Sri Sivasubramaniya Nadar College of Engineering

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

Rajiv Gandhi Salai (OMR), Kalavakkam – 603110

Curriculum and Syllabus

Bachelor of Engineering

Electrical and Electronics Engineering

Regulations 2018

Choice Based Credit System (CBCS)

Sri Sivasubramaniya Nadar College of Engineering, Kalavakkam - 603110

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

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

Programme Educational Objectives

PEO 1: Graduates of the programme will have successful career in electrical and electronics industries and can pursue higher education and research.

PEO 2: Graduates of the programme can work in teams discharging social responsibilities as engineers following ethical practices.

PEO 3: Graduates of the programme will continue to develop their knowledge and skills throughout their career

Programme Outcomes (POs)

Students graduating with a degree in Electrical and Electronics Engineering have:

A. Ability to apply knowledge of mathematics, science, and engineering.

B. Ability to design and conduct experiments as well as analyze and interpret data.

C. Ability to design a system, component, or process to meet desired needs.

D. Ability to function on multidisciplinary teams.

E. Ability to identify, formulate, and solve engineering problems.

F. Ability to use modern engineering and IT tools appropriately.

G. Understanding of professional and ethical responsibility.

H. Ability to communicate effectively.

I. A broad education necessary to understand impact of engineering solutions in global/societal context.

J. A knowledge of contemporary issues and the need for sustainable development.

K. Ability to use techniques, financial & management skills necessary for engineering practice.

L. A recognition of need for and ability to engage in lifelong learning.

PEO/PO	A	B	C	D	E	F	G	H	I	J	K	L
1	2	2	1	2	2	3	1	3	1	2	1	3
2	3	3	3	3	3	1	1	1	1	1	2	1
3	1	1	2	1	1	3	3	1	3	3	2	1

3-High, 2-Medium, 1-Low

STRUCTURE OF CURRICULUM

Categorization of Courses

Every B.E. EEE Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

i. **Humanities and Social Sciences (HS)** courses include Technical English, Employability Skills, Engineering Ethics and Human Values, Communication skills, Environmental Science and Engineering.

ii. **Basic Sciences (BS)** courses include Mathematics, Physics, Chemistry, Biology, etc.

iii. **Engineering Sciences (ES)** courses include Engineering practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering, Instrumentation etc.

iv. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization/branch.

v. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization / branch.

vi. **Open Elective (OE)** courses include the courses relevant to the chosen specialization / branch which a student can choose from the curriculum of other B.E. / B. Tech. programmes and courses offered by the Departments under the Faculty of Science and Humanities

vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

S. No.	Category	Credit
1	Humanities and Social Sciences **(HS)**	9
2	Basic Sciences **(BS)**	26.5
3	Engineering Sciences **(ES)**	19
4	Professional Core **(PC)**	83.5
5	Professional Electives **(PE)**	15
6	Open Electives **(OE)**	6
7	Employability Enhancement Courses **(EEC) -**Project & Seminar	13
Total Credits		**172**

TOTAL NO. OF CREDITS: 172

Number of Courses Per Semester

Curriculum of a semester shall normally have a blend of 6 lecture courses and laboratory courses not exceeding 2. In addition, EEC may also be included. Each course may have credits assigned as below.

Credit Assignment

Each course is assigned certain number of credits based on the following:

S. No.	Contact Period per week	Credits
1	1 Lecture Period	1
2	2 Tutorial Periods	1
3	2 Practical Periods (Laboratory / Seminar / Project Work / etc)	1

Contact Periods per week for Tutorials and Practical can only be in multiples of 2

SEMESTER-WISE STRUCTURE OF CURRICULUM

[L=Lecture, T=Tutorial, P=Practical & C = Credits]

Credit distribution

SEMESTER	HS	BS	ES	PC	PE	OE	EEC	Total Credits (Sem-Wise)
I	3	11.5	7.5	-	-	-	-	**22**
II	6	7	4.5	5.5	-	-	-	**23**
III	-	4	4	14	-	-	-	**22**
IV	-	4	-	20	-	-	-	**24**
V	-	-	-	22	-	-	-	**22**
VI	-	-	3	13	3	3	-	**22**
VII	-	-	-	9	6	3	5	**23**
VIII	-	-	-	-	6	-	8	**14**
Total Credits (Category Wise)	**9**	**26.5**	**19**	**83.5**	**15**	**6**	**13**	**172**

SEMESTER I

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

SEMESTER II

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UEN1276	Technical English	HS	3	3	0	0	3
2	UMA1276	Complex Functions and Laplace Transforms	BS	5	3	2	0	4
3	UPH1277	Physics for Electronics Engineering	BS	3	3	0	0	3
4	UCY1276	Environmental Science	HS	3	3	0	0	3
5	UGE1276	Basic Civil and Mechanical Engineering	ES	3	3	0	0	3
6	UEE1201	Electric Circuit Analysis	PC	5	3	2	0	4
PRACTICALS								
7	UGE1297	Design Thinking and Engineering Practices Lab	ES	3	0	0	3	1.5
8	UEE1211	Electric Circuits Lab	PC	3	0	0	3	1.5
			TOTAL	**28**	**18**	**4**	**6**	**23**

SEMESTER III

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UMA1376	Transform Techniques and Partial Differential Equations	BS	5	3	2	0	4
2	UEE1301	Electrical Machines I	PC	4	2	2	0	3
3	UEE1302	Electromagnetic Theory	PC	4	2	2	0	3
4	UEE1303	Electronics Devices and Circuits	PC	3	3	0	0	3
5	UEE1304	Object Oriented Programming	ES	3	3	0	0	3
6	UEE1305	Modern Power Plant Engineering	PC	3	3	0	0	3
PRACTICALS								
7	UEE1311	Electrical Machines Lab - I	PC	4	0	0	4	2
8	UEE1312	Object Oriented Programming Lab	ES	2	0	0	2	1
			Total	**28**	**16**	**6**	**6**	**22**

SEMESTER IV

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UMA1452	Numerical methods	BS	5	3	2	0	4
2	UEE1401	Electrical Machines – II	PC	4	2	2	0	3
3	UEE1402	Transmission and Distribution	PC	3	3	0	0	3
4	UEE1403	Control Systems	PC	5	3	2	0	4
5	UEE1404	Digital Logic System Design	PC	3	3	0	0	3
6	UEE1405	Analog Electronic Circuits	PC	3	3	0	0	3
PRACTICALS								
7	UEE1411	Electrical Machines Lab – II	PC	4	0	0	4	2
8	UEE1412	Analog and Digital electronic circuits Lab	PC	4	0	0	4	2
			Total	**31**	**17**	**6**	**8**	**24**

SEMESTER V

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
S.No								
1	UEE1501	Power System Analysis	PC	3	3	0	0	3
2	UEE1502	Discrete Time Signals and Systems	PC	3	3	0	0	3
3	UEE1503	Microprocessor and Microcontroller - Theory and Applications	PC	3	3	0	0	3
4	UEE1504	Power Electronics	PC	3	3	0	0	3
5	UEE1505	Electrical Measurements and Instrumentation Systems	PC	3	3	0	0	3
6		Professional Elective - I	PE	3	3	0	0	3
PRACTICALS								
7	UEE1511	Control and Instrumentation Lab	PC	4	0	0	4	2
8	UEE1512	Microprocessors and Microcontrollers Lab	PC	4	0	0	4	2
			Total	**26**	**18**	**0**	**8**	**22**

SEMESTER VI

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UEE1601	Solid State Drives	PC	3	3	0	0	3
2	UEE1602	Communication Engineering	ES	3	3	0	0	3
3	UEE1603	Protection and Switch Gear	PC	3	3	0	0	3
4	UEE1604	Power System Operation and Control	PC	3	3	0	0	3
5		Open Elective	OE	3	3	0	0	3
6		Professional Elective II	PE	3	3	0	0	3
PRACTICALS								
7	UEE1611	Power Electronics and Drives Lab	PC	4	0	0	4	2
8	UEE1612	Power System Simulation Lab	PC	4	0	0	4	2
			Total	**26**	**18**	**0**	**8**	**22**

SEMESTER VII

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	UEE1701	Electrical Machine Design	PC	3	3	0	0	3
2	UEE1702	High voltage Engineering	PC	3	3	0	0	3
3	UEE1703	Special Electrical Machines	PC	3	3	0	0	3
4		Open Elective	OE	3	3	0	0	3
5		Professional Elective – III	PE	3	3	0	0	3
6		Professional Elective - IV	PE	3	3	0	0	3
PRACTICALS								
7	UEE1711	Advanced Electrical Engineering Lab	EEC	4	0	0	4	2
8	UEE1718	Project work - Phase I	EEC	6	0	0	6	3
			Total	**28**	**18**	**0**	**10**	**23**

SEMESTER VIII

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1		Professional Elective – V	PE	3	3	0	0	3
2		Professional Elective - VI	PE	3	3	0	0	3
PRACTICALS								
3	UEE1818	Project Work Phase - II	EEC	16	0	0	16	8
			Total	**22**	**6**	**0**	**16**	**14**

PROFESSIONAL ELECTIVE – I
(Management Studies)
SEMESTER V

Sl. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UGE1576	Professional Ethics	PE	3	3	0	0	3
2	UGE1476	Total Quality Management	PE	3	3	0	0	3
3	UEE1521	Principles of Management	PE	3	3	0	0	3
4	UGE1578	Human Rights	PE	3	3	0	0	3
5	UEE1522	Resource Management Techniques	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – II
(Electronic Systems)
SEMESTER VI

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEE1621	VLSI Design Techniques	PE	3	3	0	0	3
2	UEE1622	Embedded System Design	PE	3	3	0	0	3
3	UEE1623	Biomedical Instrumentation	PE	3	3	0	0	3
4	UEE1624	Adaptive Filtering and Wavelets	PE	3	3	0	0	3
5	UEE1625	Microcontroller based System Design	PE	3	3	0	0	3
6	UEE1626	IOT in Power System Engineering	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III
(Control and Automation)
SEMESTER VII

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEE1721	Advanced Control Theory	PE	3	3	0	0	3
2	UEE1722	System Identification and Adaptive Control	PE	3	3	0	0	3
3	UEE1723	Optimal Control Theory	PE	3	3	0	0	3
4	UEE1724	Digital Control Systems	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV

(Energy Systems)

SEMESTER VII

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEE1725	Energy Management and Auditing	PE	3	3	0	0	3
2	UEE1726	Smart Grids	PE	3	3	0	0	3
3	UEE1727	High Voltage Direct Current Transmission	PE	3	3	0	0	3
4	UEE1728	Distributed Generation and Micro Grid	PE	3	3	0	0	3
5	UEE1729	Energy Resources and Utilization	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – V

(Power Electronics and Drives)

SEMESTER VIII

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	UEE1821	Power Quality	PE	3	3	0	0	3
2	UEE1822	Switched Mode Power Supplies	PE	3	3	0	0	3
3	UEE1823	Solar and Energy Storage Systems	PE	3	3	0	0	3
4	UEE1824	Wind Energy Conversion Systems	PE	3	3	0	0	3
5	UEE1825	Modern Power Converters	PE	3	3	0	0	3
6	UEE1826	Power Electronics for Renewable Energy Systems	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI

(Power Systems)

SEMESTER VIII

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	UEE1827	Power Systems Transients	PE	3	3	0	0	3
2.	UEE1828	Power Systems Dynamics	PE	3	3	0	0	3
3.	UEE1829	Flexible AC Transmission Systems	PE	3	3	0	0	3
4.	UEE1831	Power Systems Planning and Reliability	PE	3	3	0	0	3
5.	UEE1832	Advanced Power System Protection	PE	3	3	0	0	3

OPEN ELECTIVES
(Offered by the department of EEE to other branches)

ODD SEMESTER

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	UEE1941	Energy Storage Systems for E-Mobility	OE	3	3	0	0	3
2.	UEE1942	Sensors and Instrumentation	OE	3	3	0	0	3
3.	UEE1943	Fundamentals of Manufacturing and Automation	OE	3	3	0	0	3

EVEN SEMESTER

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	UEE1041	Cyber Security in Smart Grid	OE	3	3	0	0	3
2.	UEE1042	FEA and CAD for Engineers	OE	3	3	0	0	3
3.	UEE1043	Renewable Energy Systems	OE	3	3	0	0	3

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

OBJECTIVES

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

UNIT I LANGUAGE FOR 'SMALL TALK' 9

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

UNIT II DEVELOP WRITING THROUGH READING 9

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

UNIT III PREPARING FOR A CAREER 9

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

UNIT IV IMPROVING SPEAKING 9

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

UNIT V LISTENING FOR DEEPER UNDERSTANDING 9

- Reading: Reading for comparisons and contrast and other deeper levels of meaning.
- Writing: Writing short pieces – developing an outline, identifying main and subordinate ideas.

- Language Development: modal verbs, perfect tenses
- Vocabulary Development: phrasal verbs, fixed and semi-fixed expressions (including idioms), fillers
- Speaking: Group Discussions.
- Listening: Listening to lectures and making notes.

TOTAL PERIODS: 45

OUTCOMES

At the end of the course, learners will be able to:

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

TEXT BOOK

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

REFERENCE BOOKS

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

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

OBJECTIVES

The objective of this course is to enable the student to

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

UNIT I TRIGONOMETRIC SERIES 12

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

UNIT II MATRICES 12

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

UNIT III DIFFERENTIAL CALCULUS 12

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

UNIT IV FUNCTIONS OF SEVERAL VARIABLES 12

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

UNIT V INTEGRAL CALCULUS 12

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

TOTAL PERIODS: 60

OUTCOMES

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

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

- Solve problems using beta and gamma functions and evaluate problems in double integral and triple integral.

TEXT BOOKS

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2016.

REFERENCE BOOKS

1. Bali N. P, Goyal M, Watkins C, Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. James Stewart, Calculus: Early Transcendental, Cengage Learning, New Delhi, 7th Edition, 2013.
3. Narayanan, S. and Manicavachagom Pillai, T. K., Calculus Volume I and II, S. Viswanathan (Printers & Publishers), Pvt., Ltd., 1997.
4. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus Early Transcendentals, John Wiley & Sons, Inc., 11th Edition, 2016.
5. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 2015.

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

OBJECTIVES

Enable the students to

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

UNIT I CRYSTAL PHYSICS 9

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

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

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

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

UNIT III ACOUSTICS AND ULTRASONICS 9

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

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

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton Effect. Theory and experimental verification – Properties of Matter waves – wave particle duality - Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box and extension to three dimensional box – Degeneracy of electron energy states - Scanning electron microscope - Transmission electron microscope.

UNIT V PHOTONICS AND FIBRE OPTICS 9

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

TOTAL PERIODS: 45

OUTCOMES

At the end of this course, students will be able to

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

OBJECTIVES

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

UNIT I WATER AND ITS TREATMENT 9

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

UNIT II POLYMER CHEMISTRY 9

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

UNIT III PHASE RULE AND ALLOYS 8

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

UNIT IV FUELS AND COMBUSTION 9

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

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

UNIT V ELECTROCHEMISTRY AND CORROSION 10

Electrochemical cell - redox reaction, electrode potential - origin of electrode potential - oxidation potential - reduction potential, measurement and applications – electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion – causes – factors -

types chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – electrochemical protection – sacrificial anode method and impressed current cathodic method. Paints - constituents and function. Electroplating of Copper and electrodeless plating of nickel.

TOTAL PERIODS: 45

OUTCOMES

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

TEXT BOOKS

1. Jain P.C. and Monika Jain, Engineering Chemistry Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Vairam, S., Kalyani, P. and Suba Ramesh, Engineering Chemistry, Wiley India Pvt., Ltd, New Delhi, 2013.

REFERENCE BOOKS

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

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

OBJECTIVES

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

UNITI ALGORITHMIC PROBLEM SOLVING 9

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

UNIT II DATA, EXPRESSION, STATEMENT, CONDITIONAL 9

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

UNIT III ITERATION, FUNCTION, STRINGS 9

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

UNIT IV LISTS, TUPLES 9

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

UNIT V DICTIONARIES, FILES 9

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

TOTAL PERIODS: 45

OUTCOMES

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

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

OBJECTIVES

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

CONCEPTS AND CONVENTIONS (Not for Examinations)

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

UNIT I PLANE CURVES AND FREEHAND SKETCHING 10

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

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

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

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

UNIT III PROJECTION OF SOLIDS 15

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 20

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

UNIT V ISOMETRIC PROJECTION AND BUILDING DRAWING 15

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

TOTAL PERIODS: 75

OUTCOMES

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

- Familiarize with the fundamentals and standards of Engineering graphics

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

TEXT BOOKS

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

REFERENCE BOOKS

1. Bhatt, N.D., and Panchal, V.M., Engineering Drawing, Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal, and Agarwal, C.M., Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna, K.R., Engineering Drawing (Vol. I&II Combined), Subhas Stores, Bangalore, 2007.
4. Luzzader J Warren, and Jon M Duff, Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production, Prentice Hall of India Pvt. Ltd, New Delhi, Eastern Economy Edition, 2005.
5. Parthasarathy, N.S., and Vela Murali, Engineering Graphics, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., Engineering Drawing, Pearson, 2nd Edition, 2009.
7. Bhattacharyya, B., and Bera, S.C., Engineering Graphics, I.K. International Publishing House Pvt. Ltd., New Delhi.

Publication of Bureau of Indian Standards:

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

Special points applicable to End Semester Examinations on Engineering Graphics:

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

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

OBJECTIVES

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

SUGGESTIVE EXERCISES

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

TOTAL PERIODS: 45

OUTCOMES

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

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

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

PHYSICS LABORATORY

OBJECTIVES

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

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

and enable the students to enhance acuracy in experimental measurements.

LIST OF EXPERIMENTS

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

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

OUTCOMES

At the end of this course, the students will be able to demonstrate the ability to formulate, conduct, analyse and interpret the results of experiments related to study/determination of

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

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

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

OBJECTIVES

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

LIST OF EXPERIMENTS

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

TOTAL PERIODS: 45

OUTCOMES

The students will be able to

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

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

OBJECTIVES

- To develop strategies and skills to enhance their ability to read and comprehend texts in engineering and technology.
- To improve their ability to write convincing job applications and effective reports.
- To develop their speaking skills to make technical presentations, participate in group discussions.
- To strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I INTRODUCING TECHNICAL WRITING 9

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

UNIT II INTERPRETING CHARTS AND GRAPHS 9

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

UNIT III PREPARING FOR A PRESENTATION 9

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

UNIT IV WRITING AND SPEAKING IN FORMAL SITUATIONS 9

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

UNIT V WRITING REPORTS 9

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

TOTAL PERIODS: 45

OUTCOMES

At the end of this course learners will be able to:

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

TEXT BOOK

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

REFERENCE BOOKS

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

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

OBJECTIVES

The objective of this course is to enable the student to

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

UNIT I ANALYTIC FUNCTIONS 12

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

UNIT II COMPLEX INTEGRATION 12

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

UNIT III LAPLACE TRANSFORMS 12

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

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 12

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

UNIT V VECTOR CALCULUS 12

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

TOTAL PERIODS: 60

OUTCOMES

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

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

TEXT BOOKS

1. Grewal, B.S., Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2016.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, Inc., 2016.

REFERENCE BOOKS

1. Bali, N.P., Goyal, M., Watkins, C., Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. Boyce, W.E., and DiPrima, R.C., Elementary Differential Equations and Boundary Value Problems, Wiley India, 2012.
3. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, Thomas' Calculus: Early Transcendental, 13th Edition, Pearson Education, 2013.
4. O'Neil. P. V., Advanced Engineering Mathematics, 7th Edition, Cengage Learning India Pvt., Ltd, New Delhi, 2011.
5. *Howard Anton*, *Irl* C. *Bivens*, *Stephen Davis*, Calculus Early Transcendentals, 11th Edition, John Wiley & Sons, Inc., 2016.
6. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 2015.
7. Srivastava, A.C., and Srivastava, P.K., Engineering Mathematics Volume I and II, PHI learning Pvt. Ltd, 2011.

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

OBJECTIVES

Enable the students to

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

UNIT I CONDUCTING MATERIALS 9

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

UNIT II SEMICONDUCTING MATERIALS 9

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

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

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

UNIT IV DIELECTRIC MATERIALS 9

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

UNIT V OPTO AND NANO ELECTRONIC DEVICES 9

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

TOTAL PERIODS: 45

OUTCOMES

At the end of this course, students will be able to

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

TEXT BOOKS

1. Adaptation by Balasubramanian, R, Callister's Material Science and Engineering, Wiley India Pvt Ltd., 2nd Edition, 2014.
2. Kasap, S.O. - Principles of Electronic Materials and Devices, (Special Indian Edition) McGraw-Hill Education, 3rd Edition, 2017.

REFERENCE BOOKS

1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Wiley Student Edition Publications, 2012.
2. Umesh K Mishra, & Jasprit Singh, Semiconductor Device Physics and Design, Springer, 2008.
3. Wahab, M.A., Solid State Physics: Structure and Properties of Materials, Narosa Publishing House, 3rd Edition, 2015.
4. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2nd Edition, 2017.
5. Avadhanulu, M. N. , P. G. Shirsagar, A Text book of Engineering Physics, S. Chand & Co. Ltd., Ninth Revised Edition, 2012.
6. Salivahanan, S., Rajalakshmi, A., Karthie, S., Rajesh, N.P., Physics for Electronics Engineering and Information Science, McGraw Hill Education (India) Private Limited, 2018
7. Gaur, R.K., & Gupta, S.L., Engineering Physics, Dhanpat Rai Publishers, 2012.

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

OBJECTIVES

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

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

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

UNIT II NATURAL RESOURCES 9

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

UNIT III ENVIRONMENTAL POLLUTION 9

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

UNIT IV SOCIAL ISSUES AND ENVIRONMENT 9

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

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

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

TOTAL PERIODS: 45

OUTCOMES

After successful completion of this course, student will be able to

- Understand the importance of the environment and describe the structure and functions of an ecosystem.
- Identify the value and need for conservation of bio-diversity.
- Know the importance of natural resources and its equitable use for sustainable life styles.
- Explain the causes, effects and control measures of different types of pollution.
- Understand various environmentally related social issues and their solutions.
- Recall the tools for environmental regulations
- Relate the role of environment in human population growth and development
- Get knowledge about various techniques used for environmental monitoring and management.

TEXTBOOKS

1. Anubha Kaushik, and Kaushik, C. P., Environmental Science and Engineering, New Age International Publishers, 14thEdition, 2014.
2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2006.

REFERENCE BOOKS

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

COURSE CODE	COURSE TITLE	L	T	P	C
UGE1276	BASIC CIVIL AND MECHANICAL ENGINEERING	3	0	0	3

OBJECTIVES

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

A – OVERVIEW

UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 9

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering

Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

B – CIVIL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber – modern materials

UNITI III BUILDING COMPONENTSAND STRUCTURES 9

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations.

Civil Engineering Structures: Brick masonry – stone masonry – beams – columns – lintels – roofing, flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.

C – MECHANICAL ENGINEERING

UNIT IV INTERNAL COMBUSTION ENGINES ANDPOWERPLANTS 9

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants – working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNITV REFRIGERATION AND AIRCONDITIONING SYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

TOTAL PERIODS: 45

OUTCOMES

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

- Appreciate the Civil and Mechanical Engineering components
- Explain the usage of construction material and proper selection of construction materials.
- Measure distances and area by surveying
- Identify the components used in power plant cycle.
- Demonstrate working principles of petrol and diesel engine.
- Elaborate the components of refrigeration and Air conditioning cycle.

TEXTBOOK

1. Shanmugam, G., and Palanichamy, M.S., Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 1996.

REFERENCE BOOKS

1. Shanmugasundaram, S. and Mylsamy, K., Basic Civil and Mechanical Engineering, II Ed, CENGAGE Learning.
2. Palanikumar, K, Basic Mechanical Engineering, ARS Publications, 2010.
3. Ramamrutham, S., Basic Civil Engineering, Dhanpat Rai Publishing Co.(P) Ltd.,1999.
4. Vekatasubramani, R., Christina Mary, V., Ramachandran, S., Basic Civil and Mechanical Engineering, Airwalk Publications, Chennai.
5. Shantha Kumar, SRJ, Basic Mechanical Engineering, Hi-Tech Publications, Mayiladuthurai, 2000.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1201	ELECTRIC CIRCUIT ANALYSIS	3	2	0	4

OBJECTIVES:

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits and two port network.
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I BASIC CIRCUIT ANALYSIS 12

Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchoffs laws – Mesh current and node voltage - methods of analysis.

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

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

UNIT III RESONANCE AND COUPLED CIRCUITS 12

Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT IV TRANSIENT RESPONSE ANALYSIS 12

L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input-Characterization of two port networks in terms of Z,Y and H parameters

UNIT V THREE PHASE CIRCUITS 12

A.C. circuits – Phasors - Average and RMS value - Phasor Diagram – Power, Power Factor and Energy.- Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – Phasor diagram of voltages and currents – power measurement in three phase circuits.

TOTAL PERIODS: 60

OUTCOMES

- Ability to analyze electrical circuits
- Ability to apply circuit theorems
- Ability to analyze transients

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly, and Steven M. Durbin, Engineering Circuits Analysis, McGraw Hill publishers, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, Fundamentals of Electric Circuits, Second Edition, McGraw Hill, 2013.

REFERENCE BOOKS

1. Allan H. Robbins, Wilhelm C. Miller, Circuit Analysis Theory and Practice, Cengage Learning India, 2013.

2. Chakrabarti, A, Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
3. Jegatheesan, R., Analysis of Electric Circuits, McGraw Hill, 2015.
4. Joseph A. Edminister, Mahmood Nahri, Electric circuits, Schaum's series, McGraw- Hill, New Delhi, 2010.
5. M E Van Valkenburg, Network Analysis, Prentice-Hall of India Pvt. Ltd, New Delhi, 2015.
6. Mahadevan, K., Chitra, C., Electric Circuits Analysis, Prentice-Hall of India Pvt. Ltd., New Delhi, 2015.
7. Richard C. Dorf, and James A. Svoboda, Introduction to Electric Circuits, 7th Edition, John Wiley & Sons, Inc. 2015.
8. Salivahanan, S., Pravin Kumar, S, Circuit Theory, Vikas Publishing House, 2014.

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

OBJECTIVES

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

GROUP A (CIVIL & MECHANICAL)

I - CIVIL ENGINEERING PRACTICE

Buildings:

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

Plumbing Works:

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

Carpentry using Power Tools only:

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

II - MECHANICAL ENGINEERING PRACTICE

Basic Machining:

(a) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending: (b) Model making – Trays, dust pan and funnels. (c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump (b) Study of air conditioner

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

Demonstration on:

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

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

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

5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

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

TOTAL PERIODS: 45

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1211	ELECTRIC CIRCUITS LAB	0	0	3	1.5

OBJECTIVES

- To simulate various electric circuits using Pspice / Matlab /e-Sim / Scilab.
- To gain practical experience on electric circuits and verification of theorems.

LIST OF EXPERIMENTS

1. Simulation and experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental verification of electrical circuit problems using Norton's theorem.
4. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
5. Simulation and experimental verification of Maximum Power transfer Theorem.
6. Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.
7. Simulation and Experimental validation of R-C electric circuit transients.
8. Simulation and Experimental validation of frequency response of RLC electric circuit.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonant circuits.
11. Simulation of three phase balanced and unbalanced star, delta networks circuits.

TOTAL PERIODS: 45

OUTCOMES

- Understand and apply circuit theorems and concepts in engineering applications.
- Simulate electric circuits.

COURSE CODE	COURSE TITLE	L	T	P	C
UMA1376	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS (Common to EEE, MECH, BME, CHEM & CIVIL)	3	2	0	4

OBJECTIVES

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To introduce the effective mathematical tools for the solutions of partial differential equations.
- To introduce the application of Fourier series in solving the initial boundary value problems in one dimensional wave and heat equations and boundary value problems in two dimensional heat equations.
- To acquaint the student with Fourier transform techniques which is used in solving boundary value problems
- To develop Z- transform techniques which will perform the analysis for discrete time systems.

UNIT I FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series– Parseval's identity - Complex form of Fourier series.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations –Solutions of standard types of first order partial differential equations –Reducible forms to standard types- Lagrange's linear equation -- Solution of linear homogeneous partial differential equations of second and higher order with constant coefficients.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction with zero and non-zero steady state conditions – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNITIV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair (Infinite) – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem- Parseval's identity– Applications to boundary value problems.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12

Z-transforms - Elementary properties– Convolution theorem– Inverse Z - transform (using partial fraction, convolution theorem and residues) - Discrete time systems and Difference equations, Solution of difference equations using Z – transform.

TOTAL: 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Solve engineering problems using Fourier series
- Understand and solve partial differential equations of first and higher order
- Use Fourier series techniques to solve partial differential equations

- Apply Fourier transform techniques to solve some of the physical problems of engineering.
- Apply Z - transform techniques to solve some of the physical problems of engineering.

TEXT BOOKS

1. Veerarajan. T., "Transforms and Partial Differential Equations", Second reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2015.

REFERENCE BOOKS

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V, "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company Limited, New Delhi, 2008.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
4. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd,Sixth Edition, New Delhi, 2012.
5. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt. Ltd, Delhi, 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1301	ELECTRICAL MACHINES-I	2	2	0	3

OBJECTIVES

- To familiarize the constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.
- To introduce the principles of electromechanical energy conversion in singly and multiply excited systems.
- To study the working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.
- To study the working principles of DC machines as Generator and Motor, types, determination of their no-load/load characteristics, starting and methods of speed control of motors.
- To estimate the various losses taking place in D.C. machines and to study the different testing methods.

UNIT I MAGNETIC CIRCUITS 12

Basic magnetic circuit analysis - Magnetization characteristics (BH curves) – BH loop - hysteresis and eddy-current losses. Magnetically induced EMF and force – Energy in magnetic system - field energy and mechanical force - singly and doubly excited magnetic field systems.

UNIT II DC GENERATOR 12

Constructional features of DC machines - lap and wave windings - principle of operation - EMF equation – types of DC generators – commutation - Armature reaction - interpoles - voltage regulation - external and internal or total characteristics - Parallel operation of Generators.

UNIT III DC MOTOR 12

Principle of operation, types of DC motors – Torque and speed of DC motor – Electrical and Mechanical characteristics - Starting, speed control and braking of DC motors - Parallel operation of motors - Losses in DC machines, Efficiency- Swinburne's and Hopkinson's test – Permanent magnet DC motors (PMDC) and its applications.

UNIT IV TRANSFORMER 12

Working principle-Construction, Core-type and Shell type transformers- ideal transformer, EMF equation, performance of transformer on no load and loaded conditions - Phasor diagrams - Equivalent circuit – open circuit and short circuit test - Voltage regulation - efficiency and losses- Sumpner Test - all day efficiency - Auto transformer - parallel operation of single phase transformer.

UNIT V TRANSFORMER : THREE PHASE 12

Three phase transformer connections – Open Delta Connection- Scott connections. Three-phase to single phase conversion- parallel operation of three phase transformer. Instrument Transformers – Current Transformer, Potential Transformer.

TOTAL: 60 PERIODS

OUTCOMES:

After completing this course, the students will be able to

- Understand the constructional details ,working principle, control and applications of DC Machines
- Understand the constructional details and working principle of transformers.
- Design and conduct experiments, as well as to identify, formulate and solve machine related problems.
- Analyze the performance of the DC Machines under various operating conditions using their various characteristics.
- Evaluate the performance of Transformers using phasor diagrams and equivalent circuits.
- Discuss electric and magnetic field interactions in electromechanical devices and machines

TEXT BOOKS

1. Nagrath, I.J. and Kothari.D.P., Electric Machines', McGraw-Hill Education, 2004
2. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Sixth edition, McGraw Hill Books Company, 2003.

REFERENCE BOOKS

1. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2010.
2. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education., (5th Edition)**,** 2002**.**
3. B.L.Theraja and A.K.Theraja, 'A Textbook of Electrical Technology Vol II AC and DC Machines.
4. B.R. Gupta ,'Fundamental of Electric Machines' New age International Publishers,3rd Edition ,Reprint 2015.
5. S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 3rd Edition, 2009.
6. P.C. Sen'Principles of Electric Machines and Power Electronics' John Wiley & Sons; 3rd Edition 2013.
7. K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2002.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1302	ELECTROMAGNETIC THEORY	2	2	0	3

OBJECTIVES

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of
  - ✓ Electrostatic fields, electrical potential, energy density and their applications.
  - ✓ Magneto static fields, magnetic flux density, vector potential and its applications.
  - ✓ Different methods of emf generation and Maxwell's equations
  - ✓ Electromagnetic waves and characterizing parameters

UNIT I VECTOR ANALYSIS **9**

Sources and effects of electromagnetic fields – Coordinate Systems – Differential Elements of Length, Surface and Volume - Vector fields –Gradient of a scalar field - Divergence of a vector field - Curl of a vector filed – Gauss's Divergence Theorem - Stoke's Theorem.

UNIT II STATIC ELECTRIC FIELDS **15**

Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications-Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT III STATIC MAGNETIC FIELDS **12**

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

UNIT IV ELECTRODYNAMIC FIELDS **12**

Faraday's law – Transformer and motional EMF –Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Electromagnetic boundary conditions - Applications of electrodynamic fields

UNIT V ELECTROMAGNETIC WAVES **12**

Electromagnetic wave equations – Wave parameters: velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector.

TOTAL : 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the basic mathematical concepts related to electromagnetic vector fields.
- Understand the basic concepts about electrostatic fields, electrical potential, energy density and their applications.
- Acquire the knowledge in magneto static fields, magnetic flux density, vector potential and its applications.
- Understand the different methods of emf generation and Maxwell's equations
- Understand the basic concepts electromagnetic waves and characterizing parameters

- Understand and compute Electromagnetic fields and apply them for design and analysis of electrical equipment and systems

TEXT BOOKS

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. Salivahanan S and Karthie S, 'Electromagnetic Field Theory", 2nd Edition, McGrawHill, 2018.

REFERENCE BOOKS

1. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
2. V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers,1993.
3. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers.
4. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.
5. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2012.
6. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1303	ELECTRONIC DEVICES AND CIRCUITS	3	0	0	3

OBJECTIVES

- To understand the structure of basic electronic devices
- To expose to active and passive circuit elements.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To learn the required functionality of positive and negative feedback systems.

UNIT I DIODE AND ITS APPLICATIONS 9

PN junction diode – Structure, Operation, VI characteristics, models; Applications - Half wave rectifier, Full wave rectifier, impact of filters; Zener diode – Breakdown characteristics, Voltage regulation; Varactor diode, Light emitting diode (LED), Schottky diode – Operation and Applications.

UNIT II TRANSISTORS AND THYRISTORS 9

Transistors: BJT, UJT, FET, MOSFET – Structure, Operation, Input-output characteristics; Biasing methods of BJT, FET & MOSFET; Thyristors: Structure, Operation and VI characteristics.

UNIT III SMALL SIGNAL AND LARGE SIGNAL AMPLIFIERS 9

BJT–Configurations, Small signal analysis using hybrid model – Analysis of CE amplifiers, Frequency response; MOSFET – Configurations, Small signal models, Analysis of CS and Source follower amplifiers; Power amplifiers - Class A, Class B, Class AB, Class C and Class D amplifiers (Qualitative analysis only)

UNIT IV MULTISTAGE AND DIFFERENTIAL AMPLIFIERS 9

Introduction to Multistage amplifiers, Different coupling methods and their frequency response, Darlington connection; Differential Amplifier – Common mode analysis, Differential mode analysis, CMRR, frequency response; Single tuned and double tuned amplifiers- Operation and frequency response.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Feedback amplifiers - Types, Stability, Distortion; Negative feedback: Voltage/current, series/shunt feedback amplifiers; Positive feedback: Barkhausen criterion, Operation and analysis of RC phase shift, Wienbridge, Hartely, Colpitts and crystal oscillators; Non-sinusoidal oscillators: Astable, Monostable & bistable Multivibrators.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Explain the structure and working operation of basic electronic devices.
- Identify and differentiate both active and passive elements
- Analyze the characteristics of different electronic devices such as diodes and transistors
- Choose and adapt the required components to construct an amplifier circuit.
- Employ the acquired knowledge in design and analysis of oscillators

TEXT BOOKS

1. Electronic Devices- Floyd T.L, 9th Edition, Pearson Education, 2012.

2. Electronic Devices and Circuits – S.Salivahanan, N.Suresh Kumar, Mcgraw Hill Education, New Delhi, Fourth Ed, 2016.

REFERENCE BOOKS

1. Electronic devices and circuits – Allen Mottershead, Goodyear Publishing company,1973.
2. Electronic Devices and Circuits – B. P. Singh, Rekha Singh, Pearson, Second Ed, 2013.
3. Electronic Devices and Circuits – Anil K. Maini, VarshaAgarwal, First Ed, Wiley India Pvt. Ltd, 2009.
4. Millman's Electronic Devices and Circuits – J. Millman, C.C.Halkias and Satyabratajit, Second Ed,1998, TMH.
5. Electronic Devices and Circuits – David A. Bell, 5th Ed, Oxford, 2008.
6. Electronic Devices and Circuits – Mohammad Rashid, Cengage Learing, 2013

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1304	OBJECT ORIENTED PROGRAMMING	3	0	0	3

OBJECTIVES

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

UNIT I INTRODUCTION TO OBJECT ORIENTED PROGRAMMING 7

Object oriented programming concepts – objects-classes- methods and messages abstraction and encapsulation-inheritance- abstract classes- polymorphism. Introduction to C++- objects-classes-constructors and destructors

UNIT II OVERLOADING AND POLYMORPHISM 12

Operator overloading – friend functions- type conversions- templates - Inheritance – virtual functions- static and runtime polymorphism.

UNIT III FILES AND I/O 8

Exception handling – Streams and formatted I/O – file handling – namespaces – String Objects – standard template library.

UNIT IV INTRODUCTION TO JAVA 8

Introduction to JAVA, bytecode, virtual machines – objects – classes – methods - Javadoc – packages – Arrays – Strings

UNIT V OBJECT OREINTED PARADIGM IN JAVA 10

Inheritance – polymorphism - interfaces and inner classes – exception handling – threads – Streams and I/O

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Develop Java programs using OOP principles
- Develop Java programs with the concepts inheritance and interfaces
- Build Java applications using exceptions and I/O streams
- Develop Java applications with threads and generics classes
- Develop interactive Java programs using swings

TEXT BOOKS

1. B. Trivedi, “Programming with ANSI C++”, Oxford University Press, 2007.
2. Cay S. Horstmann, Gary Cornell, “Core JAVA volume 1”, Eighth Edition, Pearson Education, 2008.

REFERENCE BOOKS

1. ISRD Group, “Introduction to Object-oriented Programming and C++”, Tata McGrawHill Publishing Company Ltd., 2007.

2. ISRD Group, “Introduction to Object-oriented programming through Java”, Tata McGraw-Hill Publishing Company Ltd., 2007.
3. S. B. Lippman, Josee Lajoie, Barbara E. Moo, “C++ Premier”, Fourth Edition, Pearson Education, 2005.
4. D. S. Malik, “C++ Programming: From Problem Analysis to Program Design”, Third Edition, Thomson Course Technology, 2007.
5. K. Arnold and J. Gosling, “The JAVA programming language”, Third edition, Pearson Education, 2000.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1305	MODERN POWER PLANT ENGINEERING	3	0	0	3

OBJECTIVES

- To provide an overview of Power Plants
- To understand the role of engineers in their operation and maintenance.

UNIT I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV RENEWABLE ENERGY POWER PLANTS 9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photovoltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems- Hybrid power plants.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Explain the layout, construction and working of the components inside a thermal power plant.
- Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
- Explain the layout, construction and working of the components inside nuclear power plants.
- Explain the layout, construction and working of the components inside Renewable energy power plants.
- Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

TEXT BOOKS

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. Khan B. H., "Non-Conventional Energy Resources" , First Edition, Tata McGraw-Hill Education, 2006

REFERENCE BOOKS

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd.,2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1311	ELECTRICAL MACHINES LAB - I	0	0	4	2

OBJECTIVES

- To expose the students to the operation of D.C. machines and transformers and give them experimental skill.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator
2. Load characteristics of DC compound generator
3. Load characteristics of DC series generator
4. Load characteristics of DC shunt and compound motor
5. Load characteristics of DC series motor
6. Swinburne's test and speed control of DC shunt motor.
7. Hopkinson's test
8. Load test on single phase transformer
9. Load test on three phase transformer
10. Open circuit and short circuit tests on single phase transformer
11. Sumpner's test
12. Separation of no-load losses in single phase transformer

TOTAL :60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand and analyze the DC Generator
- Understand and analyze the DC Motor
- Understand and analyse the Transformers

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1312	OBJECT ORIENTED PROGRAMMING LAB	0	0	2	1

OBJECTIVES

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, exception handling and file processing.
- To develop applications using generic programming and event handling.

LIST OF EXPERIMENTS

C++:

1. Program using functions
    - functions with default arguments
    - implementation of call by value, address, reference
2. Simple classes for understanding objects, member functions & constructors
    - classes with primitive data members,
    - classes with arrays as data members
    - classes with pointers as data members
    - classes with constant data members
    - classes with static member functions
3. Compile time polymorphism
    - operator overloading
    - function overloading
4. Run time polymorphism
    - inheritance
    - virtual functions
    - virtual base classes
    - templates
5. File handling
    - sequential access
    - random access

JAVA:

6. Simple java applications
    - for understanding references to an instant of a class
    - handling strings in JAVA
7. Simple package creation
    - developing user defined packages in java
8. Interfaces
    - developing user defined interfaces
    - use predefined interfaces
9. Threading
    - creation of threading in java applications
    - multi-threading
10. Exception handling mechanism in java
    - handling predefined exceptions

- handling user defined exceptions

TOTAL :30 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Gain the basic knowledge on Object Oriented concepts.
- Develop applications using Object Oriented Programming Concepts.
- Implement features of object-oriented programming to solve real world problems.

COURSE CODE	COURSE TITLE	L	T	P	C
UMA1452	NUMERICAL METHODS	3	2	0	4

OJECTIVES

- To introduce the basic concepts of Algebraic and transcendental equations and linear programming
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration with plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND LINEAR PROGRAMMING 12

Solution of algebraic and transcendental equations – Fixed point Theorem (Statement only) – Newton-Raphson method – Regula-falsi method - Solution of linear system of equations - Gauss elimination method – Pivoting – Iterative method – Gauss Seidel – Formulation of the linear programming problem – Graphical method – Simplex method involving slack variables.

UNIT II INTERPOLATION AND APPROXIMATION 12

Difference operators and relations – Interpolation with equal intervals – Newton's forward and backward difference formulae – Central difference interpolation – Gauss's forward and backward interpolation formula – Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule –Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods – Taylor's series method – Modified Euler's method – Fourth order Runge – Kutta method for solving first order equations – Multi step methods – Milne's and Adams – Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving second order two – point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9thEdition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCE BOOKS

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6thEdition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. SankaraRao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rdEdition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1401	ELECTRICAL MACHINES – II	2	2	0	3

OBJECTIVES

- To expose various types of AC Electrical Machines and fractional KW motors
- To familiarize the Construction and performance of salient and non – salient type synchronous generators.
- To introduce the principle of operation and performance of synchronous motor.
- To study the construction, working principle and performance of induction machines.
- To understand the starting and speed control of three-phase induction motors.
- To study the construction, principle of operation and performance of single phase induction motors.

UNIT I FUNDAMENTALS OF AC MACHINES 12

Types of AC Machines: Synchronous machines and Induction machines - Components of rotating AC machines - stator, rotor and armature windings - Generated EMF of AC winding - Distribution factor - Chording factor - MMF of distributed windings - Magnetic field in rotating machinery - Concept of rotating flux - Relationship between electrical frequency and the speed of rotating magnetic field.

UNIT II SYNCHRONOUS GENERATORS 12

Basic principle - types- salient and cylindrical pole rotor, equivalent circuit - EMF equation - armature reaction - alternator on load - synchronous reactance - voltage regulation - EMF, MMF, ZPF and A.S.A methods - power developed by a synchronous generator - power - angle characteristics - Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input - Two reaction theory.

UNIT III SYNCHRONOUS MOTOR 12

Principle of operation - Equivalent circuit - Power and Torque equation - phasor diagrams -V and inverted V curves - Method of Starting - Current loci for constant power input, constant excitation and constant power developed – Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT IV INDUCTION MOTOR 12

Principle of operation - Types - Squirrel cage rotor - slip ring rotor - slip - cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency - parameter determination from no-load and blocked rotor tests -Circle Diagram- Starting and speed control-Braking methods-Induction generator.

UNIT V SINGLE PHASE INDUCTION MOTORS 12

Double revolving field theory – Equivalent circuit – Starting methods of single-phase induction motors – Constructional features and Working principle: Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Repulsion motor - AC series motor - Universal motor - Reluctance motor - Hysteresis motor.

TOTAL : 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the construction and working principle of Synchronous Generator
- Understand MMF curves and armature windings.

- Acquire knowledge on Synchronous motor.
- Understand the construction and working principle of Three phase Induction Motor
- Understand the construction and working principle of Special Machines
- Predetermine the performance characteristics of Synchronous Machines.

TEXT BOOKS

1. Nagrath, I.J. and Kothari.D.P., Electric Machines', McGraw-Hill Education, 2004
2. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Sixth edition, McGraw Hill Books Company, 2003.

REFERENCE BOOKS

1. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2010.
2. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education., (5th Edition)**,** 2002**.**
3. B.L.Theraja and A.K.Theraja, 'A Textbook of Electrical Technology Vol II AC and DC Machines.
4. B.R. Gupta ,'Fundamental of Electric Machines' New age International Publishers,3rd Edition ,Reprint 2015.
5. S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 3rd Edition, 2009.
6. P.C. Sen'Principles of Electric Machines and Power Electronics' John Wiley & Sons; 3rd Edition 2013.
7. K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2002.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1402	TRANSMISSION AND DISTRIBUTION	3	0	0	3

OBJECTIVES

- To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
- To analyze the voltage distribution in insulator strings to improve the efficiency.
- To study the types, construction of cables and methods to improve the efficiency.
- To understand the mechanical design of transmission lines and methods of grounding.
- To study about distribution systems.

UNIT I TRANSMISSION LINE PARAMETERS 9

Structure of electric power system - typical configurations of transmission line, conductor types - parameters of single and three phase transmission lines with single and double circuits - resistance, inductance and capacitance of solid, stranded and bundled conductors, symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD - Skin and Proximity effects - corona discharges.

UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Classification of transmission lines - short, medium and long transmission lines – equivalent circuits, phasor diagram, attenuation and phase constants - surge impedance loading - Ferranti effect - ABCD constants - voltage regulation and transmission efficiency - power flow through transmission line.

UNIT III INSULATORS AND CABLES 9

Insulators - types - voltage distribution in insulator string – string efficiency -methods of improving string efficiency - testing of insulators.

Underground cables - construction and types - capacitance of single and multi core cables - dielectric stress – grading of cables - capacitance grading - intersheath grading.

UNIT IV MECHANICAL DESIGN OF LINES AND GROUNDING 9

Line supports - sag and tension calculations - sub-station layout (AIS,GIS) - types of bus bar arrangements - grounding - methods of grounding.

UNIT V DISTRIBUTION SYSTEMS 9

Classification of distribution systems - DC distribution systems - concentrated and distributed loads - two wire distributor- fed at one end- fed at both ends - radial and ring main systems - AC distribution systems - method of solving AC distribution problems.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the structure of electric power system
- Calculate the transmission network parameters for various configurations.
- Analyse the transmission line models and evaluate its performance parameters.
- Understand the various types of insulators, cables and their construction.
- Analyse the string efficiency of insulators.
- Calculate sag and tension for different weather conditions

- Understand the importance and types of grounding.
- Analyze the DC and AC distribution systems

TEXT BOOKS

1. C.L. Wadhwa - Electrical Power systems – New Age International-6th Edition – 2010.
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India, Second edition 2008.

REFERENCE BOOKS

1. B.R.Gupta, 'Power System Analysis and Design', S.Chand, Fifth Edition 2005.
2. V.K. Mehta and Rohit Mehta, ' Principles of Power System', S. Chand, 2013.
3. S. Sivanagaraju and S. Sathyanarayana, 'Electric Power Transmission and Distribution', Pearson, 2009.
4. Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
5. Arun Ingole, "Power transmission and distribution" Pearson Education, 2017
6. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.
7. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1403	CONTROL SYSTEMS	3	2	0	4

OBJECTIVES

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce stability analysis and design of compensators.
- To introduce state variable representation of physical systems.

UNIT I SYSTEMS AND THEIR REPRESENTATION 12

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE 12

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

UNIT III FREQUENCY RESPONSE 12

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

UNIT IV STABILITY AND COMPENSATOR DESIGN 12

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

UNIT V STATE VARIABLE ANALYSIS 12

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

TOTAL: 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the importance of transfer function
- Analyse the system with respect to time domain
- Analyse the system with respect to frequency domain
- Analyse the stability of the system
- Design a compensator system to meet the desired specifications
- Implement a PID controller to improve the stability of the system

TEXT BOOKS

1. S.Salivahanan, R.Rengaraj, and G.R.Venkatakrishnan, "Control systems Engineering", Pearson India Education, 2015.
2. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.

REFERENCE BOOKS

1. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014.
2. Katsuhiko Ogata, “Modern Control Engineering”, Pearson India Education, 2015.
3. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Pearson India Education,2009.
4. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
5. M.Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1404	DIGITAL LOGIC SYSTEM DESIGN	3	0	0	3

OBJECTIVES

- To study various number systems and simplify the logical expressions using Boolean functions
- To study combinational circuits
- To design various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLDs
- To introduce digital simulation for development of application oriented logic circuits.

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Review of number system, Computer codes-BCD, Gray code, Excess 3 code, Error detection and correction codes - Parity, Hamming codes. Digital Logic Families- RTL, TTL, ECL and MOS, Operations and characteristics.– Voltage and current ratings, Noise margin, Propagation delay, Power dissipation, Comparison of logic families

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Standard representation of logic functions - Incompletely specified functions, Simplification of logic functions using K-map and Quine–McClusky method, Implementation using logic gates, Decoders, Encoders, Multiplexer and Demutiplexer, Code converters, Arithmetic circuits - Binary ,BCD adders and subtractors, Magnitude comparator.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

General model of sequential circuits, Latch, Flip-Flops - Level, Edge triggering, Master-slave configuration, Binary counter-Up/down, Modulo, Ring Counter, Johnson counter- Timing diagram, Shift register, Mealy /Moore Models -Concept of state, State diagram, State reduction and state assignment – Minimal flip-flop/ one hot realization, Design of synchronous sequential circuits –Sequence detector.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES 9

Asynchronous sequential logic circuits-Transition table, Flow table - Race conditions, Hazards, Analysis of asynchronous sequential logic circuits. Introduction to Programmable Logic Devices: PROM, PLA, PAL, CPLD and FPGA.

UNIT V VHDL 9

RTL Design – Combinational logic – Sequential circuit – Operators – Behavioral, Dataflow, and structural modeling- Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Know the fundamentals of number systems and logic families in digital system design
- Simplify the logical expressions using Boolean functions
- Understand the methods related to combinational logic circuit design
- Understand the various methods in synchronous sequential logic circuit design
- Design asynchronous sequential logic circuits and explore on the design challenges
- Design, debug and test simple digital logic circuits using VHDL and its supporting tools

TEXT BOOKS

1. Morris. M. Mano and Michael.D.Ciletti, "Digital Design", Fourth edition, Pearson Education, 2008.
2. S. Salivahanan and S. Arivazhagan "Digital Circuits & Design", Oxford University Press, 5th Edition, 2017

REFERENCE BOOKS

1. John M.Yarbrough, "Digital Logic Application & Design", First edition, West Publishing Company, College & School Division, 1997.
2. Raj Kamal, "Digital systems-Principles and Design", Second edition, Pearson educaion, 2007.
3. Floyd and Jain, "Digital Fundamentals", Eighth edition, Pearson Education, 2003.
4. John F.Wakerly, "Digital Design Principles and Practice", Third edition, Pearson Education,2002.
5. D.P.Kothari,J.S.Dhillon, 'Digital circuits and Design',Pearson Education, 2016.
6. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
7. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
8. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
9. Bhasker.J, "A VHDL Primer" Third edition, PHI Learning, 2009.
10. Charles H.Roth, Jr, Lizy Lizy Kurian John, 'Digital System Design using VHDL, Cengage, 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1405	ANALOG ELECTRONIC CIRCUITS	3	0	0	3

OBJECTIVES

- To familiarize the signal analysis using Op-amp based circuits.
- To understand the applications of Op-amp.
- To study the functional blocks and applications of special ICs like Timers, PLL circuits, regulator circuits.
- To know the IC fabrication procedure.

UNIT I IC FABRICATION 8

IC classification, Fundamental of monolithic IC technology – basic silicon planar processes including packaging, Fabrication of typical circuit, Fabrication of resistors, capacitors, diodes and FETs, Thin and Thick film technology.

UNIT II CHARACTERISTICS OF OPAMP 8

Functional block diagram of op-amp IC741, Ideal op-amp characteristics, DC characteristics, AC characteristics, frequency compensation and stability of op-amp, slew rate, Differential amplifier, Basic applications of op-amp – Inverting and non-inverting amplifiers, voltage follower.

UNIT III APPLICATIONS OF OPAMP 12

Summer, Differentiator & Integrator, Voltage to Current and Current to Voltage converters, Instrumentation amplifier, Log and Antilog Amplifiers. Characteristics of filters, First and second order active Butterworth filters. Comparators, Multivibrators, Waveform generators, Clippers, Clampers, Peak detector, Sample & Hold circuit. DAC (R- 2R ladder, Inverted R-2R & Weighted resistor) and ADC (Flash, Successive approximation, Dual slope) using op-amps, Specifications.

UNIT IV SPECIAL ICs 8

Functional block, characteristics, modes & applications of 555 Timer IC, 566 voltage controlled oscillator IC, 565-phase lock loop IC, Analog multiplier ICs.

UNIT V APPLICATION ICs 9

IC voltage regulators – Fixed voltage regulators LM78XX & LM79XX - Variable voltage regulators LM317 & IC723, Concept of Switching regulator- Schematic diagram & function of SMPS- LM 380 power amplifier- ICL 8038 function generator IC.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the IC fabrication procedure
- Describe the Characteristics of Op-amp ICs
- Design & analyze the Op-amp circuits for different Applications
- Illustrate the internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits, ADCs

TEXT BOOKS

1. D. Roy Choudhary, Sheil B. Jani, ‘Linear Integrated Circuits’, II edition, New Age, 2003.

2. S. Salivahanan and V. S. Kanchana Bhaaskaran, " Linear Integrated Circuits" McGraw Hill Edition, New Delhi, 2nd edition, 2018.

REFERENCE BOOKS

1. Ramakant A. Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI, 2000.
2. David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013.
3. Fiore,"Opamps & Linear Integrated Circuits Concepts & Applications", Cengage,2010.
4. Floyd , Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
5. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', Tata McGraw Hill, 2003.
6. Robert F. Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', PHI Learning, 6th edition, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1411	ELECTRICAL MACHINES LAB-II	0	0	4	2

OBJECTIVES

- To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

LIST OF EXPERIMENTS

1. Predetermination of voltage regulation of three phase alternator by EMF, MMF and ZPF method
2. Determination of voltage regulation of three phase salient pole alternator by slip test
3. Determination of negative and zero sequence impedance of three phase alternator
4. Load test on three phase alternator
5. Determination of V and inverted V curves of three phase synchronous motor
6. Load test on three phase squirrel cage induction motor
7. No-load and blocked rotor test on three phase squirrel cage induction motor
8. Load test on single phase induction motor
9. No-load and blocked rotor test on single phase induction motor
10. Speed control of three phase slip ring induction motor using rotor resistance and variable frequency method
11. Separation of no-load losses of three phase induction motor

TOTAL: 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Acquire knowledge in the characteristics of synchronous machines
- Understand the characteristics of induction machines
- Gain knowledge about speed control of induction motor

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1412	ANALOG AND DIGITAL ELECTRONIC CIRCUITS LAB	0	0	4	2

OBJECTIVES

- To learn design, testing and characterizing of circuit behavior with digital and analog ICs.
-

LIST OF EXPERIMENTS

Digital:

1. Implementation of Boolean Functions, Adder/ Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa.
3. Parity generator and parity checking.
4. Encoders and Decoders.
5. Multiplexer and De-multiplexer.
6. Counters: Asynchronous, synchronous & modulo counters
7. Shift Registers: 4-bit shift registers in SISO, SIPO, PISO, PIPO modes

Analog:

8. Characteristics of Semiconductor devices
9. Design and Frequency response characteristics of a Common Emitter amplifier
10. Basic Op-amp applications using IC 741: inverting and non-inverting amplifier, voltage follower
11. Adder, Subtractor and comparator circuits using Op-amp
12. Integrator and Differentiator circuits using Op-amp
13. Waveform generators using Op-amp: Sine, Triangular & Square
14. Timer NE/SE 555 applications: Astable, Monostable Operations.

TOTAL: 60 PERIODS

OUTCOMES:

After completing this course, the students will be able to

- Practice various analog & digital integrated circuits used in simple system configuration.
- Learning and application of VHDL programming to digital circuits

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1501	POWER SYSTEM ANALYSIS	3	0	0	3

OBJECTIVES

- To model the power system under steady state operating condition
- To understand and apply iterative techniques for power flow analysis
- To model and carry out short circuit studies on power system
- To model and analyze stability problems in power system

UNIT I INTRODUCTION 9

Need for power system planning and operational studies - Modeling of Power System Components - Single line diagram - Per unit System - Impedance diagram - Reactance diagram - Representation of off nominal transformer - Primitive Network - Incident Matrices - Formation of bus admittance matrix (Y_{BUS}) - Direct Inspection method and Singular transformation methods - Formation of bus impedance matrix (Z_{BUS}) without mutual coupling.

UNIT II POWER FLOW ANALYSIS 9

Importance of power flow analysis – Bus Classification – Load Flow Equations – Load flow solutions – Gauss-Seidel Method – Handling of Voltage controlled buses - Newton-Raphson Method – Fast Decoupled Method – Computation of slack bus power and transmission line losses.

UNIT III SYMMETRICAL FAULT ANALYSIS 9

Assumptions in fault analysis – Types of Faults – Short circuit current calculation using Thevenin's theorem and Bus Impedance Matrix – Short circuit capacity – Selection of circuit breakers.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS 9

Symmetrical Components – Sequence Impedances – Sequence Network of power system components: Synchronous Machines, Transmission Line, Transformer and Loads – Single Line to Ground Fault – Line to line Fault – Double Line to Ground Fault – Unsymmetrical fault analysis using bus impedance matrix.

UNIT V STABILITY ANALYSIS 9

Importance of stability analysis – Classification of Power System Stability – Power-Angle Equations – Swing Equation – Equal Area Criterion – Critical clearing angle and time - Solution of Swing Equation: Modified Euler's Method and Runge – Kutta Method.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Develop a mathematical model of a power system under steady state operating condition by single line diagram and per unit notations
- Formulate the network matrices for the given power system.
- Perform steady state power flow analysis of power system networks using iterative methods.
- Analyze symmetrical faults in power system networks
- Analyze unsymmetrical faults in power system networks
- Analyze the power system using symmetrical components transformation.
- Understand the concept of steady state and transient stability.

TEXT BOOKS

1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.

REFERENCE BOOKS

1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
2. E.W.Kimbark, Power system stability, Vol I & III, John Wiley & Sons, 2006
3. J. Duncan Glover, Thomas Overbye, Mulukutla S. Sarma, 'Power System Analysis and Design' Cengage learning, 5th edition, 2016.
4. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, 2001.
5. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1502	DISCRETE TIME SIGNALS AND SYSTEMS	3	0	0	3

OBJECTIVES

- To impart knowledge about the following topics:
  - ✓ Signals and systems & their mathematical representation.
  - ✓ Analysis of Discrete time signals and systems
  - ✓ Transformation techniques & their use.
  - ✓ Filters and realisation of DT systems.
  - ✓

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Standard signals-Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids-Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT II ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband signal Sampling – Discrete Fourier series - Fourier Transform of discrete time signals (DTFT) & its properties - Z Transform & its properties – Evaluation of the inverse z-transform.

UNIT III ANALYSIS OF DISCRETE TIME SYSTEMS 9

Impulse response – Unit Step response - Difference equations – Convolution sum – Discrete Time Fourier Transform and Z transform Analysis of recursive & non-recursive systems – Realization of DT systems connected in parallel and series.

UNIT IV DISCRETE AND FAST FOURIER TRANSFORM 9

Discrete Fourier transform – properties of DFT – Convolution using DFT – Magnitude and phase representation, Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Linear Filtering using FFT.

UNIT V DESIGN OF DIGITAL FILTERS 9

Characteristics of Butterworth and Chebyshev filters – Design of IIR filters using impulse invariance method and bilinear transformation, Design of FIR filter using Rectangular and Hamming windows.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Acquire knowledge on Signals and systems & their mathematical representation
- Understand and analyze the discrete time systems
- Understand the importance of transforms & their computation
- Understand the types of digital filters and design for digital implementation

TEXT BOOKS

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, ―Signals and Systems‖, Pearson, 2015.
2. John G. Proakis & Dimitris G. Manolakis, - Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
3. S.Salivahanan-Digital Signal Processing,McGraw Hill Eductaion,New Delhi, Third Edition,2015.

REFERENCE BOOKS

1. R.E.Zeimer, W.H.Tranter and R.D.Fannin, ―Signals & Systems - Continuous and Discrete‖, Pearson, 2007.
2. A.V.Oppenheim, R.W.Schafer and J.R.Buck-Discrete-Time Signal Processing,8th Indian Reprint,Pearson ,2004.
3. Sanjit K.Mitra-Digital Signal Processing-A Computer Based Approach-McGraw Hill Education, New Delhi,2013.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1503	MICROPROCESSOR AND MICROCONTROLLER - THEORY AND APPLICATIONS	3	0	0	3

OBJECTIVES

- To impart knowledge on the following Topics
  - ✓ Architecture of μP8085 & μC 8051
  - ✓ Addressing modes & instruction set of 8085 & 8051.
  - ✓ Need & use of Interrupt structure 8085 & 8051.
  - ✓ Simple applications development with programming 8085 & 8051

UNIT I 8085 PROCESSOR 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up tability - Subroutine instructions - stack.

UNIT III 8051 MICRO CONTROLLER 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.

UNIT IV PERIPHERAL INTERFACING 9

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters &Interfacing with 8085& 8051.

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Simple programming exercises- key board and display interface –Control of servo motor, stepper
motor control- Application to automation systems.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Acquire knowledge in Addressing modes & instruction set of 8085 & 8051.
- Need & use of Interrupt structure 8085 & 8051.
- Uderstand the importance of Interfacing
- Explain the architecture of Microprocessor and Microcontroller.
- Write the assembly language programme.
- Develop the Microprocessor and Microcontroller based applications.

TEXT BOOKS

1. Sunil Mathur &Jeebananda Panda, “Microprocessor and Microcontrollers”, PHI Learning Pvt. Ltd, 2016.
2. R.S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, with 8085, Wiley Eastern Ltd., New Delhi, 2013.

REFERENCE BOOKS

1. Douglas V Hall, “Microprocessor and Interfacing”, Tata McGraw Hill, 2006.
2. Kenneth ayala, “Intel 8051 – Microcontrollers”, Prentice hall of India, Second Edition, 2005.
3. Steve Furber, “ARM System-on-chip architecture”, Pearson education, India, 2000.
4. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
5. B.RAM," Computer Fundamentals Architecture and Organization” New age International Private Limited, Fifth edition, 2017.
6. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
7. Ajay V.Deshmukh, ‘Microcontroller Theory &Applications’, McGraw Hill Edu,2016
8. Douglas V.Hall, ‘Microprocessor and Interfacing’, McGraw Hill Edu,2016
9. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 5th Indian reprint, 2003.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1504	POWER ELECTRONICS	3	0	0	3

OBJECTIVES

- To impart knowledge on the following Topics
  - ✓ Different types of power semiconductor devices and their switching
  - ✓ Operation, characteristics and performance parameters of controlled rectifiers
  - ✓ Operation, switching techniques and basics topologies of DC-DC switching regulators.
  - ✓ Different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
  - ✓ Operation of AC voltage controller and various configurations.

UNIT I POWER SEMI-CONDUCTOR DEVICES 9

Study of switching devices - SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT, Static characteristics - SCR, MOSFET and IGBT, Introduction to Silicon carbide (SiC) devices, Triggering and commutation circuit for SCR, Introduction to Driver and snubber circuits.

UNIT II PHASE-CONTROLLED CONVERTERS 9

2-pulse, 3-pulse and 6-pulse converters– performance parameters –Effect of source inductance - Firing Schemes for converter–Dual converters, Applications-light dimmer, Excitation system, Solar PV systems.

UNIT III DC TO DC CONVERTERS 9

Control strategy, Step-down and step-up chopper, Types of choppers-A, B, C, D and E - Switched mode regulators- Buck, Boost, Buck- Boost regulator, switching loss calculations. Introduction to Resonant Converters, Applications-Battery operated vehicles.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters (both1200 mode and 1800 mode)– Voltage & harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, selective harmonic elimination – Introduction to space vector modulation –Single-phase Current source inverter, Applications-Induction heating, UPS.

UNIT V AC TO AC CONVERTERS 9

Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase and three phase cyclo converters – Introduction to Matrix converters, Applications –welding.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Learn the basic principle of switching devices and understand the concept of switching losses.
- Understand the operation, design DC-DC,DC-AC,AC-DC and AC-AC converters and analyze the performance
- Understand the operation, design, AC-DC and AC-AC converters and analyze the performance
- Introduce resonant converters and matrix converters

TEXT BOOKS

1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Third Edition, New Delhi, 2004.
2. P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.

REFERENCE BOOKS

1. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2003.
2. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Edition, 2013.
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.
4. L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2010.
5. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003.
6. S.Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, 2014.
7. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2013.
8. JP Agarwal," Power Electronic Systems: Theory and Design" 1e, Pearson Education, 2002.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1505	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION SYSTEMS	3	0	0	3

OBJECTIVES

- To impart knowledge on the following Topics
  - ✓ Basic functional elements of instrumentation
  - ✓ Fundamentals of electrical and electronic instruments
  - ✓ Comparison between various measurement techniques
  - ✓ Various storage and display devices
  - ✓ Various transducers and the data acquisition systems

UNIT I INTRODUCTION 9

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration- Principle and types of analog and digital voltmeters, ammeters.

UNIT II ELECTRICAL AND ELECTRONIC INSTRUMENTS 9

Principle and types of multi meters – Single and three phase watt meters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III COMPARATIVE METHODS OF MEASUREMENTS 9

D.C and A.C potentiometers, D.C (Wheat stone, Kelvin and Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic Interference – Grounding techniques.

UNIT IV STORAGE AND DISPLAY DEVICES 9

Magnetic disk and tape recorders, Graphic recorder, Oscillographic recorder, digital plotters and printers, Cathode ray oscilloscope (CRO), CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors-Thermal Imagers.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the basic functional elements of any instrument
- Understand the concept of fundamentals of electrical and electronic instruments
- Compare various principles and techniques involved in measurement
- Understand the concept of different storage and display devices
- Acquire knowledge about the various transducers and data acquisition system concepts
- Select a appropriate instrument for a particular application

TEXT BOOKS

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2010.
2. Doebelin E.O. and anik D.N., Measurement Systems – Applications and Design, Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007.

REFERENCE BOOKS

1. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi, 2013.
2. H.S. Kalsi, 'Electronic Instrumentation', McGraw Hill, III Edition 2010.
3. D.V.S. Murthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2015.
4. David Bell, 'Electronic Instrumentation & Measurements', Oxford University Press,2013.
5. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
6. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1511	CONTROL AND INSTRUMENTATION LAB	0	0	4	2

OBJECTIVES

- To provide knowledge on analysis and design of control system along with basics of instrumentation

LIST OF EXPERIMENTS

CONTROLSYSTEMS:

1. P, PI and PID controllers
2. Stability Analysis
3. Modeling of Systems – Machines, Sensors and Transducers
4. Design of Lag, Lead and Lag-Lead Compensators
5. Position Control Systems
6. Synchro-Transmitter- Receiver and Characteristics
7. Simulation of Control Systems by Mathematical development tools

INSTRUMENTATION:

8. Bridge Networks –AC and DC Bridges
9. Dynamics of Sensors/Transducers
   a. Temperature transducer
   b. Pressure transducer
   c. Displacement transducer
   d. Strain gauge
   e. Flow meter
10. Power and Energy Measurement
11. Signal Conditioning
    a. Instrumentation Amplifier
    b. Analog – Digital and Digital –Analog converters (ADC and DACs)
12. Process Simulation

TOTAL: 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Solve Apply the control system concept to electrical engineering problems
- Analyze the characteristics of different converters, compensators and other instruments
- Design a signal conditioning circuit
- Implement a specific bridge network for a particular application
- Apply the transducer concept to a particular engineering problem

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1512	MICROPROCESSORS AND MICROCONTROLLERS LAB	0	0	4	2

OBJECTIVES

- To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
- To simulate various microprocessors and microcontrollers using KEIL or Equivalent simulator.

LIST OF EXPERIMENTS

1.Simple arithmetic operations: addition / subtraction / multiplication / division.
2 Programming with control instructions:
(i) Ascending / Descending order, Maximum / Minimum of numbers.
(ii) Programs using Rotate instructions.
(iii) Hex / ASCII / BCD code conversions.
3 Interface Experiments: with 8085
(i) A/D Interfacing. & D/A Interfacing.
4 Traffic light controller.
5 I/O Port / Serial communication
6 Programming Practices with Simulators/Emulators/open source
7 Read a key ,interface display
8 Demonstration of basic instructions with 8051 Micro controller execution, including:
(i) Conditional jumps & looping
(ii) Calling subroutines.
9 Programming I/O Port and timer of 8051
(i) study on interface with A/D & D/A
(ii) Study on interface with DC & AC motors
10 Application hardware development using embedded processors.

TOTAL: 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Develop, compile, debug, and implement assembly language program for 8085, 8086 microprocessor
- Develop, compile, debug, and implement assembly language and C program for 8051 microcontroller
- Develop, compile, debug, and implement C program for ARM processor with Keil IDE

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1601	SOLID STATE DRIVES	3	0	0	3

OBJECTIVES

- To impart knowledge on the following Topics
  - ✓ Steady state operation and transient dynamics of a motor load system.
  - ✓ Analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
  - ✓ Operation and performance of AC motor drives.
  - ✓ Analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

UNIT I DRIVE CHARACTERISTICS 9

Advantages of electrical drives-Dynamics of electrical drive- Load torques-Steady state stability- Converter motor system- Multi quadrant operation-starting and braking methods-Selection of electric drives.

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

Analysis of the single and three phase converter fed separately excited DC motor drive-Chopper controlled DC drive-Four quadrant operation of converter / chopper fed drives-Applications.

UNIT III INDUCTION MOTOR DRIVES 9

Stator voltage control-V/f control- Rotor Resistance control-Slip power recovery drives-Vector control-Applications.

UNIT IV SYNCHRONOUS MOTOR DRIVES 9

Voltage source inverter and current source inverter fed synchronous motor drives- Margin angle control and power factor control-Closed loop control-Applications.

UNIT V CONTROL OF ELECTRICAL DRIVES 9

Transfer function for DC motor – closed loop control with current and speed feedback–armature voltage control and field weakening control – Design of controllers; current controller and speed controller.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand and select a suitable converter and motor for solid state drive
- Study about the steady state operation and transient dynamics of a motor load system
- Analyze the operation of the converter/chopper fed dc drive
- Analyze the operation and performance of AC motor drives
- Analyze and design the current and speed controllers for a closed loop solid state DC motor drive

TEXT BOOKS

Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.

1. R.Ramaprabha, R.Seyezhai, Solid State Drives DC and AC, SCITECH Publications, 2019

REFERENCES

1. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson, 2001.

2. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.
3. Shaahin Felizadeh, “Electric Machines and Drives”, CRC Press (Taylor and Francis Group), 2013.
4. John Hindmarsh and Alasdain Renfrew, “Electrical Machines and Drives System,” Elsevier 2012.
5. Theodore Wildi, “ Electrical Machines ,Drives and power systems ,6th edition, Pearson Education ,2015
6. N.K. De., P.K. SEN” Electric drives” PHI, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1602	COMMUNICATION ENGINEERING	3	0	0	3

OBJECTIVES

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques
- To study the various Spread Spectrum and Multiple Access techniques

UNIT I ANALOG MODULATION 9

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – modulators and demodulators – Angle modulation – PM and FM, modulators and demodulators – Super heterodyne receivers, Comparison of AM, FM and PM

UNIT II PULSE MODULATION 9

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing

UNIT III DIGITAL MODULATION AND TRANSMISSION 9

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

UNIT IV INFORMATION THEORY AND CODING 9

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS 9

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA, Application of wireless communication- GSM

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course, the student should be able to:

- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.
- Analyze Spread Spectrum and Multiple Access Techniques.

TEXT BOOKS

1. H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007
2. S. Haykin “Digital Communications” John Wiley 2005

REFERENCE BOOKS

1. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – “Analog and Digital Communications” TMH 2006
3. B.Sklar, Digital Communications Fundamentals and Applications” 2/e Pearson Education 2007.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1603	PROTECTION AND SWITCH GEAR	3	0	0	3

OBJECTIVES

- To impart knowledge on the following Topics
  - ✓ Causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
  - ✓ Characteristics and functions of relays and protection schemes.
  - ✓ Apparatus protection, static and numerical relays
  - ✓ Functioning of circuit breaker

UNIT 1 FUSES AND PRINCIPLES OF CIRCUIT BREAKERS 9

Fuses - Fuse Characteristics, Types of Fuses, Selection of Fuses. Circuit Breakers - Difference between fuse and circuit breaker, Requirement of a circuit breakers, Difference between an isolator and circuit breaker, Basic principle of operation of a circuit breaker, Phenomena of arc, Properties of arc, Initiation and maintenance of arc, Arc interruption theories - Slepian's theory and Energy balance theory, Restriking voltage, Recovery voltage, Rate of rise of Restriking voltage, DC circuit breaking, AC circuit breaking, Current chopping, Capacitance switching, Resistance switching, Selection of breakers.

UNIT II TYPES OF CIRCUITS BREAKERS 9

Air Circuit breakers – Air break and Air blast Circuit breakers, Oil Circuit breakers - Single break, double break, minimum OCB, SF6 breaker - Preparation of SF6 gas, Puffer and non Puffer type of SF6 breakers. Vacuum circuit breakers. (Principle of operation and constructional details, Advantages and disadvantages of different types of Circuit breakers).

UNIT III PROTECTIVE RELAYS 9

Introduction, Fundamental requirements of protective relaying, Zones of Protection - Primary and Back up Protection, Classification of Relays. Electromagnetic Relays-Attracted Armature, Balanced Beam, Induction disc, Thermal Relays. Relay timing, Functional protective relay schemes - over current, directional and non-directional, distance, negative sequence, differential relays (Brief Description only).

UNIT IV APPARATUS PROTECTION 9

Alternator Protection: Stator, rotor and other miscellaneous protections -Stator inter turn fault, Earth fault and Differential protection. Transformer Protection - Protection against internal faults, Percentage Differential Protection, overheating Protection, Buchholz Relay, Protection against magnetizing inrush current, Earth fault protection, Overfluxing protection. Bus bar protection - Differential current protection. Feeder protection – Over-current, distance, pilot wire and carrier current protection.

UNIT V POWER SYSTEM EARTHING 9

Objective- tolerable limits of body current – step and touch voltage (tolerable and actual values) – Impulse behaviour of earthing systems – Neutral earthing – Arc suppression coils – grounding practice.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Select Fuses for a given situation and discuss the principles of Circuit breakers

- Discuss the different types of circuit breakers and Select circuit breakers for a given situation.
- Explain the characteristics and principles of various relays.
- Apply proper protective schemes for power apparatus.
- Explain the advantages and methods of power system earthing

TEXT BOOKS

1. Rao S.S. "Switchgear and Protection",13th ed. Khanna Publishers: Delhi; 2007.
2. Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill, 2001.

REFERENCE BOOKS

1. Soni M.L., Gupta P.V., Bhatnagar V.S., Chakrabarti A., "A Text Book on Power System Engineering", Dhanpat Rai & Co., 1998.
2. I.J.Nagrath, D.P.Kothari, "Power system Engineering", TMH, 1994.
3. Ravindranath B., and Chander N., "Power System Protection & Switchgear", Wiley Eastern Ltd., 1977.
4. Rajput R.K, "A Text book of Power System Engineering" Laxmi Publications, First Edition Reprint 2007.
5. Paithankar Y.G. and Bhide S.R., "Fundamentals of Power System Protection", Prentice Hall of India Pvt. Ltd., New Delhi–110001, 2003.
6. Oza, Nair, Mehta and Makwana, "Power System Protection and Switchgear", Tata McGraw- Hill.
7. T.S. Madhava Rao "Digital/Numerical Relays", Tata McGraw Hill 1st edition - 2005

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1604	POWER SYSTEM OPERATION AND CONTROL	3	0	0	3

OBJECTIVES

- To impart knowledge on the following topics
  - ✓ Significance of power system operation and control.
  - ✓ Real power-frequency interaction and design of power-frequency controller.
  - ✓ Reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
  - ✓ Economic operation of power system.
  - ✓ SCADA and its application for real time operation and control of power systems

UNIT I INTRODUCTION 9

Load characteristics - load curves - load factor - diversity factor - Importance of load forecasting - quadratic and exponential curve fitting techniques of forecasting - requirements of good power system - necessity of voltage and frequency regulation - P-f and Q-V control loops - plant level and system level controls.

UNIT II REAL POWER-FREQUENCY CONTROL 9

Basics of speed governing mechanism - speed-load characteristics - load sharing between two synchronous machines in parallel - control area concept - LFC control of a single-area system - static and dynamic analysis of uncontrolled and controlled cases - LFC control of two-area system and modelling - static analysis of uncontrolled case - tie line with frequency bias control - state variable model.

UNIT III REACTIVE POWER-VOLTAGE CONTROL 9

Generation and absorption of reactive power - Automatic Voltage Regulator (AVR): brushless AC excitation system - block diagram representation of AVR loop - static and dynamic analysis - stability compensation - voltage drop in transmission line - methods of reactive power injection - shunt and series compensation - tap changing transformer.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 9

Statement of Unit Commitment (UC) problem - constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints - UC solution methods: Priority-list method - forward dynamic programming approach - Statement of Economic Dispatch (ED) problem - input and output characteristics of thermal plant - incremental cost curve - co-ordination equations without loss and with transmission losses - ED solution by direct method and λ-iteration method - base point and participation factors method - integration of economic dispatch control with LFC.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Power scenario in Indian grid - Load Despatch Centre (LDC) - functions of energy control centre - PMU and SCADA - contingency analysis for generator and line outages using linear sensitivity factors - state transition diagram.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand system load variations and forecasting techniques
- Understand the need for voltage and frequency regulation

- Analyse the load frequency dynamics in power system and design power-frequency controller
- Model automatic voltage regulator
- Analyse the various conventional methods of reactive power compensation
- Understand the significance of unit commitment and economic dispatch
- Compute the optimal dispatch of the generating units in a power system by solving Unit Commitment and economic dispatch problems
- Understand the functions of energy control centre
- Analyse power system security using contingency analysis

TEXT BOOKS

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.

REFERENCE BOOKS

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
2. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.
3. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
4. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1611	POWER ELECTRONICS AND DRIVES LAB	0	0	4	2

OBJECTIVES

- To provide hands on experience with power electronic converters and testing.

LIST OF EXPERIMENTS

1. Characteristics of SCR and IGBT.
2. Characteristics of GTO & IGCT.
3. Single-phase AC to DC semi-converter and fully controlled converter.
4. MOSFET based step down and step up choppers.
5. IGBT based single phase PWM inverter.
6. IGBT based three phase PWM inverter.
7. Single- phase AC Voltage controller.
8. Switched mode power converter.
9. Arduino based Gate Pulse Generation for DC-DC converter & single-phase inverter.
10. Design of gate drive circuit for power electronic converters.
11. Chopper based DC drive
12. Simulation of PE circuits (1Φ & 3Φ semi converters, 1Φ & 3Φ full converters, DC-DC converters, 1Φ & 3Φ Inverters & AC voltage regulators).

TOTAL: 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Trigger power devices with suitable triggering methods
- Analyse the characteristics of power devices
- Construct AC-DC half and full controlled converters for the given specifications
- Design and analyse the DC-AC circuits
- Analyse and implement AC voltage regulators
- Analyse the single and three phase PWM inverters
- Analyse the working of SMPS
- Develop a gating pulse generation for power converters
- Construct gate drive circuits for converters.
- Evaluate the performance of the given Power electronic circuit using PSIM/ MATLAB

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1612	POWER SYSTEM SIMULATION LAB	0	0	4	2

OBJECTIVES

- To provide better understanding of power system analysis through digital simulation.
-

LIST OF EXPERIMENTS

1. Computation of Parameters and Modelling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices
3. Load Flow Analysis: Gauss-Seidel (GS), Newton Raphson (NR) and Fast Decoupled Load Flow (FDLF) method
4. Fault Analysis
5. Transient Stability Analysis of Single-Machine Infinite Bus System
6. Switching surge analysis using EMTP
7. Load –Frequency Dynamics of Single-Area and Two-Area Power Systems
8. Economic Dispatch: Direct method, Lambda iteration method, Base point and participation factor method
9. Unit commitment : Priority list method and Forward Dynamic programming
10. Contingency analysis using linear sensitivity factors: Generator shift factors and line outage distribution factors

TOTAL: 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Compute transmission line parameters and model the line for steady state analysis
- Formulate the bus admittance matrix using inspection method
- Analyse the computational performance of Gauss-Seidel (GS), Newton Raphson (NR) and Fast Decoupled Load Flow (FDLF) methods for solving power flow problem
- Calculate the fault current for various types of faults in the power system
- Analyse the transient stability by applying different fault clearing time to the circuit breakers
- Analyse load frequency control dynamics and design appropriate controllers for single and multiple area power system
- Analyse the switching surge in long transmission line using EMTP
- Compute the optimal dispatch of the generating units in a power system by solving Unit Commitment and economic dispatch problems
- Analyse the power system reliability by performing Contingency Analysis using linear sensitivity factors

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1701	ELECTRICAL MACHINE DESIGN	3	0	0	3

OBJECTIVES

- To impart knowledge about the following topics:
  - ✓ Magnetic circuit parameters and thermal rating of various types of electrical machines.
  - ✓ Armature and field systems for D.C. machines.
  - ✓ Core, yoke, windings and cooling systems of transformers.
  - ✓ Design of stator and rotor of induction machines and synchronous machines.
  - ✓ The importance of computer aided design method.

UNIT I DESIGN OF FIELD SYSTEM AND ARMATURE 12

Major considerations in Electrical Machine Design – Materials for Electrical apparatus – Design of Magnetic circuits – Magnetising current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding.

UNIT II DESIGN OF TRANSFORMERS 12

Construction - KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers. Computer program: Complete Design of single phase core transformer

UNIT III DESIGN OF DC MACHINES 12

Construction - Output Equations – Main Dimensions – Choice of specific loadings – Selection of number of poles – Design of Armature – Design of commutator and brushes – design of field Computer program: Design of Armature main dimensions

UNIT IV DESIGN OF INDUCTION MOTORS 12

Construction - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations – Operating characteristics : Magnetizing current - Short circuit current – Circle diagram - Computer program: Design of slip-ring rotor

UNIT V DESIGN OF SYNCHRONOUS MACHINES 12

Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators -Computer program: Design of Stator main dimensions-Brushless DC Machines

TOTAL : 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand basics of design considerations for rotating and static electrical machines
- Design and analyze single and three phase transformer
- Design and analyze armature and field of DC machines
- Design and analyze stator and rotor of induction motor
- Design and analyze synchronous machines.

TEXT BOOKS

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai& Sons, New Delhi, Fifth Edition, 1984.
2. V Rajini, V.S Nagarajan, 'Electrical Machine Design', Pearson, 2017.

REFERENCE BOOKS

1. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.
2. 'Electrical Machine Design', Balbir Singh, Vikas Publishing House Private Limited,1981.
3. K.M.Vishnumurthy 'Computer aided design of electrical machines' B SPublications,2008.
4. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Lt,2011.
5. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes',Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1702	HIGH VOLTAGE ENGINEERING	3	0	0	3

OBJECTIVES

- To impart knowledge on the following Topics
  - ✓ Various types of over voltages in power system and protection methods.
  - ✓ Generation of over voltages in laboratories.
  - ✓ Measurement of over voltages.
  - ✓ Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
  - ✓ Testing of power apparatus and insulation coordination

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against over voltages.

UNIT II DIELECTRIC BREAKDOWN 9

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- design, planning and layout of high voltage laboratory - Insulation Coordination.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the various types of over voltages in power system and protection methods.
- Understand the Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Analyse the various methods for Generation of different types of over voltages
- Analyse the various methods for Measurement of different types of over voltages
- Testing of power apparatus and insulation coordination.

TEXT BOOKS

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.

2. E. Kuffel and W.S. Zaengl, J.Kuffel, ‘High voltage Engineering fundamentals’, Newnes Second Edition Elsevier , New Delhi, 2005.

REFERENCE BOOKS

1. Subir Ray,’ An Introduction to High Voltage Engineering’ PHI Learning Private Limited, New Delhi, Second Edition, 2013.
2. L.L. Alston, ‘High Voltage Technology’, Oxford University Press, First Indian Edition, 2011.
3. C.L. Wadhwa, ‘High voltage Engineering’, New Age International Publishers, Third Edition, 2010.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1703	SPECIAL ELECTRICAL MACHINES	3	0	0	3

OBJECTIVES

- To impart knowledge about the following topics:
  - ✓ Construction, principle of operation and performance of synchronous reluctance motors.
  - ✓ Construction, principle of operation, control and performance of stepping motors.
  - ✓ Construction, principle of operation, control and performance of switched reluctance motors.
  - ✓ Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
  - ✓ Construction, principle of operation and performance of permanent magnet synchronous motors.

UNIT I SYNCHRONOUS RELUCTANCE MOTORS

Constructional features – Types – Axial and Radial flux motors – Operating principles – Phasor diagram- Voltage and Torque Equations - Performance Characteristics – Applications.

UNIT II STEPPER MOTORS

Constructional features – Principle of operation – Variable reluctance motor –Permanent magnet motor - Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitation – Static and Dynamic Characteristics – Drive circuits -Suppressor circuits– Closed loop control– Applications.

UNIT III SWITCHED RELUCTANCE MOTORS

Constructional features – Principle of operation – Torque production - Power Converters and their controllers – Performance Characteristics – Closed loop control – Applications.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS

Fundamentals of Permanent Magnets -Principle of operation – Magnetic circuit analysis – EMF and torque equations – Performance characteristics - Closed loop control– Applications.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS

Principle of operation – EMF and Torque equations – Phasor diagram – Performance characteristics – Closed loop control– Applications.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Analyze and design controllers for special Electrical Machines.
- Acquire the knowledge on construction and operation of stepper motor.
- Acquire the knowledge on construction and operation of stepper switched reluctance motors.
- Understand the construction and principle of operation of switched reluctance motors.
- Acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
- Acquire the knowledge on construction and operation of permanent magnet synchronous motors.

- Select a special Machine for a particular application.

TEXT BOOKS

1. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
2. Mrunal Deshpande, "Special Electrical Machines", Scitech Publications, 2016

REFERENCE BOOKS

1. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.
2. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
3. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
4. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London, 1982.
5. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
6. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1711	ADVANCED ELECTRICAL ENGINEERING LAB	0	0	4	2

LIST OF EXPERIMENTS

1. Breakdown Mechanism In Solid, Liquid And Air In Uniform and Non Uniform Fields
2. Power Frequency Withstand Test using Transformer
3. Determination of the Flashover Voltage of A 11kv Insulator
4. Performance of Conventional Lighting Protection Air Terminal
5. Characteristics curves of SPV using V-I method & Electronics load method.
6. Effect of variation of Angle tilt, Temperature & Shading (with & without bypass diodes)
7. Characteristics of series connected & parallel connected modules
8. Simple Maximum Power Point Tracker
9. Testing of SiC MOSFET DC-DC boost converter
10. IGBT Based Single-phase Quasi Z-source Inverter for PV
11. Study and characteristics of Li-Ion battery
12. Charging and Discharging characteristics of super capacitors.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Knowledge of the high voltage testing equipment and methods, requirements for high voltage testing procedures, testing procedures.
- Analyze and understand the Breaking voltages and arcs in gasses and solid insulators.
- Acquire knowledge of performance characteristics of renewable energy sources.
- Understand the effects of partial shading on the operation of PV systems and program different MPPT algorithms for extracting the maximum power .
- Design and model PV power electronic converters.
- Familiarization with battery storage systems & super capacitors.
- Selection of the most appropriate energy storage technology based on the requirements of each application.

COURSE CODE	COURSE TITLE	L	T	P	C
UGE1576	PROFESSIONAL ETHICS	3	0	0	3

OBJECTIVES

- To enable the students to create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 9

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga andmeditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics –A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest– Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the human values and work ethics
- Understand moral issues and ethical theories
- Understand codes of ethics and infer the ethical Issues from the case studies
- Know about the safety and risks of a product/service and the professional rights
- Understand the globalization issues and Corporate social responsibility

TEXT BOOKS

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.115
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
4. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” McGraw Hill education, India Pvt.Ltd., New Delhi, 2013.
6. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1521	PRINCIPLES OF MANAGEMENT	3	0	0	3

OBJECTIVES

- To facilitate the understanding of Quality Management principles and process

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques– Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure– types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership –communication – process of communication – barrier in communication – effective communication –communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Explain the Total Quality Management (TQM) principles
- Understand TQM tools and techniques
- Know about the quality systems

TEXT BOOKS

1. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India)Pvt. Ltd., 1 0th Edition,2009.

REFERENCE BOOKS

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 1998.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo& Mary Coulter, “Fundamentals of Management”,7thEdition, Pearson Education, 2011 .
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1 999

COURSE CODE	COURSE TITLE	L	T	P	C
UGE1476	TOTAL QUALITY MANAGEMENT	3	0	0	3

OBJECTIVE

To introduce principles of total quality management (TQM) and impart knowledge in TQM tools, techniques and quality systems

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors.

TOTAL PERIODS: 45

OUTCOMES

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

CO1 Describe basic concepts of total quality management (TQM) and customer relations (K2: U)

CO2 Describe principles of total quality management (K2: U)

CO3 Explain traditional and new management tools and bench marking process (K2: U)

CO4 Explain concepts of six sigma, quality function development and total productive maintenance (K2: U)

CO5 Describe various quality systems, quality auditing and TQM implementation (K2: U)

TEXT BOOKS

1. Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield, Mary Besterfield-Sacre, Hemant Urdhwareshe, Rashmi Urdhwareshe, Total quality Management, Revised Third Edition, Pearson Education Asia, 2011.

2. Kannan SM, Jayabalan V, Total Quality Management, RKR Publications, 2005

REFERENCE BOOKS

1. James R. Evans and William M. Lindsay, The Management and Control of Quality, 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi. L and Anand Samuel, Total Quality Management, Prentice Hall (India) Pvt.Ltd., 2006.
3. Janakiraman. B and Gopal. R. K., Total Quality Management - Text and Cases, Prentice Hall (India) Pvt. Ltd., 2006.
4. Sharma DD,Total Quality Management, Sultan Chand and Sons, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UGE1578	HUMAN RIGHTS	3	0	0	3

OBJECTIVES

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective /Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948.Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disability persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Acquire the basic knowledge of human rights
- Learn the fundamental theories of human rights
- Understand the UN laws on human rights
- Know about human rights in India
- Know the rights of physically challenged people and human rights commission

TEXT BOOKS

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi..

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1522	RESOURCE MANAGEMENT TECHNIQUES	3	0	0	3

OBJECTIVES

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT I INTRODUCTION TO OR and LINEAR MODELS 9

Basic of Operation Research, Origin & development, Applications and Phases an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION and SEQUENCING MODELS 9

Transportation and Assignment Models – Traveling Salesman problem. Sequencing – Basic Assumptions, n Jobs through 2-3 machines, 2 Jobs on m machines.

UNIT III NETWORK MODELS 9

Networks models – Shortest route – Minimal spanning tree – Maximum flow – Project network – CPM and PERT – Network Crashing, Resource Smoothening and Levelling.

UNIT IV INVENTORY MODELS AND QUEUEING MODELS 9

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population.

UNIT V DECISION MODELS 9

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Solve Apply graphical method and simplex method to solve linear programming problems and perform sensitivity analysis.
- Solve transportation, assignment and sequencing problems.
- Apply CPM and PERT techniques to analyse the given project network.
- Solve inventory and queueing problems.
- Apply game theory, replacement models and dynamic programming technique for decision making problems.

TEXT BOOKS

1. Hillier and Libeberman, “Operations Research”, Holden Day, 2005
2. Taha H.A., “Operations Research”, Sixth Edition, Prentice Hall of India, 2003.

REFERENCE BOOKS

1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.
2. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
5. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

Course Code	Course Title	L	T	P	C
UEE1621	VLSI DESIGN TECHNIQUES	3	0	0	3

OBJECTIVES

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

UNIT I VLSI SYSTEM DESIGN 9

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

UNIT II MOS TRANSISTOR 9

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

UNIT III CMOS INVERTER 9

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

UNIT IV CMOS LOGIC CIRCUITS 9

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

UNIT V DATA PATH SUBSYSTEMS & TESTING 9

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

TOTAL: 45 PERIODS

OUTCOMES

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

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

TEXT BOOKS

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

REFERENCE BOOKS

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

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1622	EMBEDDED SYSTEM DESIGN	3	0	0	3

OBJECTIVES

- To impart knowledge on the following Topics
  - ✓ Building Blocks of Embedded System
  - ✓ Various Embedded Development Strategies
  - ✓ Bus Communication in processors, Input/output interfacing.
  - ✓ Various processor scheduling algorithms.
  - ✓ Basics of Real time operating system and example tutorials to discuss on one real time operating system tool.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM 9

Introduction to Embedded Systems –Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –Ethernet - need for device drivers.

UNIT III EMBEDDED ARCHITECTURES 9

Instruction Set Architecture-CISC architecture [8051] and RISC instruction set architecture [ARM processors], DSP Processors, Harvard Architecture-PIC. Coprocessors and Hardware Accelerators, Processor Performance Enhancement-Pipelining, Super-scalar Execution, CPU Power Consumption, Memory System Architecture-, Caches, Virtual Memory, Memory management unit and address Translation.

UNIT IV RTOS BASED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance..

UNIT V EMBEDDED SYSTEM APPLICATION 9

Open-loop and Closed Loop Control Systems-Application Examples-Washing Machine, Automotive Systems, Smart Card system, Auto-focusing digital camera, Air-conditioner, Elevator Control System, ATM System.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Learn the basic modules of embedded system
- Learn fundamentals and standards of communication framework among the modules of embedded system
- Acquire the knowledge to choose a suitable processor for the system design
- Know the salient features in designing a real time system using RTOS

- Acquire the knowledge of the complete embedded system design with various case studies

TEXT BOOKS

1. Peckol, "Embedded system Design", John Wiley & Sons,2010
2. Shibu. K.V, "Introduction to Embedded Systems", 2e, Mc graw Hill, 2017.

REFERENCE BOOKS

1. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013
3. C.R.Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.
4. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
5. Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning, 2009.
6. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.
7. David E. Simon, "An Embedded Software Primer", Pearson Education, 1999.
8. Wayne wolf, "Computers as components", Morgan Kaufmann publishers, 2nd Edition, 2008.
9. Dr. Prasad, "Embedded Real Time System", Wiley Dreamtech, 2004.
10. Jean J.Labrosse, "Embedded system building blocks", CMP books, 2ndEdition, 1999.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1623	BIOMEDICAL INSTRUMENTATION	3	0	0	3

OBJECTIVES

- To understand the fundamentals of Biomedical Engineering.
- To study the measurement of certain important non-electrical parameters.
- To understand the characteristics of different bio potentials and its recording methods.
- To know the basic principles in imaging techniques.
- To have a basic knowledge in life assisting and therapeutic devices.

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Cardiovascular systems- Respiratory systems -Kidney and blood flow - Basic components of a biomedical system - Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Whole Body Plethysmography – Blood Gas analyzers, pH of blood –measurement of blood pCO2, pO2 - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms.

UNIT IV MEDICAL IMAGING SYSTEMS 9

X-ray machine – Computer tomography – Magnetic resonance imaging – Nuclear medicine – Single photo emission computer tomography – Positron emission tomography – Ultrasonography – Endoscopy – Thermal Imaging.

UNIT V ASSIST AND THERAPEUTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Short wave diathermy –Surgical diathermy – Heart - Lung machine – Hearing Aids – Dialyzers – Lithotripsy – Infant Incubators – Drug Delivery Devices.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Describe the origin of bio potentials and Select appropriate transducers for measurement of physical phenomenon.
- Explain the various nonelectrical parameters measurements and diagnostic procedures.
- Measure and analyze various electrical parameters and describe its characteristics.
- Summaries the working principles of various imaging techniques.
- Explain the working of life assisting and therapeutic instruments.

TEXT BOOKS

1. John G. Webster, Medical Instrumentation Application and Design, Wiley India Pvt. Ltd, New Delhi, 4th edition, 2015.
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.

REFERENCE BOOKS

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3rd Edition, New Delhi, 2014.
2. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", 2nd Edition, Boca Raton, CRC Press LLC, 2000.
3. Joseph J. Carr and John M. Brown," Introduction to Biomedical Equipment Technology", John Wiley and sons, 4th Edition, New York, 2000.
4. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1624	ADAPTIVE FILTERING AND WAVELTS	3	1	0	4

OBJECTIVES

- To give an overview of Advanced Digital Signal Processing subject with conceptual clarity.
- To provide the foundation for signal modeling, linear prediction and estimation theory.
- To impart the basic knowledge on up-sampling and down-sampling
- To impart knowledge on adaptive filter design, multi-rate signal processing and filter banks.
- To provide the foundation on time frequency analysis and the need for the same.
- To impart the knowledge on Short Time Fourier Transforms (STFT).
- To impart the knowledge on Haar and Daubechies Wavelet transforms, its theoretical analysis
- To provide the knowledge on wavelets and its 1D and 2D applications.

UNIT I REVIEW OF DIGITAL SIGNALS, SYSTEMS AND FILTERS 8

Discrete Time Fourier Transforms - properties – DFS, DFT and FFT algorithms – mixed radix algorithms – DIT and DIF - Digital filters: FIR filter, IIR filter design – Z transforms- Properties and filter implementations - Mathematical description of change of sampling rate - Interpolation and Decimation – Up-sampling and Down-sampling of filters.

UNIT II RANDOM SIGNAL PROCESSING AND SPECTRUM ESTIMATION 9

Discrete random processes - Expectation, Variance, Parseval's Theorem, Wiener Khintchine Relation - Power spectral density - Periodogram – Sample autocorrelation – Sum decomposition theorem, Spectral factorization theorem - Non-parametric methods – Correlation method - Co-variance estimator - Consistent estimators -Periodogram estimator – Barlett spectrum estimation - Welch estimation - Model based approach - AR, MA, ARMA signal modeling - Parameter estimation using Yule-Walker method.

UNIT III LINEAR ESTIMATION AND PREDICTION 8

Maximum likelihood criterion - efficiency of estimator - Least mean squared error criterion - Wiener filter - Discrete Wiener-Hoff equations - Recursive estimators - Kalman filter – Linear prediction, prediction error - whitening filter, inverse filter - Levinson recursion, Lattice realization, and Levinson recursion algorithm for solving Toeplitz system of equations**.**

UNIT IV ADAPTIVE AND MULTIRATE FILTERS 9

FIR adaptive filters - Newton's steepest descent method - Adaptive filter based on steepest descent method - Widrow Hoff LMS adaptive algorithm - Adaptive channel equalization - Adaptive echo chancellor - Adaptive noise cancellation - RLS adaptive filters – Exponentially weighted RLS - Sliding window RLS - Simplified IIR LMS adaptive filter. - Direct digital domain approach - Decimation by an integer factor - Interpolation by an integer factor - Single and multistage realization - poly phase realization

UNIT V TIME - FREQUENCY ANALYSIS 11

Introduction - Time–frequency description of signals – Bandwidth, Duration, Mean Time in term of spectrum – Covariance of the signal – Calculation of Analytic signal – Physical Interpretation – Instantaneous frequency – Need for Time frequency Analysis – Analytical Examples – Global and Local Averages – Time and Frequency shift invariance – STFT and

Spectrogram – Properties of STFT – group delay and examples – Origin of wavelets – Time frequency resolution - Haar and Daubechies wavelets – Analysis and Synthesis filter banks of Haar wavelets – Frequency response for Haar LPF and HPF - Time Bandwidth product – Daubechies MRA – Condition for Perfect reconstruction – Effect of Minimum phase requirement on filter coefficients - Application to sub-band coding- Implementation of wavelet packet transform and its applications.

TOTAL: 60 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Apply the knowledge of mathematics, science, and engineering for the analysis and design of digital systems
- Identify, formulate and solve engineering problems in the area of random signal processing and spectrum estimation
- Design adaptive and multi-rate filters with realistic constraints
- Distinguish between selection of tools for Time- Frequency analysis
- Select and apply Time-Frequency Analysis tools such as wavelet transforms for 1D and 2D applications

TEXT BOOKS

1. J.G.Proakis and D.G.Manolakis, " Digital Signal Processing: Principles, Algorithms and Applications ", 4th Edition, Pearson, PHI, 2007.
2. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling ", Wiley India, 2008.
3. Tulay Adali and Simon Haykin, “Adaptive Signal Processing, Next Generation Solutions”, John Wiley and Sons, 2010.

REFERENCE BOOKS

1. P. P. Vaidyanathan, “Multirate Systems and Filter Banks”, Prentice Hall Signal Processing Series, Pearson, 2004.
2. Ali Ahammad Shoukat Choudhury, Sirish L. Shah and Nina F.Thornhill, “Diagnosis of Process Nonlinearities and Valve Stiction: Data Driven Approaches”, Springer, 2008.
3. Michael W. Frazier, "An Introduction to Wavelets through Linear Algebra”, Springer, 1999.
4. Stephane Mallat, "A Wavelet Tour of Signal Processing", Academic Press, Elsevier, 1999, Second Edition.
5. M. Vettterli and J. Kovacevic, “ Wavelets and Subband Coding,” , Prentice Hall PTR , A Pearson Education Company, Upper Saddle River, NJ, 1995.
6. I. Daubechies, “ Ten Lectures on Wavelets”, SIAM publishers, 1992.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1625	MICROCONTROLLER BASED SYSTEM DESIGN	3	0	0	3

OBJECTIVES

OBJECTIVES: To impart knowledge about the following topics:

- Architecture of PIC microcontroller
- Interrupts and timers
- Peripheral devices for data communication and transfer
- Functional blocks of ARM processor
- Architecture of ARM processors

UNIT I INTRODUCTION TO PIC MICROCONTROLLER 9

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–IC16cxx–- Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.

UNIT II INTERRUPTS AND TIMER 9

PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variability strings.

UNIT III PERIPHERALS AND INTERFACING 9

I^2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM— Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

UNIT IV INTRODUCTION TO ARM PROCESSOR 9

Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy – ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems.

UNIT V ARM ORGANIZATION 9

3- Stage Pipeline ARM Organization– 5Stage Pipeline ARM Organization–ARM Instruction Execution- ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.

TOTAL: 45 PERIODS

OUTCOMES

- Ability to understand and apply computing platform and software for engineering problems.
- Ability to understand the concepts of Architecture of PIC microcontroller
- Ability to acquire knowledge on Interrupts and timers.
- Ability to understand the importance of Peripheral devices for data communication.
- Ability to understand the basics of sensor interfacing
- Ability to acquire knowledge in Architecture of ARM processors

TEXT BOOKS:

1. Peatman,J.B., “Design with PIC Micro Controllers”, Pearson Education, 3rd Edition, 2004.
2. Furber,S., “ARM System on Chip Architecture” Addison Wesley trade Computer Publication, 2000.

REFERENCES

1. Mazidi, M.A., “PIC Microcontroller” Rollin Mckinlay, Danny causey, Prentice Hall of India, 2007.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1626	IOT in Power System Engineering	3	0	0	3

OBJECTIVES:

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I BASICS OF IoT 9

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II IoT PROTOCOLS 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4,802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT III DESIGN AND DEVELOPMENT 9

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning –No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to:
- Explain the concept of IoT.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario in Electric Power Distribution Network

TEXTBOOKS

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017

REFERENCES

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi, ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012 (for Unit 2).
3. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
5. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2 nd Edition, O'Reilly Media, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1721	ADVANCED CONTROL THEORY	3	0	0	3

OBJECTIVES

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis
- To give basic knowledge in describing function analysis
- To study the design of optimal controller.
- To design a nonlinear control

UNIT I FUNDAMENTAL MATHEMATICS FOR STATE SPACE ANALYSIS 9

Linear vector spaces – Basis –Span –Subspaces-Rank Nullity dimension theorem- Similarity transformations- Inner product –Matrix norms - Cayley Hamilton theorem - Quadratic functions and Definiteness of matrices - Projection theorem- Gram Smith ortho-normalization procedure – Grammian matrix – Factorization – Eigen decomposition- Jordon form -Singular value decomposition.

UNIT II STATE VARIABLE ANALYSIS 9

Introduction- Concepts of state space – non uniqueness of state model –Evaluation of matrix exponents - Solution of state equations- Decomposition – Controllable, Observable & canonical from- Controllability & Observability - Duality (LTI).

UNIT III STATE CONTROLLER DESIGN 9

Controllability and Observability Grammians, Open loop minimum energy control, State feedback - Pole placement – Design of State regulator & state observer- Separation principle- Design of servo systems: State feedback with integral control.

UNIT IV NON LINEAR SYSTEMS 9

Common physical nonlinearities, Phase plane method: concepts, Singular points, phase plane trajectories- Stability analysis by describing function method, Jump resonance.

UNIT V NON LINEAR CONTROL 9

Lyapunov's stability theory - Jacobian linearization and gain scheduling - Feedback linearization: Input-output linearization, full-state linearization, stabilization, Sliding Mode Control.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Remember and Apply linear vector space concepts
- Design and analyze state feedback controller and state observer.
- Understand and analyze linear and nonlinear systems using phase plane method and analyze nonlinear systems using describing function method.
- Understand and design a nonlinear control.
- Apply advanced control strategies to practical engineering problems.

TEXT BOOKS

1. M.Gopal, "Digital Control and State Variable Methods", 4th edition, McGraw Hill India, 2012
2. K. Ogata, 'Modern Control Engineering', 5th Edition, Pearson, 2012.

REFERENCE BOOKS

1. M. Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2014.
2. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.
3. Glibert Stang, Introduction to Linear Algebra – 5th Edition, Wellesley - Cambridge Press, 2016
4. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1722	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	3	0	0	3

OBJECTIVES

- To impart knowledge on how to recursively estimate the parameters of discrete input – output models (BJ/MA/ARX/ARMAX etc.) using least squares method and recursive parameter estimation methods.
- To enable the student to tune the PID controller parameters using various auto tuning methods applied to real time systems.
- To make the student understand the principles of STR, MRAC and Gain scheduling with real time applications
- To make the student design simple adaptive controllers for linear systems using above methods

UNIT I NON-PARAMETRIC METHODS 8

Non-parametric methods - Transient analysis - frequency analysis - Correlation analysis - Spectral analysis - Input signal design for identification

UNIT II PARAMETRIC METHODS 8

Least squares estimation – Analysis of the least squares estimate - Best linear unbiased estimate – Model parameterizations - Prediction error methods.

UNIT III RECURSIVE IDENTIFICATION METHODS 9

The recursive least square methods - Model validation –Model structure determination - Introduction to closed loop system identification.

UNIT IV ADAPTIVE CONTROL SCHEMES 10

Introduction – Auto-tuning of PID controller using relay feedback approach – Types of adaptive control, Gain scheduling, Model reference adaptive control, Self–tuning controller – Design of gain scheduled adaptive controller – Applications of gain scheduling – Conical Tank System Example.

UNIT V MODEL-REFERENCE ADAPTIVE SYSTEM (MRAS) and SELF-TUNING REGULATOR (STR) 10

STR – Pole placement design – Indirect STR and direct STR – MRAC - MIT rule – Lyapunov theory – Relationship between MRAC and STR - Design of minimum variance controller - Design of moving average controller -stochastic self-tuning regulators

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand various system identification techniques and features of adaptive control like STR and MRAC
- Analyze with the analytical concepts of system identification and adaptive control
- Understand about Black-box approach based system identification
- Acquire knowledge about batch and recursive identification
- Design concept for adaptive control schemes

TEXT BOOKS

1. T.Soderstrom and Petre Stoica, System Identification, Prentice Hall International (UK) Ltd. 1989
2. Karl J. Astrom and Bjorn Witten mark, Adaptive Control, Pearson Education, Second edition, Fifth impression, 2009.

REFERENCE BOOKS

1 L. Ljung, System Identification - Theory for the User, 2nd edition, PTR Prentice Hall, 112 Upper Saddle River, N.J., 1999.

2 Arun.K Tangirala, "Principles of System Identification – Theory and Practice", CRC Press, 2015.

3 K. S. Narendra and A. M. Annaswamy, Stability Adaptive Systems, Prentice-Hall, 1989.

4 H. K. Khalil, Nonlinear Systems, Prentice Hall, 3rd edition, 2002.

5 William S.Levine, "Control Systems Advanced Methods, the Control Handbook, CRC Press 2011.

6 S. Sastry and M. Bodson, Adaptive Control, Prentice-Hall, 1989

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1723	OPTIMAL CONTROL THEORY	3	0	0	3

OBJECTIVES

- To give exposure to different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems
- To impart knowledge and skills needed to design Linear Quadratic Regulator for Time invariant and Time-varying Linear system (Continuous time and Discrete-time systems)
- To introduce concepts needed to design optimal controller using Dynamic Programming Approach and H-J-B equation.
- To give exposure to various types of fault tolerant control schemes such as Passive and active approaches
- To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller

UNIT I CALCULUS OF VARIATIONS AND OPTIMAL CONTROL 9

Introduction – Performance Index- Constraints – Formal statement of optimal control system – Calculus of variations – Function, Functional, Increment, Differential and variation and optimum of function and functional – The basic variational problem Extrema of functions and functionals with conditions – variational approach to optimal control system

UNIT II LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM 9

Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case- Time-invariant case – Stability issues of Time-invariant regulator – Linear Quadratic Tracking system: Fine time case and Infinite time case

UNIT III DISCRETE TIME OPTIMAL CONTROL SYSTEMS 9

Variational calculus for Discrete time systems – Discrete time optimal control systems:- Fixed final state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system – Steady state regulator system.

UNIT IV PONTRYAGIN MINIMUM PRINCIPLE 9

Pontryagin Minimum Principle – Dynamic Programming:- Principle of optimality, optimal control using Dynamic Programming – Optimal Control of Continuous time and Discrete-time systems – Hamilton-Jacobi-Bellman Equation – LQR system using H-J-B equation

UNIT V CONSTRAINED OPTIMAL CONTROL SYSTEMS 9

Time optimal control systems – Fuel Optimal Control Systems- Energy Optimal Control Systems– Optimal Control Systems with State Constraints.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Explain different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problem.
- Design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems)
- Design optimal controller using Dynamic Programming Approach and H-J-B equation.
- Explain the Pontryagin Minimum Principle

- Design optimal controller in the presence of state constraints and time optimal controller

TEXT BOOKS

1. Donald E. Kirk, Optimal Control Theory – An Introduction, Dover Publications, Inc. Mineola, New York, 2012.
2. D. Subbaram Naidu, Optimal Control Systems, CRC Press, New York, 2003.

REFERENCE BOOKS

1. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control, 3rd Edition, Wiley Publication, 2012.
2. M. Gopal, "Modern Control System Theory", New Age International Publishers, Reprint, 2015
3. Andrew P Sage, Chelsea P. White," Optimum Systems Control", Second Edition, Prentice Hall Ins, Englewood Cliffs, NJ, 1977,
4. Julius T Tou," Optimum Design of Digital Control Systems", Academic Press Inc, 1963

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1724	DIGITAL CONTROL SYSTEMS	3	0	0	3

OBJECTIVES

- To introduce the components of digital control system
- To provide knowledge on pulse transfer functions and their analysis
- To introduce stability concepts in discrete domain
- To educate on tuning of PID controllers in discrete domain
- To introduce state variable analysis in discrete domain

UNIT I INTRODUCTION 9

Introduction to digital control – Sampling Process – Sample and Hold Circuit – Zero and First Order hold – Z-Transform – Inverse Z- Transform – Region of convergence – Initial and Final Value Theorem.

UNIT II PULSE TRANSFER FUNCTION AND TIME RESPONSE 9

Block diagram reduction methods – Reduction Rules- Multi-loop – MIMO Systems – Signal Flow Graph- steady state error – error transfer functions- Error Constants-Time-Domain Analysis of Second Order Systems-Time Response.

UNIT III STABILITY 9

Introduction-Jury Stability Test- Schur-Cohn stability Test- Bilinear transformation- Stability by Pole Location – Root locus method- Bode Plot- Nyquist Plot.

UNIT IV DIGITAL PID CONTROLLER 9

Cascade Compensation- Digital Lag Lead Compensator by Bode method- Design of P,PI and PID Controller- Ziegler's- Nichols Method, Cohen-Coon Method.

UNIT V STATE SPACE ANALYSIS 9

Realization of Pulse Transfer Function- Diagonalisation- discretization of Continuous time systems, State Transition Matrix- Solution of Discrete-time state equations- Controllability and Observability.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the importance of digital Control
- Solve multi input multi output system MIMO
- Investigate the stability of MIMO system
- Apply advanced control theory to practical engineering problems

TEXT BOOKS

1. V.I. George and C.P. Kurien, Digital Control System, Cengage Learning, 2012.
2. B.C. Kuo, Digital Control System, 2nd Edition, Oxford University Press, 2010.
3. M. Sami Fadali, Antonio Visioli, Digital Control Engineering Analysis and Design, Academic.

REFERENCE BOOKS

1. M. Gopal, 'Digital Control and State Variable Methods', Tata McGraw Hill, 3rd Edition, 2009.

2. C.M. Houpis, G.B. Lamount, 'Digital Control Systems - Theory, Hardware, Software', International Student Edition, McGraw Hill Book Co., 1985.
3. Kannan M. Moddgalya, Digital Control, Wiley India, 2007.
4. C.L.Philips and J.M.Pan, "Feedback Control System, Pearson, 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1725	ENERGY MANAGEMENT AND AUDITING	3	0	0	3

OBJECTIVES

To impart knowledge about the following topics:

- ✓ Concepts of economic analysis and Load management.
- ✓ Energy management on various electrical equipments and metering.
- ✓ Concept of lighting systems and cogeneration.

UNIT I ENERGY MANAGEMENT IN ELECTRICAL SYSTEMS 9

Electricity billing - Power Factor improvements and benefits - transformers - distribution loss in industrial system - Assessment of T&D losses in power systems - Demand side management

UNIT II ELECTRIC ENERGY MANAGEMENT FOR MOTOR LOADS 9

Effects of Unbalanced Voltages on the Performance of Motors - Determining Electric Motor Operating Loads - Motor Efficiency Management - Motor Performance Management Process

UNIT III ELECTRIC ENERGY MANAGEMENT FOR LIGHTNING SYSTEMS 9

Basic parameters and terms - light sources and lamp types - Methods of calculating luminance - energy efficient lightning controls - standards and labelling programs

UNIT IV ENERGY MANAGEMENT IN BUILDINGS 9

Energy conservation building code (ECBC) - Guidelines on heating ventilation, Air conditioning system, water pumping system, Uninterruptible power supply, escalators and elevators - Energy efficiency measures in buildings - Energy performance assessment and energy savings measures of DG sets

UNIT V ENERGY AUDIT 9

Energy Audit definition - Need for energy audit - Types of energy audit and approach - benchmarking - Bureau of energy efficiency regulation 2008 - energy monitoring and targeting - Energy management information system (EMIS)

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the concept of electricity billing, power factor improvements and demand side management
- Analyze the effect of power factor on power system
- Understanding the effect of unbalanced voltage on performance of motors
- Estimate the energy performance of Electrical Motors
- Estimate the energy performance of Lighting System
- Understand the energy conservation building code
- Understand the energy audit process and energy management information system

TEXT BOOKS

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,.Logman Scientific & Technical, ISBN-0-582-03184 , 1990.

REFERENCE BOOKS

1. Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
4. Electricity in buildings good practice guide, McGraw-Hill Education, 2016.
5. National Productivity Council Guide Books

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1726	SMART GRIDS	3	0	0	3

OBJECTIVES:

- To impart knowledge about the following topics:
  - ✓ Smart Grid technologies, different smart meters and advanced metering infrastructure.
  - ✓ The power quality management issues in Smart Grid.
  - ✓ The high performance computing for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Need for Smart Grid, Difference between conventional & Smart Grid, Smart grid drivers, Benefits, Functions of smart grid components, Overview of the technologies required for the Smart Grid, National and International Initiatives in Smart Grid.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart energy resources: Renewable generation, Energy storage, Electric Vehicles, Microgrids, Smart substations: protection, monitoring and control, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution
Transformers. Distribution automation equipment.

UNIT III SENSING, CONTROL AND AUTOMATION TECHNOLOGIES 9

Smart metering, Smart meters: An overview of the hardware used, Communications infrastructure and protocols for smart metering, Advanced Metering Infrastructure (AMI), AMI Drivers and Benefits, AMIN needs in smart grid, AMI standards and security, Demand-side integration.

UNIT IV COMMUNICATION TECHNOLOGIES FOR THE SMART GRID 9

Data communication- Switching techniques, Communication channels, Layered architecture and protocols, Communication technologies - Communications Requirements for the Smart Grid, Wireless Network Solutions, Communication Standards and Protocols, Standards for information exchange, Communications Challenges in the Smart Grid.

UNIT V HIGH PERFORMANCE COMPUTING AND CYBER SECURITY 9

Computational Challenges in a Smart Grid, Existing Functions Improved and New Functions Enabled by HPC, Cyber security in the Smart Grid- Definitions, Security Functions, Security Threats, Cyber security in the Smart Grid, Digital signatures, Cyber security standards.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the concepts of smart grid and its latest developments
- Acquire knowledge about different smart grid technologies
- Explain advanced metering infrastructure and demand side management
- Explain the data communication and computing for smart grid applications
- Understand high performance computing and information security for smart grid

TEXT BOOKS

1. Stuart Borlase “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press 2013.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley 2012.

REFERENCE BOOKS

1. James Momoh, “Smart Grid Fundamentals of Design and Analysis”, Wiley, 2012.
2. Tony Flick, Justin more house, “Securing the smart grid: Next generation power grid security”, Elsevier, 2010
3. Daphne Mah, Peter Hills, Victor O.K. Li, Richard Balme -Smart Grid Applications and Developments-Springer, 2014.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1727	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	3	0	0	3

OBJECTIVES

To impart knowledge about the following topics:

- ✓ Planning of DC power transmission and comparison with AC power transmission.
- ✓ HVDC converters.
- ✓ HVDC system control.
- ✓ Harmonics and design of filters.
- ✓ Power flow in HVDC system under steady state

UNIT I INTRODUCTION 9

Development of HVDC technology, Advantages of HVDC Systems, HVDC System Costs, Overview and Organization of HVDC Systems, HVDC System Reliability, HVDC Characteristics and Economic Aspects, Planning for HVDC transmission, Modern trends in HVDC technology, HVDC Applications.

.

UNIT II ANALYSIS OF HVDC CONVERTERS 9

Basic conversion principle, Selection of converter configuration, Commutation process, Rectifier and inverter operation, Analysis of Graetz circuit with and without overlap, Converter bridge characteristics.

UNIT III CONTROL OF HVDC CONVERTERS AND SYSTEMS 9

Principles of DC link control, Converter control - characteristics, System control hierarchy, Firing angle control, Current and extinction angle control, Starting and stopping of DC link, Power control, Higher level controllers, HVDC Control Functions.

UNIT IV REACTIVE POWER CONTROL AND HARMONICS 9

Reactive power requirements in steady state, Sources of reactive power, Static VAR systems, Generation of harmonics, Effect of increasing pulse number, Determination of resulting harmonic impedance, AC filters, DC side filters, Active power filters.

UNIT V FAULT DEVELOPMENT AND PROTECTION 9

Converter disturbances, AC system fault, DC line fault, Fault analysis, Valve protection functions, Protective action of an HVDC system, Protection by control actions, DC line protection, Filter protection

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the principles and types of HVDC system
- Analyze and understand the concepts of HVDC converters and acquire knowledge on DC link control
- Understand the concepts of reactive power management and harmonics
- Get knowledge about Planning of DC power transmission and comparison with AC power transmission
- Analyze the fault conditions in HVDC components and design the protection

TEXT BOOKS

1. Padiyar, K.R., “HVDC power transmission system”, New Age International(P)Ltd. NewDelhi, Second Edition,2010.
2. Arrillaga,J., “High Voltage Direct Current Transmission”, Peter Pregrinus, London,1983.

REFERENCE BOOKS

1. Kundur P., “Power System Stability and Control”, McGraw-Hill,1993.
2. Colin Adamson and Hingorani NG, “High Voltage Direct Current Power Transmission”, Garraway Limited, London, 1960. Dragan Jovcic and Khaled Ahmed, High Voltage Direct Current Transmission: Converters, Systems and DC Grids, Wiley, 2015.
3. Edward Wilson Kimbark, “Direct Current Transmission”, Vol.I, Wiley inter science, New York, London, Sydney,1971.
4. Chan-Ki Kim, “HVDC TRANSMISSION Power Conversion Applications in Power Systems”, John Wiley & Sons Pvt. Ltd., 2009

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1728	DISTRIBUTED GENERATION AND MICRO GRID	3	0	0	3

OBJECTIVES

- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Microgrid and its configuration

UNIT I INTRODUCTION 9

Conventional power generation: advantages and disadvantages, Energy crises, Nonconventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II DISTRIBUTED GENERATIONS (DG) 9

Concept of distributed generations, topologies, selection of sources, regulatory standards/framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

UNIT III IMPACT OF GRID INTEGRATION 9

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV BASICS OF A MICROGRID 9

Concept and definition of microgrids, micogrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrids, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids

UNIT V CONTROL AND OPERATION OF MICROGRID 9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the knowledge on the various schemes of conventional and nonconventional power generation.
- Understand the knowledge on the topologies and energy sources of distributed generation.
- Understand and analyse the requirements for grid interconnection and its impact with NCE sources
- Understand the fundamental concept of Microgrid.

TEXT BOOKS

1. Gevork B. Gharehpetian, S. Mohammad Mousavi Aga, " Distributed Generation Systems: Design, Operation and Grid Integration ", Elsevier, 2017.

2. S. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks", Institution of Engineering and Technology, 2009.

REFERENCE BOOKS

1. Amirnaser Yezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modelling, Control and Applications”, IEEE John Wiley Publications, 2010.
2. DorinNeacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006.
3. Chetan Singh Solanki, “Solar Photo Voltaics”, PHI learning Pvt. Ltd., New Delhi,2009.
4. J.F. Manwell, J.G. McGowan “Wind Energy Explained, theory design and applications”, Wiley publication 2010.
5. D. D. Hall and R. P. Grover, “Biomass Regenerable Energy”, John Wiley, New York, 1987.
6. John Twidell and Tony Weir, “Renewable Energy Resources” Taylor and Francis Publications, Second edition 2006.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1729	ENERGY RESOURCES AND UTILIZATION	3	0	0	3

OBJECTIVES

- To study the various conventional and non conventional power plants.
- To understand the principle, design of illumination systems and energy efficiency lamps.
- To understand the electric traction systems and their performances.

UNIT I ENERGY SCENARIOS 9

Global primary energy reserve - Indian Energy Scenario - Energy needs of growing economy - energy conservation and its importance

UNIT II CONVENTIONAL POWER PLANTS 9

Thermal, Hydro, Nuclear, Gas and Diesel power plants - schematic arrangement - operation - advantages & disadvantages - choice of site - environmental aspects

UNIT III RENEWABLE POWER PLANTS 9

Wind Power Plant - efficiency of wind power - classifications of wind turbine - basic components. Solar PV power Plant - basics of solar radiation - solar PV systems and their components. Biomass Energy , Geothermal, Tidal and Magneto Hydro Dynamic (MHD) power plants - basic working principle, types, features

UNIT IV UTILIZATION OF ELECTRICAL ENERGY - STATIC LOAD 9

Laws of illumination - effect of voltage variation on lamp efficiency - design of lighting schemes for different applications - factors to evaluate lighting design - Role of electric heating for industrial applications – resistance, induction, dielectric heating - electric arc furnaces. Electric welding – welding generator, welding transformer and the characteristics.

UNIT V UTILIZATION OF ELECTRICAL ENERGY - DYNAMIC LOAD 9

Merits of electric traction – requirements of electric traction system – supply systems – mechanics of train movement – traction motors and control – braking – recent trends in electric traction.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Summarize the Global and Indian energy scenarios
- Explain the basic principles of conventional power plants
- Explain the concept of GHG emission status and its controlling mechanism.
- Explain the basic principles and technologies of various Renewable energy resource based power generation
- Design lighting schemes to Domestic, Office, Industrial and Commercial applications based on the specific lighting level standards.
- Understand the Heating and Welding system for specified applications
- Understand the requirements and mechanisms of electric traction systems

TEXT BOOKS

1. Wadhwa, C.L. “Generation, Distribution and Utilization of Electrical Energy”, New Age International Pvt. Ltd, 2003

2. Sivanagaraju S et al., Generation and Utilization of Electrical Energy, Pearson Education India, 2010

REFERENCE BOOKS

1. Partab.H, “Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co, New Delhi, 2004.
2. Openshaw Taylor.E, “Utilization of Electrical Energy in SI Units”, Orient Longman Pvt. Ltd, 2003.
3. Gupta.J.B, “Utilization of Electric Power and Electric Traction”, S.K.Kataria and Sons, 2002.
4. Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
5. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council.
6. Energy Efficiency in Electric Utilities, BEE Guide Book, 2010

PROFESSIONAL ELECTIVE – V

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1821	POWER QUALITY	3	0	0	3

OBJECTIVES

To impart knowledge about the following topics:

- ✓ Causes & Mitigation techniques of various PQ events.
- ✓ Various Active & Passive power filters.

UNIT I CHARACTERISATION OF POWER QUALITY 9

Introduction – Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Nonlinear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT II ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM 9

Single phase sinusoidal, non-sinusoidal source supplying linear and nonlinear loads – Three phase Balance system – Three phase unbalanced system – Three phase unbalanced and distorted source supplying nonlinear loads – Concept of PF – Three phase three wire – Three phase four wire system.

UNIT III CONVENTIONAL LOAD COMPENSATION METHODS 9

Principle of Load compensation and Voltage regulation – Classical load balancing problem : Open loop balancing – Closed loop balancing, Current balancing – Harmonic reduction and voltage sag reduction – Analysis of unbalance – instantaneous real and reactive powers – Extraction of fundamental sequence component.

UNIT IV LOAD COMPENSATION USING DSTATCOM 9

Compensating single phase loads – Ideal three phase shunt compensator structure – Generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode.

UNIT V SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM 9

Rectifier supported Dynamic Voltage Restorer – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified Power Quality Conditioner: Configurations and characteristics.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the effects of power quality issues
- Analyse the effects though design and simulate power supplies for generic load and machine loads.
- Analyse the harmonics present in the system
- Perform various tests on power supplies and drive systems.
- Design the load compensation methods for mitigating power quality problems.

TEXT BOOKS

1. Arindam Ghosh ―Power Quality Enhancement Using Custom Power Devices‖, Kluwer Academic Publishers, 2002
2. G.T.Heydt, ―Electric Power Quality, Stars in a Circle Publications, 1994(2nd edition)

REFERENCE BOOKS

1. Barry W.Kennedy: Power Quality Primer, McGraw-Hill, New York, 2000
2. Sankaran.C: Power Quality, CRC Press, Washington D.C., 2002
3. Roger C. Dugan, Mark F. McGranaghan and H.Wayne Beaty: Electrical Power System Quality, McGraw-Hill, New York, 2nd Edition, 2002
4. Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", IEEE Press, New York, 2000
5. Arrillaga.J, Watson.N.R and Chen.S, "Power System Quality Assessment", John Wiley & Sons Ltd., England, 2000

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1822	SWITCHED MODE POWER SUPPLIES	3	0	0	3

OBJECTIVES

- To provide conceptual knowledge in modern power electronic converters and its applications in electric power utility

UNIT I BASIC DC-DC CONVERTER CIRCUITS 9

Operation and design of Buck , Boost , Buck- Boost and Cuk Converters (both CCM & DCM), Choice of switching frequency and applications.

UNIT II ISOLATED SMPS 9

Operation and design of Fly back Converter, Forward Converter, Half-Bridge and Full Bridge Converters, Push-Pull Converter and SMPS with multiple outputs.

UNIT III CONTROL ASPECTS OF SMPS 9

PWM Controllers, Isolation in feedback loop, Power Supplies with multiple output. Stability analysis using Bode Diagrams.

UNIT IV DESIGN CONSIDERATIONS OF SMPS 9

Selection of output filter capacitor, Selection of energy storage inductor, Design of High Frequency Inductor and High frequency Transformer, Selection of switches. Snubber circuit design, Design of driver circuits.

UNIT V ELECTROMAGNETIC INTERFERENCE (EMI) 9

EMI Filter Components, Conducted EMI suppression, Radiated EMI suppression, Measurement. Protection - Over current protection, over voltage protection, Inrush current protection, Thermal Model - Thermal Resistance, Cooling Considerations, Selection of Heat sinks, Simple Heat sink calculations.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand various DC-DC converter topologies
- Analyse isolated converter topologies of SMPS
- Design SMPS with multiple outputs
- Control SMPS with isolation and multiple outputs
- Understand the stability using Bode diagrams
- Design and implement the SMPS components
- Design the snubber and driver circuits of SMPS
- Design the protection circuits for SMPS

TEXT BOOKS

1. Switched Mode Power Supplies, Design and Construction, H. W. Whittington, B. W. Flynn and D. E. MacPherson, Universities Press, 2009 Edition.
2. Mohan N. Undeland . T & Robbins W., Power Electronics Converters, Application and Design. John Wiley, 3rd edition, 2002

REFERENCE BOOKS

1. Krein P.T .Elements of Power Electronics., Oxford University Press

2. M. H. Rashid, Power Electronics. Prentice-Hall of India
3. Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters. , Wiley Eastern Ltd.,1992
4. Robert. W. Erickson, D. Maksimovic .Fundamentals of Power Electronics., Springer International Edition, 2005
5. Course Material on Switched Mode Power Conversion, V. Ramanarayanan

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1823	SOLAR AND ENERGY STORAGE SYSTEMS	3	0	0	3

OBJECTIVES

- To study about solar modules and PV system design and their applications
- To deal with grid connected PV systems
- To discuss about different energy storage systems

UNIT I INTRODUCTION 9

Characteristics of sunlight – semiconductors and P-N junctions –behavior of solar cells – cell properties – PV cell interconnection.

UNIT II STAND ALONE PV SYSTEM 9

Solar modules – storage systems – power conditioning and regulation - MPPT- protection – standalone PV systems design – sizing.

UNIT III GRID CONNECTED PV SYSTEMS 9

PV systems in buildings – design issues for central power stations – safety – Economic aspect – standards and guidelines for PV systems, Efficiency and performance - International PV programs.

UNIT IV ENERGY STORAGE SYSTEMS 9

Impact of intermittent generation – Battery energy storage – solar thermal energy storage - pumped hydroelectric energy storage, introduction to super capacitors.

UNIT V APPLICATIONS 9

Water pumping – battery chargers – Electric vehicle – direct-drive applications –Space – Telecommunications.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Learn about the solar energy conversion and its applications
- Design standalone and grid connected PV system
- Understand the issues in grid connected PV systems.
- Understand the different energy storage systems

TEXT BOOKS

1. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, Applied Photovoltaics, 2007,Earthscan, UK.
2. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progensa,1994.

REFERENCE BOOKS

1. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook, CRC Press, 2011.
2. Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990
3. S.P. Sukhatme , “Solar Energy”, Tata McGraw Hill,1987.
4. Solanki C.S., “Solar Photovoltaics: Fundamentals, Technologies And Applications”, PHI Learning Pvt. Ltd., 2015.

5. R. Seyezhai and R. Ramaprabha, “Power Electronics for Renewable Energy Systems”, Scitech Publications, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1824	WIND ENERGY CONVERSION SYSTEM	3	0	0	3

OBJECTIVES

- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed and variable speed, wind energy conversion systems.
- To analyze the grid integration issues.

UNIT I INTRODUCTION 9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory - Power coefficient- Sabinin's theory-Aerodynamics of Wind turbine.

UNIT II WIND TURBINES 9

HAWT-VAWT-Power developed - Thrust-Efficiency-Rotor selection - Rotor design considerations Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS 9

Generating Systems- Constant speed constant frequency systems -Choice of Generators - Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS 9

Need of variable speed systems-Power-wind speed characteristics - Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modelling - Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS 9

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modelling issue.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Acquire knowledge on the basic concepts of Wind energy conversion system
- Understand the mathematical modelling and control of the Wind turbine
- Develop more understanding on the design of Fixed speed system
- Study about the need of Variable speed system and its modeling.
- Able to learn about Grid integration issues and current practices of wind interconnections with power system.

TEXT BOOKS

1. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990
2. S.N.Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Sytems", Oxford University Press,2010.

REFERENCE BOOKS

1. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
2. E.W.Golding “The generation of Electricity by wind power”, Redwood burn Ltd.,Trowbridge,1976.
3. N. Jenkins,” Wind Energy Technology” John Wiley & Sons,1997
4. S.Heir “Grid Integration of WECS”, Wiley 1998.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1825	MODERN POWER CONVERTERS	3	0	0	3

OBJECTIVES

- To impart knowledge about the following topics:
  - ✓ Switched mode power supplies
  - ✓ Matrix Converter
  - ✓ Soft switched converters

UNIT I AC-DC CONVERTERS 9

Switched mode AC-DC converters, Synchronous rectification - single and three phase topologies, with and without input-output isolation, switching techniques, performance indices, Design examples.

UNIT II DC-AC CONVERTERS 9

Basic concept of multilevel inverters, classification, principle of operation of Diode clamped, Flying capacitor and cascaded multilevel inverters, Modulation strategies (SPWM), single-phase Impedance source inverter.

UNIT III AC-AC CONVERTERS 9

Basic topology of matrix converter, Commutation & current path, Modulation techniques - scalar modulation, indirect modulation, Matrix converter as only AC-DC converter, AC-AC converter with DC link - topologies and operation - with and without resonance link, comparison of performance parameters of matrix converter with DC link converters.

UNIT IV SWITCHED MODE POWER SUPPLIES (SMPS) 9

Classification of DC Power supplies, Switched mode DC power supplies – with & without isolation and single & multiple outputs, closed loop control and regulation, Design examples on SMPS converters.

UNIT V RESONANT CONVERTERS 9

Resonant converters – ZVS & ZCS, L-type and M-type ZCS, ZVS resonant converters, comparison of ZVS and ZCS resonant converters, Two quadrant ZVS resonant converters – resonant dc – link inverters- evaluation of L and C for zero current switching inverter .

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the operation and need of various power converters
- Describe the role of the power converters in various applications
- Design the switched mode AC-DC converters and implement the synchronous rectification
- Acquire knowledge and design multilevel inverter topologies
- Apply various modulation control strategies to multilevel inverters
- Familiar with AC-AC Converters at system level
- Design the matrix converter and apply various modulation schemes
- Implement AC-AC converter with and without DC link
- Understand the operation of SMPS with/without isolation and single/multiple outputs
- Implement the closed loop control of SMPS
- Acquire knowledge about soft switching techniques – ZVS and ZCS

- Design and implement soft switched converters with quasi resonance

TEXT BOOKS

1. Power Electronics Handbook, M.H.Rashid, Academic press, New york, 2000.
2. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press, NewYork, 2004.

REFERENCE BOOKS.

1. Control in Power Electronics: Selected Problems, Marian P.Kazmierkowski, R.Krishnan and Frede Blaabjerg, Academic Press (Elsevier Science), 2002.
2. Power Electronic Circuits, Issa Batarseh, John Wiley and Sons, Inc.2004.
3. Power Electronics for Modern Wind Turbines, Frede Blaabjerg and Zhe Chen,Morgan & Claypool Publishers series, United States of America, 2006.
4. Krein Philip T, Elements of Power Electronics,Oxford University press, 2008
5. Agarwal, Power Electronics: Converters, Applications, and Design, 3rd edition, Jai P, Prentice Hall,2000
6. L. Umanand, Power Electronics: Essentials & Applications, John Wiley and Sons, 2009.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1826	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	3	0	0	3

OBJECTIVES

- To provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms

UNIT I INTRODUCTION 9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Geothermal and Hydrogen energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS 9

Solar: Block diagram of solar photovoltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters. Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS 9

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues, Grid standards -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Types of Hybrid system- Case studies of Wind-PV, Maximum Power Point Tracking (MPPT).

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Learn about the electrical machines and modern power converters for renewable energy power harnessing.
- Analyse and comprehend the various operating modes of wind electrical generators and solar photovoltaic systems.
- Equip with required skills to derive the criteria for the design of power converters for Renewable energy applications.
- Develop maximum power point tracking algorithms

TEXT BOOKS

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. R.Seyezhai and R.Ramaprabha, “Power Electronics for Renewable Energy Systems”, Scitech Publications, 2015.

REFERENCE BOOKS

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Rai. G.D,” Solar energy utilization”, Khanna publishes, 1993.
3. Rai. G.D,” Solar energy utilization”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
5. B.H.Khan, "Non-conventional Energy sources", Tata McGraw-hill Publishing Company, New Delhi, 2009.
6. B.H.Khan, " Non-conventional Energy sources", Tata McGraw-hill Publishing Company.
7. P.S.Bimbhra,“Power Electronics”,Khanna Publishers, 3rd Edition,2003.
8. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013.
9. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
10. Andrzej M. Trzynnadlowski, ‘Introduction to Modern Power Electronics’, Second edition, wiley

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1827	POWER SYSTEM TRANSIENTS	3	0	0	3

OBJECTIVES

- To impart knowledge about the following topics:
  - ✓ Generation of switching transients and their control using circuit – theoretical concept.
  - ✓ Mechanism of lighting strokes and the production of lighting surges.
  - ✓ Propagation, reflection and refraction of travelling waves.
  - ✓ Voltage transients caused by faults, circuit breaker action, load rejection on integrated power system

UNIT I INTRODUCTION 9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS 9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT III LIGHTNING TRANSIENTS 9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires – tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE 9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram – standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults –switching surges on integrated system Qualitative application of EMTP for transient computation

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Classify the different types and causes of power system transients and study the effect of transients on power systems
- Understand the generation of switching transients and their control using circuit – theoretical concept.

- Study the mechanism of lighting strokes and the production of lighting surges.
- Analyse the propagation, reflection and refraction of travelling waves.
- Analyse the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

TEXT BOOKS

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2ndEdition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.

REFERENCE BOOKS

1. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.
2. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', McGraw Hill, Fifth Edition, 2013.
3. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
4. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
5. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.
6. Akihiro ametani," Power System Transient theory and applications", CRC press, 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1828	POWER SYSTEM DYNAMICS	3	0	0	3

OBJECTIVES

- To impart knowledge about the following topics:
  - ✓ Basics of dynamics and stability problems
  - ✓ Modeling of synchronous machines
  - ✓ Excitation system and speed-governing controllers.
  - ✓ Small signal stability of a single-machine infinite bus system with excitation system and power system stabilizer.
  - ✓ Transient stability simulation of multi machine power system.

UNIT I INTRODUCTION 9

Basics of system dynamics – numerical techniques – introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design – distinction between transient and dynamic stability - complexity of stability problem in large system – necessity for reduced models - stability of interconnected systems.

UNIT II SYNCHRONOUS MACHINE MODELLING 9

Synchronous machine - flux linkage equations - Park's transformation - per unit conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants. Simplified models (one axis and constant flux linkage) - steady state equations and phasor diagrams.

UNIT III MACHINE CONTROLLERS 9

Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit. Function of speed governing systems - block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines.

UNIT IV TRANSIENT STABILITY 9

State equation for multi machine system with one axis model and simulation – modelling of multi machine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer. For all simulations, the algorithm and flow chart have to be discussed.

UNIT V DYNAMIC STABILITY 9

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact – linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation - supplementary stabilizing signals – dynamic performance measure - small signal performance measures.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the basics of dynamics and stability problems modeling of synchronous machines

- Analyse the need and study the operation of the excitation system and speed-governing controllers.
- Analyse the small signal stability of a single-machine infinite bus system with excitation system and power system stabilizer.
- Analyse the transient stability simulation of multi machine power system.
- Model and Analyse the dynamic stability of synchronous machine in power system.

TEXT BOOKS

1. P.M. Anderson and A.A.Fouad, 'Power System Control and Stability', Galgotia Publications, New Delhi, 2003.
2. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc., USA, 1994.

REFERENCE BOOKS

1. M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.
2. R.Ramanujam, "Power System Dynamics – Analysis and Simulation", PHI, 2009.
3. James A.Momoh, Mohamed. E. EI-Hawary. " Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.
4. C.A.Gross, "Power System Analysis," Wiley India, 2011.
5. B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac," Electric Power Systems", Wiley India, 2013.
6. K.Umarao, "Computer Techniques and Models in Power System," I.K. International, 2007.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1829	FLEXIBLE AC TRANSMISSION SYSTEMS	3	0	0	3

OBJECTIVES

- To impart knowledge about the following topics:
  - ✓ The start-of-art of the power system
  - ✓ Performance of power systems with FACTS controllers.
  - ✓ FACTS controllers for load flow and dynamic analysis

UNIT I INTRODUCTION 9

Control of power flow in AC transmission line - analysis of uncompensated line - passive reactive power compensation: effect of series and shunt compensation on power transfer capability - need for FACTS controllers - classification of FACTS controllers.

UNIT II STATIC VAR COMPENSATOR (SVC) 9

Analysis of Thyristor Controlled Reactor (TCR) - configuration of SVC - voltage control by SVC - modelling of SVC for load flow and transient stability studies - design of SVC voltage regulator based on the concept of system gain - Applications: transient stability enhancement - power oscillation damping and prevention of voltage instability.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) 9

Need for controlled series compensation - modes of operation of TCSC - modelling of TCSC for load flow and transient stability studies - applications of TCSC.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Operation of Static Synchronous Compensator (STATCOM) and Static Synchronous Series Compensator (SSSC) - power flow control with STATCOM and SSSC - modes of operation in Unified Power Flow Controller (UPFC) - applications.

UNIT V CO-ORDINATION OF FACTS CONTROLLERS 9

Controller interactions - SVC–SVC interaction - Co-ordination of multiple controllers using linear control techniques - Control co-ordination using Genetic Algorithm (GA).

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the need for reactive power compensation and FACTS controllers in AC transmission system
- Classify the various FACTS controllers under certain sub-categories based on the power electronic components and connection
- Analyze the voltage regulation in power system using SVC
- Model SVC for power system studies and design SVC voltage regulator
- Analyse the various application of SVC
- Analyse the need for series compensation and operation of TCSC
- Analyse the need and operation of Voltage Source Converter based FACTS controllers
- Analyze the FACTS controller interaction and control coordination

TEXT BOOKS

1. R. Mohan Mathur, Rajiv K.Varma,"Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2002.

2. NarainG. Hingorani, “Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors,Delhi-110006,2011.

REFERENCE BOOKS

1. T.J.E Miller, Power Electronics in power systems, John Wiley and sons.
2. K.R. Padiyar, ”FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Limited, Publishers, New Delhi, 2008.
3. A.T.John,“FlexibleA.C.TransmissionSystems”,InstitutionofElectricalandElectronic Engineers(IEEE), 1999.
4. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1831	POWER SYSTEMS PLANNING AND RELIABILITY	3	0	0	3

OBJECTIVE

- To acquire skills in planning and building reliable power system

UNIT I LOAD FORECASTING & BASICS OF SYSTEM PLANNING 9

Classification and characteristics of loads - approaches to load forecasting - Forecasting methodology - Energy forecasting - Introduction to system planning: Short, Medium and Long Term planning - reactive power planning.

UNIT II FUNDAMENTALS OF POWER SYSTEM RELIABILITY 9

Concepts, Terms and Definitions - outage, failure rate, and outage rate availability, unavailability - Reliability models - Morkov process Reliability function - Mean time to failure

UNIT III GENERATION PLANNING AND RELIABILITY EVALUATION 9

Factors affecting generation planning, , loss of load probability methods, loss of energy probability method. Frequency and duration methods, load forecasting uncertainty.

UNIT IV COMPUTATION OF OPERATING RESERVE 9

Importance of operating reserve - Computational methods: PJM method, Modified PJM method - Security function approach - Response risk - Effect of distributing spinning reserve, Effect of hydro-electric units

UNIT V DISTRIBUTION SYSTEM PLANNING AND RELIABILITY EVALUATION 9

Radial Networks, Network Reconfiguration, Evaluation Techniques, Interruption Indices, Distribution Reliability Indices, Parallel & Meshed Networks, Bus Bar Failure, Scheduled Maintenance, Temporary and Transient Failure, Breaker Failure

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand Load Growth Characteristics and forecasting techniques
- Understand the various types of planning involved in power system
- Understand the fundamentals tools involved in power system reliability
- Apply Markov process in as a reliability tool.
- Understand the concepts involved in generation planning and reliability evaluation
- Analyse probability method for generation planning and evaluation
- Understand the concept of operation reserve and security approach
- Understand distribution planning and its reliability

TEXT BOOKS

1. Sullivan, R.L., 'Power System Planning', Heber Hill, 1987.
2. Roy Billington, 'Power System Reliability Evaluation', Gordan & Breach Scain Publishers, 1990.

REFERENCE BOOKS

1. Eodrenyi, J., 'Reliability modelling in Electric Power System' John Wiley, 1980.
2. X. Wang & J.R. McDonald, "Modern Power System Planning", McGraw Hill Book Company 1994.
3. T. Gonen, "Electrical Power Distribution Engineering", McGraw Hill Book Company, 1986.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1832	ADVANCED POWER SYSTEM PROTECTION	3	0	0	3

OBJECTIVES

- To illustrate concepts of protection against over voltages
- To describe concepts of pilot wire and carrier protection
- To familiarize the concepts of microprocessor based protective relays

UNIT I PROTECTION AGAINST OVER VOLTAGES 9

Generation of over voltages in power systems - lightning, switching, insulation failure, arcing grounds. Protection of Transmission lines, Stations and Sub-Stations against direct lightning over voltage - Methods of protection - Earthing screen, Ground wires, Valve type and Zinc-Oxide Lightning Arresters. Protection against travelling waves - Surge absorber. Peterson coil - insulation coordination.

UNIT II PILOT WIRE AND CARRIER PROTECTION 9

Circulating current scheme, Balanced Voltage scheme, Translay scheme. Half wave comparison scheme – Phase comparison carrier current protection – carrier transfer scheme – carrier blocking scheme.

UNIT III STATIC RELAYS 9

Overview, Merits Demerits and Basic components of solid state relays, Classification of static relays, Relays as comparators- Amplitude and Phase comparison schemes - General equation of comparators for different types of relays, Duality of comparators. Basic static relays used in protective scheme - Static Over current, Differential, Distance, Directional Relays (Principle and Block diagram only).

UNIT IV MICROPROCESSOR BASED PROTECTIVE RELAYS 9

Over current, directional, impedance, reactance relays. Generalized mathematical expressions for distance relays, mho and offset mho relays, quadrilateral relay. Microprocessor implementation of digital distance relaying algorithms. Microprocessor Based Relay-Block diagram and flow chart of Over current Relay.

UNIT V NUMERICAL RELAYS 9

Introduction, block diagram of numerical relay, sampling theorem, anti aliasing filter, block diagram of phasor measurement unit and intelligent electronic device, data acquisition systems and numerical relaying algorithms, applications and numerical problems.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the concepts of protection against over voltages
- Handle modern power system relaying systems.

TEXT BOOKS

1. Badri Ram, Vishwakarma, ‘Power System Protection and Switchgear’, Tata McGraw Hill, 2001.
2. Paithankar, S R Bhide, “Fundamentals of Power System Protection”, PHI, 1st Edition, 2003.

REFERENCE BOOKS

1. Rao S.S. "Switchgear and Protection",13th ed. Khanna Publishers: Delhi; 2007.
2. Ravindranath B., and Chander N., "Power System Protection & Switchgear", Wiley Eastern Ltd., 1977.
3. Oza, Nair, Mehta and Makwana, “Power System Protection and Switchgear”, Tata McGraw- Hill.
4. T. S. Madhava Rao (2008), Power System Protection Static Relays, 2nd edition, Tata McGraw Hill Publications, New Delhi.
5. Stanley Horowitz, “Protective Relaying for Power System II”,IEEE press , New York, 2 nd Edition, 2008
6. T.S.M. Rao, “Digital Relay / Numerical relays”, Tata McGraw Hill, New Delhi, 1989.

OPEN ELECTIVES - ODD SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1941	ENERGY STORAGE SYSTEMS FOR E-MOBILITY	3	0	0	3

OBJECTIVES

- To present an overview of Electric Vehicle (EV), Hybrid Electric vehicle (HEV) and their architecture.
- To demonstrate the basics of energy storage systems such as battery, super capacitor, fuel cell and hydrogen storage systems.
- To familiarize the standards for battery testing and design of battery management systems.

UNIT I INTRODUCTION TO STORAGE & ELECTRIC VEHICLES 9

General background on alternative energy sources & sustainability - Overview of energy storage systems – Introduction to electric based transportation, Overview of electric vehicles, Vehicle dynamics, sizing components, Fuel economy, emissions & electric mileage calculations – Applications –Land, space and marine**.**

UNIT II SYSTEM COMPONENTS OF EV & HEV 9

Classification of electric vehicles (EV) - General architecture, Layout & System components. HEV system modelling - Modelling of Combustion engine, Electric motor, Battery storage, Transmission system – Modelling of multimode electrically variable transmission – Lever analogy – Modelling of Vehicle body, Final drive & wheel and driver, Performance analysis – test driving cycles.

UNIT III BATTERY STORAGE SYSTEMS 9

Principle of operation of Lithium ion battery, battery components & design, electrode, battery modules & packs, Advanced batteries, double layer & super capacitors for transportation applications, Design of battery & super capacitors for large vehicles.

UNIT IV FUEL CELL AND HYDROGEN STORAGE SYSTEMS 9

Introduction to fuel cell – Types, Operation, Modelling & characteristics, proton exchange membrane (PEM) fuel cell for E-mobility, solid oxide fuel cell – Design of Fuel cell vehicles.

Hydrogen storage system – solid state hydrogen storage tanks, gas phase hydrogen storage tanks, cryogenic & liquid phase hydrogen storage tanks.

UNIT V BATTERY TESTING & MANAGEMENT SYSTEMS 9

Charging methods of battery – constant voltage, constant current and hybrid – Battery power testing for various vehicles - Battery management system & controls – Active & passive cooling of battery - Battery life & safety impacts – Code & standards

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand the concept of electric vehicle and energy storage systems.
- Describe the working and components of Electric Vehicle and Hybrid Electric Vehicle.
- Illustrate the operation of storage systems such as battery and super capacitors.

- Analyze the various energy storage systems based on fuel cells and hydrogen storage.
- Design and develop the battery management systems.

TEXTBOOKS

1. Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
2. Iqbal Hussain, 'Electric and Hybrid Vehicles: Design Fundamentals, Second Edition', CRC Press, Taylor & Francis Group, Second Edition (2011).

REFERENCE BOOKS

1. James Larminie, John Lowry, 'Electric Vehicle Technology Explained', Wiley, 2003.
2. Sheldon S. Williamson, 'Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles', Springer, 2013.
3. C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press, 2001.
4. Mehrdad Ehsani, YiminGao, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', Second Edition, CRC Press, 2010.
5. Chris Mi, M. Abul Masrur, David Wenzhong Gao, 'Hybrid Electric Vehicles Principles And Applications With Practical Perspectives', Wiley Publication, 2011.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1942	SENSORS AND INSTRUMENTATION	3	0	0	3

OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems.

UNIT I INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis –Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers– Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Selection of sensors– calibration methods– Sensor Output Signal Types. Instrumentation Standards - significance of codes and standards

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gauge, Load Cell, Magnetic Sensors – types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor, Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure –Diaphragm, Bellows, Piezo resistive pressure sensor-Resonator pressure sensor -Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors- Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING and DAQ SYSTEMS 9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL: 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Familiar with various calibration techniques and signal types for sensors.
- Apply the various sensors in the Automotive applications
- Describe the working principle and characteristics of force, magnetic and heading sensors.
- Understand the basic principles of various pressure and temperature, smart sensors.
- Implement the DAQ systems with different sensors for real time applications.

TEXT BOOKS

1. Ernest O Doebelin, 'Measurement Systems – Applications and Design', Tata McGraw-Hill, 2009.
2. Sawney A K, Puneet Sawney, 'A Course in Mechanical Measurements and Instrumentation and Control', 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES

1. Patranabis D, 'Sensors and Transducers', 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, 'Instrumentation for Engineers and Scientists', Oxford Science Publications, 1999.
3. Richard Zurawski, 'Industrial Communication Technology Handbook', 2nd edition, CRC Press, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1943	FUNDAMENTALS OF MANUFACTURING AND AUTOMATION	3	0	0	3

OBJECTIVES

- Classify automated material handling, automated storage and retrieval systems.
- Acquire the fundamental concepts of automated flow lines and their analysis.
- Describe the basic concepts systems of automation in manufacturing systems.
- Illustrate adaptive control systems and automated inspection methods.

UNIT I MATERIAL HANDLING, TRANSPORT & STORAGE **9**

Overview of Material Handling Systems - Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.

UNIT II MANUFACTURING SYSTEMS & PLANNING **9**

Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines & Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly

UNIT III INTRODUCTION TO FUNDAMENTALS OF AUTOMATION **9**

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity

UNIT IV INDUSTRIAL CONTROL & COMPONENTS OF CONTROL **9**

Industrial Control Systems, Process Industries Verses Discrete - Manufacturing, Industries Continuous Verses Discrete Control, Computer Process and its Forms. Sensors Actuators and other Control System Components.

UNIT V EVALUATION OF AUTOMATION PRODUCTION **9**

Orientation devices - active and passive devices, parts orientation and escapement.

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Understand modern manufacturing operations, including their capabilities, limitation and how to design for lowest cost.
- Analyse, design, implement and maintaining practical, mechanical and manufacturing systems.
- Understand communicate effectively and work well on team-based engineering projects.
- Succeed in manufacturing and mechanical engineering technology positions.

TEXT BOOKS

1. M.P. Groover, 'Automation, Production Systems and Computer integrated Manufacturing', Pearson Education.
2. W. P. David, John, 'Industrial Automation', Wiley and Sons.

REFERENCES

1. R.C. Dorf, John, 'Hand book of design, manufacturing and Automation', Wiley and Sons.
2. Krishna Kant, 'Computer Based Industrial Control', EEE- PHI

OPEN ELECTIVES OFFERED - EVEN SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1041	CYBER SECURITY IN SMART GRID	3	0	0	3

OBJECTIVES

- To develop network architecture for generation, transmission, and distribution of smart grid
- To address various threats with respect to the consumers and utilities
- To implement the security control of the smart grid
- To understand various cyber security standards and regulations
- To explain the various challenges for the future development of the smart grid

UNIT I INTRODUCTION 9

History of electrical grid – Bulk and distributed generation architectures – Transmission and distribution architectures – Metering Architecture – Micro grid – System interdepandicies.

UNIT II THREATS AND IMPACTS 9

Consumers – Naturally occurring threats – Individual and Organizational threats – Impacts on consumers & availability – Financial impact

Utility Companies – Confidentiality: Consumer privacy – Proprietary information: Integrity – Service fraud and Sensor data manipulation: Availability: Consumer targets – Organizational targets – Vertical targets – Market manipulation – National security target

UNIT III SECURING THE SMART GRID 9

Implementation of security control – establishing boundaries and zone separation – protecting data – Situational awareness

UNIT IV STANDARDS AND REGULATIONS 9

NISTIR 7628 Smart Grid cyber security architecture - EU M/490 and the SGCG reference architecture for the Smart Grid - IEEE 2030-2011 - ISA-62443: zones and conduits and Smart Grids

UNIT V FUTURE CHALLENGES 9

Challenge of making predictions – value of personal data – cyber security for the future – counter measures

TOTAL : 45 PERIODS

OUTCOMES

After completing this course, the students will be able to

- Design the network architecture behind generation, transmission, and distribution within the smart grid
- Device the safety control of the smart grid
- Explain various cyber security standards and regulations imposed by governments and industry from “best practices” recommendations

TEXT BOOKS

1. Tony Flick, Justin Morehouse, Christophe Veltsos, ‘Securing the Smart Grid’, Elsevier, Syngress, 2011.
2. Eric D. Knapp, Raj Samani, ‘Applied Cyber Security and the Smart Grid’, Elsevier, Syngress, 2013.

3. Eric D. Knapp, James Broad, 'Industrial Network Security', Elsevier, Syngress, 2011.

REFERENCE BOOKS

1. The Smart Grid Interoperability Panel – Cyber Security Working Group Guidelines for Smart Grid Cyber Security: Vol. 1, Smart Grid Cyber Security Strategy, Architecture, and High-Level Requirements, August 2010.
2. The Smart Grid Interoperability Panel – Cyber Security Working Group Guidelines for Smart Grid Cyber Security: Vol. 2, Privacy and the Smart Grid, August 2010.
3. The Smart Grid Interoperability Panel – Cyber Security Working Group Guidelines for Smart Grid Cyber Security: Vol. 3, Supportive Analyses and References, August 2010.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1042	FEA AND CAD FOR ENGINEERS	3	0	0	3

OBJECTIVES

- To understand the principles of finite element method
- To familiarize the design and analysis of electromagnetic devices and actuators using finite element analysis based computer aided design packages
- To understand the concepts of thermal and structural analysis using finite element analysis based computer aided design packages

UNIT I INTRODUCTION 9

Conventional design procedures – Limitations – Need for field analysis based design – Review of Basic principles of energy conversion – Development of Torque/Force.

UNIT II MATHEMATICAL FORMULATION OF FIELD PROBLEMS 9

Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in Electric and Magnetic fields – Capacitance - Inductance- Laplace and Poisson's Equations – Energy functional.

UNIT III PHILOSOPHY OF FEM 9

Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization – Variational method- 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

UNIT IV FEM CAD PACKAGES 9

Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions – Setting up solution – Post processing.

UNIT V DESIGN APPLICATIONS 9

Design and analysis of solenoid actuator-Design and analysis of reluctance motor-structural and thermal analysis using finite element package.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Describe the principles of energy conversion and need for finite element analysis based design
- Outline the basics of finite difference and finite element method
- Describe the procedure involved in modelling and simulation of devices and actuators using finite element analysis based computer aided design package
- Design and analyse

TEXT BOOKS

1. S.J Salon, 'Finite Element Analysis of Electrical Machines', Springer, Yes DEE publishers, Indian reprint, 2007.
2. Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor & Francis, 2005.

REFERENCES

1. Joao Pedro, A. Bastos and Nelson Sadowski, 'Electromagnetic Modeling by Finite

Element Methods', Marcell Dekker Inc., 2003.
2. P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press,1983.
3. D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986.
4. S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices',Elsevier, New York, 1989.
5. User Manuals of MAGNET, MAXWELL & ANSYS Softwares.

COURSE CODE	COURSE TITLE	L	T	P	C
UEE1043	RENEWABLE ENERGY SYSTEMS	3	0	0	3

OBJECTIVES:

- To explain concept of various forms of renewable energy
- To introduce the division aspects and utilization of renewable energy sources for both domestics and industrial applications
- To discuss the environmental and cost economics using renewable energy sources

UNIT I INTRODUCTION 9

World energy use – Reserves of energy resources – Environmental aspects of energy utilization – Renewable energy scenario in India – Potentials – Achievements – Applications.

UNIT II SOLAR ENERGY 9

Solar thermal – Flat plate and concentrating collectors – Solar heating and cooling techniques –
Solar desalination – Solar cooker – Solar thermal power plant – Solar photo voltaic conversion –
Solar cells – PV applications.

UNIT III WIND ENERGY 9

Wind data and energy estimation – Types of wind energy systems – Performance – Details of wind turbine generator – Safety and Environmental Aspects.

UNIT IV BIOMASS ENERGY 9

Biomass direct combustion – Biomass gasifier – Biogas plant – Ethanol production –Bio diesel –
Cogeneration –Biomass applications.

UNIT V OTHER RENEWABLE ENERGY SOURCES 9

Tidal energy – Wave energy – Open and closed OTEC Cycles – Small hydro – Geothermal energy – Fuel cell systems.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the Environmental aspects of energy utilization and Renewable energy scenario
- Illustrate the various applications of solar energy
- Discuss the concepts of types and performance of wind energy systems
- Analyze the processes of biomass
- Analyze the process of other possible renewable energy sources

TEXT BOOKS

1. Rai G.D., 'Non-Conventional Energy Sources', Khanna Publishers,1999.
2. Khan B.H., 'Non-Conventional Energy Resources', Tata McGraw Hill Publishing Company Ltd., 2006.

REFERENCE BOOKS

1. Godfrey Boyle, 'Renewable Energy, Power for a Sustainable Future', Oxford University Press, 1996.
2. Twidell J.W. and Weir, 'Renewable Energy Sources', EFN Spon Ltd, 1996.
3. Tiwari, 'Solar Energy – Fundamentals Design, Modelling and applications', Narosa Publishing House, 2002.
4. Freris L.L., 'Wind Energy Conversion systems', Prentice Hall, 1990.
5. Sukhatme S.P., 'Solar Energy', Tata McGraw Hill Publishing Company Ltd., 1997.