept of biasing of BJTs and MOSFETs and enable the students to understand the frequency analysis of amplifiers
2 To enable the students to understand the concept of negative feedback in amplifiers
3 To study about the power amplifiers and their thermal stability.
4 To understand the analysis and design of oscillators and multivibrators
5 To allow students to get familiarized with the concept of tuned amplifiers and analyze different types of tuned amplifiers.

Course Outcomes:

Upon completion of the course, students shall have ability to

C303.1	Recall the concepts of BJT, MOSFET and the concepts of circuit theory	[R]
C303.2	Understand the biasing of transistors, the frequency response of amplifiers and the operation of various power amplifiers	[U]
C303.3	Illustrate the operation of negative feedback, positive feedback in amplifiers and the performance of tuned amplifiers	[U]
C303.4	Apply the concepts of negative feedback and positive feedback to construct negative feedback amplifier, audio and radio frequency oscillators	[AP]
C303.5	Use the concepts of frequency response of amplifier to analyze the behaviour of 2 stage RC coupled amplifier	[AN]
C303.6	Compare the different types of power amplifiers	[AN]
C303.7	Design and develop a circuit based on the concepts of oscillators and multivibrators	[C]

Course Contents:

Transistor biasing: BJT,MOSFET; **Frequency response of amplifiers**: Analysis of transistor using h parameter model low frequency response, high frequency response, 2 stage RC coupled amplifier; **Feedback amplifiers:** basic feedback topologies and their properties, analysis of practical feedback amplifiers, stability; **Power amplifiers:** class A, B, AB, C, D, E stages, output stages, short circuit protection, power transistors and thermal design considerations; **Signal generation:** sinusoidal oscillators- RC, LC and crystal oscillators, multi-vibrators, **Tuned Amplifiers:** Single tuned amplifier, Overview of Double tuned amplifier and stagger tuned amplifier.

Total Hours: 60

Text Books:

1 Jacob Millman, Chritos C Halkias, SatyabrataJit, "Electronic Devices and Circuits", 4th edition (SIE), McGraw Hill Education India Private Ltd., 2015
2 Salivahanan, "Electron Devices and Circuits", 4th edition, McGraw Hill Education India Private Ltd., 2016

Reference Books:

1 Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 9th Edition, Pearson Education / PHI, 2014.
2 Floyd, "Electronic Devices", 9th Edition, Pearson Education, 2011
3 David A. Bell, " Electronic Devices & Circuits", 5th Edition, PHI, 2008

Web References:

1 http://www.allaboutcircuits.com
2 http://www. circuitstoday.com

Online Resources:

1 http://www.nesoacademy.org/electronics-engineering/analog-electronics/analog

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C303.1	Remember	Quiz	2
C303.2	Understand	Quiz	2
C303.3	Understand	Quiz	2
C303.4	Apply	Group Assignment	4
C303.5	Analyse	Simulation Exercise	3
C303.6	Analyse	Simulation Exercise	3
C303.7	Create	Mini Project	4

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	20	10	10	10
Understanding	80	30	40	40
Applying	-	30	30	30
Analysing	-	30	20	20
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC305 **DIGITAL ELECTRONICS** **4/0/0/4**

Nature of Course :G (Theory analytical)
Pre requisites :16PH103- Engineering Physics

Course Objectives:

1 To introduce the principles of digital logic and minimize the logic expression.
2 To enable the students to understand the operation of various combinational logic Circuits.
3 To enable the students to understand the concepts of various flip flops and their role in sequential circuits design.
4 To allow students to design synchronous and asynchronous sequential circuits.
5 To enable the students to differentiate between various types of memory and understand their roles in digital systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C304.1	Demonstrate knowledge on recalling the number systems, Boolean algebra and the operation of basic logic gates	[U]
C304.2	use basic logic gates to realize given Boolean logic function in SOP and POS forms with various methods	[U]
C304.3	Understand and use flip-flops to realize various sequential logic circuits including synchronous and asynchronous types	[U]
C304.4	Give examples for various types of memory devices and their role in digital systems	[U]
C304.5	Apply various optimization techniques to design efficient combinational circuits	[AP]
C304.6	Apply the design procedure to design synchronous and asynchronous sequential circuits for any given specification	[AP]
C304.7	Analyse the given specification and apply the design concepts of combinational and sequential circuits to implement an elementary system like a simple computer and analyse the timing information.	[AN]

Course Contents:

Switching algebra: Number systems and Conversion,1's and 2's complement, Implementation using basic and universal logic gates, minimizing functions using Karnaugh maps, Minimization using Quine Mc-Clusky method **Different logic families:** TTL, ECL, I^2L. NMOS, CMOS. Pass transistor logic.**Combinational logic circuits:** adders/Subtractors, fast adder, magnitude comparator, multiplexer demultiplexers, encoders, decoders **Sequential logic circuits:** flip flops and latches, shifters, counters. Finite state machine- state transition diagrams and state transition tables. **Memory elements:** ROM, PROM, RAM-SRAM, DRAM, PLDs. **Case studies:** a simple computer, RTL - micro-instruction, instruction decoders timing and controller circuits, data path unit.

Total Hours: 60

Text Books:

1 M. Morris Mano, Michael D.Ciletti., "Digital Design",5thEdition, Pearson education,2013
2 Donald D. Givone, "Digital principles and Design", 2004, McGraw Hill Education India Private Ltd., 29th Reprint, 2016

Reference Books:

1 J. F. Wakerly, "Digital Design - principles and practices", 4th Edition, Pearson Education, 2008.
2 Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education, New

Delhi, 2011
3 M. D. Ercegovac, T. Lang, and J.H. Moreno, "Introduction to Digital Systems", John Wiley, 2000

Web References:

1 http://www.electrical4u.com/digital-electronics.htm
2 http://www.technologystudent.com/elec1/dig1.htm

Online Resources:

1 http://www.nesoacademy.org/electronics-engineering/digital-electronics/digital

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C304.1	Understand	Quiz	4
C304.2			
C304.3	Understand	Class Presentation	3
C304.4	Understand	Writing Skills	3
C304.5	Apply	Group Assignment	3
C304.6	Apply	Problem Solving	4
C304.7	Analyse	Simulation Exercise	3

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	-	-	-	-
Understanding	80	40	30	30
Applying	20	60	40	40
Analysing	-	-	30	30
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC306 **ELECTROMAGNETICS** **4/0/0/4**

Nature of Course :G (Theory analytical)
Pre requisites : 16PH103- Engineering Physics

Course Objectives:

1 To review about co-ordinate systems and to enable the students to understand the concepts of electrostatics.
2 To enable the students to understand the concepts of static and vector magnetic fields.
3 To understand how electric and magnetic fields affect materials and the relation between the fields under time varying situations.
4 To analyze the principles of propagation of uniform plane waves and waveguides.

Course Outcomes:

Upon completion of the course, students shall have ability to

C305.1	Recall the basics of co-ordinate systems and understand the concepts of EM field distribution under static conditions for various geometries	[R]
C305.2	Classify the basic Magneto static laws and interpret the nature of magnetic fields	[U]
C305.3	Understand the concepts of time varying electric and magnetic fields.	[U]
C305.4	Apply the concepts of Maxwell's equations in propagation of uniform plane waves	[AP]
C305.5	Analyze the propagation of electromagnetic waves in different waveguides	[AN]

Course Contents:

Co-ordinate Systems: Introduction to Co-ordinate System -Rectangular , Cylindrical and Spherical Co-ordinate System , Differential Length, Area and Volume ,Introduction to line, Surface and Volume Integrals, Gradient of Scalar, Divergence of a vector and Divergence theorem, Curl of a Vector and Stoke's theorem, Laplacian of a Scalar, **Electrostatics:** Electric charge, Coulomb's law, Electric field, Electric potential, Charge densities – Line, Surface, Volume charge densities, Electric flux, Electric flux density, Gauss's law, Laplace and Poisson's equations, dielectric materials, Boundary conditions, Capacitance, Electric energy and energy density, Electric current, Current density, Point form of Ohm's law, **Applications**- CRT-electric deflection, Heart dipole field, Defibrillators, Pacemakers, Cross talk. **Magnetostatics:** Magnetic field, Biot-Savart's law, Ampere's law, magnetic flux, Magnetic flux density,Gauss's law, Magnetic vector potential, Lorentz force equation, Magnetic materials, Boundary conditions, Inductance and Inductors, Magnetic energy and energy density, **Applications** - CRT – magnetic deflection, Magnetic brake, Linear motor, **Time Varying Field:**Induction, Faraday's law, Lenz's law, Curl, Displacement current, Limitations of Ampere's law, Maxwell's equations, **Applications** – Generator, Rotary motor . **Uniform Plane Wave:**Wave, Wave equation, Wave propagation in space, Travelling waves and standing waves, Conducting media and Dielectric loss, Plane waves at interfaces, Normal incidence, Phase velocity, Group velocity, Index of refraction, Power and energy relations, Polarizations - Linear, Elliptic and Circular, Oblique incidence - reflection, and refraction for parallel and perpendicular cases, diffraction, **Applications** – Retinal optic fibres, Electromagnetic hazards and the environment.

Total Hours: 60

Text Books:

1 John D Kraus and Daniel A Fleisch, "Electromagnetic with applications", 5th Edition, McGraw-Hill, 2005.
2 Matthew N.O. Sadiku, "Principles of Electromagnetic", 4th Edition, Oxford University Press, 2009

3 William H. Hayt, John A. Buck, "Engineering Electromagnetic", 8th Edition, McGraw-Hill, 2014.

Reference Books:

1 N.N Rao, "Elements of Engineering Electromagnetic", 6th Edition, Prentice- Hall, 2008.
2 J. Edminister, "Schaum's Outline of Electromagnetics", Special Indian Edition, McGraw-Hill, 2006

Web References:

1 https://www.youtube.com/watch?v=Q5fRmZzgEpU
2 https://www.youtube.com/watch?v=n6mVIX7yNws
3 http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-630-electromagnetics-fall-2006/

Online Resources:

1 nptel.ac.in/courses/108104087

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C305.1	Remember	Quiz	4
C305.2	Understand	Writing Skills	4
C305.3	Understand	Class Presentation	4
C305.4	Apply	Problem Solving	4
C305.5	Analyse	Case Study	4

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	10	10
Understand	80	40	40	40
Apply	-	40	30	30
Analyse	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC307 **DIGITAL ELECTRONICS LABORATORY** **0/0/3/2**

Nature of Course :M (Problem application)
Co requisites :16EC305 Digital Electronics

Course Objectives:

1 To design, construct and debug complex combinational and sequential circuits based on an abstract functional specification.

Course Outcomes:

Upon completion of the course, students shall have ability to

C306.1	Ability to choose between different techniques for implementing combinational and sequential digital circuits	[U]
C306.2	Prepare laboratory reports that clearly communicate experimental information in a logical and scientific manner	[U]
C306.3	Identify and apply appropriate sources of information for conducting laboratory experiments involving digital circuits and systems	[AP]
C306.4	Analyse the obtained results and timing information	[AN]
C306.5	Design, create and evaluate combinational and sequential circuits for given specification	[C]

Course Contents:

1. Analysis and Synthesis of Boolean Expressions using Basic Logic Gates
2. Analysis and Synthesis of Arithmetic Expressions using Adders/Subtractors
3. Analysis and Synthesis of Logic Functions using Multiplexers
4. Analysis and Synthesis of Logic Functions using Decoders
5. Analysis and Synthesis of Boolean Relations using Digital Comparator
6. Analysis of Functions of BCD-TO-7-segment Decoder / Driver and Operation of 7-segment LED Display
7. Analysis and Synthesis of Sequential Circuits using Basic Flip-Flops
8. Analysis and Synthesis of Multi-bit Sequential Circuits using Shift Registers
9. Design and evaluation of 4-bit Arithmetic Logic Unit
10. HDL based combinational circuits
11. HDL based sequential circuits

Total Hours: 45

Reference Books:

1 M. Morris Mano, Michael D.Ciletti., "Digital Design",4th Edition Pearson education,2011
2 C. H. Roth Jr., Larry L. Kinney "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2014
3 Thomas L. Floyd, Digital Fundamentals, 10th Edition, Pearson Education, New Delhi, 2011
4 Donald Giveone, "Digital Systems and Design", McGraw-Hill education (P) Ltd., New Delhi

Web References:

1 http://www.electrical4u.com/digital-electronics.html
2 http://www.technologystudent.com/elec1/dig1.html

Online Resources:

1 http://www.digital.iitkgp.ernet.in/dec/index.php

Assessment Methods & Levels (based on Revised Bloom's Taxonomy) Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	10	10
Understand	20	20
Apply	20	20
Analyse	20	20
Evaluate	10	10
Create	20	20

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC308 **ELECTRONIC CIRCUITS LABORATORY** **0/0/3/2**

Nature of Course :M (Practical application)
Co requisites : 16EC304 Electronic Circuits

Course Objectives:

1 To design and construct single stage, multistage amplifier circuits and verifies the voltage gain, frequency response characteristics.
2 To design and construct circuits to generate sinusoidal and pulse waveforms.

Course Outcomes:

Upon completion of the course, students shall have ability to

C307.1 Understand and construct various types of BJT and MOSFET biasing circuits [AP]
C307.2 Construct amplifier circuits and analyse the performance of different amplifier circuits [AN]
C307.3 Analyse the performance of amplifier circuits with and without negative feedback [AN]
C307.4 Construct different circuits to generate sinusoidal and non-sinusoidal waveforms [C]

Course Contents:

1. D.C. characterization and finding parameters of transistors (BJT and MOSFET)
2. Design of simple amplifiers (common emitter and common source)
3. Design and implementation of 2- stage RC Coupled Amplifier
4. Design and implementation of Class B Power Amplifier
5. Design and implementation of Current Series feedback amplifier
6. Implementation of Single tuned amplifier
7. Design and Implementation of radio frequency oscillator
8. Design and Implementation of audio frequency oscillator
9. Design of Astable, Monostable and Bistable multivibrators

Total Hours: 45

Reference Books:

1 Millman J and Halkias .C, "Integrated Electronics", Second Edition, TMH, 2012
2 Salivahanan, "Electron Devices and Circuits", 4th edition, McGraw Hill Education (India) Private Ltd., 2016
3 David A Bell, "Laboratory Manual for Electronic Devices and Circuits", 4thedition, PHI.
4 Paul B Zbar and Albert P Malvino, Michael A Miller, "Basic Electronics: A Text Lab Manual", 7th edition, Tata McGraw Hill, 2009
5 Poornachandra Rao.S and Sasikala.B, "Electronics Laboratory Primer: A Design Approach", 2nd edition, S.Chand, 2005.

Web References:

1 www.allaboutcircuits.com
2 www.circuitstoday.com

Online Resources:

1 http://iitb.vlab.co.in/index.php?sub=43&brch=223
2 http://vlab.amrita.edu/?sub=3&brch=223

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	10	10
Understand	20	20
Apply	30	30
Analyse	20	20
Evaluate	10	10
Create	10	10

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16MA108 **PROBABILITY AND RANDOM PROCESSES (ECE)** **3/2/0/4**

Nature of Course : J (Problem analytical)
Pre requisites : Basic concepts of probability , basic integration

Course Objectives:

1 To study the basic probability concepts
2 To acquire skills in handling situations involving more than one random variable
3 To understand and have a well – founded knowledge of standard distributions which can be used to describe real life phenomena
4 To know the probabilistic model used for characterizing a random signal and the nature of dependence relationship existing among the members of the family of the random variables

Course Outcomes:

Upon completion of the course, students shall have ability to

C401.1	Recall concepts of probability and integration	[R]
C401.2	Predict the correlation and regression between the random variables	[U]
C401.3	Apply skills to handle situations involving single and multiple random variables	[AP]
C401.4	Use distribution in cluster analysis of similar binary variables.	[AP]
C401.5	Analyse various types of random processes.	[AP]
C401.6	Use the concepts of random processes in signals and systems	[AP]

Course Contents:

Probability - Probability concepts-Addition and Multiplication law of probability – Conditional probability - Total probability theorem, Bayes theorem(statement) - Problems– **Random Variables**- One dimensional random variable - Probability mass function - Probability density function – Discrete and continuous random variables – **Standard distributions**-Discrete distributions - Binomial – Poisson – Geometric – Continuous distributions - Uniform – Exponential - Normal distributions – MGF- Simple problems-**Two dimensional random variables**- Joint distributions - Marginal and conditional distributions – Covariance – Correlation and Regression- **Classification of Random processes**- Definitions - strictly stationary processes - wide – sense stationary processes - Poisson process - Markov process - Markov Chain - Transition probabilities - Limiting distributions. **Correlation and Spectral densities** - Auto correlation - Cross correlation - Properties – Power spectral density-Cross spectral density- Properties- Relationship between cross correlation and cross spectral densities.

Total Hours: 60

Text Books:

1 Peebles Jr. P.Z., "Probability Random Variables and Random Signal Principles", Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2010
2 Palaniammal, S., "Probability and Random Processes", Prentice hall of India, New Delhi, 2014, Reprint 2015.
3 Gupta, S.C., &Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand &sons, 2000, Reprint 2014.

Reference Books:

1 Ross, S., "A First Course in Probability", Sixth edition, Pearson Education, Delhi, 2014.
2 Henry Stark and John W. Woods, "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Fourth Edition, Delhi, 2011
3 Veerarajan.T, "Probability, Statistics and Random Processes", Tata McGraw-Hill, Second Edition, New Delhi, 2010.

Web References:

1 http://nptel.ac.in/courses/111104079/
2 http://www.nptelvideos.in/2012/12/probability-random-variables.html
3 http://freevideolectures.com/Course/3028/Econometric-Modelling/22
4 http://freevideolectures.com/Course/2311/Digital-Communication/4
5 http://nptel.ac.in/syllabus/111105041/

Online Resources:

1 https://www.coursera.org/learn/probability-intro
2 https://ocw.mit.edu/courses/.../18-440-probability-and-random-variables-spring-2014/
3 https://www.coursera.org/learn/wharton-introduction-spreadsheets-models/lecture/Y3bCF/3-1-random-variables-and-probability-distributions
4 http://nptel.ac.in/upcoming_courses.php

Assessment Methods & Levels (based on Blooms'Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Tentative Assessment Component	Marks
C401.1	Remember	Classroom or Online Quiz	2
C401.2	Understand	Class Presentation/Power point presentation	4
C401.3& C401.4	Apply	Group Assignment	7
C401.5 & C401.6	Apply	Group activities	7

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination
	CIA1	CIA2	Term End Assessment	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

16EC309 **ANALOG INTEGRATED CIRCUITS** **3/0/0/3**

Nature of Course :G (Theory analytical)
Pre requisites : 16EC201 - Electric Circuits

Course Objectives:

1 To enable the students to learn the basic building blocks of Linear Integrated Circuits
2 To acquaint the students about linear and non-linear applications of operational amplifiers.
3 To enable the students to understand theory and applications of analog multipliers and PLL.
4 To teach the theory and applications of ADC and DAC.
5 To impart knowledge on integrated circuits of special functions.

Course Outcomes:

Upon completion of the course, students shall have ability to

C402.1	Identify the building blocks and their role in Linear Integrated Circuits	[R]
C402.2	Understand the operations and characteristics of operational amplifiers	[U]
C402.3	Gain knowledge by understanding the application areas of operational amplifiers	[U]
C402.4	Apply the characteristic properties of operational amplifier in designing ADCs, DACs and Voltage regulators	[AP]
C402.5	Perform simulation related to AC and DC analysis on these circuits and analyse the results	[AN]

Course Contents:

Basic information of Op-Amp, **Differential amplifier:** differential amplifier with constant current source-current mirror-characteristics of Op-Amp, OP-AMP design **OP-AMP applications:** inverting and non-inverting amplifiers, instrumentation amplifier, integrator and differentiator, current-to-voltage converter, voltage-to-current converter, precision rectifier, Schmitt trigger, Active filters. Analog Multiplier: Four quadrant multiplier, VCO, PLL and its applications. **Digital-to-analog converters (DAC):** Weighted resistor, R-2R ladder, Sample and Hold circuit, **Analog-to-digital converters (ADC):** flash; counter type, Single slope, dual slope, successive approximation - Astable and Monostable Multivibrators using 555 Timer, **Voltage regulators:** 723 General Purpose regulators, switching regulator - Audio Power Amplifier - Video amplifiers – Opto couplers - Isolation Amplifiers - Fiber optic ICs- **ac and dc analysis using circuit simulation software.**

Total Hours: 60

Text Books:

1 Sergio Franco, "Design with operational amplifiers and analog integrated circuits", McGraw-Hill, 4thedition, 2016. (Reprint)
2 D.RoyChoudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd.,2010 (Reprint)

Reference Books:

1 S.Salivahanan, V S KanchanaBhaaskaran, "Linear Integrated Circuits", McGraw-Hill, 2ndedition,2015
2 WilliamD.Stanely, "Operational Amplifiers with Linear Integrated Circuits". Pearson Education, 2004

Web References:

1 http://www.electronics-tutorials.ws
2 http://www.allaboutcircuits.com

Online Resources:

1 http://www.nesoacademy.org/electronics-engineering/analog-electronics/analog

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C402.1	Remember	Quiz	4
C402.2	Understand	Class Presentation	4
C402.3	Apply	Group Assignment	4
C402.4	Apply	Problem solving	4
C402.5	Analyse	Simulation Exercise	4

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	10	10
Understand	60	40	40	40
Apply	20	40	30	30
Analyse	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC310 **ANALOG AND PULSE COMMUNICATION** **3/0/0/3**

Nature of Course : G (Theory analytical)
Pre requisites : 16MA104 Discrete Transforms and Fourier Analysis
Co requisites : 16EC311 Signals and Systems

Course Objectives:

1 To introduce the concepts of analog communication systems and to make the studentsunderstand the functions of major building blocks of communication system and noise performance.

2 To develop a clear insight into techniques involved in different types of modulation and demodulation of AM & FM signals.
3 To introduce the fundamental concepts of sampling theorem and coding.
4 To discuss the different types of digital pulse and band pass signalling techniques
5 To describe the effect of noise in analog and pulse modulation systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C403.1 Explain the fundamental parameters of a communication system and analog transmission and detection techniques [R]
C403.2 Outline and distinguish between different types of analog modulation techniques based on bandwidth Occupied and power transmitted [U]
C403.3 Interpret the basic knowledge of Sampling theorem and various aspects of sampling theorem [U]
C403.4 Identify the techniques used for waveform coding and familiarized with basic techniques for generating and demodulating pulse code modulated signals [AP]
C403.5 Analyse the performance of analog communications in the presence of noise by evaluating the figure of merit for different schemes of modulation [AN]
C403.6 Design a communication system and select an appropriate modulation technique for a particular application. [C]

Course Contents:

Basic blocks in a communication system: transmitter, channel and receiver; baseband and pass band signals and their representations; concept of modulation and demodulation. **Continuous wave (CW) modulation:** amplitude modulation (AM) - double sideband (DSB), double sideband suppressed carrier (DSBSC), single sideband suppressed carrier (SSBSC) and vestigial sideband (VSB) modulation; angle modulation - phase modulation (PM) & frequency modulation (FM); narrow and wideband FM. **Pulse Modulation:** sampling process; pulse amplitude modulation (PAM); pulse width modulation (PWM); pulse position modulation (PPM) ; pulse code modulation (PCM); line coding; differential pulse code modulation; delta modulation; adaptive delta modulation. **Noise in CW and pulse modulation systems:** Receiver model; signal to noise ratio (SNR); noise figure; noise temperature; noise in DSB-SC, SSB, AM & FM receivers; pre-emphasis and de-emphasis, noise consideration in PAM and PCM systems.

Total Hours: 45

Text Books:

1 J. G. Proakis and M. Salehi, "Communication system engineering", 2/e, Pearson Education Asia, 2002.
2 R. E. Ziemer, W. H. Tranter, "Principles of Communications: Systems, Modulation,

and Noise", 5/e, John Wiley & Sons, 2001.

3 Simon Haykins and Michael Moher,"Communication Systems", 5th Edition, John Wiley and sons, 201

Reference Books:

1 Wayne Tomasi, "Electronic Communications Systems – Fundamentals Through advanced", 5th Edition Pearson Education, , 2012

2 H. Taub and D. L. Schilling, Principles of Communication Systems, 3rdReprint , McGraw Hill, 2006.

3 George Kennedy and Bernard Davis," Electronic Communication systems", 4th Edition, TMH, , 2008

Web References:

1 nptel.ac.in/downloads/117108038/

2 elearning.vtu.ac.in/10EC53.html

3 https:/class.coursera.org/eefun-001/lecture/32

Assessment Methods & Levels (based on Revised Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C403.1	Remember	Quiz	2
C403.2	Understand	Group discussion	2
C403.3	Understand	Technical Presentation	3
C403.4	Apply	Group Assignment	3
C403.5	Analyze	Test	3
C403.6	Create	Mini Project	4

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	0	0	0
Understand	20	20	20	20
Apply	60	60	60	60
Analyse	0	20	20	20
Evaluate	0	0	0	0
Create	0	0	0	0

5.1.15

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC311 **SIGNALS AND SYSTEMS** **3/0/2/4**

Nature of Course : G (Theory analytical)
Pre requisites : 16MA106: Discrete Transforms and Fourier Analysis

Course Objectives:

1 To introduce the transformation techniques in engineering applications and the concept of signals and systems and its classification based on properties
2 To enable the students to understand Laplace and Fourier transform techniques and its applications and to analyse CT systems using transformation techniques
3 To enable the students to understand DT Fourier series, sampling and reconstruction of signals
4 To enable the students to understand Z transform and DTFT and its applications and to analyse DT systems using Z transform and DTFT
5 To enable the students to understand the structure realization
6 To enable students to design, simulate and evaluate various properties of signals and systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C404.1	Explore their acquired knowledge on recalling the applications of transformation techniques	[R]
C404.2	Understand the concept of signal and its classifications, operations on signals and classifications of systems based on its properties	[U]
C404.3	Apply the concepts of converting the time domain functions into frequency domain functions of various systems	[AP]
C404.4	Analyse the systems using various transformation techniques and their output response to various input functions	[AN]
C404.5	Evaluate the properties of various signals and systems through design and simulation using software.	[E]

Course Contents:

Signals - Classification of signals – Operations on signals – Systems- Classification of systems - System properties: linearity, causality, stability, continuous-time Linear Time Invariant (LTI) and discrete-time Linear Shift Invariant (LSI) systems - System representation using differential equations – Continuous Time Fourier transform - Properties - Laplace transform – Region of convergence – Properties - Inverse Laplace transform - Relationship between Laplace and Fourier transform - Analysis using Laplace transform and Fourier transform - impulse response and step response - frequency response – magnitude and phase response - convolution integral - Signal representation: Fourier series representation of discrete-time signals - Sampling: sampling theorem – aliasing - signal reconstruction: ideal interpolator, zero-order hold, first-order hold - Z-transform – Region of Convergence - Properties – Inverse Z-transform - Discrete Time Fourier Transform (DTFT) and its properties - system representation using difference equations – Relationship between Z-transform and DTFT - Analysis using Z-transform and DTFT - system function - poles and zeros – stability – impulse response and step response - frequency response – magnitude and

phase response - convolution sum– Realization structures: Direct form I, II, Cascade and Parallel.

Lab Component

1	Generation of Signals	[E]
2	Computation of Linear Convolution	[E]
3	Computation of Circular Convolution	[E]
4	Verification of Sampling Theorem	[E]
5	Stability analysis of a system	[E]
6	Frequency response of LTI system	[E]
	Total Hours:	**75**

Text Books:

1 MahmoodNahvi, "Signals and systems", McGraw Hill Education, 1/E, 2015.
2 Allan V. Oppenheim et al," Signals and Systems", Prentice Hall of India, 2/E, 2015.
3 Ramakrishna Rao P, "Signals and Systems", McGraw Hill Education, New Delhi, 2/E, 2013.

Reference Books:

1 J. Roberts, "Fundamentals of Signals and Systems", Tata McGraw Hill, 2007.
2 B. P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.
3 R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems – Continuous and Discrete", Prentice Hall, 4/E, 1998.

Web References:

1 http://www.nptelvideos.in/2012/12/signals-and-system.html
2 http://freevideolectures.com/Course/3177/Signals-and-Systems

Online Resources:

1 https://www.edx.org/course/signals-systems-part-1-iitbombayx-ee210-1x-2
2 https://www.edx.org/course/signals-systems-part-2-iitbombayx-ee210-2x-2

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [6 marks]	CIA-II [6 marks]	Term End Examination [8 marks]	Rubric based CIA [40 Marks]	
Remembering	20	20	10	-	10
Understanding	80	20	20	20	20
Applying	-	30	30	30	30
Analysing	-	30	40	30	40
Evaluating	-	-	-	20	-
Creating	-	-	-	-	-

COURSE INCHARGE COE CO-ORDINATOR HOD/ECE

16EC312 **TRANSMISSION LINES AND WAVEGUIDES** **3/0/0/3**

Nature of Course :G (Theory analytical)
Pre requisites : 16EC306 Electromagnetics

Course Objectives:

1. To study basics of transmission line and discuss the parameter estimation.
2. To enable the students to understand the principles of transmission line at radio frequencies.
3. To allow students to design matching networks using smith chart.
4. To enable the students to understand the attenuation characteristics in different modes of waveguides.
5. To learn the characteristics of guided waves and wave propagation in waveguides.

Course Outcomes:

Upon completion of the course, students shall have ability to

C405.1	Understand the concepts of transmission line theory and compute the electrical parameters of transmission lines at low frequencies.	[U&R]
C405.2	Calculate reflection and transmission co-efficients, SWR and power for transmission lines using HF applications and solve single stub and double stub problems.	[AP]
C405.3	Describe the concepts of propagation of radio waves and possible existence of various modes in guided medium.	[U]
C405.4	Determine and analyze parameters such as frequency, phase constant, velocity, attenuation and associated characteristic impedance for different types of waveguides.	[AN]
C405.5	Understand the concepts of propagation of radio waves and modes in circular waveguides and resonators.	[U]

Course Contents:

TRANSMISSION LINE PARAMETERS-Transmission line Parameters- Characteristic impedance–as a cascade of T-Sections - Definition of Propagation Constant- General Solution of the transmission line – The two standard forms for voltage and current of a line terminated by an impedance- Physical significance of the equation and the infinite line- reflection coefficient – wavelength and velocity of propagation- Waveform distortion – distortion less transmission line- Input impedance of loss less lines .**THE LINE AT RADIO FREQUENCIES**- Parameter of the open wire at high frequencies-coaxial line- Standing waves and standing wave ratio on a line- One eighth wave line – The quarter wave line and impedance matching – the half wave line- The circle diagram for the dissipation less line- The Smith Chart – Application of the Smith Chart – single stub matching and double stub matching. **GUIDED WAVES**- Waves between parallel planes of perfect conductors- Transverse electric and transverse magnetic waves – characteristics of TE and TM Waves- Transverse Electromagnetic waves - Velocities of propagation- Attenuation of TE and TM waves in parallel plane guides- Wave impedances. **RECTANGULAR WAVEGUIDES**- Transverse Magnetic Waves in Rectangular Wave guides- Transverse Electric Waves in Rectangular Waveguides- Characteristic of TE and TM Waves- Dominant mode in rectangular wave guide –Attenuation of TE and TM modes in rectangular waveguides- Wave impedances. **CIRCULAR WAVEGUIDES AND RESONATORS**- Bessel functions – Solution of field equations in cylindrical co-ordinates- TM and TE waves in circular guides- Microwave cavities, Rectangular cavity resonators, circular cavity resonator.

Total Hours: **45**

Text Books:

1 J. D. Ryder "Networks, Lines and Fields", PHI, New Delhi, 2003. E.C.
2 Jordan and K. G. Balmain "Electro Magnetic Waves and Radiating System", PHI, New Delhi, 2003

Reference Books:

1 B. Somanathan Nair, "Transmission Lines and Wave guides", Sanguine Technical Publishers, 2006.
2 David M. Pozar, "Microwave Engineering" 2/e, John Wiley 2000

Web References:

1 http://www.allaboutcircuits.com/vol_2/chpt_14/index.html
2 http://en.wikipedia.org/wiki/Transmissionline

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C405.1	Remember/ Understand	Quiz	**5**
C405.2	Apply	Group Assignment1	**5**
C405.3	Understand	Class Presentation	**5**
C405.4	Analyse	Group Assignment 2	**5**
C405.5	Understand		

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	10	10
Understand	80	20	20	20
Apply	-	30	30	30
Analyse	-	30	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC313 **ANALOG INTEGRATED CIRCUITS LABORATORY** **0/0/3/2**

Nature of Course :M (Practical application)
Co requisites :16EC309 Analog Integrated Circuits

Course Objectives:

1 To design, construct and verify variety of circuits using various linear and non-linear ICs.

Course Outcomes:

Upon completion of the course, students shall have ability to

C406.1 Investigate the practical parameters of operational amplifiers and intrepretation of results. [AP]

C406.2 Analyze the operational amplifiers properties by designing various op-amp circuits and apply these to real-time applications. [AP]

C406.3 Apply the concepts of 555 Timer, PLL and develop applications. [AP]

C406.4 Ability to communicate with team members, acquire professional and ethical skills. [AP]

Course Contents:

1. Measurement of Op-Amp parameters
2. Applications of Op-Amp (Adder, Subtractor, adder-subtractor, average amplifier, Current to voltage converter)
3. Integrator and Differentiator using Op-Amp
4. Waveform generation using Op-Amp (square, triangular)
5. Design of Active filters (LPF,HPF)
6. Frequency Multiplier using PLL
7. Astable Monostable Multivibrator using 555 Timer
8. Design of Astable, Monostable and Bistable multivibrators

Total Hours: 45

Reference Books:

1 Sergio Franco, "Design with operational amplifiers and analog integrated circuits", McGraw-Hill, Fourth edition, 2008.

2 D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd.,2010

3 S.Salivahanan, V S KanchanaBhaaskaran, "Linear Integrated Circuits", McGraw-Hill, 2nd edition,2015

4 WilliamD.Stanely, "Operational Amplifiers with Linear Integrated Circuits". Pearson Education, 2004

Web References:

1 http://nptel.ac.in/courses/117107094/

2 http://www.technologystudent.com/elec1/elecex.htm

Online Resources:

1 http://iitb.vlab.co.in/?sub=43&brch=225

2 http://vlab.amrita.edu/?sub=1&brch=282

Assessment Methods & Levels (based on Bloom's Taxonomy)
Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Rubric based Continuous Assessment [60 marks] (in %)	End Semester Examination [40 marks] (in %)
Remember	10	10

Understand	30	30
Apply	40	40
Analyse	20	20
Evaluate	-	-
Create	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC314 ANALOG AND PULSE COMMUNICATION LABORATORY 0/0/3/2

Nature of Course :M (Practical application)
Co requisites :16EC310 Analog and pulse Communication

Course Objectives:

1 To construct circuits and analyse the performance of various continuous modulation and demodulation process.
2 To construct circuits for different pulse modulation techniques.

Course Outcomes:

Upon completion of the course, students shall have ability to

C407.1 Design circuits and to perform various continuous modulation and demodulation process. [AP]
C407.2 Design and Analyse circuit for intermediate frequency. [AN]
C407.3 Build circuits for different pulse modulation techniques. [C]
C407.4 Construct the circuits for Pre-emphasis, De-emphasis and Analog multiplexing techniques. [C]

Course Contents:

1 Design an amplitude modulation system with envelope detection and study its (a) signal handling and (b) frequency response characteristics.
2 Design a DSBSC modulation system with coherent demodulation and study its (a) signal handling and (b) frequency response characteristics when carrier is suppressed.
3 Design an SSB modulation system and study its (a) signal handling and (b) frequency response characteristics.
4 Design an AGC stage at 455 kHz centre frequency for voice communication and study the effect of AGC on amplifier performance.
5 Design and test a mixer stage for translating AM signal to IF frequency stage.
6 Design Frequency modulation.
7 Design PAM, PPM and PWM.
8 Design Pre-emphasis and De-emphasis circuits.

Total Hours: 45

Reference Books:

1 Gerorge Kennedy and Bernard Davis, "Electronic Communication Systems", TMH, 4th Edition, 2008.
2 Simon Haykins, "Communication Systems", John Wiley and sons, 4th Edition, 2012.
3 John G. Proakis, MasoudSalehi and Gerhard Bauch, "Contemporary Communication Systems using MATLAB", Cengage Learning, 2012.

Web References:

1 www.allaboutcircuits.com
2 www.circuitstoday.com

Online Resources:

1 http://nptel.ac.in/courses/117102059/7
2 http://ocw.usu.edu/Electrical and Computer Engineering/Communication Systems I/

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	10	10
Understand	20	20

Apply	20	20
Analyse	30	30
Evaluate	10	10
Create	10	10

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC315 **MICROCONTROLLERS AND INTERFACING** **3/0/0/3**

Nature of Course :Theory
Pre requisites : 16EC305 Digital electronics

Course Objectives:

1 To understand the architecture of microcontrollers like 8051 and MSP 430 and its usages
2 To develop interpretation, analysis and design skills using microcontrollers and various peripherals.
3 To design and develop a simple microcontroller based application.

Course Outcomes:

Upon completion of the course, students shall have ability to

C501.1	Understand the fundamentals of microprocessors 8085and 8086.	[U]
C501.2	Describe internal blocks of 8051 microcontroller	[U]
C501.3	Develop assembly language programs for various 8051 applications.	[C]
C501.4	Interface peripheral devices with 8051 microcontroller	[AN]
C501.5	Describe internal blocks of MSP 430 series microcontroller	[U]

Course Contents:

Introduction : Introduction to microprocessors, address bus, Data bus and Control bus, Tri state bus, clock generation, Connecting microprocessor to I/O devices, data transfer schemes, Architectural advancements of microprocessors, Evolution of microprocessors. 8085 & 8086 Architecture, 8085 Instruction set, 8085 & 8086 Addressing modes. **8 BIT Microcontroller:** Introduction to 8051 micro-controller, Architecture, Memory organization, Special function registers, Memory interfacing, Interrupts, Power down operation, Instruction set and Programming, 8051 micro controller based system designs **I/O Interfacingwith 8051 Microcontroller:** Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – Timer – Keyboard/display controller – Interrupt controller – DMA controller. **MSP430 Microcontroller:** Architecture of MSP430 Microcontrollers: Central Processing Unit and Registers, Basic Clock Module and operation: Digital controlled Oscillator and Registers Digital Input -Output: Input, Output Registers, Function Select Register, Port Interrupts, Pull Up /Down Registers Timers: Timer Block diagram and Operation, Timer Modes, Output Unit, Timer Interrupts, Low Power Down Modes, Watchdog Timer and operation.

Total Hours: 45

Text Books:

1 Kenneth J Ayala, "The 8051 Microcontroller – Architecture, Programming and Applications", Penram International Publications, Mumbai, India, 1996.
2 Jerry Luecke "Analog and Digital Circuits for Electronic Control System Applications: Using the TI MSP430 Microcontrollers", 1st Edition, Elsevier Science.
3 John H Devis, "MSP430 Microcontrollers Basics", 1st Edition, Newnes Publishers.
4 John Peatman , "Design with PIC Microcontroller"
5 Muhammad Ali Mazidi, Rolin D. McKinlay, and Danny Causey, "The PIC Microcontroller and Embedded systems – Using Assembly and C for PIC18", Prentice Hall, 2007.

Web References:

1 http://www.embedded.com/
2 https://www.arm.com

Online Resources:

1 https://www.edx.org/course/embedded-systems-shape-world-utaustinx-ut-6-10x

Assessment Methods & Levels (based on Revised Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C501.1	Understand	Quiz	4
C501.2	Understand	Quiz	4
C501.3	Create	Mini project	4
C501.4	Analyse	Group Assignment	4
C501.5	Understand	Quiz	4

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	70	20	40	40
Apply	30	40	30	30
Analyse	-	40	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC316 **DIGITAL SIGNAL PROCESSING** **3/0/2/4**

Nature of Course : G (Theory analytical)
Pre requisites : 16EC311 Signals and Systems

Course Objectives:

1. To enable the students to understand DFT and FFT techniques and its applications in filter design
2. To enable the students to understand and design FIR and IIR filters
3. To enable the students to understand the quantization process and various errors occur due to quantization process
4. To enable the students to understand the concept of multi rate signal processing and its applications
5. To enable students to design, simulate and evaluate various types of filters

Course Outcomes:

Upon completion of the course, students shall have ability to

C502.1	Explore their acquired knowledge on recalling the applications of transformation techniques	[R]
C502.2	Understand the concept of transformation techniques used for DT system analysis and its various properties	[U]
C502.3	Apply the transformation techniques in filtering applications	[AP]
C502.4	Design different types of filters using various filter design techniques and analyse filter response and its behavioural changes due to various quantization errors.	[AN]
C502.5	Evaluate the properties of various types of filters through design and simulation using software.	[E]

Course Contents:

Discrete Fourier Transform (DFT) – Properties - Fast Fourier Transforms (FFT) algorithms – Advantages - Decimation in Time – Decimation in Frequency algorithms – DFTs in linear filtering – overlap add/save methods - Finite Impulse Response (FIR) filters – Frequency, Amplitude and Phase responses of Linear phase FIR filters – Design of FIR filters - Windowing technique – Rectangular and Hamming windows – Frequency Sampling technique - Infinite Impulse Response (IIR) filters – Impulse Invariant Transformation - Bilinear Transformation – Design of Low Pass digital Butterworth filters – Chebyshev filters - Quantization process – co-efficient quantization error – Input quantization error – Product quantization error - Limit Cycle Oscillations (LCO) – Multirate DSP – Decimation – Interpolation - Applications – Channel vocoders - Quadrature mirror filters.

Lab Component(Analysis and simulation using TMS32C50/6713)

1	Computation of N-Point DFT using direct computational method	[E]
2	Computation of N-Point DFT using DIT method	[E]
3	Computation of N-Point DFT using DIF method	[E]
4	Design of FIR filter	[E]
5	Design of IIR filter	[E]
	Total Hours:	**75**

Text Books:

1 John G. Proakis&Dimitris G. Manolakis, "Digital Signal Processing", Pearson, 4th edition, 2006.
2 Sanjit K. Mitra, "Digital Signal Processing: A Computer-Based Approach", The McGraw-Hill Companies, 4th Edition2011.

Reference Books:

1 B. P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.

Web References:

1 http://www.nptel.ac.in/courses/108105055

Online Resources:

1 https://www.edx.org/course/discrete-time-signal-processing-mitx-6341x1
2 https://ocw.mit.edu/resources/res-6-008-digital-signal-processing

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [40 marks]
	Theory			Practical	
	CIA-I [6 marks]	CIA-II [6 marks]	Term End Examination [8 marks]	Rubric based CIA [40 Marks]	
Remembering	-	-	-	-	-
Understanding	20	20	10	20	10
Applying	40	20	20	30	20
Analysing	40	30	30	30	30
Evaluating	-	30	40	20	40
Creating	-	-	-	-	-

COURSE INCHARGE COE CO-ORDINATOR HOD/ECE

16EC317 **DIGITAL COMMUNICATION** **3/0/0/3**

Nature of Course : G (Theory analytical)
Pre requisites : 16EC310 Analog and Pulse Communication

Course Objectives:

1 To introduce the concepts of interference of noise and its effects.
2 To discuss the different types of digital pulse and band pass signalling techniques.
3 To describe the effect of ISI.
4 To study the error control coding.

Course Outcomes:

Upon completion of the course, students shall have ability to

C503.1	Calculate the noise levels in pulse transmission.	[U]
C503.2	Analyze modulation techniques with respect to bandwidth, Euclidian distance and probability of error.	[R]
C503.3	Evaluate performance of matched filter and correlator in comparison with optimum receiver.	[U]
C503.4	Calculate the channel capacity.	[AP]
C503.5	Know the concepts of Error control coding used in Digital Communication.	[U]
C503.6	Differentiate and apply Error control coding in Communication.	[U, AP]

Course Contents:

Geometric representation of signal waveforms – Baseband transmission; Matched filter; Nyquist rate and wave shaping techniques; ISI and adaptive equalization. Passband transmission; Coherent and non-coherent detection of signals in noise - Probability of error analysis of digital modulation techniques. Mary modulation schemes: QPSK, MSK; QAM Digital transmission through Band-Limited channel - Design of BL signals with zero ISI; Design of BL signals for controlled ISI- Maximum-likelihood sequence detector (MLSD), Channel capacity, Error control coding: Linear Block Codes, Cyclic Codes, Convolutional Codes.

Total Hours: 45

Text Books:

1 John. G. Proakis and M. Salehi, "Digital Communications", 4thEdition, Tata McGraw-Hill, 2001.
2 S. Haykin, "Communication Systems", 4th Ed., John Wiley & Sons, 2006.
3 B. Sklar, "Digital Communication: Fundamentals and Applications", 2nd Ed., Pearson, 2001.
4 H. Taub and D. L. Schilling, "Principles of Communication Systems", Tata McGraw-Hill, 2008.
5 A. B. Carlson, "Communication Systems: An Introduction to Signals and Noise in Electrical Communication", 3rd Ed., McGraw-Hill, 1986.

Reference Books:

1 J. G. Proakis, "Digital Communications", McGraw-Hill, 4th Ed., 2001.
2 S. Benedetto and E. Biglieri, "Principle of Digital Transmissions", Kluwer, 1999.
3 M. K. Simon, S. M. Hinedi and W. C. Lindsey, "Digital Communication Techniques: Signal Design and Detection", PHI, 1994.

Web References:

1 http://www.nptelvideos.in/2012/12/digital-communication.html
2 http://nptel.ac.in/courses/117101051/

Online Resources:

1 https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-

450-principles-of-digital-communications-i-fall-2006/video-lectures/

2 https://www.tutorialspoint.com/digital_communication/index.htm

3 http://www.sanfoundry.com/1000-digital-communications-questions-answers/

Assessment Methods & Levels (based on Revised Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C503.1	Understand	Quiz	3
C503.2	Remember	Test	5
C503.3	Understand	Class presentation	3
C503.4	Apply	Problem solving	3
C503.5	Understand	Technical presentation	3
C503.6	Understand& Apply	Technical presentation & Problem solving	3

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	20
Understand	80	70	60	60
Apply	-	10	20	20
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC318 **COMPUTER NETWORKS AND INTERFACING** **3/0/0/3**

Nature of Course : G (Theory)

Pre requisites : 16EC310 Analog and Pulse Communication

Course Objectives:

1 To introduce the concept, terminologies, and technologies used in modern data communication and computer networking

2 To introduce the students the functions of different layers.

3 To introduce the various addressing mechanisms employed in computer networking

4 To understand the types and functions of transmission control protocols.

5. To allow students to get familiarized with the concepts behind the different types of networking applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C504.1 To understand the basic concepts, protocols and standards of data communications. [R]

C504.2 To illustrate the concept of error detection & corrections techniques in the flow control & error control mechanisms. [U]

C504.3 To understand the concept of different routing techniques and to compute the shortest path. [U]

C504.4 To understand the concepts of congestion control techniques and quality of service in transport layer. [AP]

C504.5 To understand the concepts related to web and network security. [AN]

Course Contents:

DATA COMMUNICATIONS : Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Line Coding – Modems – RS232 Interfacing sequences. Flow Control and Error control - stop and wait – go back-N ARQ – selective repeat ARQ-sliding window – HDLC - LAN - Ethernet IEEE 802.3 – IEEE 802.4 - IEEE 802.5 - IEEE 802.11 – FDDI - SONET – Bridges. **NETWORK, TRANSPORT AND APPLICATION LAYER:** Internet works – Packet Switching and Datagram approach – IP addressing methods – Subnetting – Routing – Distance Vector Routing – Link State Routing – Routers. Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS) – Integrated Services- Domain Name Space (DNS) – SMTP – FTP – HTTP - WWW – Security – Cryptography.

Total Hours: 45

Text Books:

1 Behrouz A. Forouzan, "Data communication and Networking", 4th Edition Tata McGraw-Hill, 2007.

2 William Stallings, "Data and Computer Communication", Sixth Edition, Pearson Education, 2000.

Reference Books:

1 James .F. Kurouse& W. Rouse, "Computer Networking: A Top down Approach Featuring", Pearson Education, 3/e, Pearson Education.

2 Andrew S. Tannenbaum, "Computer Networks", PHI, Fourth Edition, 2003.

Web References:

1 ftp://165.165.123.124:444/Computer%20Science%20and%20%20Engineering%20%2819%29/Computer%20Networks/

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C504.1	Remember	Quiz	4
C504.2, C504.3	Understand	Quiz	8
C504.4	Apply	Group Assignment	4
C504.5	Analyse	Simulation Exercise	4

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	20	10	10	10
Understanding	80	30	40	20
Applying	-	30	30	30
Analysing	-	30	20	40
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC319 **MICROCONTROLLERS LABORATORY** **0/0/3/2**

Nature of Course :M (Practical application)
Co requisites : 16EC315 Microcontrollers & Interfacing

Course Objectives:

1 To introduce the basics of microcontroller and its applications.
2 To provide in depth knowledge of 8051 and MSP 430 assembly language programming.
3 To impart the I/O interfacing concepts for developing real time embedded systems.
4 To encourage the students in building real time applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C507.1	Familiarize with the assembly programming using 8051.	[AN]
C507.2	Familiarize with the assembly level programming using low powered MSP430.	[AN]
C507.3	Design circuits for various applications using microcontrollers.	[AP]
C507.4	Simulate and analyse Noise interference	[AN]
C507.5	Apply the concepts on real- time applications.	[AN]

Course Contents:

Programming using 8051 microcontroller

1. Arithmetic Instructions - Addition/subtraction, multiplication and division,
(16 bits Arithmetic operations – bit addressable).
2. Data Transfer - Block move, Exchange, Sorting, Finding largest element in an array.
3. Boolean & Logical Instructions (Bit manipulations).
4. Programs using Conditional CALL & RETURN.
5. Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII;
HEX - Decimal and Decimal - HEX.

INTERFACING with 8051 microcontroller

6. Generate different waveforms Sine, Square, Triangular, Ramp using DAC interface
7. Stepper motor control interface to 8051 microcontroller.
8. Programmable peripheral interface to 8051 microcontroller.
9. Keyboard and seven segment display interface with 8051 microcontroller.
10. ADC and DAC using 8051 microcontroller.

Programming using MSP430

11. ADC and DAC using 8051 microcontroller.
12. Display Programming using MSP 430
13. Interfacing motor with MSP430.
14. Study of RTOS for MSP 430.

Total Hours: **45**

Reference Books:

1 Steven Barrett, Daniel Pack, "Microcontroller Programming and Interfacing TI MSP 430: Part I (Synthesis Lectures on Digital Circuits and Systems)" .
2 MykePredko, "Programming and Customizing the 8051 Microcontroller", McGraw Hill Education.

Online Resources:

1 http://www.ti.com/lsds/ti/microcontrollers-16-bit-32-
2 bit/msp/overview.page?DCMP=MCU_other&HQS=msp430
http://www.mouser.com/new/Texas-Instruments/ti-msp430-mcus/

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remembering	-	-
Understanding	20	20
Applying	30	30
Analysing	30	30
Evaluating	10	10
Creating	10	10

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC320 DIGITAL COMMUNICATION AND NETWORKS LABORATORY 0/0/3/2

Nature of Course :M (Practical application)
Co requisites :16EC317 Digital Communication, 16EC318 Computer Networks and Interfacing

Course Objectives:

1 To construct circuits and analyse the performance of various digital modulation and demodulation process.
2 To simulate and analyse noise interference in communication and study its effect on capacity of the channel.
3 Demonstrate the performance of CSMA/CA, CSMA/CD, token bus and token ring protocol and to determine the performance metric.
4 Illustrate the concept of Stop-n-wait, Go back-N and selective repeat protocol using LAN-Trainer and to understand the concept of encryption and routing.

Course Outcomes:

Upon completion of the course, students shall have ability to

C508.1	Design circuits and to perform various Digital modulation and demodulation process.	[AN]
C508.2	Build circuits for generating PN sequences	[AN]
C508.3	Construct the circuits for Spread Spectrum techniques.	[AP]
C508.4	Simulate and analyse Noise interference	[AN]
C508.5	Simulate CSMA/CA, CSMA/CD, token bus and token ring protocols	[AN]
C508.6	Understand the concept of flow and error control protocols, encryption and routing protocols	[AN] [AN]

Course Contents:

1. Simulation of QPSK
2. Generation of ASK.
3. Generation & Spectral analysis of PN sequence.
4. Simulation of DS-SS PSK & spectral analysis.
5. Generation of BFSK, BPSK
6. Simulation of BFSK, BPSK
7. Perform and simulate the experiment on CSMA, CSMA/CD and CSMA/CA Protocols with LAN Trainer Kit with Bus Topology and Star Topology and compare the results.
8. Study the performance of Token Bus and Token Ring Protocols using Simulation.
9. Implementation of Data Link Layer Flow Control Mechanism -Stop & Wait, Sliding Window Protocols
10. Implementation of Data Link Layer Error Detection Mechanism -CRC
11. Implementation of Distance Vector and Link State Routing algorithms.

Total Hours: 45

Reference Books:

1 S. Haykin, "Communication Systems", 4th Ed., John Wiley & Sons, 2006.
2 John. G. Proakis and M. Salehi, "Digital Communications", 4thEd.,Tata McGraw-Hill, 2001
3 John G. Proakis, MasoudSalehi and Gerhard Bauch, "Contemporary Communication Systems using MATLAB", Cengage Learning, 2012.

Web References:

1 www.allaboutcircuits.com
2 www.circuitstoday.com

Online Resources:

1 https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/
2 http://www.nptelvideos.in/2012/12/digital-communication.html

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	10	10
Understand	20	20
Apply	30	20
Analyse	30	20
Evaluate	10	10
Create	-	20

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC321 **Embedded Systems** **3/0/0/3**

Nature of Course :Theory
Pre requisites : 16EC315 Microcontrollers & Interfacing

Course Objectives:

1. Learn the architecture and process of embedded systems .
2. Be familiar with the embedded computing platform design and analysis.
3. Be exposed to the basic concepts of real time Operating system.
4. Learn the system design techniques and networks for embedded systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C601.1	Understand the concepts of embedded systems	[U]
C601.2	Illustrate the knowledge on Embedded computing and design platform	[U]
C601.3	Analyse the compilation techniques and program optimization techniques	[AN]
C601.4	Make use of the concepts of Real Time Operating Systems	[AP]
C601.5	Apply the system design techniques and distributed Embedded Systems	[AP]

Course Contents:

INTRODUCTION TO EMBEDDED SYSTEMS: Characteristics-Challenges of Embedded Systems –design process –Choice of Microcontroller –building an embedded systems **EMBEDDED COMPUTING**: The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture ;**DESIGNPLATFORM** 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 **PROCESSES AND OPERATING SYSTEMS:**Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE.; **SYSTEM DESIGN TECHNIQUES AND NETWORKS:**Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques-Distributed embedded systems – MPSoCs and shared memory multiprocessors.;

Total Hours: **45**

Text Books:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.

Reference Books:

1. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
2. Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall, 1999.

Web References:

1. http://www.embedded.com/
2. https://www.arm.com

Online Resources:

1. https://www.edx.org/course/embedded-systems-shape-world-utaustinx-ut-6-10x

Assessment Methods & Levels (based on Revised Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C601.1	Understand	Quiz	5
C601.2	Understand		
C601.3	Analyse	Mini Project	10
C601.4	Apply	Group Assignment	5
C601.5	Apply		

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	70	20	40	40
Apply	30	40	30	30
Analyse	-	40	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC322 **VLSI CIRCUITS** **3/0/0/3**

Nature of Course :G (Theory analytical)
Pre requisites : 16EC305- Digital Electronics

Course Objectives:

1 Introduce the basics of MOS Circuit Design & modelling.
2 Familiarize the basics of MOS process Technology.
3 Gain knowledge on the technology, design concepts, electrical properties and modelling of Very Large Scale Integrated circuits.
4 Impart knowledge on various combinational and sequential circuits
5 Introduce the semiconductor memory architectures and associated circuitry

Course Outcomes:

Upon completion of the course, students shall have ability to

C602.1	Understand the concept behind design of VLSI circuits and different manufacturing approaches used in industry	[U]
C602.2	Derive the electrical characteristics of MOSFETs considering the first order and second order effects	[AP]
C602.3	Analyse the regions of operation in MOSFETs (nMOS and pMOS) in CMOS circuits with inverter as the basic circuit	[AN]
C602.4	Implement digital logic circuits using various technologies (static, dynamic and Pass transistor logic).	[AP]
C602.5	Construct bigger circuits using combinational and sequential circuits with considering the power and timing constraints	[AN]
C602.6	Understand the basic concepts behind various semiconductor memory cells such as SRAM, DRAM and their associated circuitry.	[U]

Course Contents:

Issues and Challenges in Digital IC Design: general overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles; **MOSFET fabrication:** basic steps of fabrication, CMOS p-well and n-well processes, layout design rules; **CMOS Inverter:** MOS Device Model with Sub-micron Effects, VTC Parameters (DC Characteristics), CMOS Propagation Delay, Parasitic Capacitance Estimation, Layout of an Inverter, Switching, Short-Circuit and Leakage Components of Energy and Power; **Interconnects:** Resistance, Capacitance Estimation; **Combinational Logic Design:** Static CMOS Construction, Ratioed Logic, Pass Transistor, Transmission Gate Logic, DCVSL, Dynamic Logic Design Considerations, noise considerations in dynamic design, Power Dissipation in CMOS Logic, Domino and NORA designs; **Sequential Circuits Design:** Classification, Parameters, Static Latches and Register, Race Condition, Dynamic Latches and Registers, Two Phase vs. Single Phase clock designs, Pulse Based Registers; **Semiconductor memories:** non-volatile and volatile memory devices, flash memories, SRAM Cell Design, Differential Sense Amplifiers, DRAM Design, Single Ended Sense Amplifier.

Total Hours: 45

Text Books:

1 J.M. Rabaey, A. Chandrakasan and B. Nikolic, "Digital Integrated Circuits- A Design Perspective", 2/e, Prentice Hall of India, 2003.
2 N. Weste and D. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", 3/e,Pearson Education India, 2007.

Reference Books:

1 D. A. Hodges, H. G. Jackson, R. Saleh, "Analysis and Design of Digital Integrated Circuits in Deep submicron Technology", 3/e, McGraw Hill, 2004.
2 Kang and Leblevici, "CMOS Digital Integrated Circuits Analysis and Design"3/e,

McGraw Hill, 2003.
3 J. P. Uyemura, Introduction to VLSI Circuits and Systems, John Wiley & Sons (Asia), 2002.
4 W. Wolf, Modern VLSI Design - System on Chip design, 3/e, Pearson Education, 2004.

Web References:

1 www.vlsi-expert.com/p/vlsi-basic.html
2 ee.iith.ac.in/micro/links.html
3 electronicsforu.com › Resources › Learning Corner

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C602.1, C602.4, C602.5 & C602.6	Understand Apply Analyse	Quiz	10
C602.2, C602.3	Apply Analyse	Group Assignment	10

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	-	-	-	-
Understanding	20	20	20	20
Applying	40	40	40	40
Analysing	40	40	40	40
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC323 **ANTENNAS AND WAVE PROPAGATION** **3/0/0/3**

Nature of Course :J (Problem analytical)
Pre requisites :16EC312- Transmission Lines and Waveguides

Course Objectives:

1 To gain knowledge in radiation field and its basic characteristics.
2 To know the basic parameters of antenna measurements and its applications.
3 To acquire knowledge on special antennas and its design parameters.
4 To gain knowledge in modern antennas like microstrip antenna and its application.
5 To study about different wave propagation phenomenon and its importance.

Course Outcomes:

Upon completion of the course, students shall have ability to

C603.1 Understand the antenna parameters and analyze the wired antenna and antenna arrays. [AN]
C603.2 Analyze broadband and special antennas for complex communication systems. [AN]
C603.3 Analyze printed antennas and its feeding techniques. [AN]
C603.4 Understand and analyze different wave propagation techniques for appropriate applications. [AN]

Course Contents:

Fundamental Concepts: Physical concept of radiation, retarded potentials, Hertzian dipole; Antenna parameters: Radiation pattern, gain, directivity, effective aperture, and reciprocity principle; Radiation from half wave dipole antenna. **Antenna Arrays:** Array of point sources, end fire and broadside arrays, pattern multiplication, synthesis of binomial array. **Broadband Antennas:** Log-periodic and Yagi antennas, rhombic antenna, Helical antenna. **Aperture and Reflector Antennas:** Huygens' principle, slot antenna, and horn antenna, parabolic reflector antennas. **Printed Antennas:** Radiation from rectangular and circular patches, feeding techniques. **Wave Propagation:** Ground wave, surface wave, and space wave propagation; Tropospheric and duct propagation; Structure of Ionosphere and ionospheric propagation; Multipath fading and ray bending.

Total Hours: 45

Text Books:

1 John D.Kraus Ronald J Marhefka, and Ahmad S Khan "Antennas and Wave Propagation", Fourth Edition Tata McGraw-Hill Publications 2013.
2 Constantine A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley & Sons. 2005.

Reference Books:

1 Edward C. Jordan and Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Ed., Prentice-Hall of India.2015.
2 Warren L. Stutzman, Gary A. Thiele, "Antenna Theory and Design", 3rd Ed., John Wiley & Sons. May 2012.
3 Elliot, Robert.S., "Antenna Theory and Design", Revised edition, Wiley-IEEE Press. 2003.
4 Collin, R.E., "Antennas and Radio Wave Propagation", McGraw-Hill. 1985.

Web References:

1 http://nptel.ac.in/courses/108101092/
2 http://nptel.ac.in/courses/117107035/

Online Resources:

1 http://www.antenna-theory.com

2 https://www.tutorialspoint.com/antenna_theory
3 http://www.amanogawa.com/archive/antenna.html

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C603.1	Understanding	Quiz	4
C603.2	Understanding	Class Presentation	4
C603.3	Applying	Group Assignment	6
C603.4	Applying	Group Assignment	6

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering				
Understanding	30	20	30	30
Applying	40	40	40	40
Analysing	30	40	30	30
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC324 **VLSI CIRCUITS LABORATORY** **0/0/3/2**

Nature of Course :M (Practical application)
Co requisites :16EC322 VLSI Circuits

Course Objectives:

1 To design and construct single stage, multistage amplifier circuits and verifies the voltage gain, frequency response characteristics.
2 To design and construct circuits to generate sinusoidal and pulse waveforms.

Course Outcomes:

Upon completion of the course, students shall have ability to

C607.1	Understand and construct various types of BJT and MOSFET biasing circuits	[AP]
C607.2	Construct amplifier circuits and analyse the performance of different amplifier circuits	[AN]
C607.3	Analyse the performance of amplifier circuits with and without negative feedback	[AN]
C607.4	Construct different circuits to generate sinusoidal and non-sinusoidal waveforms	[C]

Course Contents:

Circuit Simulation using SPICE: NMOS and PMOS characteristics; Inverter characteristics; Characterization of CMOS Ring Oscillator; Basic gates using different design styles; Design of a 1-bit Shift Register; **Logic Simulation using HDL:** VHDL Coding and functional verification of combinational and sequential circuits; **Mini Project.**

SPICE Simulation

1. DC Characteristics of NMOSFET
2. DC Characteristics of PMOSFET
3. Switching Characteristics of CMOS Inverter
4. Characterization of CMOS Ring Oscillator
5. Transient analysis of CMOS NAND,NOR and simple multiplexers

Logic Simulation & Synthesis

6. Simulation and Synthesis of basic logic gates
7. Simulation and Synthesis of MSI combinational circuits
8. Simulation and Synthesis of MSI sequential circuits

Mini Project

9. FPGA based system design

Total Hours: 45

Reference Books:

1 K.C.Chang, "Digital Systems Design with VHDL and Synthesis: An Integrated Approach", Wiley-IEEE Computer Society Press, 1999
2 Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL Design", McGrawHill India Ltd., 2004
3 Muhammed H Rashid, "SPICE for circuits and Electronics using PSPICE"
4 Gordon Roberts, Adel Sedra, SPICE, The Oxford Series in Electrical and Computer Engineering, 2nd edition

Web References:

1 www.vlsi-expert.com/p/vlsi-basic.html
2 ee.iith.ac.in/micro/links.html
3 electronicsforu.com › Resources › Learning Corner

Online Resources:

1 nptel.ac.in/courses/117106092/

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)
Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Rubric based Continuous Assessment [60 marks] (in %)	End Semester Examination [40 marks] (in %)
Remember	-	-
Understand	20	20
Apply	30	30
Analyse	20	20
Evaluate	20	20
Create	10	10

COURSE INCHARGE

COE CO-ORDINATOR

HOD/ECE

16EC325 **EMBEDDED SYSTEMS LABORATORY** **0/0/3/2**

Nature of Course :M (Practical application)
Co requisites : 16EC321 Embedded systems

Course Objectives:

1 To design and construct simple applications and analyse the output.

Course Outcomes:

Upon completion of the course, students shall have ability to

C608.1 Learn the working of 89C51 family and ARM processor [AP]

C608.2 Implement microcontroller concepts in programming. [AN]

C608.3 Use concepts of embedded system to design and model simple embedded systems. [C]

Course Contents:

1 Study of Keil Compiler using 89C51XX and ARM
2 Interfacing LED and LCD.
3 Interfacing Stepper motor.
4 Programming with timers and interrupts.
5 Interfacing 7 segment display

Total Hours: **45**

Reference Books:

1 Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2 Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.

Online Resources:

1 http://nptel.ac.in/courses/108102045/
2 https://www.arm.com

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remembering	-	-
Understanding	20	20
Applying	30	30
Analysing	30	30
Evaluating	10	10
Creating	10	10

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16MG003 **PRINCIPLES OF MANAGEMENT** **2/0/0/2**

Nature of Course : C (Theory Concept)
Pre requisites : 16EN001 Communication Skills

Course Objectives:

1 To enable the students to understand the principles of management and the management concepts
2 To enable the students to understand the need for business process reengineering
3 To enable the students to understand the concepts of organizational behaviour
4 To enable the students to understand the human resource management

Course Outcomes:

Upon completion of the course, students shall have ability to

C701.1	Understand the concepts of basic managerial functions that helps to accomplish organizational goals.	[U]
C701.2	Understand the responsibility of an individual towards the organizational environment	[U]
C701.3	Apply the management concepts in an organization.	[AP]
C701.4	Analyse organizational behaviour with a case study.	[AN]

Course Contents:

PRINCIPLES OF MANAGEMENT: Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling - **ENGINEERS AND ORGANIZATIONAL ENVIRONMENT:** Social, Economic, Technological and Political - Social Responsibility of Engineers - **MANAGEMENT CONCEPTS:** MBO, Theory Z, Kaizen, Six Sigma, Quality Circles and TQM - **BUSINESS PROCESS REENGINEERING:** Need for BPR, Various phases of BPR. **ORGANISATIONAL BEHAVIOUR:** Significance of OB, Role of Leadership, Personality and Motivation, Stress, Attitudes, Values and Perceptions at work **HUMAN RESOURCE MANAGEMENT:** Importance, Objectives and Functions, Job Analysis and Recruitment, Selection and Placement, Training and Development –Case Discussion

Total Hours: 30

Course-Incharge **COE Coordinator** **HOD/ECE**

Text Books:

1 Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management"-Tata McGraw Hill, NewDelhi, 2004.
2 Gary Dessler, "Human Resource Management", Prentice Hall of India, New Delhi, 2009

Reference Books:

1 Mamoria, C. B., "Personnel Management", Sultan Chand and Sons, New Delhi, 2005.

Web References:

1 http://www.nptel.ac.in/courses/110102016

Online Resources:

1 https:// www.coursera.org/learn/fundamentals-of-management

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Revised Bloom's Level	Tentative Assessment Component	Marks
C701.1	Understand	Quiz	5
C701.2	Understand	Writing Skills	5
C701.3	Apply	Group Assignment	5
C701.4	Analyse	Class Presentation	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA-I [6 marks]	CIA-II [6 marks]	Term End Examination [8 marks]	
Remember	-	-	-	-
Understand	60	20	20	20
Apply	40	40	40	40
Analyse	-	40	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

Course-Incharge COE Coordinator HOD/ECE

16EC326 **MICROWAVE AND OPTICAL COMMUNICATION** **4/0/0/4**

Nature of Course :G (Theory analytical)
Pre requisites :16EC323- Antennas and Wave Propagation
Course Objectives:

1 To study the basics of Microwave network and characterization of passive microwave components.
2 To enable the students to understand the principles and operations of Microwave tubes.
3 To enable the students to understand the fundamentals of optical fibre communication.
4 To enable the students to understand characteristics of optical transmitters and receivers.

Course Outcomes:
Upon completion of the course, students shall have ability to

C702.1	Understand the concepts of microwave network characterization and passive components.	[U]
C702.2	Understand the concepts of microwave tubes and their operational features.	[U]
C702.3	Describe the functional and operational features of semiconductor devices.	[AP]
C702.4	Describe the operation of optical fiber and their operational modes.	[AN]
C702.5	Understand the concepts of optical transmitters and optical receivers and apply this knowledge to modern fiber optic systems.	[AP]

Course Contents:
Microwave Network Characterization and Passive Components: Microwave Frequency band and S parameter representation of N ports- Losses in terms of s parameters- Properties of S parameters, Directional Coupler, Microwave Hybrid circuits, Circulator and isolator, Matched loads and movable shorts. **Microwave Tubes**: Two cavity klystron, Reflex Klystron, Travelling Wave Tube (TWT). **Microwave Semiconductor Devices:** Gunn Diode, Avalanche Multiplication, Manley – Rowe Power Relations. **Introduction to Optical Fiber Communications:** Optical Fibers: Ray and Mode theories, Multimode and Single-mode fibers, Fiber Loss, Dispersions, Power coupling: splices, connectors, coupler. **Optical Transmitters:** Light Emitting diode and Laser diodes, Laser modes. **Optical Receivers:** PIN and APD, Optical Amplifier.

Total Hours: 45

Text Books:

1 J Annapurna Das and Sisir K Das, "Microwave Engineering", Tata McGraw Hill Inc., 2007.
2 D.M.Pozar, "Microwave Engineering", John Wiley & sons, Inc., 2008.
3 Gerd Keiser, "Optical Fiber Communications", 4th Ed, McGraw Hill, 2010

Reference Books:

1 Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2008.
2 AmnonYariv, PochiYeh, "Photonics: Optical Electronics in modern communications", 6th Ed, Oxford University Press, 2013.

Web References:

1 https://nptel.ac.in/courses/108101112/
2 https://nptel.ac.in/courses/117101119/

Online Resources:

1 www.microwave101.com
2 http://www.microwaveresourcesinc.com/

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C702.1	Understanding	Quiz	5
C702.2	Understanding	Group Assignment	5
C702.3	Applying	Class Presentation	5
C702.4	Analysing	Group Assignment	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering				
Understanding	30	20	30	30
Applying	40	40	40	40
Analysing	30	40	30	30
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC327 WIRELESS COMMUNICATION AND NETWORKS 3/0/0/3

Nature of Course :G (Theory analytical)

Pre requisites :16EC317- Digital Communication

Course Objectives:

1 To introduce the concepts of cellular fundamentals and to make the students understand the spectral efficiency involved in the working of mobile and base stations.
2 To develop a clear insight into radio propagation and fading effects in cellular communication.
3 To discuss different types of multiplexing in cellular communication
4 To discuss the different types of wireless mobile communication systems
5 To introduce and discuss about wireless networks

Course Outcomes:

Upon completion of the course, students shall have ability to

C706.1 Interpret the fundamental concepts of cellular communication system [U]
C706.2 Apply the basic knowledge of radio propagation and fading effects to model a wireless channel [AP]
C706.3 Identify and Understand the multiplexing techniques used for different types of wireless mobile communication systems. [AP]
C706.4 Outline the various evolution of mobile communication systems [U]
C706.5 Discover the different wireless networks suitable for a particular application [AN]

Course Contents:

Fundamentals of Cellular Communication: History of Wireless Communication, Cellular revolution, Cellular Systems, Frequency reuse, Hand-off, Cell Splitting, Adjacent Channel Interference, Co-channel Interference, Channel Assignment Strategies, Cell Sectoring, Microcell Zone Concept, QoS. **Mobile Radio Propagation:** Introduction to Radio Wave Propagation, Free Space Propagation Model, The Three Basic Propagation Mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Small-Scale Multipath Propagation-Types of Small-Scale Fading, Rayleigh and Ricean Distributions, **Multiplexing:** Introduction to Multiple access, FDMA, TDMA, Spread Spectrum Multiple Access, SDMA, OFDMA **Cellular Mobile Communication Systems:** First Generation Analog (AMPS), Second Generation TDMA(GSM, IS-95), 2.5G (GPRS, EDGE), Third Generation Wireless Systems (UMTS) Fourth Generation Wireless Systems (LTE). **Wireless Networks:** WPAN, Bluetooth (IEEE 802.15.1),WLAN, WLAN equipment, WLAN Topologies, WLAN Technologies, IEEE 802.11 WLAN architecture, Zigbee, Introduction to Heterogeneous Networks

Total Hours: 45

Text Books:

1 Theodore S. Rappaport, "Wireless Communications: Principles &Practice",Second Edition, Prentice Hall, 2002
2 William Stallings, "Wireless Communications and Networks", Pearson Education / PHI, 2002

Reference Books:

1 Vijay K Garg, "Wireless Communications and Networking", Elsevier, 2007
2 ItiSahaMisra, "Wireless Communications and Networks",,5th Reprint , McGraw Hill, 2000.

Web References:

1 http://www.egr.msu.edu/~tongli/Introduction-WCN.pdf
2 http://nptel.ac.in/courses/117102062/2
3 http://www.nptelvideos.com/course.php?id=520

Online Resources:

1 https://books.google.co.in/books?id=XoHvAwAAQBAJ&pg=PR24&lpg=PR24&dq=wireless+communication+networks+online+resources&sour
2 http://keshi.ubiwna.org/2015IotComm/Wireless_Communications_&_Networking_Stallings_2nd.pdf
3 https://books.google.co.in/books?id=UE2wEc9NfB8C&printsec=frontcover&dq=Vijay+K+Garg
4 http://ece.ut.ac.ir/classpages/F87/ECE637/FILES/material/rappaport%2025-66.pdf

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C706.1	Understand	Quiz	4
C706.2	Apply	Problem Solving	3
C706.3	Apply	Problem Solving	3
C706.4	Understand	Group Assignment	5
C706.5	Analyse	Poster Presentation	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	60	40	30	30
Apply	40	60	40	40
Analyse	-	-	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC328 MICROWAVE AND OPTICAL COMMUNICATION LABORATORY 0/0/3/2

Nature of Course : M (Practical application)
Co requisites: : 16EC323 Antenna and Wave Propagation

Course Objectives

1 To learn the various parameters of microwave networks.
2 To measure the characteristics of optical diodes.
3 To study the performance of different types of antenna and its radiation pattern.
4 To gain knowledge about the reflex klystron.

Course Outcomes:

Upon completion of the course, students shall have ability to

C707.1 Calculate the power distribution in microwave components.
C707.2 Compute the impedance and frequency.
C707.3 Design of loop antenna
C707.4 Generation of polarization

MICROWAVE EXPERIMENTS:

Reflex Klystron – Mode characteristics.
Gunn Diode – Characteristics.
VSWR, Frequency and Wave Length Measurement.
Directional Coupler – Directivity and Coupling Coefficient – S – parameter measurement.
Attenuation and Power measurement.
S - Matrix Characterization of E-Plane Tee, H-Plane Tee.
Radiation Pattern of Antennas.

OPTICAL EXPERIMENTS:

DC characteristics of PIN Photo Diode.
Measurement of Bending Losses.
Fiber Optic Analog and Digital Link.
Numerical Aperture Determination for Fibers.

TOTAL LABORATORY HOURS 45

Reference Books:

1 Annapurna Das and Sisir K Das, "Microwave Engineering", Tata McGraw Hill Inc., 2007.
2 D.M.Pozar, "Microwave Engineering".John Wiley & sons, Inc., 2008.
3 Gerd Keiser, "Optical Fiber Communications", 4th Ed, McGrawHill, 2010
4 Samuel Y Liao, "Microwave Devices & Circuits" , Prentice Hall of India, 2008.
5 AmnonYariv, PochiYeh, "Photonics: Optical Electronics in modern communications", 6th Edition, Oxford.

Web References:

1 www.antennatheory.com
2 www.microwave101.com

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	10	10
Understand	20	20
Apply	30	30
Analyse	20	20
Evaluate	10	10
Create	10	10

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC401 **DIGITAL IMAGE PROCESSING** **3/0/0/3**

Nature of Course : C(Theory Concept)
Pre requisites : 16EC316 - Digital signal processing

Course Objectives:

1 To provide knowledge about the basic steps and mathematical transforms in image processing.
2 To give a view on human visual perception.
3 To learn various techniques to improve the visual appeal of the image.
4 To analyse the noise and technique to remove noise from the degraded images.
5 Understand the implementation of algorithm for image analysis.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1 Have an idea about the building blocks of a digital image processing system, and learn about the different types of images to be processed in the course as well as the type of problems to be solved. [R]
CO2 Learn the principles of image formation, sampling, quantization and the human visual system, which will allow them to investigate specific image processing techniques later on. [U]
CO3 Understand various image intensity transformations and spatial filtering for the purpose of image enhancement. [U]
CO4 Learn how to deal with different types of noise models, degradation processes and filtering techniques for restoration. [U]
CO5 Be aware of the difference between the various compression and segmentation algorithms and the types of objects (size and shape) they each produce. [AP]
CO6 Acquire an appreciation for the image processing issues and techniques and be able to apply these techniques to real world problems. [AN]

Course Contents:

Elements of a Digital Image Processing system – Structure of Human eye – Image formation and contrast sensitivity -Sampling and Quantization – Neighbours of a pixel – Distance measures – **Image Transforms**: DFT –FFT algorithm –Walsh transform – Hadamard transform – Discrete Cosine transform-Introduction to wavelet transforms. **Image Enhancement:** Basic Gray Level Transformations - Histogram equalization and specification technique–Smoothening and sharpening in spatial domain – Smoothening and sharpening in frequency domain – Homomorphic filtering- Color image processing basics. **Image Restoration**: Model Of Image Degradation/Restoration Process - Noise Models – Filters for Restoration in the Presence of Noise, Periodic Noise Reduction by Frequency Domain Filtering - Inverse Filtering -Wiener Filtering - Geometric Mean Filter. **Image Compression** : Image Compression Models –Lossless Compression –Huffmann, Arithmetic coding, LZW, RLE – Lossy Compression-Transform coding –Predictive coding– JPEG and MPEG Compression Standards **Image Segmentation** – Detection of Discontinuities - Edge linking and Boundary detection – Thresholding – Region Oriented segmentation -Basic Morphological algorithm **Image Representation** Boundary Descriptors– Regional Descriptors –Relational Descriptors.

Total Hours: 45

Text Books:

1 Rafael C., Gonzalez and Richard. E., Woods, "Digital Image Processing", Addison Wesley, 1992.
2 Anil K Jain, "Fundamentals of Digital Image processing", PHI, 1st Edition –1998.
3 S.Annadurai, R.Shanmugalakshmi, " Fundamentals of Digital Image Processing", Pearson Education,New Delhi,2007.

Reference Books:

1 W. K. Pratt, ``Digital Image Processing,'' 2nd Edition, John Wiley and Sons, 1991.
2 B.Chanda, D DuttaMajumdar, "Digital Image Processing and Analysis",Prentice HallEdition, New Delhi,2000.

Web References:

1 nptel.ac.in/downloads/117105079/
2 https://www.coursera.org/learn/digital#

Online Resources:

1 http://web.stanford.edu/class/ee368/handouts.html
2 http://www.ee.columbia.edu/~sfchang/course/dip/

Assessment Methods & Levels (based on Revised Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Remember	Quiz	2
CO2	Understand	Group discussion	2
CO3	Understand	Technical Presentation	3
CO4	Understand	Test	3
CO5	Apply	Problem solving	3
CO6	Analyse	Case study	4

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	-	-	-
Understand	20	20	20	20
Apply	60	60	60	60
Analyse	-	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC402 **INTERNET OF EVERYTHING** **3/0/0/3**

Nature of Course : G (Theory analytical)
Pre requisites : 16EC315- Microcontrollers & Interfacing

Course Objectives:

1. To Understand the vision of IoT from a global context.
2. To enable the students to understand the State of the Art – IoT Architecture.
3. To interpret the use of internet principles, protocols and network management in IoT.
4. To help the students to understand the principles of design in prototyping and provide ability to change and modify it.
5. Being able to analyse how the related concepts help to challenge the product idea a well-thought-out model of the business.
6. Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Interpret the vision of IoT from a global context.	[R]
CO2	Implement state of the art architecture in IoT.	[U]
CO3	Compare and Contrast the use of network layers, protocols and Data Management in IoT.	[U]
CO4	Exploring the features of prototyping the embedded devices for IoT applications.	[AP]
CO5	Design and develop an Effective usage of IoT deployment for different sectors.	[AN]
CO6	Illustrate the application of IoT in Industrial Automation and identify Real World Design Constraints.	[AN]

Course Contents:

Introduction-Overview, Flavour of the IoT, The "Internet of Things", Technology, Enchanted objects, Making of Internet of things, Design Principles for connected devices. **IoT Architecture:** Background and initial visions, Definitions and Functional requirements, Opportunities and Motivation, Future developments, Possible Architecture for the future IoT. **Internet principles:** Internet communication, IP addresses, MAC addresses, TCP and UDP ports, and Application layer protocols, IEEE 802 committee family of protocols, physical layer, and Media access control layer. **Prototyping:** Prototypes and production, Open source versus closed source, Prototyping embedded devices-Electronics, Embedded computing basics, Arduino, Raspberry Pi, and Electric Imp. **Prototype to reality**: Business Models-Business model canvas, Models, Funding an Internet of Things start-up, lean start up. **Applications**: Smart grid introduction, Marginal cost of electricity: Base and peak production, Managing demand, Demand response for transmission system operators, smart home, smart city and Health care.

Total Hours: 45

Text Books:

1. Adrian McEwen and HackimCassimally, "Designing the Internet of Things",John wiley and Sons Ltd.,UK,2014.
2. Dieter Uckelmann, Mark Harrison,Florian MIchahelles, "Architecting the Internet of Things",Springer,Newyork,2011.

Web References:

1. http://www.cisco.com/c/en_in/solutions/internet-of-things/resources.html
2. https://openwsn.atlassian.net/wiki/

Online Resources:

1 http://iot.ieee.org/newsletter/january-2016/hypercat-resource-discovery-on-the-internet-of-things.html

Assessment Methods & Levels (based on Revised Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Remember	Quiz	2
CO2	Understand	Quiz	2
CO3	Understand	Quiz	2
CO4	Apply	Group Assignment	4
CO5	Analyse	Simulation Exercise	5
CO6	Analyse	Simulation Exercise	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	10	10
Understand	80	30	40	40
Apply	-	30	30	30
Analyse	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC403 **TELEVISION AND VIDEO ENGINEERING** **3/0/0/3**

Nature of Course : C(Theory Concept)

Pre requisites : 16EC317 Digital Communication

Course Objectives:

1 To study the analysis and synthesis of TV Pictures, Composite Video Signal, Receiver Picture Tubes and Television Camera Tubes.
2 To study the principles of Monochrome Television Transmitter and Receiver systems.
3 To study the various Colour Television essentials and Colour Television systems.
4 To study the advanced topics in Television systems and Video Engineering.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Describe the fundamentals of analysis and synthesis of TV pictures, Composite video signal, picture tubes and television camera tubes.	[U]
CO2	Associate the working principles of monochrome television transmitter and Receiver systems.	[AN]
CO3	Define the terminologies associated with colour TV systems.	[U]
CO4	Demonstrate the applications of television and other latest Television related developments.	[AN]
CO5	Engage in self-study and to cite the current application trends and new directions in the digital Television systems.	[AN]

Course Contents:

Television Fundamentals: Geometry form and Aspect Ratio - Image Continuity - Interlaced scanning - Camera tubes-monochrome picture tubes- composite video signal- Picture signal transmission – positive and negative modulation – VSB transmission sound signal transmission-standard Channel bandwidth; **Monochrome Television:** TV transmitter–TV signal propagation–Interference–TV transmission Antennas – Monochrome TV receiver–RF tuner–UHF, VHF tuner-Digital tuning techniques-AFT-IF subsystems-AGC– Noise cancellation- DC re-insertion-Video amplifier circuits-Sync separation–EHT generation – Receiver Antennas. **Colour Television Essentials**: Compatibility – colour perception- Three colour theory- luminance, hue and saturation-colour television cameras- values of luminance and colour difference signals- colour television display tubes- delta gun-precision-in-line and Trinitron colour picture tubes- purity and convergence- pincushion correction techniques- automatic degaussing circuit- grey scale tracking – colour signal transmission- bandwidth- modulation of colour difference signals – weighting factors- Formation of chrominance signal; **Colour Television Systems**: NTSC – PAL - SECAM; **Advanced Television Systems:** Satellite TV technology-Cable TV– Digital television–Transmission and reception- Projection Television–Flat panel display TV receiver––3D TV – EDTV–Digital equipments for TV studios-HDTV-Remote control circuits, MATV, CATV and CCTV systems, LED TV, LCD TV, Curved Television.

Total Hours: **45**

Text Books:

1 R.R.Gulati, " Monochrome Television Practice, Principles, Technology and servcing" , Second edition, New age International Publishes, 2004.
2 R.R.Gulati "Monochrome and colour television", New age International Publisher, 2003.

Reference Books:

1 A.M Dhake, "Television and Video Engineering", Second edition, TMH, 2003.
2 S.P.Bali, "Colour Television, Theory and Practice", TMH, 1994.

Web References:

1 http://ieeexplore.ieee.org/document/639242/?reload=true
2 rhopkins.us/drbob.tv/documents/ATV_Systems_IEEE_CE_1988.pdf

Online Resources:

1 http://nptel.ac.in/courses/117102059/26

Assessment Methods & Levels (based on Revised Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	2
CO2	Analyse	Quiz	2
CO3	Understand	Quiz	1
CO4	Analyse	Assignment	10
CO5	Analyse	Seminar	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	10	10
Understand	80	30	40	40
Apply	-	30	30	30
Analyse	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC404 **NANO ELECTRONICS** **3/0/0/3**

Nature of Course : C (Theory Concept)
Pre requisites : 16EC322 VLSI Circuits

Course Objectives:

1. To present the state of the art in the areas of semiconductor device physics and materials technology to enable the Nano electronics.
2. The fundamentals of classical CMOS technology will be discussed and the issue in scaling MOSFET in the sub-100nm regime will be elaborated.
3. In this context the need for non-classical transistors with new device structure and nano materials will be elucidated.
4. The issues in realizing Germanium and compound semiconductor MOSFET will be presented. Extensive materials characterization techniques will also be discussed, which help in engineering high performance transistors.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Explore their acquired knowledge on semiconductor devices.	[R]
CO2	Understand the concept of CMOS and MOSFET technology.	[U]
CO3	Apply the nanotechnology in synthesizing.	[AP]
CO4	Analyse the characterization techniques for nano materials.	[AN]

Course Contents:

Overview: Nano devices, Nano materials, Nano characterization - Definition of Technology node, Basic CMOS Process flow - MOS Scaling theory - **Issues in scaling MOS transistors:** Short channel effects, Description of a typical 65 nm CMOS technology - Requirements for Non classical MOS transistor - MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics - Integration issues of high-k - Interface states, bulk charge, band offset, stability, reliability - Qbd high field, possible candidates, CV and IV techniques - **Metal gate transistor:** Motivation, requirements, Integration Issues - Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot - SOI - PDSOI and FDSOI - Ultrathin body SOI - double gate transistors, integration issues - Vertical transistors - FinFET and Surround gate FET - Metal source/drain junctions - Properties of Schottky junctions on Silicon, Germanium and compound semiconductors –Work function pinning - **Germanium Nano MOSFETs:** strain, quantization , Advantages of Germanium over Silicon , PMOS versus NMOS - Compound semiconductors - material properties, MESFETs Compound semiconductors MOSFETs in the context of channel quantization and strain, Hetero structure MOSFETs exploiting novel materials, strain, quantization - **Synthesis of Nano materials:** CVD, nucleation and Growth, ALD, Epitaxy, MBE - **Compound semiconductor hetero-structure growth and characterization:** Quantum wells and **Thickness measurement techniques:** Contact - step height, Optical - reflectance and ellipsometry – AFM- **Characterization techniques for nano materials:** FTIR, XRD, AFM, SEM, TEM, EDAX etc.-Applications and interpretation of results - **Emerging nano materials:** Nano tubes, nano rods and other nano structures, LB technique, Soft lithography etc.- Microwave assisted synthesis – Self-assembly.

Total Hours: 45

Text Books:

1. Y. Taur and T. Ning,"Fundamentals of Modern VLSI Devices", Cambridge University Press.
2. Plummer, Deal, Griffin,"Silicon VLSI Technology", Pearson Education India.

Reference Books:

1. Encyclopedia of Materials Characterization, Edited by: Brundle, C.Richard; Evans,

Charles A. Jr.; Wilson, Shaun; Elsevier.

Web References:

1 http://ece.iisc.ernet.in/~navakant/nano/2007/course.html

Online Resources:

1 https://www.coursera.org/learn/nanotechnology1

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Revised Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Remember	Quiz	5
CO2	Understand	Writing Skills	5
CO3	Apply	Group Assignment	5
CO4	Analyse	Class Presentation	5

Summative assessment based on Continuous and End Semester Examination

Revised Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	40	20	20	20
Understand	60	60	40	40
Apply	-	20	20	20
Analyse	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC405 **ROBOTICS** **3/0/0/3**

Nature of Course :C (Theory Concept)
Pre requisites : 16EC321 Embedded System

Course Objectives:

1 To learn the Robot organization and hardware.
2 To study the Robotic vision systems and Principles of edge detection.
3 To study the Robots in material handling, processing assembly and storage.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1 Learning the basics of robot sensors and its applications [U]
CO2 Gain the knowledge about various sensors used in robotics. [R]
CO3 Learn about various hardware used in design of robotics [U]

Course Contents:

Overview of Robots: Introduction- Robot Behaviors-Design Challenge-Engineering design Process-Programming-Motors-Sensors-Chassis-Direct Drive-Indirect Drive –Gearing-End Effectors-Wheels VsTnk Tread. **Hardware:** Parts Identification-Building Instruction for the Tetrix Platform, DC Motor and Servo Motor wiring Configuration and Power Supplies-Transmitters-Receivers-DC Motor-Speed-Controllers-Loops-Switch blocks-DC Motor-Servo Motor-Using sensors and actuators with ROS-SCOR BOT-Structures and Programming-IS.14533:2005 Manipulating Industrial robots. **Robot ARM Kinematics:** Forward Kinematics- A 6-axis Robot-Inverse Kinematics-Trajectories-Joint Space Motion-Cartesian Motion-Motion through a singularity installing ROS. **Embedded Robotics:** Interfaces-Operating System-Sensors-Categories-Binary Sensors-Analog Vs Digital Sensor-Soft encoder-A/D convertor-Position sensitive Device- Compass-Gyroscope-Accelerometer-Actuators-DC motors-H bridge-Pulse Width Modulation-Stepper Motors-Servos-Controls-On-Off Control-PID Control-Velocity Control and Position control-Multiple motors-Driving Straight-V-Omega Interface-Multitasking-Co-operative-Preemptive-Synchronization-Scheduling-Interrupts. **Recent Trends in Robotics:** Appetites-Collaborative Robots-Robotics as a Service- Logistics and materials handling-Parallel actuated robots and closed loop robots.

Total Hours: 45

Text Books:

1 Koren, "Robotics for Engineers", TMH International Company, 1995.
2 Vokopravotic, "Introduction to Robotics", Springer, 1988.
3 RathmillK., "RobotTechnologyand Application" , Springer, 1985.
4 CharniakandMcDarmott,'Introduction to Artificial Intelligence" ,TMH, 1986.

Reference Books:

1 FuK.S, GonzallyR.C, LeeC.S.G, "Robotics Control, Sensing, Vision and Intelligence",TMH Book Company,2008.
2 Barry Leathamand Jones, 'Elements of Industrial Robotics", Pittman Publishing, 1987.
3 MikellP. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotic Technology Programming and Applications",TMHBookCompany,2008

Web References:

1 http://www.engineering108.com/pages/Robotics/Robotics_ebooks_free_download.html
2 http://www.engineering108.com/pages/Robotics/Robot-Manipulators-New-Achievements.html

Online Resources:

1 http://www.engineering108.com/pages/Robotics/automation-and-robotics.html

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	10
CO2	Understand	Quiz	5
CO3	Analyse	Case Study	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	40	50	30	50
Understand	60	50	70	50
Apply	-	-	-	-
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC406 INFORMATION THEORY AND CODING TECHNIQUES 3/0/0/3

Nature of Course : G (Theory analytical)
Pre requisites : 16MA108 Probability and Random Processes

Course Objectives:

1 To study the basics of Rate distortion theory and achievability of rate distortion function.
2 To enable the students to understand the principles of conditional limit theorem.
3 To enable the students to understand the principles maximum entropy.
4 To enable the students to understand the fundamentals of Interactive codes.
5 To enable the students to understand Turbo codes.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1 Understand the concepts of rate distortion function and its computation. [R]
CO2 Understand the concepts of conditional limit theorem. [R]
CO3 Describe the features spectrum estimation. [AP]
CO4 Describe various types of coding and its applications. [AN]
CO5 Understand the concepts of Interactive codes and turbo codes. [AP]

Course Contents:

Rate Distortion theory: Calculation of the rate distortion function, achievability of the rate distortion function, computation of the rate distortion function; **Information Theory and Statistics:** Source and channel coding, Sanov's theorem, conditional limit theorem, Chernoff-Stein lemma, Fisher Information; **Maximum Entropy:** Spectrum estimation, Burg's maximum entropy theorem; **Iterative Codes:** LDPC Codes, Tanner graph, Cycles, irregular codes, Message-passing decoder and density evolution; **Turbo codes:** Definition, BCJR algorithm and EXIT charts.

Total Hours 45

Text Books:

1 Cover & Thomas, "Elements of Information Theory", 2nd ed, Wiley, 2006.
2 Csisz´ar&K¨orner, "Information Theory: Coding Theorems for Discrete Memory less Systems", Cambridge university press, 2011.
3 W. E. Ryan and S. Lin," Channel Codes-Classical and Modern", Cambridge University Press, 2009.
4 R. W. Yeung, "Information Theory and Network Coding", Springer, 2008.

Reference Books:

1 El Gamal, Y.-H. Kim, "Network Information Theory", Cambridge University Press, 2011.
2 Robert M. Gray, "Entropy and Information Theory", Springer, 1988.
3 F. J. Mac Williams and N. J. A Sloane, "The Theory of Error-Correcting Codes", Elsevier Science, 1988.

Assessment Methods & Levels (based on Revised Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Remember	Quiz	5
CO2	Remember	Group Assignment 1	5
CO3	Apply	Class Presentation	5
CO4	Analyse	Group Assignment 2	5
CO5	Apply	Quiz	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	10	10
Understand	80	30	40	40
Apply	-	30	30	30
Analyse	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC407 **SOFT COMPUTING** **3/0/0/3**

Nature of Course : C (Theory Concept)
Pre requisites : 16CS201Problem Solving Techniques and C Programming

Course Objectives:

1 To make the students to understand Fuzzy logic concepts.
2 To acquire the basic knowledge of Genetic algorithms.
3 To equip the students with the latest application of soft computing.
4 To make the capable of applying soft computational techniques to solve various problems

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Understand to soft computing algorithms inspired by nature.	[R]
CO2	Apply soft computing techniques in real life problems.	[AP]
CO3	Understand modelling of human brain, reproduction and thinking.	[U]
CO4	Understand the neural network concepts.	[U]
CO5	Understand the fuzzy logic concepts.	[U]
CO6	Understand the Genetic algorithms concepts.	[U]

Course Contents:

NEURAL NETWORKS: Human Brain, Model of an Artificial Neuron, Neural Network Architectures, Characteristics, Learning methods **BACK PROPOGATION NETWORKS**: Architectures, Perceptron, Single layer, Multilayer, BPN Learning, Applications **ASSOCIATIVE MEMORY**: Auto correlators, Hetero correlators, BAM, Applications. **ADAPTIVE RESONANCE THEORY**: Cluster structure, vector quantization, ART1: Architecture, Algorithm, Applications. **FUZZY LOGIC**: Fuzzy versus Crisp sets, Operations, Properties, Relations, Fuzzy Systems: Crisp logic versus Fuzzy logic, Fuzzy Rule based Systems, Defuzzification methods, Applications **GENETIC ALGORITHMS**: Basic Concepts, Biological background, Creation of offsprings, Working principle, Encoding, Fitness Function, Reproduction. Inheritance operators, Cross over, Inversion and Deletion, Mutation, Bit-wise operators, Generation cycle, Convergence, Applications.

Total Hours: 45

Text Books:

1 Laurene V. Fausett, " Fundamentals of Neural Networks: Architectures, Algorithms and Applications" Pearson Prentice Hall, New Delhi, Second Edition, 1994.
2 Hung T. Nguyen, Elbert A. Walker, "A First Course in Fuzzy Logic", Third Edition, CRC Press, 2005.
3 Mitchell Melanie, "An Introduction To Genetic Algorithms", Prentice Hall of India, New Delhi, 1998.

Reference Books:

1 S.Rajasekaran and G.A.VijayalakshmiPai, " Neural networks,Fuzzylogics,and Geneticalgorithms",PHI,2003
2 Timothy J.Ross, "Fuzzy Logic Engineering Applications", McGrawHill, 1997
3 David E Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning",Pearson Education, 1996

Web References:

1 http://www2.cs.uh.edu/~ceick/6367/Soft-Computing.pdf

Online Resources:

1 https://www.coursera.org/learn/neural-networks
2 http://nptel.ac.in/courses/117105084/

Assessment Methods & Levels (based on Revised Blooms' Taxonomy)
Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Tentative Assessment Component	Marks
CO1	Remember	Quiz	2
CO2	Apply	Case study	4
CO3	Understand	Quiz	2
CO4	Understand	Problem solving	4
CO5	Understand	Test	4
CO6	Understand	Group discussion	4

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA-I [6 marks]	CIA-II [6 marks]	Term End Examination [8 marks]	
Remember	20	-	-	-
Understand	20	20	20	20
Apply	60	60	60	60
Analyse	-	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE COE CO-ORDINATOR HOD/ECE

16EC408 **HARDWARE DESCRIPTION LANGUAGES** **3/0/0/3**

Nature of Course :F (Theory Programming)
Pre requisites :16EC305 Digital Electronics

Course Objectives:

1 To introduce the HDL way of prototyping digital circuits
2 To introduce modular design concepts
3 To enhance the coding skills.
4 To discuss the synthesis issues in the coding.
5 To understand various modelling styles in coding

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Understand the basic FPGA design flow	[U]
CO2	Develop a code for any digital circuit using VHDL	[AP]
CO3	Develop code for any digital circuit using Verilog	[AP]
CO4	Utilize test bench to test the developed HDL Code	[AP]
CO5	Analyse the various issues encountered during the synthesis process	[AN]

Course Contents:

VHDL Overview – FPGA Design Flow Process –Libraries– Data Objects - Data Types – Data Operators – Entities – Architectures. Basic Concurrent Statements– Usage of Blocks In Dataflow Modeling. Component Declarations – Component Instantiation – Types of Component Instantiation- Test Benches –Process – Delays – Basic Sequential Statements – Usage of Variables Inside The Process –Multi Process Statements – Generics – Operator Overloading – Conversion Functions –Attributes – File Concepts - Packages – Functions & Procedures – Predefined & User Defined Library Implementations **Verilog** :Design Methodology – Module – Ports –Operators –Data Types – Arrays – Parameters – Gate Delays – Operator Types – Conditional Statements –Modeling Elements -Dataflow Modeling- Continuous Assignment. Delays, Expression, Operators and Operands-BehavioralModeling-Procedural Assignments, Timing Controls, Loops- implementation of Basic Circuit Using Dataflow &BehavioralModeling. Switch Level Modeling-FSM Implementation – Test Benches **VHDL Synthesis**: Synthesis basics-modeling a wire- modeling combinational logic- modelling sequential logic- Modeling Flip-flopwith Synchronous/ Asynchronous Preset and clear-Modeling a latch. **Verilog Synthesis**: Synthesis of combinational logic and sequential logic - synthesis of explicit and implicit state machines- Synthesis of gated clocks and clock enables -synthesis of Loops

Total Hours: 45

Text Books:

1 D. Ciletti, "Advanced Digital Design with the VERILOG HDL" PHI.2008
2 J. Bhaskar, "A VHDL Primer", Prentice Hall, 2nd Edition 1998
3 Samir Palnitkar, "Verilog HDL", Pearson Publication, II Edition. 2003

Reference Books:

1 Bhaskar J, "Verilog Synthesis Primer", Prentice Hall,1999
2 Bhaskar J, "VHDL Synthesis Primer", BS Publications, II Edition, 2001
3 Douglas Perry, "VHDL", 3rd Edition, McGraw Hill 2001
4 Kevin Skahill , "VHDL for PROGRAMMABLE LOGIC" Pearson Publications, 2004.

Web References:

1 nptel.ac.in/downloads/117108040/

Online Resources:

1 http://vol.verilog.com/
2 www.ee.iitb.ac.in/~smdp/DKStutorials

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)
Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Tentative Assessment Component	Marks
CO1	Understand	Group discussion	2
CO2	Apply	Coding exercise	5
CO3	Apply	Coding exercise	5
CO4	Apply	Group Assignment	3
CO5	Analyse	Case study	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA-I [6 marks]	CIA-II [6 marks]	Term End Examination [8 marks]	
Remembering	-	-	-	-
Understanding	40	20	20	20
Applying	60	70	60	60
Analysing	-	10	20	20
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE COE CO-ORDINATOR HOD/ECE

16EC409 **ASIC AND FPGA DESIGN** **3/0/0/3**

Nature of Course :G (Theory analytical)
Pre requisites :16EC305 Digital Electronics

Course Objectives:

1. To study the design flow of different types of ASIC.
2. To familiarize with the different types of programming technologies and logic devices.
3. To learn the architecture of different types of FPGA.
4. To gain knowledge about partitioning, floor planning, placement, routing and circuit extraction of ASIC.
5. To analyse the simulation, synthesis and testing of systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Design various digital systems using PLDS.	[AP]
CO2	Simulate, synthesize and test different systems using VHDL and Verilog.	[U]
CO3	Differentiate various FPGAs like Spartan, Altera, Apex, Cyclone and Virtex.	[AN]
CO4	Configure SOCs like Digital camera, Bluetooth Radio/modem, SDRAM and USB.	[AP]

Course Contents:

Overview of ASIC and PLD: Types of ASICs – Design Flow – CAD tools used in ASIC Design-Programming Technologies. Antifuse – Static RAM- EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA- PAL, Gate Arrays – CPLDs and FPGAs. ASIC Physical Design: System Partition – partitioning methods – interconnect delay models and measurement of delay – floor planning- placement – Routing: Global routing – detailed routing – special routing – Circuit Extraction – DRC. Logic Synthesis, Simulation and Testing

FPGA: Field Programmable Gate Arrays – Logic Blocks, routing architecture, Design Flow Technology – mapping for FPGAs, Xilinx XC 4000 – ALTERA's FLEX 8000/10000, ACTEL's ACT 1,2,3 and their speed performance. Case studies: Altera MAX 5000 and 7000 – Altera MAX 9000-Spartan II and Virtex II FPGAs – Apex and Cyclone FPGAs.

Total Hours: 60

Text Books:

1. M.J. S. Smith, " Application Specific Integration Circuits", Addison – Wesley Longman, 1997
2. Parag.K. Lalka, "Digital System Design using Programmable Logic Devices", BSP, 2003.

Reference Books:

1. S. Trimberger, "Field Programmable Gate Array Technology", Kluwer Academic Publications, 1994.
2. John V. Oldfield, Richard C Dore, "Field Programmable Gate Arrays", Wiley Publications 1995.
3. P. K. Chan, S. Mourad, " Digital System Design using Field Programmable Gate Array", Prentice Hall Publications, 1994.
4. S. Brown, R. Francis, J. Rose, Z. Vransic, "Field Programmable Gate Array", Kluwer Academic Publications, 1992.

Web References:

1. www.radio-electronics.com › Electronic components
2. https://ocw.mit.edu/courses/electrical-engineering-and...notes/lecture_5
3. https://docs.numato.com/kb/learning-fpga-verilog-beginners-guide-part-1-

introduction/

Online Resources:

1 www.nptel.ac.in/courses/108105057

2 www.nptel.ac.in/courses/117108040

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Apply	Quiz	5
CO2	Understand	Mini Project	5
CO3	Analyse	Class presentation	5
CO4	Apply	Problem solving	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	-	-	-	-
Understanding	80	70	40	30
Applying	20	20	40	20
Analysing	-	10	20	10
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC410 TESTING AND VERIFICATION OF VLSI CIRCUITS 3/0/0/3

Nature of Course : G (Theory analytical)
Pre requisites : 16EC322 VLSI Circuits

Course Objectives:

1 To introduce the concepts of fault identification.
2 To develop a clear insight into techniques for generation of test vectors.
3 To enable the students to understand fundamental concepts of built in self-test.
4 To introduce verification of digital circuits.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO 1	Understand how to abstract physical faults in VLSI circuits as logical fault models	[U]
CO 2	Learn core decision principles based on Boolean and algebraic reasoning to test and verify digital systems	[U]
CO 3	Understand chip level, system level test strategies	[U]
CO 4	Apply Test Pattern Generation algorithms and generate test vectors.	[AP]
CO 5	Design circuits that are easy to test	[AP]
CO 6	Analyse whether a circuit implementation is bug free or functionally equivalent to its specification.	[AN]

Course Contents:

Motivation for testing and design for testability – **Faults** in digital circuits -Modeling of faults -Logical Fault Models - Fault detection - Fault location - Fault dominance-**CMOS testing** – Manufacturing test principles – Design Strategies for test-– chip level test techniques - System level test techniques-Testability features for board test **ATPG:**Fault Table, Boolean difference – Path sensitization, D algorithm –Sequential circuits – Random test vectors-Serial, Single-fault propagation, Deductive, Parallel and Concurrent Simulation **Builtin self-test**: Scan-in Scan-out design – Signature analysis - Built-In Self-Test – Test pattern generation for BIST - Circular BIST – BIST Architectures - Testable Memory Design - Test algorithms – Test generation for Embedded RAMs **Fault diagnosis**: Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis **Verification**: Design verification techniques based on simulation, analytical and formal approaches-function verification-timing verification-formal verification-basics of equivalence checking and model checking- hardware emulation

Total Hours: 45

Text Books:

1 M. Abramovici M.A, Breuer and A.D Friedman, "Digital Systems Testing and Testable Design", Computer Sciences Press, 2002.
2 M.L. Bushnell and V.D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2002.

Reference Books:

1 P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002
2 Robert J.Feuguate, Jr. Steven M.Mcintyre, "Introduction to VLSI testing', Prentice Hall, Englewood Cliffs, 1998.
3 Kropf.T, "Introduction to Formal Hardware verification", Springer Verlag 1999
4 Rashinkar,Patterson and Singh, " System on chip verification methodology and techniques" Kluver academics, 2001
5 LaungTerngWang,Cheng Wen Wu, XiaoqingWen,"VLSI test principles and architectures" Morgan Kaufmann,2011.

Web References:

1 nptel.ac.in/downloads/116103116/

Online Resources:

1 www.ee.iitb.ac.in/~viren/Courses/2012/EE709.htm

Assessment Methods & Levels (based on Revised Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO.1	Understand	Quiz	2
CO.2	Understand	Group discussion	3
CO.3	Understand	Technical Presentation	4
CO.4	Apply	Group Assignment	5
CO.5	Understand	Test	4
CO.6	Understand	Quiz	2

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**EndSemester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	40	40	20	20
Apply	40	40	40	40
Analyse	20	20	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC411 **Digital Low Power VLSI Design** **3/0/0/3**

Nature of Course : G (Theory conceptual)
Pre requisites : 16EC322 VLSI Circuits

Course Objectives:

1 To clearly explain students for better understanding of the sources of power consumption
2 To cover low-power design methodologies at various design levels (from system level to transistor level).
3 To make the students to understand and adapt the design procedures to design circuit within power budget.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1 Understand the sources of power consumption in CMOS circuits. [U]
CO2 Apply simulation techniques to estimate both static and dynamic power consumption in CMOS circuits. [AP]
CO3 Apply mathematical models for theoretical analysis of power dissipation [AP]
CO4 Implement various power reduction techniques at various levels for power optimization. [AP]
CO5 Design a system which consumes power within the power budget limits. [AN]

Course Contents:

Introduction: Needs for Low Power VLSI Chips - Charging and Discharging Capacitance - Short-circuit Current in CMOS Circuit - CMOS Leakage Current - Static Current – Basic Principles of Low Power Design; **Simulation Power Analysis:** SPICE Circuit Simulation - Discrete Transistor Modelling and Analysis - Gate-level Logic Simulation - Architecture-level Analysis - Data Correlation Analysis in DSP Systems - Monte Carlo Simulation; **Probabilistic Power Analysis:** Random Logic Signals - Probability and Frequency - Probabilistic Power Analysis Techniques; **Circuit:** Transistor and Gate Sizing - Equivalent Pin Ordering – Network Restructuring and Reorganization - Special Latches and Flip-flops - Low Power Digital Cell Library - Adjustable Device Threshold Voltage; **Logic:** Gate Reorganization - Signal Gating - Logic Encoding - State Machine Encoding – Pre computation Logic; **Special Techniques:** Power Reduction in Clock Networks - CMOS Floating Node - Low Power Bus -Delay Balancing – Low Power Techniques for SRAM; **Architecture and System**: Power and Performance Management: Switching Activity Reduction - Parallel Architecture with Voltage Reduction - Flow Graph Transformation; **Advanced Techniques**: Adiabatic Computation - Pass Transistor Logic Synthesis - Asynchronous Circuits

Total Hours: 45

Text Books:

1 Gary Yeap, "Practical Low Power Digital VLSI Design", Springer US,Kluwer Academic Publishers, 2002

Reference Books:

1 Kaushik Roy, Sharat Prasad, "Low Power CMOS VLSI Circuit Design", 1stedition, Wiley-Interscience Publication, 2000
2 Anantha P. Chandrakasan, R. W. Brodersen, "Low Power Digital CMOS Design", Kluwer Academic Publishers, 1995
3 Kiat-Seng Yeo, Kaushik Roy, "Low Voltage Low Power VLSI Subsystems", Mc-Graw Hill India, 2009

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	4

CO2	Apply	Class presentation	4
CO3	Apply	Group assignment	4
CO4	Apply	Problem solving	4
CO5	Analyse	Simulation exercise	4

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA-I [6 marks]	CIA-II [6 marks]	Term End Examination [8 marks]	
Remembering	20	20	10	10
Understanding	60	40	40	40
Applying	20	40	30	30
Analysing	-	-	20	20
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC412 **Analog CMOS Circuit Design** **3/0/0/3**

Nature of Course : G (Theory analytical)
Pre requisites : 16EC322 VLSI Circuits
Course Objectives:

1. To teach students the fundamentals of analog/mixed-signal (analog & digital) circuit design.
2. To teach students to use commercial design tools for schematic entry, simulation, and layout close to the state of the art for analog design.
3. To prepare students for higher-level courses in analog & RF circuits, and analog-digital conversion.

Course Outcomes:
Upon completion of the course, students shall have ability to

CO1	Understand basic MOS device physics in deep triode region	[U]
CO2	Design MOSFET based analog integrated circuits	[AP]
CO3	Understand and appreciate the importance of noise and distortion in analog circuits	[AP]
CO4	Appreciate the trade-offs involved in analog integrated circuit design	[AN]
CO5	Analyse the performance of CMOS analog circuits atleast to the first order	[AN]

Course Contents:
Introduction to analog VLSI and mixed signal issues in CMOS technologies; Basic MOS models, SPICE Models and frequency dependent parameters; Basic NMOS/CMOS gain stage, cascade and Cascode circuits; Frequency response, stability and noise issues in amplifiers; CMOS analog blocks: Current Sources and Voltage references; Differential amplifier and OPAMP design; Frequency Synthesizers and Phased lock-loops; Non-linear analog blocks: comparators, charge-pump circuits and multipliers; Basics of data converters; Analog Testing and Layout issues; Low Voltage and Low Power Circuits; Introduction to RF Electronics.

Total Hours: 45

Text Books:

1. B. Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill 2001
2. P. E. Allen and D. R. Holberg, "CMOS Analog Circuit Design", 2nd edition, Oxford University Press, 1997

Reference Books:

1. B. Razavi, "RF Microelectronics", Prentice-Hall, 1998.
2. R. Jacob Baker, "CMOS Circuit Design, Layout, and Simulation", IEEE Press, 1997.
3. P. R. Gray and R. G. Meyer, "Analysis and design of Analog Integrated circuits",4th Edition, Wiley Student Edition, 2001.
4. David. A. Johns and K. Martin, "Analog Integrated Circuit Design", Wiley Student Edition, 2002.
5. A.S. Sedra& K.C. Smith, "Microelectronic Circuits", 5th/6th Ed., Oxford University Press.

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
C01,CO2, CO3,CO4	Understand, Apply	Problem Formulation	10
C05	Analyse	Simulation Exercise	10

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA-I [6 marks]	CIA-II [6 marks]	Term End Examination [8 marks]	
Remembering	-	-	-	-
Understanding	20	20	20	20
Applying	40	40	40	40
Analysing	40	40	40	40
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE COE CO-ORDINATOR HOD/ECE

16EC413 **CAD FOR VLSI CIRCUITS** **3/0/0/3**

Nature of Course :G (Theory analytical)
Pre- requisites :16EC305 Digital Electronics

Course Objectives:

1 To study various physical design methods in VLSI
2 To illustrate the concepts behind the VLSI design rules and routing techniques
3 To understand the concepts of various algorithms used for Floor planning and routing techniques
4 To analyse the simulation, synthesis and testing of systems.
5 To use the various modelling and synthesis algorithms for VLSI system

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Design various physical design methods using VLSI tools and algorithms	[U]
CO2	To interpret the design rule set to achieve optimization in routing and placement	[U]
CO3	Compare and contrast the various routing algorithms in floorplanning	[A]
CO4	To analyze different levels of simulation and synthesis in VLSI circuits	[A]
CO5	To construct various hardware modelling and synthesis algorithms	[AP]

Course Contents:

VLSI design methodologies: Introduction to VLSI design methodologies- review of data structures and algorithms – review of VLSI design automation tools - algorithmic graph theory and computational complexity-tractable and intractable problems–general purpose methods for combinatorial optimization. **Design rules:** Layout compaction - design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning – circuit representation - placement algorithms – partitioning. **Floor planning:** floor planning concepts-shape functions and floor plan sizing – types of local routing problems – area routing – channel routing – global routing – algorithms for global routing. **Simulation levels:** Simulation - gate-level modelling and simulation - switch-level modelling and simulation- combinational logic synthesis - binary decision diagrams - two level logic synthesis. **Modelling and Synthesis:** High level synthesis - hardware models-internal representation - allocation assignment and scheduling - simple scheduling algorithm - assignment problem – high level transformations.

Total Hours: 45

Reference Books:

1 S.H.Gerez, "Algorithms for VLSI Design Automation",JohnWiley&Sons,2002.
2 SadiqM.Sait,Habibyoussef, "VLSI Physical design automation: Theory and practice", World scientific 1999.
3 N.A.Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers,2002.
4 StevenM.Rubin, "ComputerAidsforVLSIDesign",AddisonWesleyPublishing, 1987.
5 Trimburger, " Introduction to CAD for VLSI", Kluwer Academic publisher, 2002
6 A.Kuehlmann, The Best of ICCAD:20years of Excellence in computer-Aided Design,Springer, 2003.
7 E. Lawler, "Combinatorial Optimization : Networks and Matroids", Dover, 2001
8 R. Raghuram, "Computer Simulation of Electronic Circuits", Wiley, 1989.

Web References:

1 www.rulabinsky.com › cavd
2 http:// 2www.ee.iitm.ac.in/vlsi/courses/ee5390_2014/
3 IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems

Online Resources:

1 www.nptel.ac.in/courses/106106088
2 www.nptel.ac.in/courses/106106089

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1,CO2	Understand	Quiz	5
CO3	Analyze	Mini Project	5
CO.5	Apply	Class presentation	5
CO4	Analyse	Problem solving	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	-	-		
Understanding	100	40	40	40
Applying	-	-	20	20
Analysing	-	60	40	40
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC414 **SOC DESIGN** **3/0/0/3**

Nature of Course : G (Theory analytical)
Pre requisites : 16EC321 Embedded Systems

Course Objectives:

1 To design combinational and sequential logic networks.
2 To learn optimization of power in combinational and sequential logic machines.
3 To study the design principles of FPGA and PLA.
4 To learn various floor-planning methods for system design.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Design combinational and sequential logic networks.	[AP]
CO2	Interpret optimization of power in combinational and sequential logic machines	[U]
CO3	Analyse design principles of FPGA and PLA.	[AN]
CO4	Articulate various floor-planning methods for system design.	[AP]

Course Contents:

Introduction. Combinational Logic Functions. Static Complementary Gates. Switch Logic. Alternative Gate Circuits. Low-Power Gates. Delay Through Resistive Interconnect. Delay Through Inductive Interconnect. Objectives. Introduction to Combinational Logic, Standard Cell-Based Layout. Simulation. Combinational Network Delay. Logic andinterconnectDesign.PowerOptimization.SwitchLogicNetworks.CombinationalLogicTesting. Introduction to Sequential Machines. Latches and Flip-Flops. Sequential Systems and Clocking Disciplines. SequentialSystemDesign.PowerOptimization.DesignValidation.SequentialTesting. Introduction to subsystem design, Subsystem Design Principles. Combinational Shifters. Adders. ALUs. Multipliers. High-Density Memory. Field Programmable Gate Arrays. Programmable Logic Arrays. References. Problems. Introduction to floor planning, Floor-planning Methods –Block Placement &Channel Definition, Global Routing, switchbox Routing, Power Distribution, Clock Distributions, Floor-planning Tips, Design Validation. Off-Chip Connections–Packages, The I/O Architecture, PAD Design.

Total Hours: 45

Text Books:

1 Wayne Wolf, "Modern VLSI Design –System–on–Chip Design", Prentice Hall, 3rdEdition, 2008.

Reference Books:

1 Wayne Wolf, "Modern VLSI Design– IP based Design", Prentice Hall, 4th Edition, 2008.
2 Michael .J. Flynn, Wayne Luk , " Computer System Design: System-on-Chip", Wiley Publications 2011.

Web References:

1 http://internetofthingsagenda.techtarget.com/definition/system-on-a-chip-SoC
2 https://www.digikey.com/products/en/Integrated-Circuits-(ICs)/Embedded-System-On-Chip-(SoC)/777
3 http://www.in.techradar.com/news/computing/pc/System-on-a-Chip-what-you-need-to-know-about-SoCs/articleshow/38832265.cms

Online Resources:

1 http://freevideolectures.com/Course/2341/Embedded-Systems/10
2 http://nptel.ac.in/courses/108102045/10
3 http://www.learningace.com/doc/1040548/20e3eea382ce4dea2cb6ca21a8b945

23/lecture-10-system-on-chip-soc

4 http://www.dauniv.ac.in/downloads/EmbsysRevEd_PPTs/Chap01Lesson_7Emsys.pdf

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Apply	Problem solving	**5**
CO2	Understand	Quiz	**5**
CO3	Analyse	Mini Project	**5**
CO4	Apply	Problem solving	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	-	-	-	-
Understanding	80	70	60	30
Applying	20	20	20	40
Analysing	-	10	20	30
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC415 **COMPUTER ARCHITECTURE** **3/0/0/3**

Nature of Course : (Theory)
Pre requisites :16EC305 Digital Electronics

Course Objectives:

1 To understand aspects of computer architecture and program performance.
2 To provide essential understanding of different subsystems of modern computer system and design aspects these subsystems.
3 To understand the stages in instruction life cycle.
4 To understand performance enhancement methods in instruction execution.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1 Ability to identify the basic components and design of a computer, including CPU, memories, and input/output units. [U]
CO2 Ability to identify the issues involved in the instruction execution and various stages of instruction life stage. [U]
CO3 Ability to identify the issues related to performance improvement. [AP]
CO4 Ability to distinguish performance tradeoff between different memory units and instruction sets. [AN]

Course Contents:

Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set, Instruction set architecture CISC, RISC, Case study – instruction sets of common CPUs ,CPU Subblock, Datapath – ALU, registers, CPU buses; Control unit design: hardwired and micro-programmed design approaches; **Memory system design**: semiconductor memory technologies, memory organization, cache memory hierarchy; **Peripheral devices and their characteristics:** Input-output subsystems, I/O transfers – program controlled, interrupt driven and DMA, Secondary storage devices , Privileged and non-privileged instructions, software interrupts and exceptions, Programs and processes – role of interrupts in process state transitions; **Pipelining**: Basic concepts of pipelining, throughput and speedup, pipeline hazards, Introduction to superscalar processors architecture: parallel pipelines, out of order execution, branch prediction, Introduction multithreaded processors architecture and multicore processors architecture

Total Hours: 45

Text Books:

1 Patterson, D. A. & Hennessy, J. L. (2013), "Computer Organization and Design: The Hardware/ Software Interface", Elsevier Science.
2 Hamachar, C., Vranesic, Z. and Zaky, S., (2002), "Computer Organization", McGraw-Hill.

Reference Books:

1 Hayes, J. P., (1998), "Computer Architecture and Organization", McGraw-Hill.
2 Stallings, W. (2008), "Computer Organization and Architecture: Designing for Performance", Pearson Education.
3 Heuring, V. P. & Jordan, H. F., (2008), "Computer Systems Design and Architecture", Pearson Education.
4 Shen, J. P. &Lipasti, M. H., (2013), "Modern Processor Design: Fundamentals of Superscalar Processors", Tata McGraw-Hill.

Web References:

1 http://www. gem5.com
2 http://www. simplescalar.com

Online Resources:

1 http://www.nesoacademy.org/computerorganization and architecture

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Seminar	5
CO2	Understand	Quiz	5
CO3	Understand	Quiz	5
CO4	Understand	Assignment	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	30	30	40	40
Apply	70	40	40	40
Analyse	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC416 **ARM PROCESSOR ARCHITECTURE & PROGRAMMING** **3/0/0/3**

Nature of Course : [Theory]

Pre requisites : 16EC321 Embedded Systems

Course Objectives:

1. To study the concepts of Architecture and Assembly language programming of ARM Processor.
2. To study the concepts of Architectural Support for High level language and memory Hierarchy.
3. To study the concepts of Architectural support for system Development and Operating system.
4. To learn the application development with ARM processor.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Understand the features of ARM processors and identify suitable co-processor interface to ARM processor	[U]
CO2	Analyse the ARM instruction set and apply them to write small optimized programs using assembly language and explore support for higher level language.	[AN]
CO3	Identify the architectural support of ARM for operating system, floating point operations, memory management and system development.	[AP]
CO4	Understand the concepts of ARM Cortex microcontrollers.	[U]

Course Contents:

ARM Architecture: Abstraction in hardware design – MUO -Acorn RISC Machine – Architecture Inheritance – ARM programming model – ARM Development Tools – 3 and 5 Stage Pipeline ARM Organization – ARM Instruction Execution and Implementation – ARM Co-Processor Interface; **ARM Assembly Language programming:** ARM Instruction Types – data Transfer, Data Processing and Control Flow Instructions – ARM Instruction set – Co-Processor Instruction; **Architectural Support for High Level Language and Memory Hierarchy:** Data Types – Abstraction in software design – expressions – Loops – Functions and Procedures – Conditional Statements – use of memory- Memory size and speed – On Chip Memory – Caches, Design – an example –Memory management; **Architectural support for system Development:** Advantaged Microcontroller Bus Architecture – ARM memory Interface – ARM Reference Peripheral Specification – Hardware System Prototyping Tools – Emulator – Debug Architecture; **Introduction to ARM cortex:** Cortex M architecture –software development process-ARM Cortex M assembly language.

Total Hours: **45**

Text Books:

1. Steve Furber, "ARM System on Chip Architecture", Addison –Wesley Professional, 2000.
2. Jonanthanan Valvano W "Embedded systems: Introduction to ARM Cortex M microcontrollers", Createspace independent publishing, Fifth edition, June 2014.

Reference Books:

1. Ricardo Reis, "Design of System on a Chip: Devices and Components", Springer, 2004.
2. Jason Andrews, "o-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology), ewnes, BK and CD-ROM", Aug 2004.
3. William Hohl, "ARM Assebly Language Fundamentals and Techniques".

Web References:

1 http://infocenter.arm.com/help/index.jsp?topic=/com.arm.doc.set.swdev/index.html
2 http://www.dauniv.ac.in/downloads/MController_PPTs/MicroC2_eCh15L08ARMDeveloPmentTools.pdf

Online Resources:

1 http://nptel.ac.in/courses/108102045/5
2 http://nptel.ac.in/courses/117106111

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	5
CO2	Analyze	Quiz	5
CO3	Apply	Seminar	5
CO4	Understand	Assignment	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering				
Understanding	80	40	30	30
Applying	20	60	40	40
Analysing	-	-	30	30
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC417 **SENSORS FOR INDUSTRIAL APPLICATIONS** **3/0/0/3**

Nature of Course : [Theory]
Pre requisites : 16EC302 Electron Devices

Course Objectives:

1 To study the sensor characteristics and the fundamental principles of Sensing.
2 To understand the sensor interface electronics.
3 To study selected motion-related sensors.
4 To study light and radiation detectors.
5 To study selected temperature sensors and selected chemical sensors.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Understand about the sensor characteristics and the fundamental principles of sensing.	[U]
CO2	Interpret the concepts of optical components and interface electronics.	[U]
CO3	Apply the concepts of motion and occupancy related sensors.	[AP]
CO4	Apply the concepts of light and radiation detectors.	[AP]
CO5	Utilize the concepts of temperature and chemical sensors.	[AP]

Course Contents:

PRINCIPLES OFSENSING - Data Acquisition – sensor characteristics – electric charges, fields, potentials – capacitance – magnetism – inductance – resistance – piezoelectric – pyroelectric – Hall effect – thermoelectric effects – sound waves – heat transfer – light – dynamic models of sensors. **OPTICAL COMPONENTS AND INTERFACE ELECTRONICS-**Radiometry – Photometry – mirrors – lenses – fibre optics – concentrators – Interface circuits –amplifiers – light-to-voltage – excitation circuits – ADC – Digitization – Capacitance-to-voltage –bridge circuits – data transmission – noise in sensors and circuits – calibration – low power sensors. **MOTION RELATED SENSORS-**Occupancy and motion detectors: ultrasonic – microwave – capacitive detectors – triboelectric –Optoelectronic motion sensors – optical presence sensor – Pressure Gradient sensors Velocity and acceleration sensors: Accelerometer characteristics – capacitative accelerometers –Piezoelectric accelerometers – piezoresistive accelerometers – thermal accelerometers –Gyroscopes – piezoelectric cables – gravitational sensors. **LIGHT AND RADIATION DETECTORS-**Light Detectors: Photo diodes – photo transistor – photo resistor – cooled detectors – CCD and CMOS image sensors – thermal detectors – optical design – gas flame detectors Radiation Detectors: scintillating detectors – ionization detectors – cloud and bubble chambers. **TEMPERATURE AND CHEMICAL SENSORS-**Temperature Sensors: coupling with objects – temperature reference points – thermo resistive sensors – thermo electric contact sensors – semiconductor sensors – acoustic sensors –piezoelectric sensors Chemical sensors: characteristics – classes of chemical sensors – biochemical sensors – multisensory arrays – electronic noses and tongues

Total Hours: **45**

Text Books:

1 Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Applications", Fourth Edition, Springer, 2010.

Reference Books:

1 Jon Wilson, "Sensor Technology Handbook", 1st Edition, Elsevier, Dec 2004.
2 D.Patranabis, "Sensors and Transducers", Prentice Hall of India, 2004.
3 John Vetelino, AravindReghu, "Introduction to Sensors", CRC Press 2010.
4 John P. Bentley, "Principles of Measurement Systems", 4th Edition,Pearson Education, 2005.
5 E.A. Doebelin, "Measurement Systems – Applications and Design", Tata McGraw Hill, New York, 2012.

Web References:

1 http://courses.csail.mit.edu/6.141/spring2011/pub/lectures
2 http://web.eecs.umich.edu/~jfr/embeddedctrls/files

Online Resources:

1 http://nptel.ac.in/courses/112103174/3

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	5
CO2	Analyze	Mini Project	10
CO3	Apply		
CO4	Apply	Assignment	5
CO5	Understand		

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering				
Understanding	70	30	30	30
Applying	30	70	40	40
Analysing	-	-	30	30
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC418 **AUTOMOTIVE ELECTRONICS** **3/0/0/3**

Nature of Course :C (Theory)
Pre requisites :16EC302 Electronic Devices

Course Objectives:

1 To instill a fundamental understanding of various batteries and other electronic systems inside an automobile.
2 To study about the ignition system.
3 Understand all the sensors and actuators used in automotive systems.
4 To Introduce electronic engine control system and its Control modules.
5 To allow students to get familiarized with the concept of Lighting System.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1 Understand the concepts of Batteries and operation of various Ignition Systems [U]
CO2 Analyse the operation of Sensors and Actuators in various application [AN]
CO3 Use the concepts of engine control module and power train control module in automotive systems [U]
CO4 Understand the operation of Lighting System [U]
CO5 Analyse the Horn, wiper system and trafficator fuses, cables, connectors in an automobile system. [AN]

Course Contents:

Batteries: Lead acid and alkaline batteries, battery rating, **Ignition System:**electronic ignition system, capacitor discharge ignition system, distributorless ignition system, **Sensors And Actuators**: Classification of sensors, sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors and relay. **Electronic Engine Controls:** Concept of an electronic engine control system, electronic fuel injection –throttle body fuel injection, multi point fuel injection, gasoline direct injection, common rail direct injection, electronic ignition control, engine mapping, on-board diagnostics –engine control module and power train control module. **Lighting System:** Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Horn, wiper system and trafficator fuses, cables, connectors and selection.

Total Hours: 45

Text Books:

1 Robert Bosch, "Bosch Automotive Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive" Springer View ,Plochingen, Germany, 2014.
2 William B Ribbens,"Understnading Automotive Electronics-An Engineering Persepective", The Boulevard, Langford Lane, Kidlington, Oxford, 2014

Reference Books:

1 Barry Holembeak, "Automotive Electricity and Electronics" Delmar Publishers, Clifton Park, USA, 2010.
2 James D Halderman, "Automotive Electricity and Electronics" Prentice Hall, USA, 2013.
3 Al Santini, "Automotive Electricity and Electronics" Delmar Learning, 2011.

Assessment Methods & Levels (based on Revised Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	5
CO2	Analyse	Group Assignment	5
CO3	Understand	Class Presentation/Case Study	5
CO4	Understand		
CO5	Analyse	Mini Project	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	70	70	60	60
Apply	-	-	-	-
Analyse	30	30	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC419 **REAL-TIME OPERATING SYSTEMS** **3/0/0/3**

Nature of Course : C (Theory)
Pre requisites : 16EC321 Embedded Systems

Course Objectives:

1 To make students understand the concepts of real time embedded systems.
2 To learn the need for RTOS in embedded systems and comparison of different RTOS.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Understand the basic concepts of embedded operating system.	[U]
CO2	Describe various scheduling methods.	[AP]
CO3	Understand the concepts of Real time Linux.	[U]
CO4	Analyze various case studies relating its applications.	[AN]

Course Contents:

Introduction to RTOS: Defining RTOS, The Scheduler - Objects, Services - Characteristics of RTOS - Defining a Task - Tasks States and Scheduling - Task Operations -Process Synchronization- Message queues– Mail boxes -Pipes – Critical section – Defining Semaphores - Operations and Semaphores uses – Classical synchronization problem–Deadlocks- Event Registers – Signals - Other Building Blocks. **Scheduling Method:** Clock driven Approach - Weighted round robin Approach - Priority driven Approach - Dynamic Versus Static systems - Effective release times and deadlines - Optimality of the Earliest deadline first (EDF) algorithm - Challenges in validating timing constraints in priority driven systems - Off-line Versus On-line scheduling. **Real-Time Linux:** Linux and Real-Time - Real-Time Programming in Linux - Hard Real-time Linux - Building and Debugging - Building the Kernel- Integrated Development Environment - Kernel Debuggers - Embedded Drivers – Board support packages – Introduction to µClinux. **RTOS Applications:** Casestudies-RTOSforImageProcessing–EmbeddedRTOSforNetworkcommunication – RTOSforfault-TolerantApplications–RT Linux, MicroC/ OS-II, VxWorks.

Total Hours: **60**

Text Books:

1 Qing Li, "Real-Time Concepts for Embedded Systems", Elsevier - CMP Books, 2003.
2 Jane.W.S. Liu, "Real-Time systems", Pearson Education Asia, 2000.
3 Dr.CraigHollabaugh, "Embedded Linux: Hardware, Software and Interfacing" Pearson Education Asia, 2004.

Reference Books:

1 Richard Stevens, "Advanced UNIX Programming", Pearson Education Asia, 6th Edition 2009.
2 Silberschatz,Galvin,Gagne"OperatingSystem Concepts,6th ed,JohnWiley,2003
3 HermaK.,"Real TimeSystems– Designfor distributedEmbeddedApplications", KluwerAcademic,1997.
4 C.M.Krishna,Kang,G.Shin,"Real TimeSystems",McGrawHill,1997.
5 RaymondJ.A.Bhur,DonaldL.Bailey,"AnIntroductiontoReal TimeSystems",PHI.

Web References:

1 http://www.ebooklibrary.org/articles/rtos
2 http://bookboon.com/en/paulos-part-ii-ebook

Online Resources:

1 http://web.mit.edu/16.070/www/year2001/RTOS27.pdf

2 http://www.freertos.org/about-RTOS.html
3 http://freevideolectures.com/Course/3049/Real-Time-Systems#
4 http://nptel.ac.in/courses/106105036/
5 http://iiscs.wssu.edu/drupal/node/4450
6 http://nptel.ac.in/downloads/106105086/
7 http://www2.fsr.ba/nastava/sven/sven.pdf
8 http://www.dauniv.ac.in/downloads/EmbsysRevEd_PPTs/Chap_9Lesson01EmsysNewRTOSes.pdf

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)				
Formative assessment based on Capstone Model (Max. Marks:20)				
Course Outcome	**Bloom's Level**		**Tentative Assessment Component**	**Marks**
CO1	Understand		Quiz	5
CO2	Understand		Quiz	5
CO3	Understand		Seminar	5
CO4	Analyze		Assignment	5
Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	40	35	30	30
Apply	60	40	40	40
Analyse		25	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC420 ADVANCED MICROPROCESSOR AND MICROCONTROLLER 3/0/0/3

Nature of Course : (Theory)
Pre requisites : 16EC315 Microcontrollers & Interfacing

Course Objectives:

1 To introduce the concepts in internal programming model of Intel family of microprocessors.
2 To introduce the programming techniques using MASM, DOS and BIOS function calls.
3 To introduce the basic architecture of Pentium family of processors.
4 To introduce the architecture programming and interfacing of 16 bit microcontrollers.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Understand the fundamentals of advanced microprocessor architecture.	[U]
CO2	Describe the modular programming and its concepts	[U]
CO3	Develop assembly language programs for 16 bit Microcontroller.	[C]
CO4	Interface peripheral devices with 16 bit microcontroller	[AN]
CO5	Describe internal blocks of RISC Processor	[U]

Course Contents:

Advanced Microprocessor Architecture: Internal Microprocessor Architecture-Real mode memory addressing – Protected Mode Memory addressing –Memory paging - Data addressing modes – Program memory addressing modes – Stack memory addressing modes – Data movement instructions – Program control instructions- Arithmetic and Logic Instructions **Modular Programming And Its Concepts:** Modular programming –Using keyboard and Video display –Data Conversions- Disk files- Interrupt hooks- using assembly languages with C/ C++. **Pentium Processors:** Introduction to Pentium Microprocessor–Special Pentium registers-Pentium memory Management – New Pentium Instructions –Pentium Processor –Special Pentium pro features – Pentium 4 processor. **16-Bit Micro Controller:** 8096/8097 Architecture-CPU registers –RALU-Internal Program and Data memory Timers-High speed Input and Output –Serial Interface-I/O ports –Interrupts –A/D converter-Watch dog timer –Power down feature –Instruction set- External memory Interfacing –External I/O interfacing. **RISC Processors and ARM:** RISC revolution–Characteristics of RISC Architecture – Berkeley RISC– Register Windows – Windows and parameter passing–Window overflow–RISC architecture and pipelining– Pipeline bubbles–Accessing external memory in RISC systems–Reducing the branch penalties–Branch prediction –ARM processors–ARM registers–ARM instructions–ARM built-in shift mechanism –ARM branch instructions– sequence control–Data movement and memory reference instructions

Total Hours: 45

Text Books:

1 Barry B.Brey, "The Intel Microprocessors 8086/8088, 80, 86, 80286, 80386 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and interfacing" , Prentice Hall of India Private Limited, New Delhi, 2003.
2 John Peatman, " Design with Microcontroller" , McGraw Hill Publishing Co Ltd, New Delhi
3 Alan Clements, "The principles of computer Hardware", Oxford University Press, 3rd Edition, 2003.

Reference Books:

1 Rajkamal, "The concepts and feature of micro controllers 68HC11, 8051 and 8096" ,S Chand Publishers, New Delhi.

Web References:

1 www.kopykitab.com/Advanced-Microprocessor-Notes-eBook

2 http://www.newagepublishers.com/servlet/nagetbiblio?bno=000030

Online Resources:

1 https://christinatuckertech.files.wordpress.com/.../advanced-microprocessor-and-micrcontroller.

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	4
CO2	Understand	Quiz	4
CO3	Create	Group Assignment	4
CO4	Analyse	Class Presentation/Power point presentation	4
CO5	Understand	Classroom or Online Quiz	4

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	20
Understand	60	60	50	40
Apply	-	-	-	-
Analyse	20	20	30	40
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE** **COE**

16EC421 **EMBEDDED LINUX** **3/0/0/3**

Nature of Course :Theory
Pre requisites :16CS201 Problem Solving Techniques and C Programming

Course Objectives:

1. To expose the fundamentals of Linux Operating system, its basic commands and shell programming.
2. To teach the history of embedded Linux, various distributions and basics of GNU Cross Platform Tool Chain.
3. To study on different Host-Target setup, debug and various memory devices, file systems and performance tuning.
4. To introduce the concept of configuring kernel using the cross-platform tool chain.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Describe the basic concepts and tools of Linux.	[U]
CO2	Outline the various distribution platform for Linux.	[U]
CO3	Explain the basics of Linux architecture.	[U]
CO4	Use the system design techniques to develop Kernel program for embedded systems.	[AP]
CO5	Differentiate between the general purpose and Linux driver.	[AN]

Course Contents:

FUNDAMENTALS OF LINUX Basic Linux System Concepts: Working with Files and Directories - Introduction to Linux File system -Working with Partitions and File systems - Understanding Linux Permissions; Using Command Line Tools: Executing Commands from the Command Line - Getting to a Shell - Popular Command-Line Commands - Working with the Bash Shell **VARIOUS DISTRIBUTIONS AND CROSS PLATFORM TOOL CHAIN** Introduction - History of Embedded Linux - Embedded Linux versus Desktop Linux – Commercial Embedded Linux Distribution - Choosing a distribution - Embedded Linux Distributions – Architecture of Embedded Linux - Linux Kernel Architecture - Porting Roadmap - GNU Cross Platform Tool chain **HOST-TARGET SETUP AND OVERALL ARCHITECTURE** Real Life Embedded Linux Systems - Design and Implementation Methodology - Types of Host/Target Development Setups - Types of Host/Target Debug Setups - Generic Architecture of an Embedded Linux System – System Startup - Types of Boot Configurations - System Memory Layout -Processor Architectures - Buses and Interfaces - I/O – Storage **KERNEL CONFIGURATION** A Practical Project Workspace - GNU Cross-Platform Development Tool chain - C Library Alternatives - Other Programming Languages - Eclipse: An Integrated Development Environment – Terminal Emulators - Selecting a Kernel - Configuring the Kernel - Compiling the Kernel - Installing the Kernel - Basic Root Files system Structure - Libraries - Kernel Modules and Kernel Images - Device Files – Main System Applications - System Initialization **LINUX DRIVERS** Introduction in to basics on Linux drivers, introduction to GNU cross platform Tool chain- Case study on programming one serial driver for developing application using Linux Driver

Total Hours: **45**

Text Books:

1. KarimYaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, "Building Embedded Linux Systems 2nd Edition", O'Reilly Publications, 2008
2. P.Raghavan, AmolLad,SriramNeelakandan,"Embedded Linux System Design & Development", Auerbach Publications, 2012

Reference Books:

1. William von Hagen, "Ubuntu Linux Bible 3rd Edition", Wiley Publishing Inc., 2010
2. Jonathan Corbet, Alessandro Rubini& Greg Kroah-Hartman, "Linux Device Drivers 3rd Edition", O'Reilly, 2011

Web References:

1 http://elinux.org/
2 http://www.linux-drivers.org/

Online Resources:

1 http://nptel.ac.in/courses/117106113/

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	4
CO2	Understand	Quiz	4
CO3	Understand	Quiz	4
CO4	Apply	Group Assignment	4
CO5	Analyse	Case study 1	4

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	30	30	40	40
Apply	70	40	40	40
Analyse	-	30	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC422 **NEXT GENERATION NETWORKS** **3/0/0/3**

Nature of Course : Theory
Pre requisites :16EC318 Computer networks & Interfacing
Course Objectives:

1 To learn the technical, economic and service advantages of next generation networks.
2 To learn the basic architecture of the next generation network (NGN).
3 To understand NGN services.
4 To learn the role of IP Multimedia Sub-system (IMS), network attachment and admission control functions.
5 To learn and compare the various methods of providing connection-oriented services over a NGN with reference to MPLS, MPLS-TE and T-MPLS.

Course Outcomes:
Upon completion of the course, students shall have ability to

CO.1	Design routing mechanism meeting the desired QoS in NGN.	[AN]
CO.2	Design network management protocols in NGN.	[AN]
CO.3	Understand the various methods of providing connection-oriented services over a NGN with reference to MPLS, MPLS-TE and T-MPLS.	[U]
CO.4	Compare various NGN virtual network services with reference to VPNs, VLANs, pseudo wires, VPLS and typical applications.	[AP]
CO.5	Design NGN MANAGEMENT.	[AN]

Course Contents:
INTRODUCTION - Evolution of public mobile services - motivations for IP based services, Wireless IP network architecture – 3GPP packet data network architecture. Introduction to next generation networks - Changes and Opportunities future Trends. **IMS AND CONVERGENT MANAGEMENT** - IMS Architecture - IMS services, QoS Control and Authentication. Next Generation OSS Architecture - standards important to OSS architecture, Information framework, OSS interaction with IMS. **MPLS AND VPN** - Technology overview – MPLS &QoS, MPLS services and components –layer 2 VPN, layer 2 internetworking, VPN services, signalling, layer 3 VPN – Technology overview, Remote Access and IPsec integration with MPLS VPN. **MULTICAST** - MPLS Multicast VPN overview – Applications, examples, IPv6 and MPLS- Technology overview, Future of MPLS –Integrating IP and optical networks. **NGN MANAGEMENT** - Network Management and Provisioning – Configuration, Accounting, performance, security, case study for MPLS

Total Hours: 45

Text Books:

1 Thomas Plavyk, "Next generation Telecommunication Networks", Services and Management", Wiley & IEEE Press Publications, 2002.
2 Neill Wilkinson, "Next Generation Network Services", John Wiley Publications, 2002.

Reference Books:

1 Monique J. Morrow, "Next Generation Networks", CISCO Press, 2007.
2 Robert Wood, "MPLS and Next Generation Networks: Foundations for NGN and Enterprise Virtualization", CISCO Press, 2006.

Web References:

1 http://nptel.ac.in/syllabus/117101050/
2 http://www.icc-uk.com/interconnection-master-class.php

Online Resources:

1 https://www.edx.org/course/4g-network-essentials-imtx-net02x

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO.1	Analyse	Group Assignment	5
CO.2	Analyse	Technical Quiz	5
CO.3	Understand		
CO.4	Apply	Group Assignment	5
CO.5	Analyse	Case study 1	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	-	-	-	10
Understanding	30	30	20	40
Applying	70	40	40	30
Analysing	-	30	40	20
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC423 **WIRELESS SENSOR NETWORKS** **3/0/0/3**

Nature of Course : C (Theory Concept)
Pre requisites : 16EC318- Computer Networks & Interfacing

Course Objectives:

1. To obtain a broad understanding of the technologies and applications for the emerging and exciting domain of wireless sensor networks.
2. To study the challenges and latest research results related to the design and management of wireless sensor networks.
3. To focus on network architectures and security.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Understand the basic concepts of Wireless sensor networks and its enabling technologies.	[U]
CO2	Apply architecture and elements of wireless sensor networks for different functions.	[AP]
CO3	Analyse the performance of MAC and routing protocols in wireless sensor networks.	[AN]
CO4	Apply the design principles, tools and platforms to establish various applications in Wireless Sensor Networks	[AP]

Course Contents:

Overview of Wireless Sensor Networks: Challenges for Wireless Sensor Networks - Enabling Technologies for Wireless Sensor Networks – Architecture: 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, Gateway Concepts - Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, Routing Protocols: Energy-Efficient unicast - Broadcast and multicast, Geographic Routing. Mobile nodes, Topology-control: Aspects of topology-control algorithms - Time Synchronization: Introduction to the time synchronization problem - Protocols based on sender/receiver synchronization - Localization and Positioning, Single-hop localization - Positioning in multihop environments. Operating Systems for Wireless Sensor Networks: Operating System Design Issue - Examples of Operating Systems: TinyOS, Mate, MagnetOS, MANTIS, and OSPM.

Total Hours: 45

Text Books:

1. Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks ", John Wiley,2005.
2. KazemSohraby, Daniel Minoli and TaiebZnati, "Wireless Sensor Network-Technology, Protocolsand Applications", John Wiley, 2007

Reference Books:

1. Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks - An Information Processing Approach", Elsevier, 2007.
2. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
3. BhaskarKrishnamachari, "Networking Wireless Sensors", Cambridge Press, 2005.

Web References:

1. www.tfb.edu.mk/amarkoski/WSN/Kniga-w02
2. http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf

Online Resources:

1. http://ceng.usc.edu/~bkrishna/research/talks/WSN_Tutorial_Krishnamachari_ICISIP05.pdf
2. http://ijcttjournal.org/Volume4/issue-8/IJCTT-V4I8P194.pdf

Assessment Methods & Levels (based on Revised Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	4
CO2	Apply	Group Assignment	4
CO3	Analyse	Simulation Exercise	8
CO4	Apply	Group Assignment	4

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	20	10	20	20
Apply	80	40	30	30
Analyse	-	50	50	50
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC424 **BODY AREA NETWORKS** **3/0/0/3**

Nature of Course :C (Theory Concept)

Pre requisites : 16EC318 Computer Networks & Interfacing

Course Objectives:

1 To Introduce the basic concepts of body area networks
2 To Provide insight in the concepts of hardware development and systems for BAN
3 To Enable students to know about the protocols for BAN.
4 To Emphasis the role of antennas for BAN applications
5. To Realize the importance of Ultra wideband for BAN.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Acquire the knowledge in the basic standards of the networking principles	[U]
CO2	Understand the Architecture, Hardware design and Antenna modelling of WBAN system	[U]
CO3	Apply design methodology in implanted sensor nodes of WBAN system	[AP]
CO4	Analyze the performance of MAC Protocol in WBAN	[AN]
CO5	Understand the protocol and perform analysis of WBAN	[U]

Course Contents:

Concepts of body area networks: Introduction to WBAN- Physical Layer Wireless Technologies used in WBAN Applications -Architecture-Drawback of WBAN; **Ultra wideband for BAN:** Introduction-Advantages and limitations of UWB for WBAN-UWB hardware development-PHY layer for UWB WBAN-UWB WBAN Application-Design and Implementation of an UWB -WBAN System. **Hardware development and system for BAN**: Wireless body sensors-Sensor nodes and hardware designs-Wireless systems and platforms-Wireless transceivers and microcontrollers-Existing sensor boards-Design of implanted sensor nodes for WBAN-WBAN Systems- Software programs and monitoring; **Antennas for BAN:** Antenna parameters, Implanted Antennas and volume conduction antennas; **Protocols for BAN:** Network topologies and configuration-Basics of MAC protocol-Traffic characteristics-Scheduled protocol-Random access protocol-Hybrid MAC protocol-Energy management in WBAN-Performance analysis of WBAN.

Total Hours: **45**

Text Books:

1 Mehmet. R.Yuce, Jamil Khan "Wireless Body Area Networks: Technology, Implementation and Applications", Pan Stanford Publishers, 1st edition, 2011.

2 Thotahewa, Kasun Maduranga Silva, Redouté, Jean-Michel, Yuce, Mehmet Rasit "Ultra Wideband Wireless Body Area Networks",Springer,2014.

Reference Books:

1 Huan-Bang Li, Kamya Yekeh Yazdandoost Bin-Zhen, "Wireless Body Area Networks", River Publishers, 2010.
2 Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks", First Edition, Pearson Education, 2003.
3 Mark Andrew Hanson, Amy Nicole Miller, "Wireless Body Area Sensor Network Technology For Motion Based Health Assessment"

Web References:

1 https://arxiv.org/abs
2. https://www.howstuffworks.com

Online Resources:

1 http://www.sciencedirect.com

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Mini-Project Presentation	20
CO2	Understand		
CO3	Apply		
CO4	Analyse		
CO5	Understand		

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	-	-	-	-
Understanding	100	50	20	20
Applying	-	50	40	40
Analysing	-	-	40	40
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC425 **SMART ANTENNAS** **3/0/0/3**

Nature of Course : (Theory)

Pre requisites : 16EC323 - Antenna and Wave Propagation

Course Objectives:

1 To understand aspects of smart antenna radiation properties.
2 To provide essential understanding of narrow band signal processing.
3 To understand the aspects of adaptive and broad band signal processing.
4 To provide essential understanding of direction of arrival estimation and diversity combining.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Illustrate the basic components and design of a smart antennas	[U]
CO2	Utilize the Narrowband Signal Processing in optimization	[AP]
CO3	Construct algorithms using Adaptive and Broadband Signal Processing	[AP]
CO4	Distinguish the performance of Direction of Arrival Estimation and Diversity Combining	[AN]

Course Contents:

Introduction: Antenna gain, Phased array antenna, power pattern, beam steering, degree of freedom, optimal antenna, adaptive antennas, smart antenna - key benefits of smart antenna technology, wide band smart antennas, Digital radio receiver techniques and software radio for smart antennas. **Narrow Band Processing:** Signal model conventional beamformer, null steering beamformer, optimal beamformer, Optimization using reference signal, beam space processing. **Adaptive Processing:** Sample matrix inversion algorithm, unconstrained LMS algorithm, normalized LMS algorithm, Constrained LMS algorithm, Perturbation algorithms, Neural network Approach, Adaptive Beam Space Processing, Implementation Issues.

Broadband Processing: Tapped delay line structure, Partitioned realization, Derivative constrained processor, Digital beam forming, Broad band processing using DFT method.

Direction Of Arrival Estimation Methods: Spectral estimation methods, linear prediction method, Maximum entropy method, Maximum likelihood method, Eigen structure methods, Music algorithm – root music and cyclic music algorithm, the ESPRIT algorithm. Diversity Combining- spatial diversity selection combiner, switched diversity combiner, equal gain combiner, maximum ratio combiner, optical combiner.

Total Hours: **45**

Text Books:

1 Lal Chand Godara, "Smart Antennas" CRC press, 2004.
2 Balanis, "Antennas", John Wiley and Sons, 2005.

Reference Books:

1 Joseph C Liberti.Jr and Theodore S Rappaport, "Smart Antennas for Wireless Communication: IS-95 and Third Generation CDMA Applications", Prentice Hall 1999.
2 Robert A.Monzingo, R.L.Haupt, T.W. Miller, "Introduction to Adaptive Arrays", Yesdee Publishing Pvt. Ltd.,2012.

Web References:

1 http://nptel.ac.in/courses/117107035/
2 www.ece.nus.edu.sg/.../Lecture%20Notes/Smart%20Antennas%20and%20Spatial%20...

Online Resources:

1 downloads.hindawi.com/books/9789775945099.pdf

Assessment Methods & Levels (based on Revised Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	5
CO2	Apply	Group Assignment 1	5
CO3	Apply	Group Assignment 2	5
CO4	Analyse	Problem Solving	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember				
Understand	80	40	30	30
Apply	20	60	40	40
Analyse	-	-	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC426 **RF SYSTEM DESIGN AND MEMS** **3/0/0/3**

Nature of Course : G (Theory analytical)
Pre requisites : 16EC316 Digital Signal Processing

Course Objectives:

1 To understand the fundamentals of RF circuit design.
2 To design and analyse basic RF Filters.
3 To design and analyze RF transistor amplifier.
4 To understand the operation of Oscillators and mixers used in RF design.
5 To learn more about MEMS, design of MEMS and its application.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Comprehend different RF Components such as passive components, chip Components.	[U]
CO2	Design and analysis of RF filters.	[AN]
CO3	Design and analysis of RF amplifiers-High and Low gain amplifiers.	[AN]
CO4	Describe the operation of RF oscillators and mixers.	[AP]
CO5	Relate MEMS with respect to sensors and actuators.	[U]

Course Contents:

RF FUNDAMENTALS Importance of RF Frequency Design , RF behaviour of Passive Components, Chip Components and Circuit Board Considerations **RF FILTER DESIGN** Basic Resonator and Filter Design, Butterworth – Type Filter, Chebyshev-Type Filter, Filter Implementation **RF TRANSISTOR AMPLIFIER DESIGNS** Characteristics of Amplifiers, Amplifier Power Relations, Stability Considerations, Constant Gain and VSWR Circles **RF OSCILLATORS AND MIXERS** Basic Oscillator Model, High Frequency Oscillator Configurations – Fixed Frequency Oscillator, Dielectric Resonator Oscillator, Basics Concepts of Mixer and Frequency domain Considerations **RF MEMS** MEMS and Microsystems, Miniaturization, Typical Products, Micro Sensors, MEMS with Micro Actuators.

Total Hours 45

Text Books:

1 Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture", Tata McGraw hill, New Delhi, 2002. 6. Liu, "MEMS", Pearson education, 2007,
2 Mohamed Gad-el-Hak, "The MEMS Handbook", CRC press Baco Raton, 2000.

Reference Books:

1 Stephen Santuria, "Microsystems Design", Kluwer Publishers, 2000.
2 N. P. Mahalik, "MEMS", Tata McGraw hill, 2007.
3 NadimMaluf, "An Introduction to Micro electro mechanical system design", Artech House, 2000.

Web References:

1 www.tf.uni-kiel.de/matwis/amat/semitech_en/kap_7/illustr/i7_1_3.html
2 www.memsjournal.com/.../an-overview-of-rf-mems-technologies-and-applications.ht

Assessment Methods & Levels (based on Revised Blooms Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	3
CO2	Understand	Seminar	3
CO3	Analyze	Group Assignment	4
CO4	Apply	Mini project	5
CO5	Understand	Class Presentation/Power point presentation	5

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	50	20	20	20
Apply	-	40	40	40
Analyse	50	40	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC427 **HIGH SPEED NETWORKS** **3/0/0/3**

Nature of Course : (G) Theory
Pre requisites : 16EC318 - Computer Networks & Interfacing

Course Objectives:

1 To understand the concepts related to the basics of ATM and frame relay
2 To understand the congestion and traffic management strategies.
3 To learn the concepts behind TCP and ATM congestion control
4 Provide in depth knowledge of Integrated and Differentiated Services.
5 To Understand the protocols for QoS support.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO 1 Understand the basic concepts of frame relay, ATM network and its applications. [U]
CO 2 Apply traffic and congestion control mechanism for frame relay and packet switching networks. [AP]
CO 3 Apply the knowledge of TCP and ATM congestion control technique to address technical issues in high speed networks. [AP]
CO 4 Analyse the concepts of Integrated and Differentiated Services along with protocols for good QoS. [AN]

Course Contents:

High Speed Networks: Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection – ATM Cell – ATM Service Categories – AAL. **Congestion and Traffic Management:** Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Controlled. **TCP and ATM Congestion Control** :TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM –Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control- RM cell formats – ABR Capacity allocations – GFR traffic management **Integrated and Differentiated Services:** Integrated Services Architecture – Approach, Components, Services - Queuing Discipline – FQ – PS – BRFQ – GPS – WFQ – Random Early Detection – Differentiated Services. **Protocols for QOS Support**: RSVP – Goals & Characteristics, Data Flow, RSVP operations – Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking – Protocol details – RTP – Protocol Architecture – Data Transfer Protocol– RTCP.

Total Hours: **45**

Text Books:

1 William Stallings, "High speed networks and internet", Second Edition, Pearson Education, 2013.
2 Warland, PravinVaraiya, "High performance communication networks", Second Edition ,Jean Harcourt Asia Pvt. Ltd., reprinted 2009.

Reference Books:

1 IrvanPepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN architecture", Cisco Press, Volume 1 and 2, 2005.
2 Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York,2007.

Web References:

1 http://nptel.ac.in/courses/106106091/20
2 http://www.icc-uk.com/interconnection-master-class.php

Online Resources:

1 https://www.edx.org/course/4g-network-essentials-imtx-net02x

Assessment Methods & Levels (based on Revised Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	5
CO2	Apply	Group Assignment	5
CO3	Apply	Group Assignment	5
CO4	Analyse	Case study	5

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	-	-	-	-
Understand	20	10	20	20
Apply	80	40	30	30
Analyse	-	50	50	50
Evaluate	-	-	-	-
Create	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**

16EC428 **COGNITIVE RADIO COMMUNICATION** **3/0/0/3**

Nature of Course :G (Theory analytical)

Pre requisites : 16EC327 Wireless Communication & Networks

Course Objectives:

1 To Introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
2 To Introduce the concept of software defined radios and their architectures.
3 To Introduce the concept of cognitive radio communication and the components involved
4 To Introduce the cognitive radio architecture and the functions and issues involved in communication system design.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Acquire basic knowledge in the evolution of software defined radio and various technology trade-off	[U]
CO2	Understand the software , hardware and topological interfaces associated with SDR	[U]
CO3	Analyze the evolution of cognitive radio from SDR and its role in various applications	[AN]
CO4	Analyze the components, functions and design rules of cognitive radio from cognition cycle	[AN]
CO5	Discover the prime functions of next generation network when it is integrated with cognitive radio	[AN]

Course Contents:

INTRODUCTION TO SOFTWARE DEFINED RADIO Definitions and potential benefits, software radio architecture evolution – foundations, technology tradeoffs and architecture implications **SDR ARCHITECTURE** Essential functions of the software radio, architecture goals, quantifying degrees of programmability, top level component topology, computational properties of functional components, interface topologies among plug and play modules, architecture partitions. **INTRODUCTION TO COGNITIVE RADIOS** Marking radio self-aware, the cognition cycle, Enabling location and environment awareness in cognitive radios – concepts, architecture, design considerations **COGNITIVE RADIO ARCHITECTURE** Primary Cognitive Radio functions, behaviours, Components,Design Rules of CR, Radio procedure knowledge encapsulation, components of orient, plan, decide phases, act phase knowledge representation, design rules **COGNITIVE RADIO WIRELESS NETWORKS** The CR Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

Total Hours: **45**

Text Books:

1 Qusay. H. Mahmoud, "Cognitive Networks: "Towards Self Aware Network", John Wiley & Sons Ltd. 2007.

Reference Books:

1 Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio" , John Wiley, 2003.
2 Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System" , Springer, 2007.
3 Joseph Mitola, "Cognitive Radio Architecture" , John Wiley & Sons, 2006.

4 Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010.
5 J. Mitola, "Cognitive Radio: An Integrated Agent Architecture for software defined radio", Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
6 Simon Haykin, "Cognitive Radio: Brain –empowered wireless communications", IEEE Journal on selected areas in communications, Feb 2005.
7 Hasari Celebi, Huseyin Arslan , "Enabling location and environment awareness in cognitive radios", Elsevier Computer Communications , Jan 2008.

Web References:

1 http://165.165.123.124:444/Computer%20Science%20and%20%20Engineering%20%2819%29/Computer%20Networks/

Online Resources:

1 https://onlinecourses.nptel.ac.in/noc18_cs38/

Assessment Methods & Levels (based on Revised Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Tentative Assessment Component**	**Marks**
CO1	Understand	Quiz	8
CO2	Understand		
CO3	Analyse	Technical seminar	8
CO4	Analyse		
CO5	Analyse	Group Assignment	4

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remembering	-	-	-	-
Understanding	40	40	20	20
Applying	-	-	-	-
Analysing	60	60	80	80
Evaluating	-	-	-	-
Creating	-	-	-	-

COURSE INCHARGE **COE CO-ORDINATOR** **HOD/ECE**