CURRICULUM DESIGN UNDER REGULATION 2017

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER I							
S.No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credits**	**Ext/Int**	**Category**
1	17EN001	Technical Communication Skills I	3/0/2	5	4	40/60	HS
2	17MA101	Linear Algebra and Differential Calculus	3/2/0	5	4	60/40	BS
3	17PH102	Engineering Physics	3/0/2	5	4	40/60	BS
4	17ES101	Electric and Magnetic Circuits	4/0/0	4	4	60/40	ES
5	17EE301	Electron Devices and Circuits	4/0/0	4	4	60/40	PC
6	17ME205	Engineering Graphics Laboratory	0/0/3	3	2	40/60	ES
7	17EE302	Electron Devices and Circuits Laboratory	0/0/3	3	2	40/60	PC
			Total	**29**	**24**	**700**	

SEMESTER II							
S.No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	17EN002	Technical Communication Skills II	3/0/2	5	4	40/60	HS
2	17MA104	Integral Calculus and Laplace Transforms	3/2/0	5	4	60/40	BS
3	17CS211	Problem Solving using C Programming	3/0/2	5	4	40/60	ES
4	17EE303	Electric Circuit Analysis	4/0/0	5	4	60/40	PC
5	17CH103	Engineering Chemistry	3/0/2	5	4	40/60	BS
6	17EE304	Electric Circuits Laboratory	0/0/3	3	2	40/60	PC
7	17ME204	Engineering Practices Laboratory	0/0/3	3	2	40/60	ES
			Total	**31**	**24**	**700**	

SEMESTER III							
S.No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	17MA106	Discrete Transforms and Fourier Analysis	3/2/0	5	4	60/40	BS
2	17EE306	Electrical Machines – I	4/0/0	4	4	60/40	PC
3	17EE307	Linear and Digital Integrated Circuits	4/0/0	4	4	60/40	PC
4	17EE308	Instrumentation Engineering	3/0/0	4	3	60/40	PC
5	17CS212	LINUX and Programming in C++	3/0/2	5	4	40/60	ES
6	17EE309	Electrical Machines – I Laboratory	0/0/3	3	2	40/60	PC
7	17EE310	Linear and Digital Integrated Circuits Laboratory	0/0/3	3	2	40/60	PC
8	17YY7XX	Mandatory Course-I	2/0/0	2	1	0/100	MC
			Total	**30**	**24**	**800**	

SEMESTER IV							
S.No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	17MA112	Probability and Computational Methods	3/2/0	5	4	60/40	BS
2	17EE311	Electrical Machines – II	4/0/0	4	4	60/40	PC
3	17EE312	Control Systems	4/0/0	4	4	60/40	PC
4	17EE313	Generation, Transmission and Distribution	3/0/0	3	3	60/40	PC
5	17CS213	Data Structures and Algorithms	3/0/2	5	4	40/60	ES
6	17EE314	Electrical Machines - II Laboratory	0/0/3	3	2	40/60	PC
7	17EE315	Control and Instrumentation Laboratory	0/0/3	3	2	40/60	PC
8	17YY7XX	Mandatory Course-II	2/0/0	2	1	0/100	MC
9	17EE601	Mini Project-I	-	2	2	40/60	PW
		Total		**31**	**26**	**900**	

SEMESTER V							
S.No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	17EE316	Renewable Energy Systems	3/0/0	4	3	60/40	PC
2	17ES104	Virtual instrumentation	3/0/2	5	4	40/60	ES
3	17EE317	Power Electronics	4/0/0	4	4	60/40	PC
4	17EE318	Microprocessor and controllers	3/0/0	4	3	60/40	PC
5	17EE4XX	Professional Elective-I	3/0/0	3	3	60/40	PE
6	17EE319	Power Electronics Laboratory	0/0/3	3	2	40/60	PC
7	17EE320	Microprocessors and controllers Laboratory	0/0/3	3	2	40/60	PC
8	17YY7XX	Mandatory Course-III	2/0/0	2	1	0/100	MC
		Total		**28**	**22**	**800**	

SEMESTER VI							
S.No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	17EE321	Power System Analysis	4/0/0	5	4	60/40	PC
2	17EE322	Digital Signal Processing and its Application	4/0/0	5	4	60/40	PC
3	17EE323	Principles of Embedded System	3/0/2	5	4	40/60	PC
4	17EE4XX	Professional Elective-II	3/0/0	3	3	60/40	PE
5	17EE4XX	Professional Elective-III	3/0/0	3	3	60/40	PE
6	17YY5XX	Open Elective-I	3/0/0	3	3	60/40	OE
7	17EE324	Simulation Laboratory - I	0/0/3	3	2	40/60	PC
8	17YY7XX	Mandatory Course-IV	2/0/0	2	1	0/100	MC
9	17EE602	Mini Project-II	-	2	2	40/60	PW
		Total		**31**	**26**	**900**	

SEMESTER VII							
S.No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	17EE325	Power System Protection & Switchgear	3/0/0	4	3	60/40	PC
2	17EE326	Electric Drives and Control	3/0/2	5	4	40/60	PC
3	17EE4XX	Professional Elective-IV	3/0/0	3	3	60/40	PE
4	17EE4XX	Professional Elective-V	3/0/0	3	3	60/40	PE
5	17EE4XX	Professional Elective-VI	3/0/0	3	3	60/40	PE
6	17EE327	Prototype Module Laboratory	0/0/3	3	2	40/60	PC
7	17EE328	Simulation Laboratory-II	0/0/3	3	2	40/60	PC
		Total		**24**	**20**	**700**	

SEMESTER VIII							
S.No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	17EE603	Project	0/0/24	24	12	100/100	PW
		Total		**24**	**12**	**200**	

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

S. No.	**Stream**	**Credits/Semester**								**Credits**	**Courses**		**%**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		**Theory**	**Lab**	
1.	Humanities (HS)	4	4	-	-	-	-	-	-	**8**	**2**	**-**	**4.44**
2.	Basic Sciences (BS)	8	8	4	4	-	-	-	-	**24**	**6**	**-**	**13.33**
3.	Engineering Sciences (ES)	6	6	4	4	4	-	-	-	**24**	**5**	**2**	**13.33**
4.	Professional Core (PC)	6	6	15	15	14	14	11	-	**81**	**16**	**11**	**45.00**
5.	Professional Electives (PE)	-	-	-	-	3	6	9	-	**18**	**6**	**-**	**10.00**
6.	Open Electives (OE)	-	-	-	-	-	3	-	-	**3**	**1**	**-**	**1.66**
7.	Project Work (PW)	-	-	-	2	-	2	-	12	**16**	**-**	**-**	**8.88**
8.	Mandatory Courses			1	1	1	1			**4**	**-**	**-**	**2.22**
9.	Employability Enhancement Skills									**2**	**-**	**-**	**1.11**
	Total	**24**	**24**	**24**	**26**	**22**	**26**	**20**	**12**	**180**	**36**	**13**	**100**

HUMANITIES SCIENCES (8 Credits)

S.No.	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	17EN001	Technical Communication Skills I	3/0/2	5	4	HS
2.	17EN002	Technical Communication Skills II	3/0/2	5	4	HS

BASIC SCIENCES (24 Credits)

S.No.	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	17MA101	Linear Algebra and Differential Calculus	3/2/0	5	4	BS
2.	17MA104	Integral Calculus and Laplace Transforms	3/2/0	5	4	BS
3.	17MA106	Discrete Transforms and Fourier Analysis	3/2/0	5	4	BS
4.	17MA112	Probability and Computational Methods	3/2/0	5	4	BS
5.	17PH102	Engineering Physics	3/0/2	5	4	BS
6.	17CH103	Engineering Chemistry	3/0/2	5	4	BS

ENGINEERING SCIENCES (26 Credits)

S.No.	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	17ES101	Electric and Magnetic Circuits	3/0/0	4	4	ES
2.	17CS211	Problem Solving Techniques and Computer Programming	3/0/2	5	4	ES
3.	17ES102	Engineering Graphics Laboratory	0/0/3	3	2	ES
4.	17ES103	Engineering Practices Laboratory	0/0/3	3	2	ES
5.	17CS212	LINUX and Programming in C++	3/0/3	5	4	ES
6.	17CS213	Data Structures and Algorithms	3/0/3	5	4	ES
7.	17ES104	Virtual instrumentation	3/0/2	5	4	ES

PROFESSIONAL CORE (81 credits)

S.No.	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
1.	17EE301	Electron Devices and Circuits	4/0/0	5	4	PC
2.	17EE302	Electron Devices and Circuits Laboratory	0/0/3	3	2	PC
3.	17EE303	Electric Circuit Analysis	4/0/0	5	4	PC
4.	17EE304	Electric Circuits Laboratory	0/0/3	3	2	PC
5.	17EE305	Electrical Machines – I	4/0/0	5	4	PC
6.	17EE306	Linear and Digital Integrated Circuits	4/0/0	5	4	PC
7.	17EE307	Instrumentation Engineering	3/0/0	4	3	PC
8.	17EE308	Electrical Machines – I Laboratory	0/0/3	3	2	PC
9.	17EE309	Linear and Digital Integrated Circuits Laboratory	0/0/3	3	2	PC
10.	17EE310	Electrical Machines – II	3/0/0	3	3	PC
11.	17EE311	Control Systems	3/0/0	4	3	PC

12.	17EE312	Generation, Transmission and Distribution	3/0/0	4	3	PC
13.	17EE313	Electrical Machines - II Laboratory	0/0/3	3	2	PC
14.	17EE314	Control and Instrumentation Laboratory	0/0/3	3	2	PC
15.	17EE315	Renewable Energy Sources	3/0/0	4	3	PC
16.	17EE316	Power Electronics	4/0/0	5	4	PC
17.	17EE317	Microprocessor and controllers	3/0/0	5	3	PC
18.	17EE318	Power Electronics Laboratory	0/0/3	3	2	PC
19.	17EE319	Microprocessors and controllers Laboratory	0/0/3	3	2	PC
20.	17EE320	Power System Analysis	4/0/0	5	4	PC
21.	17EE321	Digital Signal Processing	4/0/0	5	4	PC
22.	17EE322	Principles of Embedded System	3/0/2	5	4	PC
23.	17EE323	Simulation Laboratory - I	0/0/3	3	2	PC
24.	17EE324	Power System Protection & Switchgear	3/0/0	4	3	PC
25.	17EE325	Electric Drives and Control	3/0/2	5	4	PC
26.	17EE326	Prototype Module Laboratory	0/0/3	3	2	PC
27.	17EE327	Simulation Laboratory-II	0/0/3	3	2	PC

ELECTIVE/AUDIT COURSES (18 Credits)

S. No.	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Category
PROFESSIONAL ELECTIVES (18 Credits)						
Elective Stream I - Power System (Prerequisite: Power Electronics and Power System)						
Group A						
1.	17EE401	Smart Grid	3/0/0	3	3	PE
2.	17EE402	Energy management	3/0/0	3	3	PE
3.	17EE403	Optimisation Technique	3/0/0	3	3	PE
Group B						
4.	17EE404	Power System Operation and Control	3/0/0	3	3	PE
5.	17EE405	Power Quality	3/0/0	3	3	PE
6.	17EE406	High Voltage Engineering	3/0/0	3	3	PE
Elective Stream II–Applied Electronics (Prerequisite: Microprocessor and Computing Systems)						
Group A						
1.	17EE407	Computer Networks	3/0/0	3	3	PE
2.	17EE408	Soft Computing Techniques	3/0/0	3	3	PE
3.	17EE409	VLSI Design	3/0/0	3	3	PE
Group B						
4.	17EE410	Wireless Sensor Networks	3/0/0	3	3	PE
5.	17EE411	ARM and Arduino Processor	3/0/0	3	3	PE
6.	17EE412	Automotive Electronics	3/0/0	3	3	PE
Elective Stream III–Power Electronics and Drives(Prerequisite: AC and DC Machines, Power Electronics)						
Group A						
1.	17EE413	Design of Electrical Machines	3/0/0	3	3	PE
2.	17EE414	Special Electrical Machines	3/0/0	3	3	PE
3.	17EE415	PLC and Automation	3/0/0	3	3	PE
Group B						
4.	17EE416	Servo and Robot Drives	3/0/0	3	3	PE
5.	17EE417	Flexible AC Transmission Systems	3/0/0	3	3	PE
6.	17EE418	Modelling and Simulation of Power Electronic Circuits	2/0/1	3	3	PE

OPEN ELECTIVES(3 credits)						
1.	17EE501	Renewable Energy Sources	3/0/0	3	3	OE
2.	17EE502	Energy Auditing, Conservation and Management	3/0/0	3	3	OE
3.	17EE503	Smart Grid	3/0/0	3	3	OE
4.	17EE504	Servo and Robot Drives	3/0/0	3	3	OE

MANDATORY COURSES (4 credits)

S.No.	Course Code	Course Title	Semester	Credits	Category
1.	17CH701	Environmental Studies / E-waste Management	II	1	MC
2.	17EN701	Foreign Language / Spoken Hindi	III	1	MC
3.	17CE701	Professional Ethics/Human Values	IV	1	MC
4.	17CS7XX	Soft skills (IOT/Big Data) / Data Base Management Systems	V	1	MC
5.	17EE701	Domain specific certification courses	V	1	MC

ONE CREDIT COURSES

S.No.	Course Code	Course Title	Credits
1.	17EE901	Electrical Testing and Safety Procedures	1
2.	17EE902	PLC and SCADA	1
3.	17EE903	Embedded System Design	1
4.	17EE904	Robotics	1
5.	17EE905	PCB design and Fabrication	1
6.	17EE906	MATLAB Programming for Electrical Engineering	1
7.	17EE907	Solar Panel Installation	1
8.	17EE908	Embedded Rashperi Pi	1
9.	17EE909	Wind Turbine Design	1
10.	17EE910	Industrial Electronics	1

EMPLOYABILITY ENHANCEMENT SKILLS (2 credits)

S.No.	Course Code	Name of the Course	L/T/P	Contact Hours/Wk	Credits
1.	17EE801	Industrial Practice	-	-	2

17EN001 TECHNICAL COMMUNICATION SKILLS I 3/0/2/4

Nature of Course: Theory

Pre Requisites: Basics of English Language

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:

C001.1	Remember language skills for business related situations.	(R)
C001.2	Understand and intensely focus on improving and increasing LSRW skills.	(U)
C001.3	Apply a good command over basic writing and reading skills.	(AP)
C001.4	Analyze and use vocabulary in corporate work environment.	(AP)

Course Contents with Course Outcomes/Blooms Taxonomy/Assessment Methods

INTRODUCTION - Basics of English language- History of English language- Etymology of scientific terms - Importance of LSRW skills – Getting to know people- How to talk about personality types- Self introduction-Introducing others. **LISTENING -** Importance of listening skills -Listening to short conversations or monologues-Seeking and supplying information - Listening for specific information- Active listening-Telephonic Conversation and Etiquette - Talking and conveying messages (over the phone)- Listening to speeches / talks- Giving directions / instruction. **SPEAKING-** Importance of Speaking skills-Grammar and Vocabulary-Pronunciation - Business topics- Talk about preferences-Agree and disagree- Giving opinions-Listening and responding- Sense of persuasion- Situational approaches- Reasons and Consequences -Making Predictions- Short presentation -Interactive communication-Discourse markers and management. **READING -** Importance of reading skills - Reading short texts such as notices, advertisements, memos, emails- Skimming and scanning -Identifying relationship between characters, facts and ideas-Comparing facts and figures-Reading and understanding specific meaning in a text - Cloze reading- Identifying relevant information- Identifying reasons and consequences through reading practices -Vocabulary practice. **WRITING -** Importance of writing skills -Brevity of communication -Notes- Memo- Email - Formal and informal – Letter writing- Job application Letter - Resume Writing - Itinerary- Paragraph Writing - Essay Writing- Check list- -Requests and Obligation- Letter Phrases –Instructions- Recommendations-Jumbled sentences. **PARTS OF SPEECH -** Present simple- Simple past- Connectors of addition and contrast- Present Continuous- Gerunds and Infinitives- Vocabulary development through prefixes-suffixes and word roots- Synonyms-Antonyms **-** Auxiliary Verbs - Countable and Uncountable Nouns - Present perfect -Future possibility/ Probability - Question formation-Sequencing words- Prepositions- If- Conditionals.

Lab Components:

1	Listening Comprehension	(E)
2	Writing Emails and Letters	(E)
3	Mini Presentation	(E)
4	Telephonic Conversation	(E)
5	Reading Comprehension	(E)

Total Hours 60

Text Books:

1. Whitby, Norman. Cambridge University Press- Students Book. 2013
2. Rizvi Ashraf M , "Effective Technical Communication", McGraw Hill Education (India) Private Limited , 2016
3. Dr. Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited 2015.

Reference Books:

1. Wood, Ian, Paul Sanderson, Anne Williams with Marjorie Rosenberg, Pass Cambridge BEC Preliminary, Cengage learning. Second Edition. 2014.
2. Sharma R.C, Mohan Krishna, Business Correspondence and Report Writing, McGraw Hill Education (India) Private Limited, 2016.
3. Lewis, Norman, Word Power Made Easy, Pocket Books, New York, 1979.

Web References:

1. http://www.cambridgeindia.org
2. http://www.cambridgeenglish.org/exams/business-certificates/business
3. https://**steptest**.in

Online Resources:

1. https://www.coursera.org/specializations/business-english
2. http://www.academiccourses.com/Courses/English/Business-English

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C001.1	Remember	Mini Presentation	**5**
C001.2	Understand	Role Play	**5**
C001.3	Apply	E-mail Writing	**5**
C001.4	Apply	Group Discussion	**5**

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	40	40	40	40
Apply	40	40	40	40
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

17MA101 LINEAR ALGEBRA AND DIFFERENTIAL CALCULUS 3/2/0/4
(COMMON TO ALL BRANCHES)

Nature of Course J (Problem analytical)
Pre requisites Basics of differentiation

Course Objectives:

1 To develop the skill to use matrix algebra techniques that are needed by engineers for practical applications.
2 To familiarize with functions of several variables applicable 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 using numerical methods

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the concepts of matrices, ordinary and partial derivatives	[R]
C101.2	Express a square matrix in the diagonal form	[U]
C101.3	Evaluate the extreme values of the given function	[AP]
C101.4	Apply the knowledge of differential equation to solve the engineering problems	[AP]
C101.5	Apply numerical method techniques to find the solution of ordinary differential equations	[AP]

Course Contents:

Matrices- Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties and Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a real symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation- **Functions of several variables**- Total derivatives – Differentiation of implicit functions – Jacobians – Taylor series expansion – Maxima and Minima – Method of Lagrangian multipliers-**Ordinary differential equations**- Second and Higher order linear differential equations with constant coefficients –Cauchy's and Legendre's linear differential equations- Method of variation of parameters - **Applications of second order differential equations**- Free and forced oscillations – Undamped and Damped system - Solution of specified differential equations connected with electric circuits and bending of beams (Differential equations and associated conditions need to be given)-**Numerical solution to first order ordinary differential equations**- Single step methods: Taylor series method - Euler's Method -Modified Euler's Method – Runge - Kutta Method of fourth order - Multistep method - Milne's Predictor- Corrector Method-Adam-Bashforth Predictor- Corrector Method.

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", 3rdedition, 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://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

Online Resources:

1 https://www.coursera.org/learn/linearalgebra2
2 https://www.coursera.org/learn/differentiation-calculus
3 https://www.coursera.org/learn/single-variable-calculus
4 https://alison.com/courses/Algebra-Functions-Expressions-and-Equations

Assessment Methods & Levels (based on Blooms'Taxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C101.1	Remember	Classroom or Online Quiz	2
C101 .2	Understand	Class Presentation/Power point presentation	4
C101.3	Apply	Group Assignment	6
C101.4 & C101.5	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	-	-	-	-

17PH102 **ENGINEERING PHYSICS** **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	[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*
7. *https://www.generalplastics.com/polyurethane-foam-**dielectric**-**materials**-f...*
8. *https://www.asme.org/.../**nano**technology/**carbon**-**nanotube**-super-fabric*
9. *https://**web**.iit.edu/.../**web**/.../Academic%20**Resource**%20Center/.../**Miller**...*
10. *https://www.boundless.com/physics/.../the-**hall**-**effect**-559-10926/*

Online Resources:

1. https://www.coursera.org/learn/ap-physics-1
2. *www.cleanroom.byu.edu › Semiconductor Properties*
3. *https://www.urmc.rochester.edu › ... › Our Resource Laboratories*
4. *https://www.jic.ac.uk/**microscopy**/links.html*

5 *https://www.merlot.org/merlot/**materials**.htm*

6 *www.**fiberopticsonline**.com/*

7 *https://ocw.mit.edu/courses/physics/8-04-**quantum-physics**-i-spring-2013/*

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	-	-	-	-	-

17ES101 ELECTRIC AND MAGNETIC CIRCUITS 4/0/0/4

Nature of Course: G (Theory analytical)

Pre Requisites: Physics for Electronics

Course Objectives:

1. To understand the basic DC, AC and magnetic circuits concepts.
2. To examine the electrical circuits using network theorems.
3. To simulate electrical circuits using PSPICE

Course Outcomes

Upon completion of the course, students shall have ability to

C101.1Remember the basic electrical elements and the laws governing the working of electrical circuits.

C101.2Understand concepts of A.C. circuits.

C101.3. Understand the electrical circuits using network theorems.

C101.4.Understand the electrostatics concepts.

C101.5.Understand the magenetostatics concepts.

C101.6.Apply PSPICE to design basic electrical circuits.(Internal mode)

Course Contents with Course Outcomes/Blooms Taxonomy/Assessment Methods

Fundamental concepts of R, L and C elements, DC circuits, series and parallel circuits - loop and nodal analysis, **AC circuits** - complex impedance - phasor diagram, real and reactive power - loop and nodal analysis applied to AC circuits, Voltage source –current source transformations, **Network theorems**-Superposition, Thevenin's, Norton's, maximum power transfer and reciprocity theorem for dc and ac circuits, star-delta transformations. Introduction electromagnetic fields and Co-ordinate Systems – **Electrostatics**-Coulomb's law – Electric field intensity- Electric flux density –Permittivity- Gauss's law -Electric potential – potential gradient – Divergence and divergence theorem. **Magenetostatics** -Magnetic field intensity – Biot-Savart's Law – Ampere's Law- Curl – Stoke's theorem – Magnetic flux – Magnetic flux density- Permeability-Force on a moving charge and current elements – Force and Torque on closed circuit-Energy stored in magnetic and electric fields-Energy density.**PSPICE** (Elementary treatment only) – DC Analysis and Control Statements - AC Analysis and Control Statements

Total Hours 60

Text Books:

1. Sudhakar and Shyammohan S Pillai, "Circuits and Networks", Tata McGraw Hill, New Delhi, 4th Edition, 2010.
2. William H. Hayt, Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", McGraw Hill, 8th Edition, 2012.
3. Charles K.Alexander, Matthew N.O.Sadiku, 'Fundamentals of Electric circuits', McGraw-Hill Publications,5th edition,2013.
4. William Hayt, "*Engineering Electromagnetics*", McGraw Hill, New york, 7th edition, 2011.
5. Gangadhar.K.A, "Field theory", *Khanna Publishers*, New Delhi,15th edition,2004.

Reference Books:

1. MahmoodNahvi, Joseph Edminister, "Schaum's Outline of Electric Circuits", McGraw Hill Education, 6th Edition, 2014.
2. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, 'Electrical Safety Handbook', McGraw-Hill Education, 4thEdition, 2012.

3. Robins & Miller, 'Circuit analysis theory and practice', Delmar Publishers, 5th edition, 2012.
4. Matthew. N.O. Sadiku, "*Elements of Electromagnetics*", Fourth Edition,Oxford University Press, First Indian Edition, 2010.
5. John D. Kraus, *"Electromagnetics*" McGraw Hill, 5th Edition, 1999.

Web References:

1. http://www.electrical4u.com/circuit-analysis.htm
2. http://www.technologystudent.com
3. http://www.allaboutcircuits.com
4. http://www.nptel.ac.in

Online Resources:

1. MIT open courseware@MITOCW
2. Circuits and Electronics@edxonline
3. Darryl Morrell@youtube
4. Electrical Knowhow@lifeneverask
5. Fundamentals of Electrical Engineering@coursera
6. NPTEL e learning courses.

Assessment Methods & Levels (based on Blooms'Taxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C101.1	Remember	Class room Quiz	**3**
C101.2	Remember	Online Quiz	**3**
C101.3	Understand	Problem solving	**4**
C101.4	Understand	Class Presentation	**3**
C101.5	Understand	Class Presentation	**3**
C101.6	Apply	Group Assignment	**4**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination
	CIA1	CIA2	Term End Assessment	
Remember	50	40	40	40
Understand	50	60	60	60
Apply	-	-	-	-
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE301 ELECTRON DEVICES AND CIRCUITS 4/0/0/4

Nature of Course: D (Theory application)

Pre Requisites: Physics

Course Objectives:

1. To understand the construction and characteristics of diode and transistors.
2. To understand differential and feedback amplifiers.
3. To apply BJT and FET in amplifiers and oscillators.
4. To apply resonance concepts in tuned amplifiers

Course Outcomes

Upon completion of the course, students shall have ability to

C301.1 Remember the construction and characteristics of Diode, BJT and FET.

C301.2 Understand the construction, theory and characteristic of multistage differential amplifiers and Oscillator circuits.

C301.3 Understand the feedback connections to be used in amplifiers

C301.4 Understand the construction, theory and characteristic of Advanced Devices

C301.5 Apply BJT and FET as amplifiers and analyse its characteristics

C301.6 Apply resonance concepts in tuned amplifiers.

Course Contents with Course Outcomes/Blooms Taxonomy/Assessment Methods

Diodes: PN Junction- Rectifier Circuits, Clipper and Clamper Circuits, Zener Diode-Photodiode and Photo transistor **Transistors:** Bipolar Junction Transistors (BJT)-NPN & PNP-Structure and Operation- CE, CB, CC Configurations-Input and Output Characteristics. Transistor Switching Times. Transistor biasing-Voltage Divider bias-Transistor hybrid model for CE configuration. Junction Field Effect Transistors (FET)-N channel & P channel - Structure, Operation and Characteristics. MOSFET-Enhancement & Depletion - Structure, Operation and Characteristics.**Amplifiers:** Construction and working principle of CE amplifier, Emitter Follower, Source Follower- Feedback Amplifiers-Positive Feedback and Negative Feedback – Input and output resistance of Voltage / Current, Series, Shunt Feedback. **Multistage Amplifiers and Oscillators:** Differential Amplifier using BJT. Common Mode and Difference Mode Analysis- Power Amplifiers –Class A, Class B & Class AB (Qualitative analysis).Oscillators-Condition for Oscillations, Construction & Working Principle of RC phase shift- Wien bridge oscillators- Hartley, Colpitts oscillators- Crystal oscillators.

Total Hours 60

Text Books:

1. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2010.
2. Floyd, Thomas.L “ElectronicDevices”, Prentice Hall,9th Edition, 2011.
3. Donald A Neamen, “Electronic Circuits”, TataMcGraw Hill, 5th Edition,2006.

Reference Books:

1. Robert Diffenderfer, ‘Electronic Devices: Systems and Applications’,Cengage Learning, 2010.
2. Robert L.Boylestad, ‘Electronic Devices and Circuit theory’, Pearson Education, 2010,
3. Jacob Millman, Christos.C.Halkias and SatyabrataJit, ‘Electronic Devices and Circuits’, Tata McGraw Hill, 2010.
4. Theodore F. Bogart, Jeffery S. Beasley and Guilermo Rico, ‘Electronic Devices and Circuits’, Pearson Education,6th edition, 2013.

5. Sedra, Chandorkar and Smith, ‘Microelectronic Circuits: Theory and Applications,’ Oxford, 6th edition,2013

Web References:

1. https://nptel.ac.in/video.php?subjectId=117103063
2. https://onionesquereality.wordpress.com/.../more-video- lectures-iit-open
3. https://nptel.iitg.ernet.in/Elec_Comm_Engg/.../Video-ECE.pdf
4. https://nptel.ac.in/courses/122106025/11
5. https://www.nptelvideos.in/2012/.../basic-electronics- drchitralekha-mahanta.html

Online Resources:

https://www.coursera.org/learn/electronics

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C304.1	Remember	Class room Quiz	**3**
C304.2	Understand	Online Quiz	**3**
C304.3	Understand	Class Presentation	**3**
C304.4	Understand	Class Presentation	**3**
C304.5	Apply	Group Assignment	**4**
C304.6	Apply	Group Assignment	**4**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17ME205 **ENGINEERING GRAPHICS** **0/0/3/2**

Nature of Course: M (Practical application)

Co Requisites: Basic drawing and Computer Knowledge

Course Objectives:

- To know the method of constructing the conic curves used in Engineering Applications.
- To develop an understanding of Isometric to Orthographic Views and vice versa.
- To learn the basic projection of straight lines and plane surfaces.
- To develop the imagination of solids inclined to one reference planes.
- To know the sectioning of solids and development of surfaces used in various fields

Course Outcomes

C202.1: Recall the basic concepts of engineering drawing. [R]
C202.2: Recall the basic syntax and commands of CAD software. [R]
C202.3: Interpret the parameters of engineering drawing. [U]
C202.4: Sketch the 2D geometries in the drafting software. [Ap]
C202.5: Examine the isometric projection and convert it into orthographic projection (Vice versa). [A]

Course Contents

1.	Construction of Conic Curves (Ellipse, Parabola and Hyperbola)	R
2.	Construction of Special Curves (Cycloid and Involutes)	R
3.	Isometric to Orthographic projections – Manual sketches	U
4.	Isometric to Orthographic projections – Software sketches	U
5.	Projection of lines - Inclined to HP	Ap
6.	Projection of lines - Inclined to VP	Ap
7.	Projection of Plane surfaces (Hexagon, Pentagon and circle) – Inclined to both HP and VP	Ap
8.	Projection of Solids (Prism and Pyramid) – Inclined to HP	Ap
9.	Projection of Solids (Cone and Cylinder) – Inclined to VP	Ap
10.	Sectioning of Solids (Prism and Pyramid) with Section plane Inclined to HP	Ap
11.	Sectioning of Solids (Cone and Cylinder) with Section plane Inclined to VP	A
12.	Development of Surfaces (Prism,Pyramid,Cone and Cylinder)	A
13.	Introduction to Perspective projection	A
	Total Hours	**45**

Reference Books:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2014.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2011.
3. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2013.

Web References:

1. http://nptel.ac.in/courses/112102101/
2. www.solidworks.com

Blooms Taxonomy based Assessment Pattern:

Tentative 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	30	30
Understand	30	30
Apply	20	20
Analyze	20	20
Evaluate	0	0
Create	0	0

17EE302 ELECTRON DEVICES AND CIRCUITS LABORATORY 0/0/3/2

Nature of Course:M (Practical application)

Co Requisites:17PH101 Engineering Physics

Course Objectives:

Design and construct simple electronic circuits to accomplish a specific function.

Course Outcomes

Upon completion of the course, students shall have ability to

C302.1 Examine the working and characteristics of diodes and transistors. [U]
C302.2 Interpret the performance of Clipper and Clamper circuits. [AP]
C302.3 Analyze the amplifier and Oscillator circuits. [A]
C302.4. Build different types of rectifiers and filter circuits. [E]

Course Contents

1. Characteristics of PN junction diode and Zener diode.(3)
2. Design of rectifiers with and without Filters. (6)
3. Characteristics of Photo diode and phototransistor.(3)
4. Characteristics of Transistor configurations.(6)
5. Characteristic of FET and MOSFET.(3)
6. Frequency response of a single stage RC coupled amplifier.(3)
7. Construct RC Phase shift oscillators and Colpitt's Oscillator.(3)
8. Experiment with Clipper and Clamper circuits.(6)
9. Design UJT relaxation Oscillators.(3)
10. Application of simulation tools for circuit characteristics.(6)

Total Hours 45

Reference Books:

1. Robert Diffenderfer, 'Electronic Devices: Systems and Applications',Cengage Learning, 2010.
2. Robert L.Boylestad, 'Electronic Devices and Circuit theory', Pearson Education, 2010,
3. Jacob Millman, Christos.C.Halkias and SatyabrataJit, 'Electronic Devices and Circuits', Tata McGraw Hill, 2010.
4. Theodore F. Bogart, Jeffery S. Beasley and Guilermo Rico, 'Electronic Devices and Circuits', Pearson Education,6th edition, 2013.

Web References:

1. https://nptel.ac.in/video.php?subjectId=117103063
2. https://onionesquereality.wordpress.com/.../more-video- lectures-iit-open
3. https://nptel.iitg.ernet.in/Elec_Comm_Engg/.../Video-ECE.pdf
4. https://nptel.ac.in/courses/122106025/11
5. https://www.nptelvideos.in/2012/.../basic-electronics- drchitralekha-mahanta.html

Online Resources:

https://www.coursera.org/learn/electronics

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	-	-
Understand	30	30
Apply	30	30
Analyse	30	30
Evaluate	10	10
Create	-	-

17EN002 TECHNICAL COMMUNICATION SKILLS II 3/0/2/4

Nature of Course: Theory

Pre Requisites: BEC Preliminary

Course Objectives

1. To develop the prominence of listening and reading practices using authentic business vocabulary.
2. To instil analytical thinking and logical reasoning to enhance LSRW skills in Business related situations.
3. To urge the need of effective communication in corporate sector with Business English.
4. To prepare students for competitive program like BEC, IELTS, TOEFL.

Course Outcomes

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

C002.1	Remember LSRW skills and employ cross-cultural communication in business related situations.	(R)
C002.2	Understand and gain proficiency with business vocabulary.	(U)
C002.3	Apply Task- Based activity to enhance an effective communication.	(AP)
C002.4	Analyse and apply Business English in working environment.	(AP)

Course Contents with Course Outcomes/Blooms Taxonomy/Assessment Methods

LISTENING - Taking and Leaving Voice mail messages –Identifying the information before listening-Inferring ideas- Listening to short monologues -Longer listening tasks -Recognise functions. **SPEAKING -** Expressing hypothetical Situations – Expressing obligation -Aspects of business – Giving examples- Giving reasons- Giving extra information- Presentation at a business meeting- Connecting ideas- Collaborative task – Short talk on a business topics- Film Reviews. **READING -** Science texts- Terms related about science and scientists - Scanning for specific information- Understanding cohesive features - Skimming the reading comprehensions - Interpret opinions and ideas expressed – Collocations - Identifying dependent preposition - Identifying the extra words. **WRITING -** Definitions, Extended Definitions -Letter writing (accepting and declining invitations)- Internal communication (notes/memo/E-mail writing to the head of the department, colleague, assistant , staff in the department etc) Report writing- Business proposal- circular- agenda and minutes- Appropriate linking words- Report Phrases - Asking for Information and Making Suggestions- Transcoding (Bar Chart, Flow Chart)- Letter for calling quotations, Replying for quotations- Placing an order and complaint letter. **PARTS OF SPEECH -** Tenses - Adjectives - Adverbs - Articles- Modal verbs, Active and Passive, Impersonal Passive voice, Homophones- Homonyms- Acronyms- Abbreviations- British and American words- Comparatives and Superlatives- Gerunds- infinitives – Participles - Modal Verbs - Relative Pronouns- Reported Speech - Indirect Questions- Spotting errors.

Lab Components:

1	Extempore	(E)
2	Mini Presentation	(E)
3	Logical Reasoning and Ethics in a given Situation	(E)
4	Technical Presentation	(E)
5	Group Discussion	(E)

Total Hours 60

Text Books

1. Whitby, Norman. Cambridge University Press- Students Book. 2013.
2. Rizvi Ashraf M , "Effective Technical Communication", McGraw Hill Education (India) Private Limited , 2016
3. Dr. Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited, 2015.

Reference Books:

1. Wood, Ian, Paul Sanderson, Anne Williams with Marjorie Rosenberg, Pass Cambridge BEC Vantage, Cengage learning. Second Edition. 2014.
2. Gunasekaran S, 'A Text and Workbook of Technical English II", United Global Publishers, June 2010.
3. Lewis, Norman, Word Power Made Easy, Pocket Books, New York, 1979.

Web References:

1. http://www.cambridgeindia.org
2. http://www.cambridgeenglish.org/exams/business-certificates/business-vantage
3. https://**steptest**.in

Online Resources:

1.https://www.coursera.org/specializations/business-english
2. http://www.academiccourses.com/Courses/English/Business-English

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C002.1	Remember	Extempore	**5**
C002.2	Understand	Mini presentation	**5**
C002.3	Apply	Technical presentation	**5**
C002.4	Apply	Group Discussion	**5**

Blooms Taxonomy based Assessment Pattern:

Bloom's Category	**Continuous Assessment Tests**			**End Semester Examination**
	CIA1	**CIA2**	**Term Examination**	
Remember	30	20	20	20
Understand	30	30	30	30
Apply	40	50	50	50
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

17MA104 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”, 3rdedition, 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	-	-	-	-

17CS211 **PROBLEM SOLVING USING C PROGRAMMING** **3/0/2/4**

(Common to Civil/Mechanical/ECE/EEE)

Nature of Course: K (Problem Programming)

Course Objectives:

1. To understand problem solving concepts .
2. To gain knowledge about the control structures in C
3. To write C programs using arrays and pointers
4. To write functions & Structures in C.

Course Outcomes

Upon completion of the course, students shall have ability to

CO1	**:** Recall syntax of various C constructs	[R]
CO2	: Select techniques to solve real world problems.	[U]
CO3	: Solve problems using C constructs	[AP]
CO4	: Use pointers and arrays in programs	[AP]
CO5	**:** Write functions and structures in C	[AP]
CO6	: Develop applications using C	[C]

Contents

Problem Solving Techniques: Algorithm, Pseudo-code and Flowchart Problem Solving with Sequential Logic Structure - Decisions – Loops. **Case Study:** Raptor and Scratch Tools - **C Fundamental Constructs** : C Character Set – Identifiers and Keywords– Data Types-Constants - Variables and Arrays-Declarations-Operators and Expressions- Data input and output-Preparing and running a Complete C Program- **Control Structures** Branching: if-else- Looping: while-do while-for- Nested control structures -switch-break-continue-comma-goto. **Arrays:** Defining an array- Processing an array- Multi dimensional arrays - **Strings**: Defining a string-Null character-initialization of strings – reading and writing a string-processing the string- **Pointers**: fundamentals – Pointer Declaration& Usage –Dynamic Memory Allocation. **Functions:**Defining a Function – Accessing a function – Function Prototype Functions - Pointer to Function - Functions Returning Pointers.- Pointers and Strings -Passing arguments to a function – Recursion. **Structures and Unions**: The Type Definition (typedef) –Enumerated types– Structure - Type Definition – Initialization – Accessing Structures.-Structures and Functions – passing Whole Structure –Self - Referential Structure-Unions. **Case Study** : GDB: The GNU Project Debugger

List of Experiments:

1. Office Automation – Resume preparation , Spreadsheet processing
2. Draw Flowchart using Raptor Tool
    a. Simple Flow Chart
    b. Decision Making
    c. Looping[Pre test&Post test]
3. Create Animation / Gaming /Application using Scratch Tool
4. Program to process data types, format input and output and to evaluate an expression
5. Program using decision making statements
6. Program using looping statements
7. Program using single and two dimensional arrays
8. Program with Strings

9. Program using Pointers.
10. Program using Recursion
11. Program using structures
12. Debugging with GDB

Total Hours:75

Text Books:

1. M. Sprankle, “Problem Solving and Programming Concepts”, 9th Edition, Pearson Education, New Delhi, 2011.
2. Byron, S. Gottfreid, “Programming with C”, Tata McGraw Hill, Schaum’s outlines, 3rd Edition, 2014.
3. YashavantKanetkar, “Understanding Pointer in C”, 3E, BPB Publication, 2011.

Reference Books:

1. Herbert Schildt, “The Complete Reference C”, 4th edition ,TMH,2015
2. S.ThamaraiSelvi and R.Murugesan, “Programming in ANSI C”, 6E, TMH, 2012.
3. K.R.Venugopal and SudeepR.Prasad , “Mastering C”, TMH ,Second edition , 2015

Web References:

1. http://nptel.ac.in/courses/106105085/
2. http://nptel.ac.in/courses/106106127/
3. http://raptor.martincarlisle.com/
4. https://scratch.mit.edu/

Summative assessment based on Continuous and End Semester Examination					
Bloom’s Level	**Continuous Assessment**			**Rubric Based CIA [40 Marks]**	**End Semester Examination [40 Marks]**
	CIA1 [6 Marks]	**CIA2 [6 Marks]**	**Term End Assessment [8 Marks]**		
Remember	30	30	20	-	-
Understand	70	50	30	-	-
Apply	-	20	50	70	70
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	30	30

17EE303 ELECTRIC CIRCUIT ANALYSIS 4/0/0/4

Nature of Course: G (Theory analytical)

Pre Requisites: 17ES101-Electric and Magnetic Circuits.

Course Objectives:

1. To remember the concepts of resonance and tuned circuits.
2. To understand the transient response of different electrical circuits.
3. To understand three-phase circuits and the methods to measure three phase power.
4. To understand network topology and to determine network parameters
5. To understand the characteristics of filter circuits.
6. To simulate electrical circuits using PSPICE

Course Outcomes

Upon completion of the course, students shall have ability to

C303.1 Remember the ac circuit and resonance. [R]

C303.2 Remember the concepts of resonance in tuned circuits. [R]

C303.3 Understand poly phase systems and measure three phase power. [U]

C303.4 Understand the network topologies and determine various parameters. [U]

C303.5 Understand the characteristics of filter circuits. [U]

C303.6 Apply PSPICE for transient response analysis and network parameters determination of electrical circuits. [AP]

Course Contents with Course Outcomes/Blooms Taxonomy/Assessment Methods

Transient analysis, resonance and Tuned circuits: Analysis of R-L, R-C, R-L-C circuits with phasor relationships. Transient analysis of different A.C and D.C electrical circuits with and without initial conditions- Resonance-Series and Parallel RLC Circuits- frequency response-Quality factor and Bandwidth. Tuned circuits- self and mutually induced emf, coefficient of coupling, dot convention rule, single and doubly tuned circuits**-** Transient response analysis using PSPICE.

Poly phase System: Comparison between single and three phase circuit- Interconnection of three phase sources and loads-Three phase Balanced star and Delta connected load - Three phase Unbalanced star and Delta connected load- Power and Power factor measurement.

Network Analysis: Graph of network, concept of tree branch, tree link. Incidence matrix, Tie-set matrix and loop currents, Cut set matrix and node pair potentials Two port networks, Open circuit Impedance and Short circuit Admittance parameters, Transmission parameters and their inter-relations. Characteristics of ideal filters - low pass and high pass filters - M - derived filters - Band pass filters - Fundamentals of harmonics – odd and even harmonics – elimination methods. Network analysis using PSPICE.

Total Hours 60

Text Books:

1. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Tata McGraw Hill, 2010
2. William H. Hay Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, TMH publishers, 7th edition, New Delhi, 2010
3. Joseph A. Edminister, MahmoodNahvi, “Electric circuits”,Schaum’s series, Tata McGraw-Hill,New Delhi ,5th edition,2010.

Reference Books:

1. Charles K. Alexander, Mathew N.O. Sadik, “Fundamentals of Electric Circuits”, 3rd Edition, McGraw Hill, 2011.
2. Robins & Miller, ‘Circuit analysis theory and practice’, Delmar Publishers, 5th edition, 2012
3. M. E. Van Valkenburg, “Network Analysis”, Phi Learning, 3/E 3rd Edition, 2014

Web References:

1. http://www.electrical4u.com/circuit-analysis.htm
2. http://www.technologystudent.com
3. http://www.allaboutcircuits.com
4. http://www.nptel.ac.in

Online Resources:

1. MIT open courseware@MITOCW
2. Circuits and Electronics@edxonline
3. Darryl Morrell@youtube
4. Electrical Knowhow@lifeneverask
5. Fundamentals of Electrical Engineering@coursera
6. NPTEL e learning courses

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C303.1	Remember	Class room Quiz	**2**
C303.2	Remember	Online Quiz	**3**
C303.3	Understand	Problem solving	**4**
C303.4	Understand	Problem solving	**4**
C303.5	Understand	Problem solving	**4**
C303.6	Apply	Group Assignment	**3**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	50	40	40	40
Understand	50	60	60	60
Apply	-	-	-	-
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17CH101 **ENGINEERING CHEMISTRY** **3 /0 /2 /4**

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

Course Objectives:

1 To make the students conversant with boiler feed water requirements, water treatment techniques, the principles and applications of electrochemistry.
2 To understand the working principles of electrodes and the significances of various component analyzer.
3 To learn the effect of corrosion in materials and the methods for prevention of corrosion.
4 To acquire knowledge in applications of plastics and rubber in engineering field.
5 To understand the concepts of photophysical and photochemical processes in spectroscopy
6 To gain knowledge about non conventional the energy sources, fuel cells and storage Devices.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the requirements of boiler feed water, water treatment procedures for industries.	[R]
C101.2	Understand the working principle of Ion Selective Electrodes, pH electrodes and conductivity meters as an analyzer.	[U]
C101.3	Apply the various corrosion control techniques in real time industrial environments.	[A]
C101.4	Use the knowledge of polymers, various energy sources and storage devices in engineering field.	[U]
C101.5	Understand the principle and working of certain analytical techniques	[U]
C101.6	Solve theoretical problems based on the concepts acquired from the module in various engineering field.	[A]

Course Contents:

Water Treatment-Boiler feed water–Requirements-disadvantages of hard water - demineralization process– desalination-reverse osmosis. Applied electrochemistry: Electrochemical cells – electrolytic cell-reversible and irreversible cells -electrode potential - single, standard - oxidation and reduction potentials - emf of a cell - emf series–significances-pH measurement, glass electrodes, hydrogen electrodes, reference electrodes. Corrosion and its control: Mechanism - types–galvanic corrosion–differential aeration–pitting corrosion – factors-Corrosion control–cathodic protection–corrosion inhibitors-protective coatings– electroplating -electroless plating. Engineering polymers: Polymerisation -free radical mechanism-Plastics-types-preparation, properties and uses of PTFE- Polyurethane - Poly Carbonate -Nylon 6,6 and Nylon 6 - Rubber-Vulcanization of rubber-synthetic rubber -Butyl rubber and SBR Spectrophotometry: Beer-Lambert law – UV Visible – IR Spectrophotometers – Flame emission photometers - Atomic absorption spectrophotometers. Energy Sources: Nuclear energy-reactor-breeder reactor- Photovoltaic cells-Wind energy -Fuel cells. Storage Devices: Batteries-alkaline -Lead acid, nickel cadmium and lithium-TiS_2 batteries.

Lab Component

1	Water hardness	[E]
2	Alkalinity	[E]
3	Chloride content	[E]
4	Dissolved oxygen in water	[E]
5	pH meter	[E]
6	Conductivity meter	[E]
7	Potentiometer	[E]
8	Spectrophotometer	[E]
9	Electroplating of Nickel	[E]
10	Corrosion rate of a metal	[E]
	Total Hours:	**75**

Text Books:

1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2013.
2. N.Krishna murthy,Vallinayagam D.,"Engineering Chemistry" PHI Learning Pvt Ltd.,2014
3. R.V.Gadag, A.Nithyananda Shetty "Engineering Chemistry" 3rd edition PHI Learning Pvt Ltd.,2014

Reference Books:

1. Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
2. Liliya.,Bazylak.I.,Gennady.E.,Zaikov.,Haghvi.A.K.,"Polymers and Polymeric Composites" CRC Press,2014.
3. Lefrou.,Christine.,Fabry.,Pierre.,Poignet.,Jean-claude.,"Electrochemistry - The Basics, with examples" 2012 ., Springer.
4. Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Elsevier Science, 2nd Edition 2012.
5. Perez, Nestor,"Electrochemistry and Corrosion Science", Springer, 2016.
6. Ghazi A.Karim. "Fuels, Energy and the Environment", CRC Press, Taylor and Francis group, 2012.

Web References:

1. http://www.analyticalinstruments.in/home/index.html
2. www.springer.com › Home › Chemistry › Electrochemistry
3. https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electrochemistry
4. www.edx.org/
5. https://www.ntnu.edu/studies/courses
6. www.corrosionsource.com/

Online Resources:

1. nptel.ac.in/courses/105104102/hardness.htm
2. https://ocw.mit.edu/courses/chemistry
3. nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf
4. https://alison.com - Spectroscopic technique, Colorimetry
5. https://ocw.mit.edu/courses/chemistry
6. nptel.ac.in/courses/113108051

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	30	30	10	20
Understand	60	50	40	20	50
Apply	10	20	30	40	30
Analyse	-	-	-	30	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

17EE304 **ELECTRIC CIRCUITS LABORATORY** **0/0/3/2**

Nature of Course: L (Problem experimental)

Co Requisites: Engineering Physics

Course Objectives:

1. To examine the basic theorems of circuit theory.
2. To measure three phase power in three Phase circuit.
3. To analyze the Transient Response characteristics of R-L-C circuits.
4. To analyze the frequency response of series & parallel resonance circuits.
5. To simulate the Electrical Circuits using Multisim software.

Course Outcomes

Upon completion of the course, students shall have ability to

C304.1 Experiment with the basic laws and theorems in electrical circuits. [U]
C304.2Measure the Three Phase Power using Wattmeter method. [AP]
C304.3 Determine the Transient Response of R-L-C circuits. [A]
C304.4Analyze the frequency response of series & parallel resonance circuits. [A]
C304.5Evaluate electrical circuits in MULTISIM. [E]

Course Contents

1. Simulation of Electrical Circuits using MULTISIM. (3)
2. Verification of Ohms Law and Kirchhoff's Law.(3)
3. Analyse the circuit by mesh and nodal Analysis.(3)
4. Analyse the circuit by Networks Theorems. (9)
5. Measurement of power by Two Watt Meter method. (3)
6. Transient response of R, L and C Circuits.(6)
7. Frequency Response of Series and Parallel resonance circuits.(6)
8. Determination of amplification factor using tuned circuits.(6)
9. Perform experiments 3, 4 and 6 using software. (6)

Total Hours **45**

Reference Books:

1. Mahmood Nahvi, Joseph Edminister, "Schaum's Outline of Electric Circuits", McGraw Hill Education, 6th Edition, 2014.
2. Sudhakar and Shyammohan S Pillai, "Circuits and Networks", Tata McGraw Hill, New Delhi, 4th edition, 2010.
3. William H. Hayt, Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", McGraw Hill, 8th edition, 2012.
4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", 3rd Edition, McGraw, 2011.

Web References:

1. http://www.electrical4u.com/circuit-analysis.htm
2. http://www.technologystudent.com
3. http://www.allaboutcircuits.com
4. http://www.nptel.ac.in

Online Resources:

1. Circuits and Electronics@edxonline
2. Fundamentals of Electrical Engineering@coursera
3. MIT open courseware@MITOCW

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

17ME204 ENGINEERING PRACTICES LABORATORY 0/0/3/2

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	[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. 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.

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://vlab.co.in/

Tentative 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	0	0
Understand	0	0
Apply	30	30
Analyse	30	20
Evaluate	20	10
Create	20	30

17MA106 DISCRETE TRANSFORMS AND FOURIER ANALYSIS 3/2/0/4
(ECE,EEE,ICE)

Nature of Course J (Problem analytical)
Pre requisites 16MA101-Linear Algebra ,Calculus and its Applications
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", 2rd edition, Tata McGraw-Hill Publishing Company Ltd., reprint,2015
2 N.P.Bali and Dr.Manish Goyal,"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	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	-	-	-	-

17EE306 ELECTRICAL MACHINES-I 4/0/0/4

Nature of Course: G (Theory analytical)

Pre Requisites: 17EE303- Electric Circuit Analysis

Course Objectives:

1. This course aims to train the students with a basic understanding of field theory concepts,
2. Also aims to train the students with basic D.C. machines andTransformer fundamentals, machine parts and help to gain the skills for operating the D.C. machines and Transformers.
3. This course also trains the students with an ability to understand and analyse the equivalent circuits of D.C. machines and Transformers and solve basic problems related to field theory.

Course Outcomes

Upon completion of the course, students shall have ability to

CO306.1 Understand the basic concepts of field theory
CO306.2 Understand the constructional details and principle of operation of DC machines
CO306.3 Understand the constructional details and principle of operation of Transformers
CO306.4 Analyse the performance of the DC Machines under various operating Conditions using their various characteristics.
CO306.5 Evaluate the performance of Transformers using phasor diagrams and Equivalent circuits.
CO306.6 Select appropriate DC motor as well as to choose an appropriate method of Speed control for any industrial application.

Course Contents:

Basics of Field Theory –Coulomb's law, electric field intensity, electric flux density, Gauss' law, Electric potential – Biot - Savart's law, magnetic flux density, magnetic field intensity, Ampere's Law - Equation of continuity. **Principles of Energy conversion** – basic magnetic circuit analysis, Faraday's law of electromagnetic induction – singly and doubly excited magnetic field systems – torque production in rotating machines and general analysis of electro mechanical system. **D.C.Generator**– construction, principle of operation– emf equation– types, Characteristics, commutation – interpoles - armature reaction. **D.C. motor** – principle of operation – torque equation – types – electrical & mechanical characteristics–soft starters – Brushless D.C. motor concepts – D.C. servo motors - Permanent magnet D.C. motors - selection of D.C. motors for various industrial application aspects.**Transformers** – principle of operation – types – basic construction – equivalent circuit - regulation and efficiency – auto transformer - Star and Delta connections – all day efficiency – parallel operation of transformers – Concept of tap changing, on-load and off-load tap changers - Cooling methods of transformers – procedure for transformer erection in power stations.

Total Hours 60

Text Books:

1. D.P. Kothari and I.J. Nagrath, "Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2010.

2. Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Sixth edition, Tata McGraw Hill Books Company, 2015.

Reference Books:

1. William H.Hayt, “Engineering Electromagnetics”,Tata McGraw Hill,8th Edition,2014.
2. J.B. Gupta, Theory and Performance of Electrical Machines‘, S.K.Kataria and Sons, 2015.
3. Stephen J.Chapman, “Electric Machinery Fundamentals”, Tata McGraw Hill International Edition, New Delhi, 5th Edition, 2011

Web References:

1. http://nptel.ac.in/course.php?disciplineId=108
2. https://ocw.mit.edu/courses/find-by topic/#cat=engineering&subcat=electricalengineering&spec=electricpower

Online Resources:

1. Electricity & Magnetism, Part 1- PHYS 102.1x (edx.in)
2. AP® Physics 2 - Part 2: Electricity and Magnetism (edx.in)

Blooms Taxonomy based Assessment Pattern:

Bloom’s Category	Continuous Assessment Tests			Semester End Examination
	CIA1	CIA2	Term Examination	
Remember (**R**)	50	30	30	30
Understand (**U**)	30	30	30	30
Apply (**Ap**)	20	40	40	40
Analyse (**A**)	0	0	0	0
Evaluate (**E**)	0	0	0	0
Create (**C**)	0	0	0	0

17EE307 LINEAR AND DIGITAL INTEGRATED CIRCUITS 4/0/0/4

Nature of Course: G (Theory analytical)

Pre Requisites: 17EE303 Electric Circuit Analysis,17EE301 Electron Devices and Circuits.

Course Objectives:

1. To study the IC Fabrication, OP-AMP characteristics and its applications
2. To simplify the expressions using Boolean functions and to design the Combinational Circuits
3. To study about Synchronous & Asynchronous Sequential circuits
4. To study about the various memories and Logic Families and programming digital systems.

Course Outcomes

Upon completion of the course, students shall have ability to

CO307.1 Understand the op-amp's basic construction, characteristics, parameter limitations and various configurations

CO307.2 Analyze and deign basic op-amp circuits, particularly various linear and non-linear circuits, active filters, signal generators, and data converters

CO307.3 Understand the functional blocks and application of 555 timer

CO307.4 Apply the learned concept to design signal conditioning units using operational amplifiers

CO307.5 Understand the operations of basic logic gates and use of Boolean algebra in optimizing the circuit complexity

CO307.6 Understand the concepts of basic combinational circuits and sequential circuits.

CO307.7 Understand the design procedure of designing synchronous and asynchronous sequential circuits for given specification

CO307.8 Understand the operation of memory devices and different types of digital logic Families

Course Contents with Course Outcomes/Blooms Taxonomy/Assessment Methods

Linear integrated circuits: IC fabrication -op amp characteristics-inverting, Non- inverting and voltage follower– applications of op-amp – summer, Difference amplifier, differentiator and integrator - Instrumentation amplifier - V/I and I/V converters – comparators - peak detectors - S/H circuits - D/A converter – R-2R ladder and weighted resistor types - A/D converter – Dual slope, successive approximation and flash types. Functional blocks and applications of ICs: 555 timer –Astable and Monostable operation Design of signal conditioning unit using operational amplifier. **Digital circuits**- Number systems - Boolean algebra: De-Morgan's theorem, switching functions and simplification using K-maps and Quine Mc Cluskey method. **Combinational circuits** – Design of Logic gates- Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers. **Flip flops** - SR, D, JK and T; shift register – types. Analysis of synchronous sequential circuits - Design of synchronous sequential circuits – Counters, state diagram, state reduction, state assignment. Design of asynchronous sequential circuits. **Memories:** RAM, ROM, PROM, EPROM - EEPROM, PLDs, FPGA - Digital Logic Families: TTL, CMOS.ECL.Design of ALU, VHDL programming concepts.

Total Hours 60

Text Books:

1. A.Anand kumar, 'Fundamental of Digital Circuits', PHI Learning Private Ltd, 4th edition, 2014.
2. James M.Fiore, 'Opamps and Linear Integrated Circuits', Cengage Learning India Pvt Ltd, 1st edition, 2010.
3. M. **Morris** R. **Mano**, Michael D. Ciletti, 'Digital Logic Design', Prentice Hall,5th

Edition,2013.

Reference Books:

1. Muhammed H.Rashid, 'Microelectronics circuit analysis and design', Cengage Learning India Pvt Ltd,, 2nd edition,2011 .
2. Floyd, 'Digital Fundamentals', Pearson education, 11th edition, 2015.
3. David A.Bell, 'Operational amplifiers and Linear ICs', Oxford University Press, 2nd edition, 2011

Web References:

1. http://nptel.ac.in/courses/117103064/
2. http://nptel.ac.in/courses/117106114/
3. http://nptel.ac.in/courses/108106069/
4. http://nptel.ac.in/courses/117106086/
5. http://nptel.ac.in/courses/108106068

Online Resources:

1.https://www.coursera.org/learn/electronics
2.http://electronics-course.com/
3.https://www.edx.org/course/circuits-electronics-3-applications-mitx-6-002-3x-0

Blooms Taxonomy based Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Semester End Examination
	CIA1	CIA2	Term Examination	
Remember	20	0	10	10
Understand	30	20	20	10
Apply	50	40	40	40
Analyse	0	40	30	40
Evaluate	0	0	0	0
Create	0	0	0	0

17EE308 INSTRUMENTATION ENGINEERING 3/0/0/3

Nature of Course: D (Theory Application)

Pre Requisites: 17EE301 Electron Devices and circuits.

Course Objectives:

1. To state about instruments utilized in various disciplines in Industries.
2. To execute the different transducers in real time.
3. To expose recent developments in Instrumentation.

Course Outcomes

Upon completion of the course, students shall have ability to

CO310.1 Apply knowledge and handle instruments for measurement of Electrical, Optical, Thermal and Mechanical quantities.

CO310.2 Can able to reproduce results published in peer reviewed journals.

CO310.3 Design and conduct experiments for measurement & can able to match industrial requirement.

Course Contents

Measurements: Significance & Methods of Measurements, Functions of Instruments & Measurements, Applications of Measurements, Characteristics. **Types of Instruments Working Principle, Construction, Torque equation, Advantages and Disadvantages:** Moving coil, PMMC, Moving Iron, Attraction and Repulsion Instruments, Electrodynamometer type Instruments. Transformers, Current transformers and Potential Transformers, Single Phase Induction type Energy Meter**. Measurement of Electrical Quantities:** Components of Generalized measurement system, Introduction of Transducers/Sensors: Characteristics of Transducers, Requirement of Transducers, Classification of transducers, Selection Criteria of Transducers, **Measurement of Mechanical Quantities:** Displacement, strain vibration and pressure: Potentiometers, Resistance Strain Gauges, Piezo resistive accelerometer, Pressure gauge, Bourdan, Manometer. **Measurement of thermal parameters:** Temperature measurement: RTD, Thermisters, Thermocouples. **Optical Instrumentation:** Optical Source LED, laser, Photo-diode, and their characteristics, UV, visible and IR spectrometry, Introduction to Interferometric technique. **Instruments for Biomedical application:** Clinical thermometer, Stethoscope, Sphygmomanometer, Bio-potential based ECG, Pacemaker and its types, Incubator, Telemetry system.

Total Hours 45

Text books:

1. Sawhney.A.K, "A course in Electrical and electronic Measurement and Instrumentation", DhanpatRai& Sons, New Delhi, 19th Revised Edition 2011 Reprint 2014.
2. Albert D Halfride& William D Cooper, "Modern Electronic instrumentation and measurement techniques", Prentice Hall of India Pvt Ltd., latest edition, 2013.

Reference books:

1. Instrumentation: Theory and Applications Paperback by S Sheel, Narosa Publishing House (2013).
2. H. Oliver and J. M. Cage, Electronic Measurement and Instrumentation, McGraw Hill, 6th edition, 2014.
3. J.J.Carr, Elements of Electronic Instrumentation and Control, Prentice Hall, 5th edition, 2014.
4. Electronic Instrumentation (Third Edition), H.S-Kalsi, Tata McGraw-Hill Education Pvt.

Ltd. Publication, 2010.
5. S Balachandar PhD Thesis "Optical Interrogation of transient heat conduction in dielectric solids".

Web sources:

1. http://www.electrical4u.com
2. http://nptel.ac.in/courses
3. https://en.wikipedia.org

Online Resources:

1. http://kupce.ku.edu
2. http://www.shortcoursesportal.com
3. www.idc-online.com

Journals for seminar/ Mini project

1. **Measurement science and Technology.**
2. **Journal of Instrumentation.**
3. **Review of scientific Instruments.**
4. **Geoscientific Instruments**
5. **IEEE sensors**
6. **The Physics teacher**

Blooms Taxonomy based Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Semester End Examination
	CIA1	CIA2	Term Examination	
Remember	20	0	10	10
Understand	30	20	20	10
Apply	50	40	40	40
Analyse	0	40	30	40
Evaluate	0	0	0	0
Create	0	0	0	0

17CS212 **LINUX AND PROGRAMMING IN C++** **3/0/2/4**
(Common to Civil/Mechanical/ECE/EEE)

Nature of Course : F (Theory Programming)
Pre requisites : 17CS201 PROBLEM SOLVING USING C PROGRAMMING

Course Objectives:

1 To introduce basic Linux concepts.
2 To understand Object Oriented Programming concepts like data abstraction and encapsulation.
3 To analyse different kinds of constructors, inheritance and polymorphism.
4 To understand and apply streams and file concepts.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO.1	Remember the basic commands of Linux.	[R]
CO.2	Understand the basic Linux Commands and file system hierarchy	[U]
CO.3	Construct and apply C++ program to solve the given problems using basic programming constructs.	[AP]
CO.4	Apply the concepts of friend function and virtual functions.	[AP]
CO.5	Apply the concepts of polymorphism.	[AP]
CO.6	Make use of I/O functionality to code basic file operations and experiment with templates.	[AP]

Course Contents:

Introduction to Linux-Linux basic Commands- File System Hierarchy-Users, groups and permissions. Programming paradigms - Basic concepts and benefits of Object Oriented Programming, An overview of C++, datatypes, Selection statements, Functions, Arrays, Function overloading . Classes and objects, Default constructor, operator overloading, Friend functions - virtual functions. Templates, Exception handling. Derived classes- Inheritance, Virtual Base Class, Abstract class, Polymorphism and Virtual Functions-Virtual Base class. Console Input /output operation, File Handling. Error handling.

Lab Component

1	Linux Commands	[E]
2	Shell Programming	[E]
3	Simple Classes for understanding objects, member functions and constructors	[E]
4	Compile time polymorphism	[E]
5	Run time polymorphism	[E]

Total Hours: 75

Text Books:

1 Christopher Negus, Christine Bresnahan, “Linux Bible”, Willey Publishing Inc., 2012.
2 Herbert Shildt , “ The Complete Reference C++” , Fourth Edition, TMH, 2003.

Reference Books:

1 K.R.Venugopal, Rajkumar Buyya, T.Ravishankar, “Mastering C++”, TMH, 2003.

2 Bjarne Stroustrup, "The C++ programming language" Addison Wesley, fourth edition.

3 Richard Blum, Christine , “ Linux Command Line and Shell Scripting Bible” , 2nd Edition, Wiley Publishing Inc. 2011.

Web References:

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

2 http://nptel.ac.in/syllabus/syllabus.php?subjectId=106106111

Online Resources:

1 www.edx.org/course/introduction-linux-linuxfoundationx-lfs101x-0

2 https://www.coursera.org/learn/c-plus-plus-a

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	30	30	-	20
Understand	30	40	40	20	40
Apply	40	30	30	30	30
Analyse	-	-	-	30	10
Evaluate	-	-	-	20	-
Create	-	-	-	-	-

17EE309 Electrical Machines – I Laboratory 0/0/3/2

Nature of Course: M (Practical application)

Co Requisites: 17EE303 Electric Circuit Analysis

Course Objectives:

1. To obtain the performance characteristics of DC machines by using Virtual Labs, MATLAB and experimental methods.
2. To obtain the performance characteristics of transformers based on various tests under no load, loading conditions, Open circuit and short circuit conditions
3. To analyse the equivalent circuit parameters of transformers using Virtual Labs.

Course Outcomes

Upon completion of the course, students shall have ability to

CO309.1 Analyze the no load and load characteristics of DC shunt generator.
CO309.2 Analyze the performance characteristics of Series and Compound generator.
CO309.3 Determine the mechanical and electrical characteristics of Shunt ,Series and Compound motor
CO309.4 Determine the electrical characteristics of Single phase Transformers.
CO309.5 Understand the different types of single and three phase transformer connections

Course Contents

1. To determine the effective efficiency and speed characteristic of DC shunt motor (3)
2. To determine the effective efficiency and speed characteristic of DC series motor(3).
3. To determine the effective efficiency and speed characteristic of DC Compound motor(3).
4. To determine the OCC characteristics of self excited DC shunt generator using Simulation software. (3).
5. To determine the no load characteristics of the separately excited DC generator.(3)
6. Determination of efficiency of DC machine through Hopkinson s Test (3).
7. Determination of the equivalent circuit parameters of a single phase transformer (3).
8. Sumpners Test on Transformers (6).
9. Swinburne's test and speed control of DC Shunt motor(9)
10. a)Scott Connection of Two Single phase Transformers (3) .b)Three phase Transformer connections(6)

Total Hours 45

Reference Books:

1. D.P. Kothari and I.J. Nagrath, "Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2010.
2. Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, 'Electric Machinery', Sixth edition, Tata McGraw Hill Books Company, 2015.
3. J.B. Gupta, Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2015.

Web References:

1. http://www.electrical4u.com/characteristic-of-separately-excited-dc-generator/
2. http://www.academia.edu

Online Resources:

http://iitg.vlab.co.in/?sub=61&brch=168

Blooms Taxonomy based Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Semester End Examination
	Mid Sem Review	Term Review	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate	10	10	10
Create	0	0	0

17EE310 LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY 0/0/3/2

Nature of Course: M (Practical application)

Co Requisites: 17EE303 Electric Circuit Analysis, 17EE301 Electron Devices and Circuits.

Course Objectives:

1. To verify the expressions using Boolean functions and to verify the Combinational circuits
2. To design and verify the output of Synchronous Sequential circuits
3. To design and verify the output of Asynchronous Sequential circuits
4. To implement the basic circuits using OP-AMP and to implement the timer IC application

Course Outcomes

Upon completion of the course, students shall have ability to

C310.1 Verify the expressions using Boolean functions and to verify the Combinational circuits

C310.2 Design and verify the output of Synchronous Sequential circuits

C310.3 Design and verify the output of Asynchronous Sequential circuits

C310.4 Implement the basic circuits using OP-AMP and the timer IC application.

Course Contents

1. Implementation of Inverting and Non inverting Amplifier.(3)
2. Comparator, Integrator and Differentiator using Op-amp. (3)
3. Astable and monostable multivibrators using 555 timers.(3)
4. Implementation of Boolean Functions, Adder, Subtractor circuits. (3)
5. Design of Code convertors , parity generator and checker.(6)
6. Design of Encoders and Decoders using logic gates. (6)
7. Design of Multiplexer and Demultiplexer using logic gates.(6)
8. Design and implementation of synchronous and asynchronous counters and shift registers using flipflops. (6)
9. VHDL programming of simple combinational and sequential circuits.(3)
10. Realization of A/D and D/A converters simulation software.(3)
11. Realization of flipflops using simulation software.(3)
12. Precision Half and Full Wave rectifier using OP-AMP

Total Hours 45

Reference Books:

1.A.Anandkumar, 'Fundamental of Digital Circuits', PHI Learning Private Ltd, edition, 2014.

2.James M.Fiore, 'Opamps and Linear Integrated Circuits', Cengage Learning India Pvt Ltd, 1st edition, 2010.

Web References:

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

Online Resources:

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

Blooms Taxonomy based Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Semester End Examination
	Mid Sem Review	Term Review	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	20	30	20
Evaluate	10	10	20
Create	0	0	0

17MA112 PROBABILITY AND COMPUTATIONAL METHODS (EEE) 3/2/0/4

Nature of Course J(Problem analytical)
Pre requisites 16MA101-Linear Algebra , Calculus and its Applications

16MA102-Integral Calculus and Laplace Transform

Course Objectives:

1 To find the roots of nonlinear (algebraic and transcendental) equations, solutions of large system of linear equations and eigen values of a matrix
2 To study the concept of fitting a curve of best fit to the given numerical data and to calculate the deviation of the expected value from the observed value
3 To apply analytic function techniques to transform irregular geometry to regular geometry
4 To study the basic probability concepts
5 To acquire skills in handling situations involving more than one random variable
6 To understand and have a well – founded knowledge of standard distributions which can be used to describe real life phenomena

Course Outcomes:

Upon completion of the course, students shall have ability to

C109.1	Recall the concepts of basic probability	[R]
C109.2	Fit a polynomial or special function curve for the given data	[U]
C109.3	Apply numerical methods to solve algebraic, transcendental and simultaneous equations	[AP]
C1O9.4	Find the derivatives of the complex valued functions and to evaluate complex valued integrals	[AP]
C109.5	Apply the probability concept in solving engineering problems	[AP]
C109.6	Use distribution in cluster analysis of similar binary variables	[AP]

Course Contents:

Numerical solution to algebraic and transcendental equations - Regula-Falsi method - Newton-Raphson method –Gauss Elimination method -Gauss Jordan method –Gauss Jacobi method - Gauss Seidel method – Inverse of a matrix by Gauss Jordan method –Eigen value of a matrix by power method- **Curve Fitting** - Empirical laws – Linear law – Method of group averages – Principle of Least squares – Fitting straight line, parabola and exponential curve - **Complex integration**-Analytic function (definition)-Cauchy's integral theorem(statement)-Laurent's series-zeros and singularities-Residues-Cauchy's residue theorem(statement)-Contour integration(excluding poles on the real axis)- **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

Total Hours: 60

Text Books:

1 Grewal B.S., Numerical methods in Engineering and Science. 10th edition, Khanna Publishers, 2014.
2 Grewal B.S, —Higher Engineering Mathematics, 43rd edition, Khanna Publications, Delhi, 2014.
3 Kreyszig. E, —Advanced Engineering Mathematics, tenth Edition, John Wiley and Sons (Asia) Limited, Singapore, 2014.
4 Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & sons, 2000,Reprint 2014.
5 Palaniammal.S.,-Probability and Random Processes, Prentice hall of India, New Delhi, 2014,Reprint 2015

Reference Books:

1 Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012.
2 Jain M.K. Iyengar, K & Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, Publishers 2013.
3 Kandasamy.P,Thilagavathy,K,P.Gunavathy,"Numerical Methods",3rd edition, S.Chand and company Pvt.Ltd.,2013
4 Peebles Jr.P.Z.,-Probability Random Variables and Random signals principles , Tata McGraw- Hill Publishers, Fourth edition , New Delhi , 2002.

Web References:

1 http://nptel.ac.in/syllabus/syllabus.php?subjectId=111999935
2 http://nptel.ac.in/courses/112106064/
3 http://nptel.ac.in/courses/111103070/

Online Resources:

1 https://ocw.mit.edu/courses/.../18-335j-introduction-to-numerical-methods
2 https://www.coursera.org/learn/complex-analysis
3 www.edx.org/Probability
4 https://ocw.mit.edu/courses/.../18-440-probability-and-random-variables-spring-2014/

Assessment Methods & Levels (based on Bloom'sTaxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C109.1	Remember	Class room Quiz	**2**
C109.2	Understand	Class presentation / Powerpoint presentation	**6**
C109.3 , C109.4	Apply	Group activity	**7**
C109.5 C109.6	Apply	Group Assignment	**7**

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	30	30	30	30

Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE311 **ELECTRICAL MACHINES - II** **4/0/0/4**

Nature of Course : G (Theory analytical)
Pre requisites : 17EE306 Electrical Machines I

Course Objectives:

1 To study the single phase Induction motor and special machines
2 To acquire the knowledge about starting and speed control of poly phase Induction motor
3 To acquire the knowledge about three phase Induction motor and Synchronous machines

Course Outcomes:

Upon completion of the course, students shall have ability to

C311.1	Remember the basic fundamentals and working principles of rotating machines.	[R]
C311.2	Understand the constructional details and principle of operation of Synchronous Machines.	[U]
C311.3	Understand and appraise the principle of operation and performance of PMBLDC Machines.	[U]
C311.4	Understand the performance of the AC Induction Machine using the phasor diagrams and equivalent circuits.	[U]
C311.5	Apply the performance of the Synchronous Machine using the phasor diagrams and equivalent circuits.	[AP]
C311.6	Select appropriate AC and special machine for any application and appraise its significance	[AP]

Course Contents:

Alternators: Construction, principle and types, armature reaction, load characteristics, voltage regulation, two-reaction theory, synchronization and synchronizing power, Parallel operation and load sharing, operation on infinite bus-bar typical applications, Alternator grounding in power stations. **Synchronous motors:** Synchronous machines on infinite bus bars, phasor diagram, V and inverted-V curves, Hunting and its suppression, starting methods, Working of synchronous motor as a condenser. **Poly-phase Induction motors:** Construction, principle and types, no load and blocked rotor test, equivalent circuit, circle diagram, Starting and speed control methods, Braking methods. Induction generators - types, principle of operation, equivalent circuit and applications – Induction generator in windmill power plant – Linear induction motor. **Single-phase Induction motors** - Construction, principle and types, double revolving field theory, equivalent circuit, Permanent magnet brushless motors: Construction, principle and types, torque equation, application aspects related to vehicle and house hold. **Special Purpose Machines:** Construction and principle of operation of Stepper motors, Linear Induction motors, A.C. servo motors and their Applications. **Energy Efficient A.C. Machines:** Construction, Basic Concepts, losses minimization and efficiency calculations. Super Conducting A.C. Machines: Construction, Principle of operation and basic concepts.

Total Hours: 60

Text Books:

1 D.P.Kothari, Electrical Machines, 4th edition, Tata McGraw-Hill, New Delhi 2010.
2 P.S.Bimbhra, Electrical Machinery, Khaana Publishers, 2011.

Reference Books:

1 Fitzgerald A.E. Kingsly C., Umans S.D., Electrical Machinery, 7th edition, McGraw Hill International Edition, New York, 2013.
2 Stephen J.Chapman, Electric Machinery Fundamentals, Tata McGraw Hill, New Delhi, 5th Edition, 2011.
3 B.L. Theraja and A.K. Theraja, Electrical Technology, S. Chand Publishing, 2010.

Web References:

1 http://nptel.ac.in/syllabus/syllabus.php?subjectId=108105018
2 http://freevideolectures.com/Course/2335/Basic-Electrical-Technology/23

Online Resources:

1 https://www.youtube.com/watch?v=b24jORRoxEc

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C311.1	Remember	Quiz	**4**
C311.2	Understand	Writing Skills	**4**
C311.3	Understand	Class Presentation	**4**
C311.4	Understand	Group Assignment	**2**
C311.5	Apply	Class Presentation	**4**
C311.6	Apply	Group Assignment	**2**

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	80	40	40
Apply	-	-	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE312 **CONTROL SYSTEMS** **4/0/0/4**

Nature of Course :G (Theory analytical)
Pre requisites :17EE301 -Electric Circuit Analysis

Course Objectives:

1. To understand the methods of representation of systems and to desire their transfer function models.
2. To provide adequate knowledge in time response of systems and steady state error analysis.
3. To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems.
4. To understand the concept of stability and methods of stability analysis.
5. To allow the students to design controllers and compensators for stability control.

Course Outcomes:

Upon completion of the course, students shall have ability to

C312.1	Develop the theoretical aspects of Control systems and to translate variousControl systems into mathematical models.	[R]
C312.2	Compute transfer function of control systems using Block diagram reduction technique and Mason's gain formula.	[U]
C312.3	Understand the transient and steady state response of first order and second order Control systems.	[U]
C312.4	Understand the generalized error coefficient and steady state error for various types and order of the system.	[U]
C312.5	Accord basic knowledge in obtaining the open loop frequency responses of systems using Bode Plot and Polar plot.	[AP]
C312.6	Appraise the stability of the control systems using Root locus and Routh-Hurwitz Criteria.	[AP]
C312.7	Design and realize the controllers and compensation techniques that can be used to stabilize the control systems using bode plot.	[AN]
C312.8	Modelling electromechanical applications in Simulation software.	[E]

Course Contents:

Control System Modeling: Basic elements in Control Systems – Open loop and Closed loop systems – Overview of Laplace Transform, Mathematical modeling of Mechanical and Electrical systems: Translational, Rotational – Block diagram reduction using Signal flow graph. **Time response analysis**: Time domain specifications - Types of test signals – First and Second Order System response – Steady state error – Generalized error coefficients. **Frequency response analysis**: Frequency domain specifications – Correlation between frequency and time domain specifications – Bode plot – Polar plot. **Stability of control system**: Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root Locus techniques – Illustration of the effect of adding zero and a pole – Nyquist stability criterion – Gain margin and Phase margin – Analysis using simulation software. **Controllers and Compensators Design**: Design of P, PI and PID controllers – Performance criteria – Lag, lead and lag – lead networks – Lag Compensator design using Bode plot - Analysis using simulation software tool**; Case studies:** Analysis of two tank liquid level system.

Total Hours: 60

Text Books:

1 I.J. Nagrath and M. Gopal, 'Control Systems Engineering', 5th Edition, New Age International, 2013.
2 K. Ogata, 'Modern Control Engineering', 5th edition, Prentice Hall India, New Delhi, 2011.
3. Benjamin C. Kuo, 'Automatic Control systems',8th Edition, Pearson Education, New Delhi, 2012.

Reference Books:

1 Norman S. Nise, 'Control Systems Engineering', 7th Edition, John Wiley, New Delhi, 2015.
2 Richard Poley, 'Control Theory Fundamentals', 2nd Edison, Createspace, 2014.
3 Richard C. Dorf, Robert H.Bishop, 'Modern Control Engineering', 13th Edition, Pearson Education, New Delhi, 2016.

Web References:

1. http://www.nptel.ac.in/courses/108101037/
2. http://www.nptel.ac.in/courses/108102043/
3. http://www.ijaiem.org/Volume4Issue5/IJAIEM-2015-05-03-4.pdf

Online Resources:

1. https://ocw.mit.edu/courses/mechanical-engineering/2-04a systems-and-controls-spring-2013/
2. https://www.edx.org/course/introduction-control-system-design- first- mitx-6-302-0x

Assessment Methods & Levels (based on Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C312.1	Remember	Online Quiz	**2**
C312.2	Understand	Writing Skill	**2**
C312.3	Understand	Technical Presentation	**3**
C312.4	Understand	Simulation Exercise	**3**
C312.5	Apply	Simulation Exercise	**3**
C312.6	Apply	Problem Solving	**2**
C312.7	Analyse	Simulation Exercise	**3**
C312.8	Evaluate	Group Assignment	**2**

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	-	-	-	-

17EE313 GENERATION, TRANSMISSION AND DISTRIBUTION 3/0/0/3

Nature of Course : G (Theory analytical)

Pre requisites :17ES101 - Electric and Magnetic Circuits

: 17EE303 - Electric Circuit Analysis

Course Objectives:

1. To introduce the Generation, Transmission and Distribution sector of power system.
2. To enable the students to understand the calculation of transmission line parameter for different conductors.
3. To analyse the concepts of modelling, corona loss and efficiency of transmission line.
4. To learn selection of cables and insulators in power system network.
5. To realise substation, distribution system and tariff calculation.

Course Outcomes:

Upon completion of the course, students shall have ability to

C313.1	Remember the operation of conventional generating stations and renewable sources of electrical power.	[R]
C313.2	Understand overhead line insulator and underground cables and corona.	[U]
C313.3	Apply the concepts of modelling, corona loss and efficiency of transmission line.	[AP]
C313.4	Apply knowledge in substations, their types and distribution systems.	[AP]
C313.5	Evaluate the electrical circuit parameters of transmission lines.	[AN]
C313.6	Analyse various economic power tariff methods.	[AN]

Course Contents:

Generation of electric power:Typical Layout of an Electrical Power System, Hydro station, Steam Power Plant, Nuclear Power Plant, Pelamis – Wave Energy, wind Energy, and Solar Energy.**Transmission line parameters calculation:**Overview of Differentiation and Integration, Resistance, inductance, capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing of solid and bundled conductors, effect of earth on capacitance.**Modelling and performance of transmission lines:**Modelling and simulation of Medium & long transmission lines, efficiency and regulation, power circle diagram, surge impedance loading Ferranti effect and corona loss, Mechanical design of transmission lines. **Overhead line insulators:** Selection of Insulators,different types, string efficiency. **Underground cables:**Selection of cables, rating of cables, constructional details of various types of cables, oil and gas-filled cables, XLPE cable , capacitance grading, sheath loss, thermal ratings. **Substation and distribution system**: Substation layout, radial and ring systems, selection of feeders and distributors, economic aspects and tariff calculations.

Total Hours: 45

Text Books:

1. Leonard.L. Grigsby, Electric Power Generation, Transmission and distribution, Third Edition, CRC Press, 2012.
2. C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, ThirdEdition, New Age International, 2015.

Reference Books:

1. B. R. Gupta, Generation of Electrical Energy, 4e,S. Chand Publication, 2013.
2. A. S. Pabla, Electric Power Distribution, McGrawHill International Edition, 2012.
3. S.N. Singh, Electric Power Generation, Transmission and Distribution, Twelflh Printing (Second Edition) Published by Asoke K. Ghosh, Prentice-Hall of India Private Limited, New Delhi, 2011.

Web References:

1. http://nptel.ac.in/video.php?subjectId=108102047
2. http://textofvideo.nptel.iitm.ac.in/108102047/lec20.pdf

Online Resources:

1 https://www.edx.org/course/smart-grids-electricity-future-ieeex-smartgrid-x-0

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C313.1	Remember	Quiz	**2**
C313.2	Understand	Class presentation	**4**
C313.3	Apply	Group Assignment	**4**
C313.4	Apply	Poster presentation	**2**
C313.5	Analyse	Simulation Exercise	**4**
C313.6	Analyse	Case study	**4**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA1 [6 marks]	**CIA2 [6 marks]**	**Term End Examination [8 marks]**	
Remember	30	20	20	20
Understand	60	30	30	30
Apply	-	30	30	30
Analyse	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

17CS213 **DATA STRUCTURES AND ALGORITHMS (Common to ECE/EEE)** **3/0/2/4**

Nature of Course :K (Problem Programming)

Pre requisites : 17CS201 PROBLEM SOLVING USING C PROGRAMMING

Course Objectives:

1. To stress the importance of Algorithms and Data structures in becoming a more productive programmer.
2. To understand the Algorithms and Data structures used for solving a problem are much more important than knowing the exact code for it in some programming language.
3. To provide an insight into the intrinsic nature of the problem as well as possible solution techniques, independent of programming language, programming paradigms, computer hardware or any other implementation technique.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO1	Identify the suitable data structure for a real world problem	[R]
CO2	Select an appropriate design paradigm that solves the given problem efficiently	[U]
CO3	Write efficient algorithms	[AP]
CO4	Analyze the complexities of algorithms	[AN]
CO5	Compare the complexities of the algorithms	[E]
CO6	Develop efficient algorithms for different applications	[C]

Course Contents:

Introduction to Data structures and Algorithms: Importance of algorithms and data structures, Stages of algorithm development for solving a problem: Describing the problem, Identifying a suitable technique, Design of an Algorithm, Proof of Correctness of the Algorithm, Computing the time complexity of the Algorithm. **Analysis of Algorithms:** Overview of Mathematical preliminaries Asymptotic notations and their significance, Running time of an algorithm, Time-complexity of an algorithm, Performance analysis of an algorithm, Analysis of iterative and recursive algorithms. Master theorem**. Data Structures:** Importance of data structures, Arrays, Stacks, Queues, Linked list, Trees, Hashing table, Binary Search Tree, AVL trees, Red Black trees, splay trees, Heaps. **Graph Algorithms:** Breadth First Search (BFS), Depth First Search (DFS), Minimum Spanning Tree (MST), Single Source Shortest Paths**.Advanced Data Structures:** Bi-connected components, Cut vertices, Matching, Network flow, Data Mining, Data Fusion, Web Data structures, Real Time application**.**

Total Hours: 75

Lab Component

1. Array, Loops
2. Stacks and Queues
3. Searching and Sorting
4. Linked List
5. Brute force technique
6. Greedy Technique
7. Backtracking
8. Dynamic Programming
9. Tree
10. BFS and DFS
11. Minimum Spanning Tree
12. Dijsktra's Shortest path algorithm

13. Domain Specific Algorithms

Text Books:

1 Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms , Paper Back 2010, Third edition, MIT Press, 2010(Reprint)

Reference Books:

1 SanjoyDasgupta, C.Papadimitriou and U.Vazirani , Algorithms , Tata McGraw-Hill, 2006.
2 V. Aho, J.E. Hopcroft and J. D. Ullman, Data Strucures and Algorithms, Pearson India, Ist Edition, 2002.
3 V. Aho, J.E. Hopcroft and J. D. Ullman, Design and Analysis of Computer Algorithms, Pearson, 1st edition, 2011.
4 Sara Baase , Allen Van Gelder, Computer Algorithms, Introduction to Design and Analysis, 3rd edition, Wesley Longman Publishing, 2000.
5 Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd edition, Pearson Education, 2007

Web References:

1 http://www.amazon.in/Data-Structures-Algorithms-Made Easy/dp/0615459811/ref=sr_1_1?ie=UTF8&qid=1474906913&sr=8-1&keywords=karumanchi-C++edition
2 http://www.amazon.in/Data-Structures-Algorithms-Made-Easy/dp/1466304162/ref=sr_1_2?ie=UTF8&qid=1474906913&sr=8-2&keywords=karumanchi-java edition
3 http://nptel.ac.in/courses//106103069/
4 http://web.stanford.edu/class/cs97si/

Online Resources:

1 https://www.coursera.org/learn/data-structures
2 https://www.coursera.org/specializations/data-structures- algorithms
3 http://nptel.ac.in/courses//data-structures

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**	
	CIA1 [6 marks]	**CIA2 [6 marks]**	**Term End Assessment [8 marks]**	**Rubric based CIA [40 Marks]**	
Remember	10	10	10	-	-
Understand	20	20	20	-	-
Apply	50	40	40	20	20
Analyse	-	30	30	30	30
Evaluate	-	-	-	20	20
Create	-	-	-	30	30

17EE314 Electrical Machines - II Laboratory 0/0/3/2

Nature of Course : M (Practical application)
Co requisites : 17EE306 Electrical Machines – I

Course Objectives:

1. To obtain the performance of induction motor, synchronous motor, Alternators and excitation characteristics of induction generator based on various tests and also using Virtual Labs.
2. To obtain the DC resistance of the stator in induction motor using Virtual Labs

Course Outcomes:

Upon completion of the course, students shall have ability to

C314.1	Measure the regulation of three phase alternator and verify Synchronization of Alternator	[AP]
C314.2	Determine the performance characteristics of single and three phase induction motors	[AN]
C314.3	Understand the Performance characteristics of Three-Phase Induction Motor from Circle diagram	[AN]
C314.4	Understand the self excitation characteristics of an induction generator	[AN]
C314.5	Analyse the performance of synchronous machine	[AN]

Course Contents:

1. Equivalent circuit parameters of a single and three phase squirrel cage induction motors. (6)
2. V and Inverted V curves of Synchronous Machine. (3)
3. Regulation of Alternator.(6)
4. Separation of No load losses of three phase induction motor.(6)
5. Performance characteristics of alternator.(6)
6. Performance characteristics of single phase and three phase induction motors using Virtual Labs.(6)
7. Characteristics of Induction generator using simulation.(6)
8. Speed control of three phase induction motor using simulation.(6)

Total Hours : 45

Reference Books:

1 Fitzgerald A.E. Kingsly C., UmansS.D., 'Electrical Machinery' 7th edition, McGrawHill International Edition, New York, 2013.
2 Stephen J. Chapman, 'Electric Machinery Fundamentals', Tata McGraw Hill International Edition, New Delhi, 5th Edition, 2011.
3 D.P.Kothari, 'Electrical Machines.' 4th edition, Tata McGraw-Hill, NewDelhi 2010.

Web References:

1 http://www.electrical4u.com/characteristic-of-separately-excited-dc-generator/
2 http://www.academia.edu

Online Resources:

1 http://iitg.vlab.co.in/?sub=61&brch=168

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	20	20
Apply	30	30
Analyse	40	40
Evaluate	0	0
Create	0	0

17EE315 CONTROL AND INSTRUMENTATION LABORATORY 0/0/3/2

Nature of Course :M (Practical application)
Co requisites :17EE308 Instrumentation Engineering
17EE312 Control Systems

Course Objectives:

1.To train the students to understand the Measuring Instruments

2. To identify the hardware and software that is needed in a basic control system.

3. To construct circuits, observe and analyse the behaviour of control system for various elementary applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C315.1	Remember the measurement of Power and Energy	[R]
C315.2	Understand the knowledge of Amplifiers, Converters and Measuring Instruments	[U]
C315.3	Determine the transfer function of DC Motor and DC Generator	[AP]
C315.4	Analyze the analog response of Type 0 and Type 1 Systems	[AN]
C315.5	Understand simulation software and its application in Control System	[E]

Course Contents:

1. Power and Energy Measurement (6)
2. Instrumentation amplifiers and A/D converters (6)
3. Transfer function of DC Machines (6)
4. Simulation of Type - 0 and Type – 1 system and controllers using simulation software tool (6)
5. DC and AC position control systems (3)
6. Simulation of Block diagram reduction techniques, first and Second order system for different test inputs (6)
7. Design of compensators using simulation software(6)
8. Speed control of Servo and Stepper motors using simulation software. (6)

Total Hours: 45

Reference Books:

1. Sawhney.A.K, "A course in Electrical and electronic Measurement and Instrumentation", Dhanpat Rai & Sons, New Delhi, 2008.
2. K. Ogata, 'Modern Control Engineering', 5th edition, PHI, New Delhi, 2011.
3. Norman S. Nise, 'Control Systems Engineering', 5th Edition, John Wiley, New Delhi, 2015.
4. I.J.Nagrath & M.Gopal, Control Systems Engineering', 5th Edition New Age International Publishers, 2013.

Web References:

1 http://nptel.ac.in/courses/108105064/
2 http://www.nptel.ac.in/courses/108101037/
3 http://www.iitk.ac.in/ee/data/Teaching_labs/Control_System/EE380_lab.pdf

Online Resources:

1 http://vlab.co.in/institute_detail.php?ins=003

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	20	20
Apply	30	30
Analyse	30	20
Evaluate	10	20
Create	0	0

17EE316 RENEWABLE ENERGY SYSTEMS 3/0/0/3

Nature of Course: D (Theory Application)

Pre Requisites: 17PH101 Engineering Physics

Course Objectives:

1. To understand different non-conventional energy systems and its applications.
2. To advance student's knowledge and assimilate new technologies.
3. To perform simple techno-economical case studies of renewable energy systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO316.1 Remember the concepts of Kyoto Protocol

CO316.2 Understand the energy scenario in India and Integrated Resource Plan

CO316.3 Understand the operation and application of Solar energy, Biomass, Wind energy and Tidal energy

CO316.4 Understand the operation and application of Geothermal energy and fuel cells

CO316.5 Understand the concepts of different energy storage methods

CO316.6 Apply ideas to perform case studies on renewable energy systems

Course Contents with Course Outcomes/Blooms Taxonomy/Assessment Methods

Energy Scenario: Energy scenario in India, Kyoto protocol, concept of clean development mechanism and prototype carbon funds, integrated resource plan **Solar Energy:** Solar thermal, solar photovoltaic, applications, maximum power point tracking**,** grid interactive solar PV systems **Wind Energy:** Site selection, wind energy conversion system, applications, maximum power operation, grid connected operations **Other Energy Sources:** Biomass energy, tidal energy, geothermal energy, fuel cells, applications. **Energy Storage and Case studies:** Storage methods of mechanical, chemical, electromagnetic, electrostatic and thermal energy, case studies on solar PV system, wind energy system and hybrid electric vehicles**.**

Total Hours 45

Text Books:

1. John Twidwell and Tony Weir, "Renewable Energy Resources", 3rd Edition, Routledge, 2015.
2. Rai, G.D, "Non Conventional Energy Sources", Khanna Publishers, 2010.

Reference Books:

1. Aldo Vieira Da Rosa, "Fundamentals of Renewable Energy Processes", Academia Press, 2012.
2. B.H. Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw Hill, New Delhi, 2010.
3. G.N. Tiwari, "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.

Web References:

1. http://nptel.ac.in/courses/108108078/
2. http://www.homepower.com/
3. http://unfccc.int/kyoto_protocol/items/2830.php
4. https://wbcarbonfinance.org/Router.cfm?Page=PCF&FID=9707&
5. http://www.pacificorp.com/es/irp.html
6. https://www.ashden.org/files/SKG%20full.pdf

Online Resources:

1. https://www.edx.org/course/sustainable-energy-design-renewable-delftx-energyx

2. https://www.coursera.org/learn/wind-energy
3. https://www.edx.org/course/solar-energy-delftx-et3034x-0

Assessment Methods & Levels (based on Blooms'Taxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C316.1	Remember	Quiz	**2**
C316.2	Understand	Class presentation	**4**
C316.3	Understand	Group Assignment	**4**
C316.4	Understand	Quiz	**4**
C316.5	Understand	Group Assignment	**2**
C316.6	Apply	Case study	**4**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA1 [6 marks]	CIA2 [6 marks]	Term End Examination [8 marks]	
Remember	30	20	20	20
Understand	70	80	80	80
Apply	-	-	-	-
Analyse				
Evaluate	-	-	-	-
Create	-	-	-	-

17ES104 **VIRTUAL INSTRUMENTATION** **3/0/2/4**

Nature of Course : D (Theory and Laboratory application)
Pre requisites : 17EE308-Instrumentation Engineering

Course Objectives:

1. To understand the Virtual instrumentation and to realize the architecture of VI.
2. To familiarize with the VI software and learn programming in VI.
3. To study various Instrument Interfacing and data acquisition methods.
4. To understand various analysis tools and develop programs for various applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

Upon completion of the course, students shall have ability to

C104.1 Understand the Architecture and features of virtual Instrument.	[U]
C104.2 Understand the Mathematical operation available in LabVIEW.	[AP]
C104.3 Apply the application of Loops and Charts with Respect to LabVIEW application	[AP]
C104.4 Understand the working principle of PC based data Acquisition System.	[U]
C104.5 Understand the working principle of Communication Protocols	[U]
C104.6 Analyse the toolkits in LabVIEW and develop programs for various applications	[A]

Course Contents

Review of Virtual Instrumentation: Historical perspective – Need of VI – Advantages of VI – Define VI – Block diagram & Architecture of VI – Data flow techniques – Graphical programming in data flow – Comparison with conventional programming. **Programming Techniques:** VI's and sub-VI's – Loops and charts – Arrays – Clusters – Graphs – Case & sequence structures – Formula nodes – Local and global variable – String & file input**. Data Acquisition Basics**: Concept of PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Analog inputs and outputs – Use of timer-counter – Grounding: Differential and Single Ended. **Instrument Interfaces and Protocols**: Serial Communication Protocols: RS232, RS 422, RS 485 and USB standards - Parallel Communication Protocols: IEEE 488 standard – Introduction to bus protocols of MOD bus and CAN bus **Use of Analysis Tools and Application of VI:** Image acquisition cards - Control System Design Toolbox- PID controller Toolbox– Temperature data acquisition system – Web Publishing Tools

Lab Component

1	Verification of Arithmetic Operations, Half adder and Full adder	[U]
2	Implementation of For loop, While loop, Array and Cluster functions.	[A]
3	Implementation of Case, Sequence Structure and Formula Nodes	[E]
4	Program for controlling the speed of a DC motor using PID tool box	[E]
5	Program to control Temperature by using Thermocouple and DAQ	[E]

Total Hours: 75

Text Books:

1. Jovitha Jerome, 'Virtual Instrumentation using LabVIEW', Prentice Hall, 2010.
2. Gary W. Johnson, Richard Jennings, "Lab-view Graphical Programming", Tata McGraw Hill Professional Publishing, IV Edition, 2006.

Reference Books:

1. Peter W. Gofton, 'Understanding Serial Communications', Sybex International ,1994 .
2. Gupta. S, Gupta. J.P, "PC Interfacing for Data Acquisition and Process Control", ISA, 1994.
3. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement Instrumentation and Control', Newness, 2000.

Web References:

1. www.ni.com/academic/students/learn_labview
2. www.ni.com/academic/students/learn_ daq

Online Resources:

http://www.ni.com/webcast/2898/en/

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C104.1	Understand	Online Quiz	**3**
C104.2	Understand	Presentation	**3**
C104.3	Apply	Simulation Software module 1	**3**
C104.4	Understand	Group Assignment	**3**
C104.5	Understand	Simulation Software module 2	**4**
C104.6	Analyse	Simulation Software module 3	**4**
Summative assessment based on Continuous and End Semester Examination			

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	20	20	10	-	10
Understand	80	20	20	20	30
Apply	-	30	30	-	30
Analyse	-	30	40	30	30
Evaluate	-	-	-	50	-
Create	-	-	-	-	-

17EE317 **POWER ELECTRONICS** **4/0/0/4**

Nature of Course:

Pre Requisites: 17EE301 Electron Devices and Circuits

Course Objectives:

1. To learn about the characteristics of Power devices
2. To use power devices in rectifier circuits.
3. To study the operation of DC choppers.
4. To learn the PWM inverters
5. To study the operation of cycloconverter.

Course Outcomes

Upon completion of the course, students shall have ability to

C317.1	Remember the characteristics and the turn on methods of power devices.	[R]
C317.2	Understand the operation of rectifier circuits.	[U]
C317.3	Understand the working principle of DC choppers.	[U]
C317.4	Understand the operation of inverter circuits.	[U]
C317.5	Understand the working principle of AC-AC Converter.	[U]
C317.6	Apply the power devices in drives.	[AP]

Course Contents

Power Devices Static Characteristics and switching behaviour of different solid- state devices namely Power Diode, SCR, TRIAC, GTO, IGBT, MOSFET and IGCT. **Firing and Protection Circuit** firing circuit of SCR using UJT, Gate driver circuit of MOSFET & IGBT, Protection of SCR, Thermal analysis of MOSFET & IGBT. Two - transistor analogy of SCR, Series and Parallel operation of SCR. **Rectifiers** Classification of Rectifiers, Phase controlled rectifiers: Single phase half controlled rectifiers, Single phase half wave and full converter. Three phase half controlled rectifiers and full converter .Effect of source impedance on the performance of single phase controlled rectifiers. Dual Converters. **Choppers** Principles, classification, Time ratio control and current limit control, use. Resonant converter. **Inverters** Single phase and three phase inverters, constant voltage source and constant current source inverters, PWM inverters. **AC-AC Converters** Characteristics of DIAC & TRIAC, Frequency conversion: Single phase cycloconverter circuit, AC-AC Voltage Controller.

Application : D.C. and A.C. drives, S.M.P.S., Resonant converters, A.C. Line Filters, ratio, interference suppression.

Total Hours 60

Text Books:

1. M.H. Rashid, “Power Electronics circuits, devices and applications”, Pearson Education, Inc. Edition 2009.
2. M.D. Singh and K.B. Khanchandani, “Power Electronics” Tata McGraw-Hill, Edition 2008.
3. Ned Mohan, Tore M. Undeland & William P. Robbins, “Power Electronics – Converters, Applications and Design”, John Wiley & Sons edition 2009.
4. Vedam Subrahmanyam, “Power Electronics” John Wiley edition 2000.

Reference Books:

1. P.S. Bhimbra, “Power Electronics”, Khanna Publishers edition 2009.
5. P.C. Sen, “Power Electronics”, Tata McGraw-Hill, edition 2008.
2. Bimal K. Bose, “Modern Power Electronics & AC Drives”, Prentice Hall, edition 2002.

Web References:

1. http://nptel.ac.in/courses/108101038

2. http://freevideolectures.com/Course/2351/Power-Electronics
3. https://www.mooc-list.com/course/introduction-power-electronics-coursera

Online Resources:

https://www.coursera.org/learn/power-electronics

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C317.1	Remember	Class room Quiz	**3**
C317.2	Understand	Online Quiz	**3**
C317.3	Understand	Class Presentation	**3**
C317.4	Understand	Class Presentation	**3**
C317.5	Understand	Group Assignment	**4**
C317.6	Apply	Group Assignment	**4**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

**We got the suggestion from Industry people, so we include the highlighted portions.

17EE318 MICROPROCESSOR AND CONTROLLERS 3/0/0/3

Nature of Course: G (Theory)

Pre Requisites: 17EE307 Linear and digital integrated circuits

Course Objectives:

1. To create a strong foundation by studying the basics of Microprocessors and interfacing to various peripherals
2. To study Architecture of microcontroller like Intel 8051,PIC microcontroller and ARM.
3. To develop skill in simple applications development with programming 8085 & 8051
4. To introduce commonly used peripheral / interfacing

Course Outcomes

Upon completion of the course, students shall have ability to

C318.1 To understand and design Microprocessor based systems.

C318.2 To understand assembly language programming in Microprocessor and controllers

C318.3 To learn and understand concept of interfacing of peripheral devices and their applications

C318.4 To learn the microcontroller architecture and usages of the instruction set of the representative microcontrollers.

C318.5 To learn about PIC microcontroller and its architecture

Course Contents

MICROPROCESSOR: Basic functions of the microprocessor. **8086:**Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming-Interrupt structure. **INTERFACING:** Study on need, Architecture, configuration and interfacing with ICs: 8255, 8259, 8254, 8237, 8251, 8279 interfacing with 8086.**MICROCONTROLLER 8051:** Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.-Applications Introduction to ARM processor and its features. **PIC MICROCONTROLLER:** CPU Architecture – Instruction set – Addressing modes - interrupts- Timers- I2C Interfacing – UART- A/D Converter –PWM and introduction to C-Compilers.

Total Hours 45

Text Books:

1. 1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi , 2007.
2. 2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.

Reference Books:

1. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
2. Steve Furber, '' ARM System –On –Chip architecture "Addision Wesley , 2000.
3. John .B.Peatman , " Design with PIC Microcontroller , Prentice hall, 1997
4. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

Web References:

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

Blooms Taxonomy based Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Semester End Examination
	CIA1	CIA2	Term Examination	
Remember	20	0	10	10
Understand	30	20	20	10
Apply	50	40	40	40
Analyse	0	40	30	40
Evaluate	0	0	0	0
Create	0	0	0	0

17EE319 POWER ELECTRONICS LABORATORY 0/0/3/2

Nature of Course: M (Practical application)

Co Requisites:17EE301 Electron Devices and Circuits

Course Objectives:

To provide an opportunity to under the operation, function and interaction between various components and to impart the knowledge in design, modelling and simulation of Power Electronic Converter based systems

Course Outcomes

Upon completion of the course, students shall have ability to

C319.1 Examine the working and characteristics of transistor & thyristor. [U]
C319.2 Study the working operation of single phase converter. [U]
C319.3 Examine the working of Chopper. [U]
C319.4 Observe the working operation of Three phase AC voltage controller. [U]
C319.5 Study of single phase Cyclo-converter. [U]
C319.6 Evaluate power electronic circuits using software. [E]

Course Contents

1. VI characteristics of SCR & TRIAC.
2. VI characteristics of POWER MOSFET & IGBT.
3. Switching characteristics of SCR and IGBT.
4. Single-phase half and fully controlled Rectifiers.
5. A) Design a buck converter & boost converter circuit using power MOSFET.

   B) Single & Four quadrant chopper.
6. Single phase IGBT based Inverter.
7. ZVS and ZCS converter.
8. Three-phase AC voltage controllers.
9. Single-phase cycloconverter.
10. Simulation of Power Electronic circuits.

Total Hours 45

Reference Books:

1. M.H. Rashid, “Power Electronics circuits, devices and applications”, Pearson Education, Inc. Edition 2009.
2. M.D. Singh and K.B. Khanchandani, “Power Electronics” Tata McGraw-Hill, Edition 2008.
3. Ned Mohan, Tore M. Undeland & William P. Robbins, “Power Electronics – Converters, Applications and Design”, John Wiley & Sons edition 2009.
4. Vedam Subrahmanyam, “Power Electronics” John Wiley edition 2000.
5. P.S. Bhimbra, “Power Electronics”, Khanna Publishers edition 2009.
6. P.C. Sen, “Power Electronics”, Tata McGraw-Hill, edition 2008.
7. Bimal K. Bose, “Modern Power Electronics & AC Drives”, Prentice Hall, edition

Web References:

1. http://nptel.ac.in/courses/108101038
2. http://freevideolectures.com/Course/2351/Power-Electronics

Online Resources:

https://www.coursera.org/learn/power-electronics

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	-	-
Understand	40	40
Apply	20	20
Analyse	30	30
Evaluate	10	10
Create	-	-

17EE320 MICROPROCESSOR AND CONTROLLERS LABORATORY 0/0/3/2

PREREQUISITES: 17EE310 Linear and Digital integrated circuits laboratory

1.To provide solid foundation on interfacing the external devices to the processor according to the user requirements to create novel products and solutions for the real time problems.

COURSE OUTCOMES

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

C320.1 To Learn an ALP in 8086 and its interfacing circuits.

C320.2 To Write an ALP in 8051 for parallel ports and timers.

C320.3 To Develop an ability in designing a microprocessor and microcontroller s ystems

C320.4 To familiarize with the assembly level programming

LIST OF EXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division using 8086

2. Programming with control instructions using 8086
   (i) Ascending / Descending order, Maximum / Minimum of numbers (ii) Programs using Rotate instructions (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments using 8086 A/D Interfacing and D/A Interfacing.

4. Interface Experiments using 8086/8051

Simple experiments using 8251, 8279, 8254.

5. Demonstration of basic instructions with 8051 Micro controller execution, including:

Conditional jumps, looping, Calling subroutines, Stack parameter testing

6. Parallel port programming with 8051 using port 1 facility:

Stepper motor interfacing

7. Simple arithmetic operations like addition, subtraction, multiplication and division using PIC Microcontroller.
8. Interfacing experiments with PIC microcontroller
9. Mini project development with processors.
10. Programming Practices with Simulators/Emulators/open source

REFERENCES BOOKS

1.Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming& Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
2. Steve Furber, '' ARM System –On –Chip architecture "Addision Wesley , 2000.
3. John .B.Peatman , " Design with PIC Microcontroller , Prentice hall, 1997

WEB REFERENCE.

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

2. http://www.technologystudent.com/

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	40	40
Apply	20	20
Analyse	30	30
Evaluate	10	10
Create	-	-

17EE 321 **POWER SYTEM ANALYSIS** **4/0/0/4**

Nature of Course : G (Theory analytical)

Pre requisites - 17EE306 Electrical machines I
- 17EE313 Generation, Transmission and Distribution
- 17EE311 Induction and Synchronous Machines

Course Objectives:

1 To provide in-depth knowledge of power system analysis under normal conditions
2 and on fault, and the concepts of power system control and stability.
3 To model and analyze power systems under abnormal conditions.
To model and analyze the dynamics of power system and to design the systems for enhancing stability.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO321.1	Understand basic components in a power system and perform a per phase analysis of generator and transformer model.	[R]
CO321.2	Evaluate the bus admittance and impedance matrix.	[AN]
CO321.3	Perform load flow computations and analyze the load flow results.	[AP]
CO321.4	Create computational models for analysis of both symmetrical and unsymmetrical conditions in power systems,	[AP]
CO321.5	Perceive knowledge in power system stability..	[U]

Course Contents:

System Representation: Single line representation, review of per unit calculations. **Formation of Network Matrices:** Formation of admittance matrix with and without mutual impedances, Z_{bus} building algorithm with and without mutual impedances. **Load Flow Analysis:** Formation of static load flow equations, solution of load flow problem by Gauss-Seidel, Newton-Raphson (polar and rectangular) and fast decoupled techniques. **Short Circuit Analysis:** Review of symmetrical components, sequence networks, fault calculations for balanced and unbalanced short circuit faults using Z_{BUS}, analysis of open conductor fault. **Power System Stability:** Swing equation, power angle equation, synchronizing power coefficient, basic concepts of steady state, dynamic and transient stability, equal area criterion, solution of the swing equation, multi-machine.

Total Hours: 60

Text Books:

1 Saadat H., "Power System Analysis" Tata McGraw-Hill Publishing Company Limited.2011, 3rd edition
2 Grainger J. J. and Stevenson W. D., "Power System Analysis", McGraw-Hill International Book Company.2008
3 Kothari D. P. and Nagrath I. J., "Modern Power System Analysis",3rdEd., Tata McGraw-Hill Publishing Company Limited.2008

Reference Books:

1 Pai M. A., "Computer Techniques in Power System Analysis", 2nd Ed., Tata McGraw-Hill Publishing Company Limited. 2014, 3rd edition

2 Miller T. J. E., "Reactive Power Control in Electric Systems", John Wiley and Sons.2010

3 Glover J. D. and Sarma M. S., "Power System Analysis and Design", 4th Ed., Cengage Learning. 2008

Web References:

1 http://nptel.ac.in/courses/108105067/
2 http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/power-system/ui/TOC.htm

Online Resources:

https://www.engineering.unsw.edu.au/electrical-engineering/search/content/power%20system%20analysis

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C321.1	Remember	Quiz	**2**
C321.2	Analyse	Simulation Exercise	**4**
C321.3	Apply	Group Assignment	**4**
C321.4	Understand	Class presentation	**4**
C321.5	Apply	Poster presentation	**2**
C321.6	Analyse	Case study	**4**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA1 [6 marks]	**CIA2 [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyse	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

17EE322 DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS 4 0 0 4

Nature of Course : G (Theory analytical)

Pre requisites - 17EE307 Linear and Digital integrated Circuits
- 17MA104 -Discrete transforms and Fourier Analysis

Course Objectives:

1. To study and analyze various signals & systems and their mathematical operations.
2. To analyze discrete time and continuous time systems.
3. To study about digital filters and their design and programmable digital signal processor.

Course Outcomes:

CO322.1Understand various concepts of Signals and Systems [R]
CO322.2To analyze the mathematical operations on signals and systems [AN]
CO322.3To study various Transform techniques [AP]
CO322.4 To study and analyze Discrete Fourier Transforms and its applications [AP, AN]
CO322.5To study various types of DSP filters using IIR and FIR filter design [U, AP, AN]
CO322.6 To understand the programmable digital signal processor [U]

Course Contents:

Signals & Systems: Definition of DSP, block diagram, Applications of DSP, ADC/DAC - sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Signals & systems - Classification and Types- mathematical operations - convolution and correlation. **Transform Techniques:** Z Transform – properties, ROC and problems, inverse z transforms responses –step, impulse and frequency response, discrete time Fourier transforms and discrete Fourier series. **Discrete Fourier Transforms**- DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure; Computation of IDFT using DFT. **Design of Digital Filters -** FIR & IIR filter realization – FIR design: Hamming and Hanning Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design - Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation - Warping, prewarping - Frequency transformation. Architecture for signal processing - Von Neumann and Harvard architecture- Architecture and features of TMS 320C54 signal processing chip

Total Hours: 60

TEXT BOOKS

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications',
Pearson Education, New Delhi, 2007
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw Hill, New Delhi,
2001.
3. A.Nagoorkanni, 'Digital Signal Processing', Tata McGraw Hill, New Delhi,2012.

REFERENCES

1. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, Discrete – Time Signal Processing',
Pearson Education, New Delhi, 2010.

2. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, _Digital Signal Processing‘, Tata McGraw Hill, New
Delhi, 2011.

Web References:

1 http://nptel.ac.in/courses/117102060/
2 http://nptel.ac.in/courses/108105055/

Online Resources:

1 https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-341-discrete-time-signal-processing-fall-2005/

Assessment Methods & Levels (based on Blooms'Taxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C322.1	Remember	Online Quiz	**2**
C322.2	Analyse	Problem solving Assignment	**4**
C322.3	Apply	Online Group Assignment	**4**
C322.4	Understand	Class presentation	**4**
C322.5	Remember	Online Quiz	**2**
C322.6	Analyse	Case study	**4**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA1 [6 marks]	CIA2 [6 marks]	Term End Examination [8 marks]	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyse	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

17EE323 PRINICIPLES OF EMBEDDED SYSTEMS 3/0/2/4

Nature of Course:D (Theory application)

Pre Requisites: 17EE318 Micro Processor &controllers.

Course Objectives:

- Introduce to features that build an embedded system.
- To help students to understand the interaction that the various components within an embedded system have with each other.
- Techniques of inter facing between processors & peripheral device related to embedded processing.
- To enable writing of efficient programs on any dedicated processor.
- To introduce the concepts of Real time operating systems.

Course Outcomes

Upon completion of the course, students shall have ability to

C323.1	Remember the building blocks for Embedded System.	[R]
C323.2	Remember the Processor and memory Organization.	[R]
C323.3	Understand the Devices and buses for device network.	[U]
C323.4	Understand the feedback connections to be used in amplifiers.	[U]
C323.5	Apply I/O Programming and Schedule Mechanism.	[AP]
C323.6	Understand the Real Time Operating System.	[U]

Course Contents

INTRODUCTION TO EMBEDDED SYSTEM : Introduction to functional building blocks of embedded systems – Register, memory devices, ports, timer, interrupt controllers using circuit block diagram representation for each categories. **PROCESSOR AND MEMORY ORGANIZATION :** Structural units in a processor; selection of processor & memory devices; shared memory; DMA; interfacing processor, memory and I/O units; memory management – Cache mapping techniques, dynamic allocation - Fragmentation. Case study**:** Required Memory devices for a Digital Camera and Voice recorder. **DEVICES & BUSES FOR DEVICES NETWORK** : I/O devices; timer & counting devices; serial communication using I^2C,SPI, CAN, USB buses, RS485,RS232, wireless applications(Bluetooth,Zigbee) parallel communication using ISA, PCI, PCI/X buses, arm bus; interfacing with devices/ports, device drivers in a system – Introduction. **I/O PROGRAMMING AND SCHEDULE MECHANISM :** Intel I/O instruction – Transfer rate, latency; interrupt driven I/O - Non-maskable interrupts; software interrupts, writing interrupt service routine in C & assembly languages; preventing interrupt overrun; disability interrupts. Case study**:** Automatic Washing machine, Chocolate vending machine **REAL TIME OPERATING SYSTEM (RTOS)**: Introduction to basic concepts of RTOS, RTOS – Interrupt handling, Scheduling Algorithms - Rate monotonic algorithm - earliest deadline algorithm – Round robin algorithm; embedded system design issues in system development process – Action plan, use of target system, emulator, use of software tools. Allocation and scheduling. Multi threaded programming – Context switching, premature & non-premature multitasking, semaphores. Scheduling – Thread states, pending threads, context switching, round robin scheduling, priority based scheduling, assigning priorities, deadlock, watch dog timers. Design Example: Elevator Controller. Introduction to IDE.

List of Experiments

1. LED Blinking Program

2. ADC using Potentiometer.

3. Communication using UART

4. Speed control of DC motor using PWM

5. Programming Using Timer is an application

6. Application Using Peripherals.

Total Hours 75

Text Books:

1. P. Rajkamal, 'Embedded System – Architecture, Programming, Design', Tata McGraw Hill, 2014.

2. Daniel W. Lewis, 'Fundamentals of Embedded Software', Prentice Hall of India, 2013.

Reference Books:

1. David E. Simon, 'An Embedded Software Primer', Pearson Education, 2004.

2. Frank Vahid, 'Embedded System Design–A Unified Hardware & Software Introduction', John Wiley, 2002.

3. Sriram V. Iyer, Pankaj Gupta, 'Embedded Real Time Systems Programming', Tata McGraw Hill, 2004.

4. Steve Heath, 'Embedded System Design', second edition, Elsevier, 2003.

Web References:

1. *www.embedded.com*
2. *nptel.ac.in/courses/108102045/*
3. *www.nptelvideos.in/2012/11/embedded-systems.htm*

Online Resources:

www.ni.com/EmbeddedSystems/Reduce_Cost
https://www.quora.com/What-are-some-good-online-resources-to-learn-for-an-embedded

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C323.1	Remember	Class room Quiz	**3**
C323.2	Understand	Online Quiz	**3**

C323.3	Understand	Class Presentation	**3**
C323.4	Understand	Class Presentation	**3**
C323.5	Apply	Group Assignment	**4**
C323.6	Apply	Group Assignment	**4**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE324 **Simulation Laboratory - I** **0/0/3/2**

Nature of Course: Power System Simulation Laboratory I

Co Requisites: 17EE321 – Power System Analysis

Course Objectives:

To Design, to simulate and to analyze the power system network

Course Outcomes

Upon completion of the course, students shall have ability to

C324.1	Determine the parameters of the Power System Network	[U]
C324.2	Experiment with the basic load flow analysis methods	[U]
C324.3	Apply the diodes to build different types of rectifiers and filter circuits	[AP]
C324.4	Analyze the short circuit conditions of the given power system network.	[A]
C324.5	Analyze the load frequency control of various network systems	[A]
C324.6	Evaluate the load flow, optimal dispatch, symmetrical and asymmetrical analysis using MATLAB software	[E]

Course Contents

1. Sinusoidal Voltages and Currents (3)
2. Equivalent circuit of a Transformer (3)
3. Determination of voltage and power at the sending end, voltage regulation using medium line model (6)
4. Determination of line performance when loaded at receiving end (3)
5. Load flow solution using Gauss Seidel Method (3)
6. Load flow solution using Newton Raphson method in Rectangular Coordinates (3)
7. Optimal Dispatch including and neglecting losses (6)
8. Transient Response of an RLC Circuit (3)
9. Unsymmetrical Fault Analysis (3)
10. Short Circuit Analysis of IEEE 14 bus system (6)
11. Load Frequency control of a single area system (3)
12. Load frequency control of a two area system (3)

Total Hours **45**

Reference Books:

1. M.H. Rashid, "Power Electronics circuits, devices and applications", Pearson Education, Inc. Edition 2009.
2. D.P Kothari and I.J. Nagrath, "Modern Power System Analysis", Tata McGraw-Hill Education Pvt. Ltd, 4th Edition, 2011
3. B.R.Gupta, " Power System Analysis and Design", S.Chand Pvt.Ltd, 2005

Web References:

1. www.power-analysis.com
2. www.4shared.com/power system analysis

Online Resources:

http://iitm.vlab.co.in/?sub=46&brch=144
http://nptel.ac.in/courses/108104051

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	-	-
Understand	40	40
Apply	20	20
Analyse	30	30
Evaluate	10	10
Create	-	-

17EE325 POWER SYSTEM PROTECTION & SWITCHGEAR 3/0/0/3

Nature of Course:D (Theory application)

Pre Requisites:17EE313- Generation,Transmission and Distribution, 17EE321- Power System Analysis

Course Objectives:

1. To learn the fundamentals of protection equipments used in power systems
2. To learn the concept of primary and backup relaying
3. To interpret theoretical and practical knowledge of modern switchgear and recent trends in protective relaying
4. To gain knowledge about the constructional features and testing methodology of AC and DC circuit breakers.

Course Outcomes

Upon completion of the course, students shall have ability to

C325.1 Understand the working and characteristics of circuit breakers. [U]

C325.2 Will have adequate knowledge about the switchgears and the protective measures. [U]

C325.3Theoretically and practically to do operation and repairing and maintenance works in substations [AP]

C325.4Take up prospective research assignments. [AP]

Course Contents

Protection : Principles and need for protective schemes, Importance of protective relaying power systems, fundamental requirements of good protection scheme, Primary and backup relaying, Zones of Protection.Classification of Relays Constructional (mechanical and static relays) and functional - over current, directional, differential, distance relays and their principles and applications. **Apparatus and Line Protection:** Generator, Transformer , Busbar and Transmission line Protection schemes, Current trends in protective relaying: Microprocessor and PC based relaying. **Switchgear**: Classification of switchgear, Nature and causes of faults , Types of faults , Fault clearing process, Arcing phenomena, principles of arc interruption, Restriking voltage & Recovery voltage, rate of rise of recovery voltage, current chopping, interruption of capacitive current, resistance switching. **Circuit Breaker:** AC and DC circuit breakers, Different types of Circuit breakers and their construction, testing and selection of Circuit breakers. **Protection against Over voltages**: Causes of over voltages ,Ground wires, surge absorbers, surge diverters, Earthing and its types, Insulation co-ordination.

Total Hours 60

Text Books:

1. Badri Ram, Vishwakarma “Power System Protection and Switchgear” Tata McGraw Hill, 2011
2. B. Ravindranath, and N. Chander, ‘Power System Protection & Switchgear’, New Age Publishers, 2010

Reference Books:

1. M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, 'A Text Book on Power System Engineering', Dhanpat Rai & Co., 1998.
2. Sunil S. Rao, 'Switchgear and Protection', Khanna publishers, New Delhi, 1986
3. Y.G Paithangar, "Fundamentals of Power System Protection" PHI learning Pvt Ltd, 2nd edition ,2010
4. C.L. Wadhwa, 'Electrical Power Systems', New Age International (P) Ltd., 2000.

Web References:

1. **http://nptel.ac.in/downloads/108101039/**
2. **http://nptel.ac.in/courses/108101039/3**
3. **http://nptel.ac.in/courses/Webcourse-contents/IIT%20Bombay/Power%20System%20Protection/TOC_M1.html**

Online Resources:

http://www.idc-online.ac.za/electrical-engineering/electrical-power-system-protection.html

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C325.1	Understand	Class room Quiz	**4**
C325.2	Understand	Online Quiz	**5**
C325.3	Apply	Group Assignment	**6**
C325.4	Apply	Class Presentation	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE326 ELECTRIC DRIVES AND CONTROL 3/0/2/4

Nature of Course:D (Theory application)

Pre Requisites:17EE306 Electrical Machines – I, 17EE311 Electrical Machines – II, 17EE317 Power electronics

Course Objectives:

1. To understand the basic concepts and various control techniques involved with DC and AC Drives.
2. To study and analyze the operation of the converter / chopper fed dc drive and to solve simple problems.
3. To study and understand the operation of both classical and modern induction motor drives.

Course Outcomes

Upon completion of the course, students shall have ability to

C326.1 Understand the concept, application fields and development trend of Power Drivers System. [U]
C326.2 Learn characteristics and control of solid state DC motors drives [R]
C326.3 Understand the stable steady state operation and transient dynamics of motor-load system. [U]
C326.4 Understand characteristics and control of induction motor drives & Synchronous motor drives [U]
C326.5 Apply digital control techniques in AC and DC drives [AP]
C326.6 Analyze the converter fed motor under different torque/speed conditions. [AP]

Course Contents

Drive characteristics: Equations governing motor load dynamics - Equilibrium operating point and its steady state stability -Mathematical condition for steady state stability - Multi quadrant dynamics in the speed torque plane -Basics of braking –Dynamic braking-Plugging-Regenerative braking Typical load torque characteristics -Acceleration, deceleration, starting and stopping. **Dc motor drives:** Steady state analysis of single, two and four quadrant converter fed D.C motor drive: Continuous and discontinuous conduction mode - Chopper fed D.C drive: Time ratio control and current limit control - Operation of four quadrant chopper. **Induction motor drives:** Stator voltage control - Slip-power recovery drives - Adjustable frequency drives: v/f control, constant slip-speed control and constant air-gap flux control – Basics of voltage/current fed inverters – Block diagram of closed loop drive. **Synchronous motor drives:** Open loop volts/hertz control and self-control of synchronous motor: Marginal angle control and power factor control - Permanent magnet synchronous motor. Applications of Adjustable Speed Drives (ASDs) in Industries and in Electric Utility Power Plants. Harmonic Analysis in ASDs. **Digital control and drive applications:** Digital techniques in speed control - Advantages and limitations - Microprocessor/Microcontroller and PLC based control of drives, networking of drives - Selection of drives and control schemes for Steel rolling mills, Paper mills, Cement mills, Machine tools, Lifts and Cranes. Solar and battery powered drives.

List of Experiments

1. Speed control DC motor using three phase rectifier

2. Speed control of three phase induction motor using PWM inverter

3. Speed control of chopper fed DC motor

4. Simulation of closed loop control of converter fed DC motor

5. Simulation of closed loop control of three phase synchronous motor

6. FPGA/DSP based motor control

Total Hours 75

Text Books:

1. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control', Prentice Hall of India, New Delhi, 2011.
2. Gopal.K.Dubey, Fundamentals of Electrical Drives', Narosa Publishing House, New Delhi, 2012.

Reference Books:

1. Bimal K. Bose. Modern Power Electronics and AC Drives', Pearson Education, 2015.
2. S.K. Pillai, A First Course on Electrical Drives', Wiley Eastern Limited, 2015.
3. Vedam Subramanyam, Electric Drives: Concepts and Applications, Tata McGraw Hill Ltd, New Delhi, 2014.
4. Shaahin Filizadeh, Electric Machines and Drives: Principles, Control, Modeling, and Simulation, CRC Press LLC, New York, 2013

Web References:

1. http://en.wikipedia.org/wiki/Industrial drives Control
2. http://en.wikibooks.org/wiki/Drives
3. http://en.wikipedia.org/wiki/Electric motors

Online Resources:

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C326.1	Understand	Class room Quiz	**3**
C326.2	Remember	Online Quiz	**3**
C326.3	Understand	Class Presentation	**3**
C326.4	Understand	Class Presentation	**3**
C326.5	Apply	Group Assignment	**4**
C326.6	Apply	Group Assignment	**4**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

https://www.coursera.org/learn/electronics

17EE328 **Simulation Laboratory - II** **0/0/3/2**

Nature of Course: Power System Simulation Laboratory II

Co Requisites: 17EE321 – Power System Analysis

Course Objectives:

To design, to simulate and to analyze the power system network

Course Outcomes

Upon completion of the course, students shall have ability to

C328.1	Understand and execute the basic commands in MATLAB	[U]
C328.2	Write the coding to simulate the various types of network in power system	[U]
C328.3	Apply the concepts of optimum loading conditions to various power generation systems	[AP]
C328.4	Analyze the conditions for designing the equations for the power system network.	[A]
C328.5	Analyze the various frequency control of network systems	[A]
C328.6	Evaluate the transient stability analysis of various network systems	[E]

Course Contents

1. Introduction To Matlab And Its Basic Commands (3)
2. Matlab Program To Simulate Ferranti Effect (3)
3. Matlab Program To Model Transmission Lines (6)
4. Matlab Program To Solve Load Flow Equations By Gauss-Seidel Method (3)
5. Matlab Program To Find Optimum Loading Of Generators Neglecting Transmission Losses (6)
6. Matlab Program To Find Optimum Loading Of Generators With Penalty Factors (6)
7. Matlab Program To Solve Swing Equation Using Point-By-Point Method (6)
8. Simulink Model of Single Area Load Frequency Control with And without PI Controller And Without PI Controller In Simulink. (3)
9. Simulink Model For Two Area Load Frequency Control (3)
10. Simulink Model For Evaluating Transient Stability Of Single Machine Connected To Infinite Bus (6)

Total Hours **45**

Reference Books:

1. John J Grainger and William D Stevenson J, "Power System Analysis " McGraw-Hill, Edition 2003.
2. J.B.Gupta, "A Course in Power Systems" S.K. Kataria & Sons, 2013

Web References:

1. www.power-analysis.com

2. www.4shared.com/power system analysis
3. http://as.wiley.com/WileyCDA/Section/id-815373.html

Online Resources:

http://iitm.vlab.co.in/?sub=46&brch=144
http://nptel.ac.in/courses/108104051

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	-	-
Understand	40	40
Apply	20	20
Analyse	30	30
Evaluate	10	10
Create	-	-

17EE401 **SMART GRID** **3/0/0/3**

Nature of Course: D (Theory application)
Pre Requisites: **17EE313 Generation, Transmission and Distribution**

Course Objectives:

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

1. Need for smart grid to attain a perfect power system network
2. DC distribution grid to attain maximum efficiency
3. IntelliGrid architecture for the effective distribution
4. Various technology alternatives for the grid connected networks.

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

CO401.1	Smartgrid for the perfect power system	[U,R]
CO401.2	Various types of DC grids and their interconnections	[U,R,AP]
CO401.3	IntelliGrid structure for the forthcoming power criteria	[U,R,AP]
CO401.4	Various alternating trends for the smart grid distribution	[U,R,AP]

Course Contents:

Introduction - Introduction to smart grid- Electricity network-Local energy networks- Electric transportation- Low carbon central generation-Attributes of the smart grid- Alternate views of a smart grid. **Smart grid to evolve a perfect power system**: Introduction- Overview of the perfect power system configurations- Device level power system- Building integrated power systems- Distributed power systems- Fully integrated power system. **DC distribution and Smart grid** - AC Vs DC sources-Benefits of and drives of DC power delivery systems-Powering equipment and appliances with DC-Data centres and information technology loads-Future neighbourhood-Potential future work and research. **Intelligrid architecture for the Smart grid**: Introduction - Intelligrid today- Smart grid vision based on the intelligrid architecture. Dynamic Energy Systems concept- Smart energy efficient end use devices-Smart distributed energy resources-Advanced whole building control systems .Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources; Power Quality Conditioners for Smart Grid, Web based Power Quality Monitoring, Power Quality Audit. **SMART GRID TECHNOLOGIES (Transmission)**- Technology Drivers, Smart energy resources, Smart substations, Substation Automation,

Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring. **SMART GRID TECHNOLOGIES (Distribution) -** DMS, Volt/VAr control, Fault Detection, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers. **Energy port as part of the Smart grid**- Concept of energy -Port, generic features of the energy port. **Policies and programs to encourage end – Use Energy Efficiency**: Policies and programs in action -multinational - national-state-city and corporate levels. **Market Implementation**: Framework-factors influencing customer acceptance and response - program planning-monitoring and evaluation. **Efficient Electric End – Use technology alternatives** - Existing technologies – lighting - Space conditioning - Indoor air quality - **High Performance Computing for Smart Grid Applications-** Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid

Total : 45 Hours

TEXT BOOKS:

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong.Wu, AkihikoYokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012
2. James Momoh, "Smart Grid: Fundamentals of Design and Analysis"-Wiley, IEEE Press, 2012.
3. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency andDemand Side Response"- CRC Press, 2009.

REFERENCE BOOKS:

1. Smart Grid: Technology and applications Author(s): Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, Published Online: 22nd February 2012 09:51PM EST, Print ISBN: 9780470974094, Online ISBN: 9781119968696DOI: 10.1002/9781119968696.
2. Smart Grid Handbook, 3 volume Set Chen-Ching Liu, Stephen McArthur, Seung-Jae Lee John Wiley & Sons, 1 Aug 2016 - Science - 1900 pages

Web References:

1. http://whatis.techtarget.com/reference/Smart-Grid-Technology-Overview
2. https://www.nist.gov/engineering-laboratory/smart-grid

Online Resources:

1. https://www.edx.org/course/smart-grids-electricity-future-ieeex-smartgrid-x-0
2. http://theinstitute.ieee.org/ieee-roundup/blogs/blog/free-online-course-covers-the-future-of-smart-grids

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
CO401.1	Understand &Remember	Assignments (2 numbers)	**5**
CO401.2	Understand, Remember & Apply	Technical Online Quiz (two)	**5**
CO401.3	Understand, Remember & Apply	Class Presentation (1 presentation)	**5**
CO401.4	Understand, Remember & Apply	Tutorials (2 numbers)	**5**

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	10	10
Understand	60	60	70	60
Apply	20	20	20	30
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE402 **ENERGY MANAGEMENT** **3/0/0/3**

Nature of Course : G (Theory)
Pre requisites : 17EE311 ELECTRICAL MACHINES II

Course Objectives:

1. To introduce about Energy Management Systems (EMS).
2. To enable the students to understand the scope for energy saving in residential sector, industries and commercial establishments.
3. To analyse the concepts of New technologies and new products are coming up in the market, for energy saving.
4. To learn the Knowledge of thermodynamic principles, usage of thermal insulation in buildings, lighting devices and new electric motor.
5. To realise energy conservation is better way to meet demand in short span of time rather than constructing new power plant.

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

C402.1	Understand the role of Energy Managers in Industries	[R]
C402.2	Evaluate Total Energy Systems Energy Audit.	[AN]
C402.3	Analyse the concepts of Energy conservation in Centrifugal pumps, Fans &Blowers, Air compressor	[AP]
C402.4	Demonstrate energy consumption & energy saving potentials – Design consideration. Refrigeration & Air conditioning	[U]
C402.5	Perceive knowledge Organizational background desired for energy management motivation	[AP]
C402.6	Identify various detailed process of M&T-Thermostats, Boiler controls.	[AN]

Course Contents:

Energy Scenario - Role of Energy Managers in Industries – Energy monitoring, auditing & targeting – Economics of various Energy Conservation schemes. Total Energy Systems Energy Audit -various Energy Conservation Measures in Steam -Losses in Boiler. Energy Conservation in Steam Systems - Case studies. Energy conservation in Centrifugal pumps, Fans &Blowers, Air compressor – energy consumption & energy saving potentials – Design consideration. Refrigeration & Air conditioning - Heat load estimation -Energy conservation in cooling towers & spray ponds – Case studies Electrical Energy -Energy Efficiency in Lighting – Case studies. Organizational background desired for energy management motivation, detailed process of M&T-Thermostats, Boiler controls- proportional, differential and integral control, optimizers; compensators.

Total Hours: 45

Text Books:

1 Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 2010
2 Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 2005

Reference Books:

1 Larry C Whitetal, Industrial Energy Management & Utilization.2010
2 Power System Engineering 2nd Ed. D P Kothari, I J Nagrath, Tata McGraw-Hill Co 2013.

Web References:

1 http://nptel.ac.in/video.php?subjectId=108102047
2 http://textofvideo.nptel.iitm.ac.in/108102047/lec20.pdf

Online Resources:

1 https://www.edx.org/course/Energy management system

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C402.1	Remember	Quiz	**2**
C402.2	Analyse	Simulation Exercise	**4**
C402.3	Apply	Group Assignment	**4**
C402.4	Understand	Class presentation	**4**
C402.5	Apply	Poster presentation	**2**
C402.6	Analyse	Case study	**4**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA1 [6 marks]	**CIA2 [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyse	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

17EE403 **OPTIMIZATION TECHNIQUES** **3/0/0/3**

Nature of Course: Problematic
Undergraduate level mathematics

Pre Requisites:

Course Objectives:

1. To learn various methods of linear programming.
2. To determine the solutions of unconstrained one & n dimensional optimization.
3. To determine the solutions of constrained optimization technique.
4. To perform dynamic programming for optimal solutions.

Course Outcomes

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

C403.1 Recognize the importance and value of Optimization Techniques in solving practical problems in industry [R]
C403.2 Understand Optimization models and apply them to real life problems [U]
C403.3 Design new models to improve decision making and develop critical thinking and objective analysis of decision problems [AP]

Course Contents

Linear programming – formulation - Graphical and simplex methods - Big-M method - Two phase method - Dual simplex method - Primal Dual problems. **Unconstrained one dimensional optimization techniques** - Necessary and sufficient conditions – Unrestricted search methods - Fibonacci and golden section method - Quadratic Interpolation methods, cubic interpolation and direct root methods. **Unconstrained n dimensional optimization techniques** – direct search methods – Random search – pattern search and Rosen brock's hill climbing method - Descent methods - Steepest descent, conjugate gradient, quasi - Newton method. **Constrained optimization Techniques** - Necessary and sufficient conditions – Equality and inequality constraints - Kuhn-Tucker conditions - Gradient projection method - cutting plane method - penalty function method. **Dynamic programming** - principle of optimality - recursive equation approach - application to shortest route, cargo - loading, allocation and production schedule problems

Total Hours 45

Text Books:

1. D.P.Kothari and J.S.Dhillon, "Power System Optimization", 2nd Edition, PHI learning private limited, 2013.
2. Jizhong Zhu, "Optimization of Power System Operation" 2nd Edition, John Wiley & sons, 2016.
3. J.C. Pant : Introduction to Optimization, Jain Brothers,2004
4. S.S. Rao :Optimization Theory and applications, Wiley Eastern Ltd. 2012.
5. K.V.Mittal : Optimization Methods, Wiley Eastern Ltd. 2008.

Reference Books:

1. Rao S.S., 'Optimization :Theory and Application' Wiley Eastern Press, 2 nd edition 2012.
2. Taha,H.A., Operations Research –An Introduction,Prentice Hall of India,2013.

Fox, R.L., 'Optimization methods for Engineering Design', Addition Wiely, 2005.

Web References:

1. http://nptel.ac.in/courses/108101040/28
2. http://www.brad.ac.uk/staff/vtoropov/burgeon/thesis_sameh/chap5.pdf
3. nptel.ac.in/courses/Webcourse.../OPTIMIZATION%20METHODS/.../M1L4slides.pdf
4. www.springer.com/cda/content/document/cda.../9783540729617-c2.pdf?SGWID

Online Resources:

1. www.open.ac.uk/courses/modules/m373

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C403.1	Remember	Class room & Online Quiz	**6**
C403.2	Understand	Class Presentation	**6**
C403.3	Apply	Group Assignment	**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	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE404 POWER SYSTEM OPERATION AND CONTROL 3 0 0 3

Nature of Course : G (Theory analytical)

Pre requisites - 17EE313 Generation Transmission and Distribution
- 17EE321 Power System Analysis

Course Objectives:

1. To get an overview of system operation and control.
2. To understand & model Reactive power-voltage interaction and different methods of control for maintaining voltage profile against varying system load & model power-frequency dynamics and to design power-frequency controller.
3. To understand Economic load dispatch and to study modern techniques in computer control of power systems.

Course Outcomes:

C404.1	Understand various concepts of power system operation and control	[R]
C404.2	To analyze and implementation Economic Load Dispatch and unit commitment solution methodologies in power system operation	[AN]
C404.3	To study various power system control methodologies	[U]
C404.4	To introduce real & reactive power control strategies and voltage & frequency control methodologies in power systems	[AP]
C404.5	To study various types of computer control of power systems and smart grid integration in power systems	[U]

Course Contents:

Power system operation: Load forecasting, unit commitment: constraints in unit commitment: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints; unit commitment solution methods: Priority-list methods, forward dynamic programming approach, numerical problems only in priority-list method. Economic load dispatch: concepts & problems. **Power System Control:** Governor Control, LFC, EDC, AVR, system voltage control, security control. **Real power & Frequency control:** - Speed-load characteristics; concept of control area, LFC control of a single-area system: Static and dynamic analysis of uncontrolled and controlled cases. Multi-area systems: Two-area system modeling; static analysis, uncontrolled case; tie line with frequency bias control of two-area system. **Reactive power & voltage control:** Typical excitation system, modeling, static and dynamic analysis, stability compensation; generation and absorption of reactive power: Relation between voltage, power and reactive power at a node; method of voltage control: Injection of reactive power. Tap-changing transformer, tap setting of OLTC transformer and MVAR injection of switched capacitors. **Computer Control of Power Systems:** Energy control centre: Functions – Monitoring, data acquisition and control. SCADA and EMS functions: Network topology determination, state estimation, security analysis and control. Various operating states: State transition diagram showing various state transitions and control strategies. Smart grid integration.

Lecture 45, Tutorial 15 -Total Hours: 60

TEXT BOOKS

1. Olle. I. Elgerd, ‗Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing
Company Ltd, New Delhi, Second Edition, 2015.
2. Allen.J.Wood and Bruce F.Wollenberg, ‗Power Generation, Operation and Control', John Wiley & Sons, Inc., October 2013.
3. P. Kundur, ‗Power System Stability and Control', McGraw Hill Publications, 2009.

REFERENCES

1. D.P. Kothari and I.J. Nagrath, ‗Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.
2. L.L. Grigsby, ‗The Electric Power Engineering, Hand Book', CRC Press and IEEE Press, June 2012.

Web References:

1. http://nptel.ac.in/courses/108104052/3
2. http://nptel.ac.in/courses/108101040/

Online Resources:

https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-061-introduction-to-electric-power-systems-spring-2011/

Assessment Methods & Levels (based on Blooms'Taxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C404.1	Remember	Online Quiz	**2**
C404.2	Analyse	Problem solving Assignment	**4**
C404.3	Apply	Online Group Assignment	**4**
C404.4	Understand	Class presentation	**4**
C404.5	Remember	Online Quiz	**2**
C406.6	Analyse	Case study	**4**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA1 [6 marks]	CIA2 [6 marks]	Term End Examination [8 marks]	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyse	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

17EE405 **POWER QUALITY** **3/0/0/3**

Nature of Course: D (Theory application)

Pre Requisites: 17 EE313 Generation, Transmission And Distribution ,
17EE325 Power System Protection & Switchgear

Course Objectives:

1. To introduce the power quality problem
2. To educate on production of voltages sags, over voltages and harmonics and methods of control.
3. To study overvoltage problems
4. To study the sources and effect of harmonics in power system
5. To impart knowledge on various methods of power quality monitoring.

Course Outcomes

Upon completion of the course, students shall have ability to

C405.1	Remember the importance of power quality.	[R]
C405.2	Understand the Voltage Sags and Interruptions.	[U]
C405.3	Understand the overvoltage problems.	[U]
C405.4	Understand the effect of harmonics in power system.	[U]
C405.5	Apply various methods of power quality monitoring.	[AP]

Course Contents

Introduction To Power Quality: Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients – short duration variations such as interruption - long duration variation such as sustained interruption. Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve. **Voltage Sags And Interruptions :** Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source - analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches. **Over voltages :** Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding – line arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP. **Harmonics:** Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion – voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards. **Power Quality Monitoring:** Monitoring considerations - monitoring and diagnostic techniques for various power quality problems -modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools -power line disturbance analyzer – quality measurement equipment - harmonic / spectrum analyzer -flicker meters - disturbance analyzer. Applications of expert systems for power quality monitoring.

Total Hours 45

Text Books:

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill,2003.(For Chapters1,2,3, 4 and 5).2013.
2. Eswald.F.Fudis and M.A.S.Masoum, "Power Quality in Power System and Electrical Machines," Elseviar Academic Press, 2013.
3. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', Wiley, 2011

Reference Books:

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)
2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5).2013.
3. G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2007.

Web References:

1. http://nptel.ac.in/courses/108106025/
2. https://onionesquereality.wordpress.com/.../more-video- lectures-iit-open

3.https://nptel.iitg.ernet.in/Elec_Engg/.../Video-EEE.pdf

Online Resources:

https://www.coursera.org/learn/energy-101

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C405.1	Remember	Class room Quiz	**3**
C405.2	Understand	Online Quiz	**3**
C405.3	Understand	Class Presentation	**3**
C405.4	Understand	Class Presentation	**3**
C405.5	Apply	Group Assignment	**4**
C405.6	Apply	Group Assignment	**4**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE406	HIGH VOLTAGE ENGINEERING	3	0	0	3

Nature of Course : G (Theory analytical)

1. Course pre-requisites : 17EE313 Generation, Transmission and Distribution

2. Course Objectives

C406.1	To expose the students to the basic causes of over voltages in power systems	[R]
C406.2	Describe the fundamentals of breakdown and partial discharge in insulating solid and gas at high voltages	[U]
C406.3	To understand the generation and measurement of high voltages and currents	[R,U]
C406.4	To understand the concepts of high voltage testing.	[U,AP]

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

1. Students will be able to describe the causes and types of overvoltage.
2. Students will be able to illustrate different methods of generating and measuring various high voltages and currents.
3. Students will be able to explain various breakdown phenomena occurring in gaseous, liquid and solid dielectrics.
4. Students will be able to familiarized with international standards of designing and testing

Course Contents

OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS- Causes of over voltages and its effect on power system – Lightning, switching surges and temporary over voltages –Surge diverters- EMI and EMC Protection against over voltages; Insulation Co-ordination. **ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS -**Basic Gaseous breakdown in uniform and non-uniform fields – corona discharges – Vacuum breakdown - conduction and breakdown in pure and commercial liquids – breakdown mechanisms in solid and composite dielectrics. **GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS -**Generation of High DC, AC, impulse voltages and currents. Tripping and control of impulse generators. High Voltage DC: Rectifier circuits, Voltage multipliers, Van-de-graph and electrostatic generators. High Voltage AC: Cascaded transformers and tesla coils. **MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS -**Measurement of High voltages and High currents and impulse current using using sphere gaps, peak voltmeters, potential dividers, high speed CRO – Digital techniques in high voltage measurement**. HIGH VOLTAGE TESTING-** High voltage testing of electrical power apparatus – Power frequency, impulse voltage and DC testing – International and Indian standards

Total: 45 Hours

Text Books

1.Naidu, M.S. and Kamaraju,V., 'High Voltage Engineering', 4th Edition, Tata McGraw-Hill Publishing Company, New Delhi,4th Edition, 2009.

Reference Books

2.E. Kuffel and W.S. Zaengl, 'High Voltage Engineering Fundamentals', Butterworth –Heinemann II Edition, 2000.

3.C.L.Wadwa, "High Voltage Engineering", New Age International, 2007.

4. E. Kuffel and M. Abdullah, 'High Voltage Engineering', Pergamon press, Oxford, 1970.

5. Gallagher T J and Pearmain A J , High Voltage Measurement Testing and Design, Wiley.

Web References:

1.http://nptel.ac.in/courses/108104048/ui/Course_home1_1.html

Assessment Methods & Levels (based on Blooms'Taxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C404.1	Remember	Online Quiz	**2**
C404.2	Analyse	Problem solving Assignment	**4**
C404.3	Apply	Online Group Assignment	**4**
C404.4	Understand	Class presentation	**4**
C404.5	Remember	Online Quiz	**2**
C406.6	Analyse	Case study	**4**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA1 [6 marks]	CIA2 [6 marks]	Term End Examination [8 marks]	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyse	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

17EE407 COMPUTER NETWORKS 3/0/0/3

Nature of Course: D (Theory application)
Pre Requisites:

Course Objectives:

1. To Understand the division of network functionalities into layers
2. To familiar with the components required to build different types of networks.
3. To expose to the required functionality at each layer
4. To Learn the flow control and congestion control algorithms

Fundamentals & Link Layer -Building a network – Requirements - Layering and protocols - Internet Architecture – Network software – Performance ; Link layer Services - Framing - Error Detection - Flow control . **Media Access & Internetworking** - Media access control - Ethernet (802.3) - Wireless LANs – 802.11 – Bluetooth - Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP,ICMP) .**Routing** (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM) .**Transport Layer** - Overview of Transport layer - UDP - Reliable byte stream (TCP) - Connection management - Flow control - Retransmission – TCP Congestion control - Congestion avoidance (DECbit, RED) – QoS – Application requirements .**Application Layer** -Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP.

Total hours 45

Text Books:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

Reference Books:

1. James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009
2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011.
4. Behrouz A. Forouzan, "Data communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011.

Web References:

1. http://nptel.ac.in/courses/106105081/1
2. http://nptel.ac.in/courses/Webcourse/contents/IIT%20Kharagpur/Computer%20networks/New_index1.html

Online Resources:

http:// https://www.udacity.com/course/computer-networking--ud436

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C407.1	Understand	Class room Quiz	**4**
C407.2	Apply	Online Quiz	**5**
C407.3	Apply	Group Assignment	**6**
C407.4	Apply	Class Presentation	**5**
Summative assessment based on Continuous and End Semester Examination			

Bloom's Level	Continuous Assessment			End Semester Examination
	CIA1	CIA2	Term End Assessment	
Remember	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE408 SOFT COMPUTING TECHNIQUES 3 /0/ 0 /3

Nature of Course : G (Theory)

Pre requisites : Fuzzy Logic

Course Objectives:

- Understand different approaches and architecture of intelligent control
- Explain the concepts of artificial neural networks, their mathematical model and data processing
- Understand the concepts of fuzzy logic system
- Solve control problems using genetic algorithm
- Apply genetic algorithm in power system optimization problems

Course Outcomes:

Upon completion of the course, students shall have ability to

C410.1	Remember the basic concepts of Fourier and Wavelet Transformation	[R]
C410.2	Understand various soft computing techniques	[R,U]
C410.3	Analyse the genetic algorithm approach	[AN]
C410.4	Apply the functions of Neural network and Fuzzy logic	[AP]

Course Contents:

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule based systems, the AI approach. Knowledge representation. Expert systems. **ARTIFICIAL NEURAL NETWORKS -**Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller. **FUZZY LOGIC SYSTEM -**Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning.Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzyknowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizingfuzzy logic control. Fuzzy logic control for nonlinear time-delay system. **GENETIC ALGORITHM -**Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems. **APPLICATIONS-**GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic.

Total Hours: 45

Text Books:

1. 1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999.
2. 2. Timothy J. Ross,|| Fuzzy Logic with Engineering Applications||, Second Edition, McGraw Hill, USA, 2004.
3. David.E.Goldberg,||Genetic Algorithms in Search, Optimization and Machine Learning||, Pearson Education Inc., 2009.

Reference Books:

1. 1. Kosko,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.
2. 2. Klir G.J. & Folger T.A. "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 1993.
3. Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.
4. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers, 2001.

Web References:

1. http://nptel.ac.in/video.php?subjectId=108102047
2. http://textofvideo.nptel.iitm.ac.in/108102047/lec20.pdf

Online Resources:

1. https://www.edx.org/course/soft computing

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C402.1	Remember	Quiz	**4**
C402.2	Remember, Understand	Simulation Exercise	**6**
C402.3	Analyse	Group Assignment	**4**
C402.4	Apply	Programming	**6**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA1 [6 marks]	**CIA2 [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyse	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

17EE409 **VLSI DESIGN** **3/0/0/3**

Nature of Course :D (Theory Application)
Pre-requisites :17EE307 Linear and Digital Integrated Circuits
Course Objectives:

1 To learn about VLSI design process
2 To learn about NMOS,PMOS,CMOS Fabrication Technology
3 To interpret CMOS circuit Design
4 To learn about PLD devices and architectures of Xilinx
5 To Sharpen the VLSI program modelling

Course Outcomes:

Upon completion of the course, students shall have ability to

C409.1	Remember the design process of VLSI and the layout styles	[R]
C409.2	Understand the Fabrication Technology	[U]
C409.3	Understand the Switching Characteristics of CMOS inverter and layout design rules	[U]
C409.4	Remember the PLD devices and its architecture.	[AN]
C409.5	Apply Modelling concepts in VLSI program	[AP]

Course Contents:

The VLSI design process Architectural design, logical design, Physical design, layout styles, Full custom, Semi custom approaches. **VLSI Fabrication Technology & Introduction to MOS Devices**: Enhancement mode & Depletion mode – Fabrication (NMOS, PMOS, CMOS) Twin tub process, Silicon on insulator. Technology – NMOS transistor current equation – second order effects – MOS Transistor. MOSFET as a Switch, MOS Layers- Stick Diagrams- Design rules and layout –Sheet resistance –Area capacitance of layers. **CMOS CIRCUIT-** NMOS Inverter –CMOS inverter -Switching characteristics. Pass Transistor and Transmission gates- NMOS and CMOS Logic gates- Stick Diagram, Layout Design Rules. **PROGRAMMABLE LOGIC DEVICES** RAM**,** Read Only Memory (ROM)- PLA, PAL- Field Programmable Logic Array (FPGA)- Types of ASICs **FPGAs** – Physical Design flow – Programming Technology - Anti fuse - Static RAM - EPROM and EEPROM technology - PREP Benchmarks - Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX - Xilinx I/O blocks**. Programming VLSI**: - Review of VLSI Design automation tools –Architectural flow, behavioral flow, dataflow modeling -Design of Adders, Multipliers using VHDL, Verilog

Total Hours: 45

Text Books:

1 D.A.Pucknell, K.Eshraghian, 'Basic VLSI Design', 3 rd Edition, Prentice Hall of India, New Delhi, 2012.
2 Eugene D.Fabricius, 'Introduction to VLSI Design', Tata McGraw Hill, 2005.

Reference Books:

1 N.H.Weste, K.Eshraghian, 'Principles of CMOS VLSI Design: a system perspective',Pearson Education, India, 2013.
2 M.J.S .Smith, "Application Specific Integrated Circuits, Addison –Wesley Longman Inc.,2013.
3 S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2011.

Web References:

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

Online Resources:

1 https://www.nptel.ac.in/courses/117106093/

Assessment Methods & Levels (based on Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C409.1	Remember	Class room Quiz	**3**
C409.2	Understand	Online Quiz	**3**
C409.3	Understand	Class Presentation	**3**
C409.4	Understand	Class Presentation	**3**
C409.5	Apply	Group Assignment	**4**
C409.6	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	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE410 **Wireless Sensor Networks** **3/0/0/3**

Nature of Course : D (Theory application)
Pre- Requisites :
Course Objectives:

1 To understand the sensor networks

2 To understand the Architecture and networking of sensors
3 To get ample knowledge of infrastructure, sensor network plot form and tools
4 To analyze operating systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C410.1	Understand the basic knowledge of sensor networks	[R]
C410.2	Understand the Architecture and networking of sensors	[U]
C410.3	Understand the infrastructure, sensor network plot form and tools	[U]
C410.4	Be familiar with the operating systems	[AP]

Course Contents:

Overview of Wireless Sensor Networks (WSNs): Introduction, Constraints and Challenges, Advantages of Sensor Networks, Sensor Network Applications, Key definitions of Sensor Networks. **Architectures:** 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. **Networking Sensors:** Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing. **Infrastructure Establishment:** Topology Control, Clustering, Time Synchronization, Localization and Localization Services. Sensor Tasking and Control: Task-Driven Sensing, Roles of Sensor Nodes and Utilities, Information-Based Sensor Tasking, Joint Routing and Information Aggregation. **Sensor Network Platforms And Tools**: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Operating Systems for WSNs: Introduction, Operating System Design Issues, Examples of Operating Systems – TinyOS, Mate, MagnetOS, EYES OS, Node-Level Simulators – ns-2, TOSSIM -State-centric programming.

Total Hours: 45

Text Books:

1 1. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor

Networks" , John Wiley, 2008.
2 2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Reference Books:

1 1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks Technology, Protocols, And Applications”, John Wiley, 2007.
2 Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
3 Wireless Sensor Networks and Energy Efficiency: Protocols, Routing and Management, Noor Zaman, Khaled Ragab and Azween Bin Abdullah, IGI Global Publisher, January, 2012
4 Wireless Sensor Networks, Raghavendra, C.S.; Sivalingam, Krishna M.; Znati, Taieb (Eds.), Springer, 2004

Web References:

1 www.ni.com/white-paper/7142/en/
2 https://www.elprocus.com/architecture-of-wireless-sensor-network-and-applications/

Online Resources:

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

Assessment Methods & Levels (based on Bloom’sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C410.1	Remember	Class room Quiz	**3**
C410.2	Understand	Online Quiz	**3**
C410.3	Understand	Class Presentation	**3**
C410.4	Understand	Class Presentation	**3**
C410.5	Apply	Group Assignment	**4**
C410.6	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	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE411 ARM and Arduino processors 3/0/0/3

Nature of Course :G (Theory Analytical)
Co- requisites :-Arduino processors

Course Objectives:

1 To introduce the basic Arduino programming.
2 To enable the students to understand automation process using micro computers
3 To enable the students to basic micro computer architecture
4 To enable the students to understand timers and counter concepts
5 To enable the students to understand sensor system applied in robotic application

Course Outcomes:

Upon completion of the course, students shall have ability to

C411.1	Introducing the basic Arduino processor	[R]
C411.2	Understand the programming of Arduino processors	[U]
C411.3	Understand the concepts and performance of Arduino processors	[U]
C411.4	Understand the concepts of RISC architectures	[AN]
C411.5	Apply the micro computer in automation applications	[AP]

Course Contents:

Arduino Environment and programming - Arduino program - setup() and loop() functions, main interface of an Arduino through its pins, UART communication protocol to gain controllability and observability, Serial library to communicate with the Arduino through the serial monitor.**Transducer Interface –** Sensor interface, LCD interface, Servo Control, PWM signal generation concepts, GPS, GSM interface with Arduino Uno. **C Programming for ARM:** Overview of C compiler andoptimization, Basic C data types, C Looping structures, Registerallocations, function calls, pointer aliasing, structure arrangement, bitfields, unaligned data and Endianness, Division, floating point, Inlinefunctions and inline assembly, Portability issues. C programs for10 20General purpose I/O, general purpose timer, PWM Modulator, UART,I2C Interface, SPI Interface, ADC, DAC. **Raspberry Pi** - Introduction about raspberry pi family, OS installation, GPIO, UART, C programming in Raspberry pi, basic computation in raspberry pi, Python scripts based accessing of GPIO pins in raspberry pi.

Total Hours: 45

Text Books:

1 **Programming Arduino Getting Started with Sketches, Simon Monk, McGraw-Hill Education TAB (1 January 2012), ISBN-10: 0071784225**
2 Arduino Programming in 24 Hours, Sams Teach Yourself , Richard Blum, Pearson Education; 1 edition (2015), ISBN-10: 9332552436
3 Programming Arduino: Getting Started with Sketches, Second Edition (Tab) by Simon Monk, McGraw-Hill Education TAB; 2 edition (1 June 2016), ISBN-10: 1259641635

Reference Books:

1 Arduino Cookbook, 2nd Edition Recipes to Begin, Expand, and Enhance Your Projects By Michael Margolis Publisher: O'Reilly Media
2 Arduino - A Technical Reference by J.m Hughes O′Reilly; 1 edition (17 May 2016), ISBN-10: 1491921765
3 Raspberry Pi Cookbook: Software and Hardware Problems and Solutions, 2nd Edition, by Simon Monk, Shroff/O'Reilly Reprints; Second edition (2016), ISBN-10: 9352133897

Web References:

1 https://www.coursera.org/learn/raspberry-pi-platform
2 https://www.coursera.org/learn/arduino-platform
3 https://www.coursera.org/learn/interface-with-arduino

Online Resources:

1 http://nptel.ac.in/courses/106105159/16
2 https://ocw.mit.edu/OcwWeb/Electrical-Engineering-and-Computer-Science/6-002Circuits-and-ElectronicsFall2000/CourseHome/index.htm
3 https://www.edx.org/course/embedded-systems-shape-world-utaustinx-ut-6-10x

Assessment Methods & Levels (based on Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C411.1	Remember	Quiz	**4**
C411.2	Understand	Technical presentation	**4**
C411.3	Understand	Group discussion	**4**
C411.4	Analyse	Case Study	**4**
C411.5	Apply	Design Automation 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	40	20	20	20
Understand	60	60	40	40
Apply	-	20	20	20
Analyse	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

17EE412 **Automotive Electronics** **3/0/0/3**

Nature of Course : D (Theory application)
Pre- Requisites :
Course Objectives:

1 To understand the principles and construction of batteries.
2 To understand the starting, charging and ignition system
3 To get ample knowledge of lighting system, sensors and actuators
4 To analyze Electronic Fuel Injection, Ignition Systems and Digital Engine Control System

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

C412.1	Understand the principles and construction of batteries	[R]
C412.2	Understand the starting, charging and ignition system	[U]
C412.3	Understand the lighting system, sensors and actuators	[U]
C413.4	Analyzing Electronic Fuel Injection, Ignition Systems and Digital Engine Control System	[AP]

Course Contents:

Batteries: Principles and construction of lead-acid battery. Characteristics of battery, rating capacity and efficiency of batteries. Various tests on battery condition, charging methods. Constructional aspect of alkaline battery. Starting System: Condition at starting. Behavior of starter during starting. Starter Switches. Charging System: Voltage & current regulators. Ignition Systems: Types, Construction & working of battery coil and magneto ignition systems. Relative merits, Centrifugal and vacuum advance mechanisms, types and construction of spark plugs, electronic ignition systems. **Lighting System and Accessories:** Insulated & earth return systems. Positive & negative earth systems. Details of head light & side light. Headlight dazzling & preventive methods. Electrical fuel-pump, Speedometer, Fuel, oil & temperature gauges, Horn, Wiper system Automotive Electronics: Current trends in modern automobiles Open and close loop systems-Components for electronic engine management. Electronic management of chassis system. Vehicle motion control **Sensors and Actuators:** Basic sensor arrangement, Types of sensors such as-Oxygen sensors, Crank angle position sensors-Fuel metering/vehicle speed sensor and detonation sensor- Altitude sensor, flow sensor. Throttle position sensors. Solenoids, stepper motors, and relays ; **Electronic Fuel Injection and Ignition Systems:** Introduction, feedback carburetor systems. Throttle body injection and multi port or point fuel injection, fuel injection systems, Injection system controls. Advantages of

electronic ignition systems: Types of solid-state ignition systems and their principle of operation, Contact less electronic ignition system, and electronic spark timing control **Digital Engine Control System:** Open loop and closed loop control systems-Engine cranking and warm up control-Acceleration enrichment- Deceleration leaning and idle speed control. Distributor less ignition-Integrated engine control systems, Exhaust mission control engineering. **Electronic dashboard instruments**-Onboard diagnosis system, security and warning system.

Total Hours: 45

Text Books:

1 Judge. A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 2012.
2 Vinal. G.W. , Storage Batteries, John Wiley & Sons Inc., New York, 4th edition, 2012.

Reference Books:

1 1. William B. Ribbens, Understanding Automotive Electronics, 6th Edition, Butterworth, Heinemann Woburn, 2003.

2 2. Automotive Hand Book, Robert Bosch, Bently Publishers, 2004.

Web References:

1 www.boschindia.com/.../automotive_electronics.../automotive-electronics.html
2 www.innovianstechnologies.com/automotive-electronics

Online Resources:

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

Assessment Methods & Levels (based on Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C410.1	Remember	Class room Quiz	**3**
C410.2	Understand	Online Quiz	**3**
C410.3	Understand	Class Presentation	**3**
C410.4	Understand	Class Presentation	**3**
C410.5	Apply	Group Assignment	**4**
C410.6	Apply	Group Assignment	**4**

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

17EE413 DESIGN OF ELECTRICAL MACHINES 3/0/0/3

Nature of Course (Analytical, Application)
Pre requisites Electrical machines I, Electrical machines II

Course Objectives:

1 To learn the basic design concepts.
2 To design DC machines, Transformers, Induction and Synchronous machines.
3 To apply the design procedures in CAD of electrical machines

Course Outcomes:

Upon completion of the course, students shall have ability to

CXXX.1	Remember the basic design concepts	[R]
CXXX.2	Understand the design of armature and field systems for D.C. machines.	[U]
CXXX.3	Understand the design of core, yoke, windings and cooling systems of transformers.	[U]
CXXX.4	Understand the design of stator and rotor of induction machines and rotor of synchronous machines and study their thermal behaviour.	[U]
CXXX.5	Apply the design procedures in CAD of electrical machines.	[AP]

Course Contents:

BASIC DESIGN CONCEPTS Considerations and Limitations in design; Choice of specific electric and magnetic loadings; Concept of magnetic circuit; MMF calculation for various types of electrical machines; Real and apparent flux density of rotating machines; Leakage reactance calculation for transformers, induction and synchronous machine; **DESIGN OF D.C.MACHINES** Output Equation; Main Dimensions; Choice of number of poles; Armature design; Design of air gap; Design of field poles and field coil; Design of commutator and brushes **DESIGN OF TRANSFORMERS** Output rating of single phase and three phase transformers; Optimum design of transformers; Design of core, yoke and windings for core and shell type transformers; Design of tanks and cooling tubes of transformers; **DESIGN OF THREE PHASE INDUCTION MOTORS** Output Equation; Main dimensions; Design of stator; Design of squirrel cage and slip ring rotor; Performance calculation from designed data **DESIGN OF SYNCHRONOUS MACHINES** Output Equation; Main dimensions; Short circuit ratio-Design of stator and rotor of cylindrical pole and salient pole machines; Design of damper winding; Design of field coil; Cooling of large alternators; Introduction to computer aided design of electrical machines.

Total Hours: 45

Text Books:

1 A.K.SAWHNEY, 'A Course in Electrical Machine Design', Dhanpat Rai and Sons, New Delhi, 2005.
2 S.K.Sen, 'Principles of Electrical Machine Design with Computer Programmes', Oxford and IBH Publishing Co.Pvt Ltd., New Delhi, 1987.

Reference Books:

1 R.K.Agarwal, 'Principles of Electrical Machine Design',S.K.Kataria and Sons, Delhi,2002.
2 V.N.Mittle and A.Mittle, 'Design of Electrical Machines', Standard Publications Distributors, Delhi, 2002.

3 Maurya, Jallan, Shukla, 'Computer Aided Design of Electrical Machines',Kataria Publications, 2014
4 User Manuals of MAGNET, MAXWELL & ANSYS Softwares.

Web References:

1 http://www.electrical-engineering-portal.com/
2 http://nptel.iitm.ac.in/courses.php
3 http://www.femm.info/

Online Resources:

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

Assessment Methods & Levels (based on Blooms'Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom's Level	Assessment Component	Marks
C413.1	Remember	Class room Quiz	**10**
C413.2	Understand	Online Quiz	**10**
C413.3	Understand	Design based problem solving tutorial	**10**
C413.4	Apply	Class Presentation	**5**
C413.5	Apply	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination
	CIA1	CIA2	Term End Assessment	
Remember	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE414 SPECIAL ELECTRICAL MACHINES 3/0/0/3

Nature of Course : D (Theory application)
Pre- requisites : 17EE306 Electrical Machines-I and 17EE311 Electrical Machines-II
Course Objectives:

1 Construction, principle of operation and performance of stepping motors.
2 Construction, principle of operation, control and performance of switched reluctance motors, synchronous reluctance motors
3 Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors, permanent magnet synchronous motors
4 Construction, principle of operation and performance of Linear Induction motor.

Course Outcomes:

Upon completion of the course, students shall have ability to

C414.1	Construction, principle of operation and performance of stepping motors.	[U,R]
C414.2	Construction, principle of operation, control and performance of switched reluctance motors, synchronous reluctance motors	[U,R,AP]
C414.3	Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors, permanent magnet synchronous motors	[U,R,AP]
C414.4	Construction, principle of operation and performance of Linear Induction Motor.	[U,R,AP]

Course Contents:

Stepping Motors - Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi-stack configurations – Torque equations – Modes of excitations – Characteristics – Drive systems and circuit for open loop and closed loop control of stepper motor. **Switched Reluctance Motor** - Constructional features – Rotary and Linear SRMs - Principle of operation – Torque production –Steady state performance prediction-Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Closed loop control of SRM – Characteristics- Introduction to Synchronous Reluctance Motors. **Permanent Magnet Brushless D.C. motors** - Introduction -Motor Morphologies -Principle of operation, EMF, power input and torque expressions, Phasor diagram, Torque -speed characteristics -Parameter Estimation Power controllers, Torque Controllers, , Self-control, Vector control, Current control schemes. **Permanent Magnet Synchronous Motor** - Introduction -Motor Morphologies -Principle of operation, EMF, power input and torque expressions, Phasor diagram, Torque -speed characteristics -Parameter Estimation Power controllers, Torque Controllers, , Self-control, Vector control, Current control schemes **Linear Motors** - Linear Induction motor (LIM) classification - construction - Principle of operation - concept of current sheet - goodness factor - DC Linear motor (DCLM) types - circuit equation - DCLM control applications.

Total Hours: 45

Text Books:

1 Miller T.J.E,"Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
2 KenjoT and Naganori, S., "Permanent Magnet and Brushless DC Motors", Clarendon Press, Oxford, 1989.
3 Naser A and BoldeaI., "Linear Electric Motors: Theory, Design and Practical Applications", Prentice Hall Inc., New Jersy, 1987.

Reference Books:

1 Kenjo T, "Stepping Motors and their Microprocessor Control", Clarendon Press, Oxford, 1989.
2 R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
3 Floyd E Saner," Servo Motor Applications", Pittman USA, 1993.

Web References:

1 www.nptel**videos**.in/2012/11/**electrical**-**machines**-i.html
2 www.academia.edu/9885014/**SPECIAL ELECTRICAL MACHINES** NPTEL NOTES

Online Resources:

1 https://ocw.mit.edu/courses/electrical...and.../6-685-electric-machines-fall-2013/
2

Assessment Methods & Levels (based on Bloom'sTaxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
CO414.1	Understand &Remember	Assignments	**5**
CO414.2	Understand, Remember & Apply	Technical Online Quiz	**5**
CO414.3	Understand, Remember & Apply	Class Presentation	**5**
CO414.4	Understand, Remember & Apply	Tutorials	**5**
CO414.5	Understand &Remember	Assignments	**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	20	10	10
Understand	60	50	50	50
Apply	20	30	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE415 **PLC AND AUTOMATION** **3/0/0/3**

Nature of Course : **D & K** (Theory application and Theory Programming)
Pre-requisites :NIL
Course Objectives:

1 To expose the rudiments of PLC and Industrial Automation
2 To know various types and programming of programmable logic controllers
3 To familiarize with different types of HMI and Installation and maintenance procedures for PLC
4 To learn the architecture and tools of Supervisory Control and Data Acquisition System
5 To learn the basic principles of communication protocols and architecture of DCS.

Course Outcomes:

Upon completion of the course, students shall have ability to

C415.1	Good knowledge of the architecture of PLC ,I/O modules and wiring	[R,U]
C415.2	Understand the basic building blocks of PLC Programming	[U]
C415.3	Apply the basic building blocks of PLC Programming for finding solution for practical issues	[AP]
C415.4	Understand the Installation and maintenance procedures and networking for PLC	[U,AP]
C415.5	Understand the architecture and application of SCADA.	[U]
C415.6	Understand the Principle of communication protocols and architecture of Distributed control system	[U]

Course Contents:

Introduction: Sensors and types of sensors, Programmable Logic Controllers: History and developments in industrial automation, Vertical integration of industrial automation Control elements in industrial automation. PLC introduction, Basics of PLC, Advantages, Capabilities of PLC. Architecture of PLC, Scan cycle, Types of PLC, Types of I/O modules- Configuring a PLC, PLC wiring. **Programming:** Types of Programming , Simple process control programs using Relay Ladder Logic , PLC arithmetic functions - Timers and counters ,data transfer-comparison and manipulation instructions, PID instructions, PTO / PWM generation. **HMI system and PLC networking:** Necessity and Role in Industrial Automation, Text display, operator panels, Touch panels, Panel PCs , Integrated displays, interfacing PLC to HMI. Installation and maintenance procedures for PLC, Troubleshooting of PLC. **SCADA:** Overview, Developer and runtime packages architecture, Tools, Tag, Internal & External graphics, Alarm logging, Tag logging, structured tags, Trends-history-Report generation, VB&C Scripts for SCADA application. **Communication protocols of SCADA:** Proprietary and open Protocols – OLE/OPC – DDE – Server/Client Configuration – Messaging – Recipe. User administration – Interfacing of SCADA with PLC, drive, and other field device.

Total Hours: 45

Text Books:

1 William Bolton, “Programmable Logic controllers”, Elsevier, Sixth Edition, 2015.
2 Robert Radvannovshy,” Handbook of SCADA/Control System Security”,CRC Press.Second Edition,2016.

Reference Books:

1 John.W.Webb & Ronald A. Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2 Christian Gerber, “Implementation and Verfication of Distributed Control System”,

Second Edition, Logos,2012
3 WinCC V7.2, Software Manual,2013.

Web References:

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

Online Resources:

1 https://www.*nptel.ac.in/courses/117106093/*

Assessment Methods & Levels (based on Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C415.1	Remember & Understand	Class room Quiz	**3**
C415.2	Understand	Online Quiz	**3**
C415.3	Apply	Assignments	**3**
C415.4	Understand & Apply	Group Assignments	**3**
C415.5	Understand	Class Presentation	**4**
C415.6	Understand	Class Presentation	**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	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE416 SERVO AND ROBOT DRIVES 3/0/0/3

Nature of Course :G (Theory Analytical)
Co- requisites :

Course Objectives:

1 To introduce the basic robotic system.
2 To enable the students to understand dynamics and control of electric drives and its application.
3 To enable the students to understand the servo motor drives
4 To enable the students to understand the robotic drives and its power transmission system
5 To enable the students to understand sensor system applied in robotic application

Course Outcomes:

Upon completion of the course, students shall have ability to

C416.1	Introducing the basic Robotic systems	[R]
C416.2	Understand the dynamics and control of electric drives	[U]
C416.3	Understand the concepts and performance of servo motor drives	[U]
C416.4	Understand the concepts of robotic drives and its power transmission system	[AN]
C416.5	Apply the sensor systems with the robotic drives	[AP]

Course Contents:

INTRODUCTION TO ROBOTIC SYSTEMS: Structure of a Robot, Classification of Robots: Cartesian, Cylindrical, Spherical, Articulated, SCARA - Accuracy, Resolution and Repeatability of Robots, Degrees of Freedom of Serial and Parallel Manipulators, Robot Application in Manufacturing: Material Transfers - Machine Loading and Unloading - Processing Operations - Assembly and Inspection. **DYNAMICS & CONTROL OF ELECTRICAL DRIVES:** Introduction – Parts of Electrical Drives- Fundamental Torque Equations – Speed Torque Conventions and Multiquadrant Operation – Nature & Classification of Load Torques - Modes of Operation – Closed-Loop Control of Drives. –**SERVOMOTORS DRIVES:** Types – Constructional features - Principle of operation – Feed back system - Sizing of servomotors –Applications to robotic system. **ROBOT DRIVES AND POWER TRANSMISSION SYSTEMS**: Robot drive mechanisms, hydraulic – electric – servomotor- stepper motor - pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws, End effectors – Types. **SENSORS:** Principle of operation, types and selection of Position& velocity sensors, Potentiometers, Encoders, Resolvers, LVDT, Tachogenerators, Internal and External State Sensors, Proximity sensors. Limit switches – Tactile sensors - Touch sensors - Force and torque sensors, Robot End Effectors. Vision Systems.

Total Hours: 45

Text Books:

1 Saeed B. Niku, —An Introduction to Robotics: Analysis, Systems and Applications||, Pearson Education, 2013.
2 Wilfried Voss,— A Comprehensible Guide to Servo Motor Sizing|| , Copperhill Media, 2007
3 Fu KS, Gonzalez RC, Lee C.S.G, "Robotics : Control, Sensing, Vision and Intelligence", McGraw Hill, 1997.

Reference Books:

1 S K Saha, —Introduction to Robotics||, Tata Mcgraw Hill, 2010.
2 Mittal R K, Nagrath I J, —Robotics and Control||, Tata McGraw Hill, 2010.
3 Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy, Prentice Hall of India P Ltd., 2006.

Web References:

1 http://nptel.ac.in/courses/112101098/
2 http://nptel.ac.in/courses/112108093/
3 http://nptel.ac.in/courses/112101099/

Online Resources:

1 https://www.futurelearn.com/courses/begin-robotics
2 https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/
3 https://www.edx.org/course/robotics-columbiax-csmm-103x

Assessment Methods & Levels (based on Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C416.1	Remember	Quiz	**4**
C416.2	Understand	Technical presentation	**4**
C416.3	Understand	Group discussion	**4**
C416.4	Analyse	Case Study	**4**
C416.5	Apply	Design drives with sensors	**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	-	-	-	-

17EE417 FLEXIBLE AC TRANSMISSION SYSTEMS 3/0/0/3

Nature of Course D (Theory application)
Co- requisites 17EE313 Generation, Transmission and Distribution

Course Objectives:

1 To understand the concepts of FACTS
2 To expose the applications of FACTS controllers in power systems
3 To learn about shunt & series compensation schemes
4 To learn the simulation of FACTS Controllers
5 To understand the phenomenon of SSR & its mitigation techniques

Course Outcomes:

Upon completion of the course, students shall have ability to

C417.1	Understand and analyze the concept of FACTS.	[U]
C417.2	To understand the various types of compensation schemes.	[R,U,A]
C417.3	Implement various FACTS controllers.	[U,A]
C417.4	Applying the knowledge gained to simulate various FACTS controllers.	[R,U,A]
C417.5	Understand about the phenomena of sub synchronous resonance.	[C,U,A]

Course Contents:

Introduction: Introduction, Electrical Transmission Network, Necessity, Power Flow in AC system, Relative importance of controllable parameter, Opportunities for FACTS, Possible benefits for FACTS Technology, Types of FACTS Controllers. **Static Var Compensation**: Need for compensation , shunt and series compensation, Configuration ,Operating characteristics, Thyristor Controlled Reactor (TCR) , Thyristor Switched Capacitor (TSC), Comparison of TCR and TSC. **Series Compensation**: Variable impedance type series compensation, Thyristor Switched Series Capacitor (TSSC) , Thyristor Controlled Series Capacitor (TCSC), Basic operating control schemes for TSSC & TCSC. **Static Voltage Phase Angle Regulator**: Objectives of voltage and phase angle Regulators- Operations an Control Applications-TCVR Model and Thyristor Controlled Voltage and Phase Angle Regulator, TCPAR Model characteristics**,**. **Second Generation Facts Controllers :** STATCOM and UPFC Introduction, Circuit model, Principle of operation, Basic operating principles and control structure , Introduction to sub synchronous resonance (SSR)- mitigation by FACTs controllers, NGH, SSR damping scheme, Simulation and study of FACTS under dynamic conditions.

Total Hours: 45

Text Books:

1 **Xiao-Ping Zhang "Flexible AC Transmission Systems" Springer ,2010**
2 K.R. Padiyar, "FACTS Controllers for Power Transmission and Distribution" New Age International Publishers, 2016

Reference Books:

1 Robert Diffenderfer, 'Electronic Devices: Systems and Applications', Cengage Learning, 2010
2 Narain G.Hingorani, Laszio Gyugyi, "Understanding FACTS concept and Technology",Standard Publisher, Delhi, 2015.
3 Gyugyi L., "Unified power flow control concept for flexible AC transmission ", IEEE Proc-C, Vol.139, No.4, July 2013.
4 Einar V.Larsen, Juan J. Sanchez-Gasca, Joe H.Chow, " Concepts for design of FACTS Controllers to damp power swings ", IEEE Trans on Power Systems, Vol.10, No.2, May 2010

Web References:

1 http://nptel.ac.in/courses/108104052/1

Online Resources:

1 https://www.edx.org/course/smart-grids- electricity-future- ieeex-smartgrid- x-0

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C417.1	Remember	Class room Quiz	**3**
C417.2	Understand	Online Quiz	**3**
C417.3	Analysing	Group Assignment	**3**
C417.4	Analysing	Class Presentation	**3**
C417.5	Create	Simulation	**4**
C417.6	Apply	Group Assignment	**4**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	20	10	10	10
Understand	50	50	50	50
Apply	30	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE418 **MODELLING AND SIMULATION OF POWER ELECTRONIC CIRCUITS** **2/0/1/3**

Nature of Course E (Theory skill based)
Pre- Requisites Power Electronics, Control Systems
Course Objectives:

1 To expose the basic theoretical and practical applications of power semiconductor devices with simulation.
2 To develop basic AC-DC, DC-DC, DC-AC conversion circuit fed drives.
3 To provide the basis for further study of controllers for power electronics circuits.

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

C418.1	Understand basic applications of various power semiconductor devices.	[U & R]
C418.2	Analyse and design various machine models.	[U & AN]
C418.3	Design practical AC/DC rectifier circuits.	[AP]
C418.4	Understand and design basic and advanced DC/DC converter circuits.	[AP]
C418.5	Understand the role of power electronic systems for improvement of power quality.	[AP]
C418.6	Analyse and design inverter circuits for control of drives.	[AN]

Course Contents:

Introduction to MATLAB and Modelling of Power Devices: Introduction to Sim Power Systems Tool Box, Modelling of Diode, SCR, MOSFET, IGBT in Simulation, Simulation of gate/base drive circuits, Simulation of Snubber circuit. **Modelling of Electrical Machines:** Introduction to electrical machine modelling: Induction, DC, and Synchronous machines. **MATLAB Simulation of Rectifier fed drives:** Simulation of single and three phase converters-Uncontrolled, Semi controlled and fully controlled converter fed DC motor drive, **Dual Converter**. **MATLAB Simulation of Chopper fed drives:** Simulation of DC-DC converter fed dc motor drives-Buck, Boost, Buck-Boost Converters, **Simulation of four quadrant operations of DC-DC converter**. Simulation of Power factor correction schemes with controllers. **Simulation of Inverter fed drives:** Simulation of single and three phase inverters with MOSFET and IGBT, Space Vector Representation, Pulse-width modulation methods for voltage and waveform control. Simulation of Inverter fed Induction and BLDC motor drives.

Lab Component

1	Modelling of Electrical Machines	[A]
2	Implementation of Controlled Converter Fed Drives	[A]
3	Implementation of DC-DC Chopper Fed Drives	[A]
4	Implementation of Closed Loop Control with PFC	[U]
5	Implementation of Space Vector Modulation for Inverter Fed Induction Motor Drive	[AP]

Total Hours: 45

Text Books:

1 Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, 3rd Edition, New Delhi, 2014.
2 Randall Shaffer., "Fundamentals of Power Electronics with MATLAB", Firewall Media,

India, 2010

3 **Dr. Shailendra Jain Modelling and Simulation using MATLAB Simulink, Wiley, 2nd Edition, 2015**

Reference Books:

1 Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3 rd Edition, John Wiley & Sons, 2009.

2 Haitham Abu-Rub., Etal., "High Performance Control of AC Drives with Matlab/Simulink Models", Wiley Publications.

Web References:

1 https://www.mathworks.com/support/books/book54209.html?category=1

2 http://nptel.ac.in/downloads/108105066/

3 http://nptel.ac.in/courses/108101038/

Online Resources:

1 https://www.coursera.org/specializations/power-electronics

Assessment Methods & Levels (based on Bloom'sTaxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C418.1	Understand and Remember	Class Presentation	**3**
C418.2	Understand and Analyse	Class Presentation	**3**
C418.3	Apply	Programming Assignment	**3**
C418.4	Apply	Programming Assignment	**3**
C418.5	Apply	Group Assignment	**4**
C418.6	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	20	-	10	10
Understand	50	40	20	20
Apply	-	20	40	40
Analyse	30	40	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

17EE501 RENEWABLE ENERGY SOURCES 3/0/0/3

Nature of Course: D (Theory Application)

Pre Requisites: 17PH101 Engineering Physics

Course Objectives:

1. To understand different non-conventional energy systems and its applications.
2. To advance student's knowledge and assimilate new technologies.
3. To perform simple techno-economical case studies of renewable energy systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

CO316.1 Remember the concepts of Kyoto Protocol

CO316.2 Understand the energy scenario in India and Integrated Resource Plan

CO316.3 Understand the operation and application of Solar energy, Biomass, Wind energy and Tidal energy

CO316.4 Understand the operation and application of Geothermal energy and fuel cells

CO316.5 Understand the concepts of different energy storage methods

CO316.6 Apply ideas to perform case studies on renewable energy systems

Course Contents with Course Outcomes/Blooms Taxonomy/Assessment Methods

Energy Scenario: Energy scenario in India, Kyoto protocol, concept of clean development mechanism and prototype carbon funds, integrated resource plan **Solar Energy:** Solar thermal, solar photovoltaic, applications, maximum power point tracking**,** grid interactive solar PV systems **Wind Energy:** Site selection, wind energy conversion system, applications, maximum power operation, grid connected operations **Other Energy Sources:** Biomass energy, tidal energy, geothermal energy, fuel cells, applications. **Energy Storage and Case studies:** Storage methods of mechanical, chemical, electromagnetic, electrostatic and thermal energy, case studies on solar PV system, wind energy system and hybrid electric vehicles**.**

Total Hours 45

Text Books:

1. John Twidwell and Tony Weir, "Renewable Energy Resources", 3rd Edition, Routledge, 2015.
2. Rai, G.D, "Non Conventional Energy Sources", Khanna Publishers, 2010.

Reference Books:

1. Aldo Vieira Da Rosa, "Fundamentals of Renewable Energy Processes", Academia Press, 2012.
2. B.H. Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw Hill, New Delhi, 2010.
3. G.N. Tiwari, "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.

Web References:

1. http://nptel.ac.in/courses/108108078/
2. http://www.homepower.com/
3. http://unfccc.int/kyoto_protocol/items/2830.php
4. https://wbcarbonfinance.org/Router.cfm?Page=PCF&FID=9707&
5. http://www.pacificorp.com/es/irp.html
6. https://www.ashden.org/files/SKG%20full.pdf

Online Resources:

1. https://www.edx.org/course/sustainable-energy-design-renewable-delftx-energyx

2. https://www.coursera.org/learn/wind-energy
3. https://www.edx.org/course/solar-energy-delftx-et3034x-0

Assessment Methods & Levels (based on Blooms'Taxonomy)

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

Course Outcome	Bloom's Level	Assessment Component	Marks
C316.1	Remember	Quiz	**2**
C316.2	Understand	Class presentation	**4**
C316.3	Understand	Group Assignment	**4**
C316.4	Understand	Quiz	**4**
C316.5	Understand	Group Assignment	**2**
C316.6	Apply	Case study	**4**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA1 [6 marks]	CIA2 [6 marks]	Term End Examination [8 marks]	
Remember	30	20	20	20
Understand	70	80	80	80
Apply	-	-	-	-
Analyse				
Evaluate	-	-	-	-
Create	-	-	-	-

17EE502 ENERGY AUDITING,CONSERVATION AND MANAGEMENT 3/0/0/3
Nature of Course : G (Theory)

Course Objectives:

1. To introduce about Energy Management Systems (EMS).
2. To enable the students to understand the scope for energy saving in residential sector, industries and commercial establishments.
3. To analyse the concepts of New technologies and new products are coming up in the market, for energy saving.
4. To learn the Knowledge of thermodynamic principles, usage of thermal insulation in buildings, lighting devices and new electric motor.
5. To realise energy conservation is better way to meet demand in short span of time rather than constructing new power plant.

Course Outcomes:

Upon completion of the course, students shall have ability to

C502.1	Understand the role of Energy Managers in Industries	[R]
C502.2	Evaluate Total Energy Systems Energy Audit.	[AN]
C502.3	Analyse the concepts of Energy conservation in Centrifugal pumps, Fans &Blowers, Air compressor	[AP]
C502.4	Demonstrate energy consumption & energy saving potentials – Design consideration. Refrigeration & Air conditioning	[U]
C502.5	Perceive knowledge Organizational background desired for energy management motivation	[AP]
C502.6	Identify various detailed process of M&T-Thermostats, Boiler controls.	[AN]

Course Contents:[REFERED FROM NIT SYLLABUS]

Energy Scenario - Role of Energy Managers in Industries – Energy monitoring, auditing & targeting – Economics of various Energy Conservation schemes. Total Energy Systems Energy Audit -various Energy Conservation Measures in Steam -Losses in Boiler. Energy Conservation in Steam Systems - Case studies. Energy conservation in Centrifugal pumps, Fans &Blowers, Air compressor – energy consumption & energy saving potentials – Design consideration. Refrigeration & Air conditioning - Heat load estimation -Energy conservation in cooling towers & spray ponds – Case studies Electrical Energy -Energy Efficiency in Lighting – Case studies. Organizational background desired for energy management motivation, detailed process of M&T-Thermostats, Boiler controls-proportional, differential and integral control, optimizers; compensators.

Text Books:

1 Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990
2 Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977.

Reference Books:

1 Larry C Whitetal, Industrial Energy Management & Utilization.
2 Power System Engineering 2nd Ed. D P Kothari, I J Nagrath, Tata McGraw-Hill Co 2008.

Web References:

1 http://nptel.ac.in/video.php?subjectId=108102047
2 http://textofvideo.nptel.iitm.ac.in/108102047/lec20.pdf

Online Resources:

1 https://www.edx.org/course/Energy management system

Total Hours: 45

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C502.1	Remember	Quiz	**2**
C502.2	Analyse	Simulation Exercise	**4**
C502.3	Apply	Group Assignment	**4**
C502.4	Understand	Class presentation	**4**
C502.5	Apply	Poster presentation	**2**
C502.6	Analyse	Case study	**4**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA1 [6 marks]	**CIA2 [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	20
Understand	70	30	30	30
Apply	-	30	30	30
Analyse	10	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

17EE503 **SMART GRID** **3/0/0/3**

Nature of Course: D (Theory application)
Pre Requisites: **-**

Course Objectives:

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

1. Need for smart grid to attain a perfect power system network
2. DC distribution grid to attain maximum efficiency
3. IntelliGrid architecture for the effective distribution
4. Various technology alternatives for the grid connected networks.

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

CO401.1	Smartgrid for the perfect power system	[U,R]
CO401.2	Various types of DC grids and their interconnections	[U,R,AP]
CO401.3	IntelliGrid structure for the forthcoming power criteria	[U,R,AP]
CO401.4	Various alternating trends for the smart grid distribution	[U,R,AP]

Course Contents:

Introduction - Introduction to smart grid- Electricity network-Local energy networks- Electric transportation- Low carbon central generation-Attributes of the smart grid- Alternate views of a smart grid. **Smart grid to evolve a perfect power system**: Introduction- Overview of the perfect power system configurations- Device level power system- Building integrated power systems- Distributed power systems- Fully integrated power system. **DC distribution and Smart grid** - AC Vs DC sources-Benefits of and drives of DC power delivery systems-Powering equipment and appliances with DC-Data centres and information technology loads-Future neighbourhood-Potential future work and research. **Intelligrid architecture for the Smart grid**: Introduction - Intelligrid today- Smart grid vision based on the intelligrid architecture. Dynamic Energy Systems concept- Smart energy efficient end use devices-Smart distributed energy resources-Advanced whole building control systems .Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources; Power Quality Conditioners for Smart Grid, Web based Power Quality Monitoring, Power Quality Audit. **SMART GRID TECHNOLOGIES (Transmission)**- Technology Drivers, Smart energy resources, Smart substations, Substation Automation,

Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring. **SMART GRID TECHNOLOGIES (Distribution) -** DMS, Volt/VAr control, Fault Detection, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers. **Energy port as part of the Smart grid**- Concept of energy -Port, generic features of the energy port. **Policies and programs to encourage end – Use Energy Efficiency**: Policies and programs in action -multinational - national-state-city and corporate levels. **Market Implementation**: Framework-factors influencing customer acceptance and response - program planning-monitoring and evaluation. **Efficient Electric End – Use technology alternatives** - Existing technologies – lighting - Space conditioning - Indoor air quality - **High Performance Computing for Smart Grid Applications-** Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid

Total : 45 Hours

TEXT BOOKS:

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong.Wu, AkihikoYokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012
2. James Momoh, "Smart Grid: Fundamentals of Design and Analysis"-Wiley, IEEE Press, 2012.
3. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency andDemand Side Response"- CRC Press, 2009.

REFERENCE BOOKS:

1. Smart Grid: Technology and applications Author(s): Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, Published Online: 22nd February 2012 09:51PM EST, Print ISBN: 9780470974094, Online ISBN: 9781119968696DOI: 10.1002/9781119968696.
2. Smart Grid Handbook, 3 volume Set Chen-Ching Liu, Stephen McArthur, Seung-Jae Lee John Wiley & Sons, 1 Aug 2016 - Science - 1900 pages

Web References:

1. http://whatis.techtarget.com/reference/Smart-Grid-Technology-Overview
2. https://www.nist.gov/engineering-laboratory/smart-grid

Online Resources:

1. https://www.edx.org/course/smart-grids-electricity-future-ieeex-smartgrid-x-0
2. http://theinstitute.ieee.org/ieee-roundup/blogs/blog/free-online-course-covers-the-future-of-smart-grids

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
CO401.1	Understand &Remember	Assignments (2 numbers)	**5**
CO401.2	Understand, Remember & Apply	Technical Online Quiz (two)	**5**
CO401.3	Understand, Remember & Apply	Class Presentation (1 presentation)	**5**
CO401.4	Understand, Remember & Apply	Tutorials (2 numbers)	**5**

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	10	10
Understand	60	60	70	60
Apply	20	20	20	30
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17EE504 SERVO AND ROBOT DRIVES 3/0/0/3

Nature of Course :G (Theory Analytical)
Co- requisites :
Course Objectives:

1 To introduce the basic robotic system.
2 To enable the students to understand dynamics and control of electric drives and its application.
3 To enable the students to understand the servo motor drives
4 To enable the students to understand the robotic drives and its power transmission system
5 To enable the students to understand sensor system applied in robotic application

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

C416.1	Introducing the basic Robotic systems	[R]
C416.2	Understand the dynamics and control of electric drives	[U]
C416.3	Understand the concepts and performance of servo motor drives	[U]
C416.4	Understand the concepts of robotic drives and its power transmission system	[AN]
C416.5	Apply the sensor systems with the robotic drives	[AP]

Course Contents:

INTRODUCTION TO ROBOTIC SYSTEMS: Structure of a Robot, Classification of Robots: Cartesian, Cylindrical, Spherical, Articulated, SCARA - Accuracy, Resolution and Repeatability of Robots, Degrees of Freedom of Serial and Parallel Manipulators, Robot Application in Manufacturing: Material Transfers - Machine Loading and Unloading - Processing Operations - Assembly and Inspection. **DYNAMICS & CONTROL OF ELECTRICAL DRIVES:** Introduction – Parts of Electrical Drives- Fundamental Torque Equations – Speed Torque Conventions and Multiquadrant Operation – Nature & Classification of Load Torques - Modes of Operation – Closed-Loop Control of Drives. –**SERVOMOTORS DRIVES:** Types – Constructional features - Principle of operation – Feed back system - Sizing of servomotors –Applications to robotic system. **ROBOT DRIVES AND POWER TRANSMISSION SYSTEMS**: Robot drive mechanisms, hydraulic – electric – servomotor- stepper motor - pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws, End effectors – Types. **SENSORS:** Principle of operation, types and selection of Position& velocity sensors, Potentiometers, Encoders, Resolvers, LVDT, Tachogenerators, Internal and External State Sensors, Proximity sensors. Limit switches – Tactile sensors - Touch sensors - Force and torque sensors, Robot End Effectors. Vision Systems.

Total Hours: 45

Text Books:

1 Saeed B. Niku, —An Introduction to Robotics: Analysis, Systems and Applications||, Pearson Education, 2013.
2 Wilfried Voss,— A Comprehensible Guide to Servo Motor Sizing|| , Copperhill Media, 2007
3 Fu KS, Gonzalez RC, Lee C.S.G, "Robotics : Control, Sensing, Vision and Intelligence", McGraw Hill, 1997.

Reference Books:

1 S K Saha, —Introduction to Robotics||, Tata Mcgraw Hill, 2010.
2 Mittal R K, Nagrath I J, —Robotics and Control||, Tata McGraw Hill, 2010.
3 Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy, Prentice Hall of India P Ltd., 2006.

Web References:

1 http://nptel.ac.in/courses/112101098/
2 http://nptel.ac.in/courses/112108093/
3 http://nptel.ac.in/courses/112101099/

Online Resources:

1 https://www.futurelearn.com/courses/begin-robotics
2 https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/
3 https://www.edx.org/course/robotics-columbiax-csmm-103x

Assessment Methods & Levels (based on Bloom'sTaxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C416.1	Remember	Quiz	**4**
C416.2	Understand	Technical presentation	**4**
C416.3	Understand	Group discussion	**4**
C416.4	Analyse	Case Study	**4**
C416.5	Apply	Design drives with sensors	**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	-	-	-	-