COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHEME & SYLLABUS
(I – VIII Semesters)

B. TECH
IN
ELECTRICAL&ELECTRONICS ENGINEERING

(2019 Admission onwards)

SEMESTER I [Stream A]

***Stream A*:** Civil Engineering, Electrical and Electronics Engineering, Mechanical Engineering and Safety and Fire Engineering.

Code No.	Subject	L Hrs /Wk	T Hrs /Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-200-0101A	Computer Programming	3	1	0	3	40	60	100
19-200-0102A	Engineering Chemistry	3	1	0	3	40	60	100
19-200-0103A	Engineering Graphics	2	1	3	3	40	60	100
19-200-0104A	Basic Electrical Engineering	3	0	0	3	40	60	100
19-200-0105A	Basic Electronics Engineering	3	0	0	3	40	60	100
19-200-0106A	Environmental Studies	3	1	0	3	40	60	100
19-200-0107A	Electrical Engineering Workshop	0	0	3	1	25	25	50
19-200-0108A	Computer Programming Laboratory	0	0	3	1	25	25	50
	TOTAL	**17**	**4**	**9**	**20**			

CA – Continuous Assessment, SEE – Semester EndExamination

SEMESTER II [Stream A]

Code No.	Subject	L Hrs /Wk	T Hrs/ Wk	P/D Hrs/ Wk	C	Marks		Total
						CA	SEE	
19-200-0201A	Calculus	3	1	0	3	40	60	100
19-200-0202A	Engineering Physics	3	1	0	3	40	60	100
19-200-0203A	Engineering Mechanics	4	1	0	3	40	60	100
19-200-0204A	Basic Civil Engineering	3	0	0	3	40	60	100
19-200-0205A	Basic Mechanical Engineering	3	0	0	3	40	60	100
19-200-0206A	Soft Skills Development	2	1	0	2	50	-	50
19-200-0207A	Civil Engineering Workshop	0	0	3	1	25	25	50
19-200-0208A	Mechanical Engineering Workshop	0	0	3	1	25	25	50
19-200-0209A	Language Lab	0	0	1	1	25	25	50
19-200-0210A	NSS/Nature conservation Activities	0	0	1	0	-	-	-
	TOTAL	**18**	**4**	**8**	**20**			

SEMESTER III

Code No.	*Subject*	**L Hrs/ Wk**	**T Hrs/ Wk**	**P/ D Hrs/ Wk**	*C*	*Marks*		*Total*
						CA	*SEE*	
19-200-0301*	Linear Algebra & Transform Techniques*	3	1	0	3	40	60	100
19-209-0302	Electrical Machines I	3	1	0	3	40	60	100
19-209-0303	Circuits and Networks	3	1	0	3	40	60	100
19-209-0304	Electrical Measurements & Measuring Instruments	3	1	0	3	40	60	100
19-209-0305	Electronic Devices and Circuits	3	1	0	3	40	60	100
19-209-0306	Electrical Engineering Materials	3	1	0	3	40	60	100
19-209-0307	Electronics Circuits Lab	0	0	3	1	25	25	50
19-209-0308	Electrical Measurements Lab	0	0	3	1	25	25	50
TOTAL		**18**	**6**	**6**	**20**			

*Common to all branches

SEMESTER IV

Code No.	*Subject*	**L Hrs/ Wk**	**T Hrs/ Wk**	**P/D Hrs / Wk**	*C*	*Marks*		*Total*
						CA	*SEE*	
19-200-0401*	Complex Variables and Partial Differential Equations*	3	1	0	3	40	60	100
19-209-0402	Circuits, Signals & Systems	3	1	0	3	40	60	100
19-209-0403	Electrical Machines II	3	1	0	3	40	60	100
19-209-0404	Power Electronics	3	1	0	3	40	60	100
19-209-0405	Digital Electronics	3	1	0	3	40	60	100
19-209-0406	Electromagnetic field Theory	3	1	0	3	40	60	100
19-200-0407*	Universal Human Values*	3	0	0	3	50	0	50
19-209-0408	Digital Electronics Lab	0	0	3	1	25	25	50
19-209-0409	Electrical Machines Lab I	0	0	3	1	25	25	50
TOTAL		**21**	**6**	**6**	**23**			

*Common to all branches

SEMESTER V

Course Code	*Subject*	L Hrs/ Wk	T Hrs / Wk	P/D Hrs / Wk	*C*	*Marks*		*Total*
						CA	SE E	
19-200-0501*	Numerical and Statistical Methods*	3	1	0	3	40	60	100
19-209-0502	Control System I	3	1	0	3	40	60	100
19-209-0503	Microprocessor and Microcontroller Based systems	3	1	0	3	40	60	100
19-209-0504	Power Systems I	3	1	0	3	40	60	100
19-209-0505	Linear Integrated Circuits	3	1	0	3	40	60	100
19-209-050**	Professional Elective I	3	1	0	3	40	60	100
19-209-0511	Electrical Machines Lab II	0	0	3	1	25	25	50
19-209-0512	Microprocessor & Microcontroller Lab	0	0	3	1	25	25	50
TOTAL		**18**	**6**	**6**	**20**			

*Common to all branches

CA – Continuous Assessment, SEE – Semester End Examination

19-209-0506 to 19-209-0509 Professional Elective – I	
Code No.	**Subject**
19-209-0506(IE)	Introduction to Machine Learning
19-209-0507	Special Electric Machines
19-209-0508	Advanced Power Electronics
19-209-0509	Electrical Safety
19-209-0510	Fluid Machinery and Heat Engines

SEMESTER VI

Course Code	*Subject*	L Hrs /Wk	T Hrs/ Wk	P/D Hrs / Wk	*C*	*Marks*		*Tota l*
						CA	*SEE*	
19-209-0601	Electric Drives	3	1	0	3	40	60	100
19-209-0602	Digital Signal Processing	3	1	0	3	40	60	100
19-209-0603	Power Systems II	3	1	0	3	40	60	100
19-209-0604	Electrical Drawing	3	1	0	3	40	60	100
19-209-0605	Control Systems II	3	1	0	3	40	60	100
19-209-06**	Professional Elective II	3	1	0	3	40	60	100
19-209-0610	Linear Integrated Circuits Lab	0	0	3	1	25	25	50
19-209-0611	Mini Project	0	0	3	1	25	25	50
TOTAL		**18**	**6**	**6**	**20**			

19-209-0606 to 19-209-0609 Professional Elective – II	
Code No.	**Subject**
19-209-0606(IE)	Industrial Automation
19-209-0607	Embedded Systems
19-209-0608	Soft Computing
19-209-0609	Electrical Machine Design

SEMESTER VII

Course Code	*Subject*	**L Hrs/ Wk**	**T Hrs / Wk**	**P/D Hrs / Wk**	*C*	*Marks*		*Total*
						CA	*SEE*	
19-209-0701*	Principles of Management*	3	1	0	3	40	60	100
19-209-0702	HVDC and FACTS	3	1	0	3	40	60	100
19-209-0703	Communication Engineering	3	1	0	3	40	60	100
19-209-07**	Professional Elective III	3	1	0	3	40	60	100
19-209-07**	Open Elective I	3	0	0	3	40	60	100
19-209-0712	Power Electronics Lab	0	0	3	1	25	25	50
19-209-0713	Advanced Electrical Engineering Lab	0	0	3	1	25	25	50
19-209-0714	Entrepreneurship Development	0	0	2	1	50	-	50
19-209-0715	Project Phase I	0	0	3	1	50	-	50
19-209-0716**	Industrial Internship**	0	0	0	1	50	-	50
TOTAL		**15**	**4**	**11**	**20**			

*common for CS/EC/EE/IT

19-209-0704 to 19-209-0707 Professional Elective – III	
Code No.	*Subject*
19-209-0704(IE)	Electric and Hybrid Vehicles
19-209-0705	Digital Control System
19-209-0706	Energy Auditing and Analysis
19-209-0707	Dynamics of Electric Machines

19-209-0708 to 19-209-0711 Open Elective – I	
Code No.	*Subject*
19-209-0708***	Universal Human Values-Undivided Society and Human Order***
19-209-0709	New and Renewable Sources of Energy
19-209-0710	IoT System Design
19-209-0711	Research Methodology

*** Common to EC and EE

SEMESTER VIII

Course Code	*Subject*	**L Hrs /Wk**	**T Hrs /Wk**	**P/D Hrs/ Wk**	***C***	***Marks***		***Total***
						CA	***SE E***	
19-209-0801	Electrical System Design	3	1	0	3	40	60	100
19-209-08**	Professional Elective IV	3	1	0	3	40	60	100
19-209-08**	Professional Elective V	3	1	0	3	40	60	100
19-209-08**	Open Elective II	3	0	0	3	40	60	100
19-209-0815	Seminar	0	0	3	1	50	-	50
19-209-0816	Project Phase II	0	0	12	6	200	-	200
19-209-0817	Comprehensive Viva-Voce	0	0	0	1	-	50	50
TOTAL		**12**	**3**	**15**	**20**			

19-209-0802 to 19-209-0805 Professional Elective – IV	
Code No.	Subject
19-209-0802	Electronic Instrumentation
19-209-0803	Artificial Intelligence and Robotics
19-209-0804	Solar PV Systems
19-209-0805	Power Quality

19-209-0806 to 19-209-0809 Professional Elective – V	
Code No.	Subject
19-209-0806	Utilization of Electrical Power
19-209-0807	Power System Operation and Control
19-209-0808	Digital Simulation of Power Electronic Systems
19-209-0809	Smart Grid Technologies and Applications

19-209-0810 to 19-209-0813 Open Elective – II	
Code No.	Subject
19-209-0810	Statistical Methods for Engineers
19-209-0811	Optimization Techniques and Algorithm
19-209-0812	Sustainability Engineering
19-209-0813***	Self Awareness and Integral Development***
19-209-0814*	Constitutional Law*

*** Common to EC and EE

*Common to all branches

Industry based Electives

Industry based Electives are offered in 5 th , 6 th and 7 th Semesters and are listed among the Professional Electives with notation (IE) along with the subject code. A student should opt for at least one Industry based elective during the B.Tech. programme.

Open Electives:

Open Electives are offered in 7 th and 8 th Semesters. A student should opt for at least one Open Elective offered by any Division other than their branch of study.

Industrial Internship:

Industrial Internship of a minimum duration of 2 weeks must be completed after 4 th Semester and before commencement of 7 th Semester. The evaluation of internship will be conducted along with Project Phase I.

Evaluation Pattern for Theory and Practical courses

1. **Theorycourses**

   Type of Questions for Semester End Examination (SEE)

PART - A (8 x 3 = 24 marks)

Question No. I (a) to (h) – Eight short answer questions of 3 marks each with two questions from each of the four modules.

PART - B (4 x 12 = 48 marks)

Question nos. II, III with sub sections(a),(b)----------12 marks each with option toanswer either II or III from Module I.

Question nos. IV, V with sub sections(a),(b)----------12 marks each with optiontoanswer either IV or V from Module II.

Question nos. VI, VII with sub sections(a),(b)----------12 marks each with option toanswer either VI or VII from Module III.

Question nos. VIII, IX with sub sections(a),(b)----------12 marks each with option toanswer either VIII or IX from Module IV.

The maximum marks that can be awarded for the Semester End Examination (SEE) will be only 60, even though the questions are for 72 marks.

2. **Practical courses**

   50% marks is earmarked for Continuous Evaluation, and 50% marks for Semester End Examination. The Semester End Examination to be conducted by a minimum of two examiners – one, not below the rank of an Associate Professor.

3. **Pass Requirements**
   A candidate has to obtain a minimum of 50% marks for continuous assessment and semester end examination put together with a minimum of 40% marks in the semester end examination for a pass in theory and laboratory courses.

   In the case of theory/laboratory/other courses having only continuous assessment, a candidate has to obtain a minimum of 50% marks in continuous assessment for a pass.

19-200-0101A COMPUTER PROGRAMMING

Course Outcomes:

On completion of this course the student will be able to:

1. Identify main components of a computer system and explain itsworking.
2. Develop flowchart and algorithms for computationalproblems.
3. Write the syntax of various constructs of Clanguage.
4. Build efficient programs by choosing appropriate decision making statements, loops anddata structures.
5. Illustrate simple search and sortalgorithms.
6. Demonstrate how to perform I/O operations in files for solving real worldproblems.
7. Design modular programs using functions for largerproblems.

Module I

Basics of Computer and Information Technology:

Digital Computer System (CPU, Memory, I/O devices)- Working of a digital computer-Hardware and Software : Definition - Categories of Software, Application of Computers.

Problem Solving Methodology:

Problem statement, Analysis, Design a solution, Implement/Coding the solution, Test the solution, Design tools (Algorithm, Flow-chart, Pseudo-code)- Develop algorithms for simple problems.

Programming Languages:

Types of programming languages-Compiler–Interpreter-Linker–Loader–Execution of program.

Module II

Basics of C:

Character set-Identifier- Keywords- Constants –Data Types- Variables and declaration –Operators and Expressions – Operator precedence and associativity – Expression Evaluation (Simple Examples) - Input and output functions – Simple computational problems involving the above constructs.

Control Statements:

Selection, Conditional operator, Iteration (for, while, do-while), Branching (switch, break, continue, goto), Nesting of control statements- Problems using control statements.

Module III

Arrays and Strings:

1D and 2D arrays –Searching (Linear and Binary) - Sorting (Bubble, Selection) – Matrix manipulation programs–Stringsandbasicoperationsonstrings–Stringsfunctions-Programsonstringmanipulation. Functions:

Definition – Calling – Declaration – Parameter Passing (by value and by reference) – Recursion – Programs based on functions.

User defined data types:

Structure – Union - Enumerated data type - Programs involving structure and union.

ModuleIV

Pointers:

Declaration, Initialization – Operations on pointers- Pointers and arrays – Pointers and Structures- Command line arguments-Dynamic memory allocation — Programs involving the above concepts.

Files:

File concept – File pointer – File handling operations (open, close, read, write etc) on sequential and random access files. Programs on file manipulations using fgetc(), fgets(),fseek().

References:

1. Pradip Dey and Manas Ghosh, Computer Fundamentals and Programming, Second Edition, Oxford University Press,(2013).
2. Byron Gottfried, Programming with C, Second edition, Tata McGraw-Hill,(2006).
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Pearson Education, (2001).
4. R.G. Dromey, How to solve it by Computer, Pearson Education,(2008).
5. Kanetkar Y, Let Us C, BPB Publications,(2007).

19-200-0102A ENGINEERINGCHEMISTRY

Course Outcomes:

On completion of this course the student will be able to:

1. Interpret the basic principles and concepts of quantummechanics
2. accountforhowspectroscopicmethodscanbeusedtodeterminemolecularstructures,with focus on the identification of characteristic groups in polyatomicmolecules
3. Apply the laws of thermodynamics to engineeringsystems.
4. Explain the chemistry of a few important engineering materials and their industrial applications.

Module I

Quantum Chemistry: Schrodinger equation. Derivation from classical wave equation. Operator form of the equation. Application of Schrodinger equation to 1-D box solutions. Significance of wave functions, probabilityand energy. Application of 1-D box solutions to conjugated molecules. Forms of hydrogen atom wave functions and the plots of these functions to explore their spatial variations.

Energy level diagrams of diatomic molecules, Pi-molecular orbitals of butadiene, and benzeneand aromaticity.

Module II

Spectroscopy: Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine.

Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging.

Surface characterisation techniques. Diffraction and scattering.

Module III

Chemical Thermodynamics: Fundamentals. First law of thermodynamics. Molecular interpretation of internal energy, enthalpy and entropy. Heat of reaction. Kirchoff's equations. Dependence on pressure and temperature. Gibbs-Helmholtz equation. Free energy changes and equilibrium constant. Chemical potential and fugacity. Thermodynamics of biochemical reactions. **Phase Rule**: Terms involved in phase rule and examples, Application of phase rule to one component water system, Application of phase rule to two-component systems. (Simple eutectic systems).

Module IV

Engineering materials:

Polymers- Classifications- Mechanism of polymerisation (Addition, free radical, cationic, anionic and coordination polymerisation)- Thermoplastics and thermosetting plastics-Compounding of plastics-Moulding techniques of plastics (Compression, Injection, Transfer and Extrusion moulding)-Preparation, properties and uses of PVC, PVA, PET, Nylon- Silicon polymers- Biodegradable plastics. Elastomers-structure of natural rubber- vulcanisation- synthetic rubbers (Buna-S, Butyl rubber and Neoprene).

Lubricants- Introduction-Mechanism of lubrication- solid and liquid lubricants- Properties of lubricants-Viscosity index- flash and fire point- cloud and pour point- aniline value.

Refractories: Classification – Properties of refractories.

Cement- Manufacture of Portland cement- Theory of setting and hardening of cement.

References:

1. B. H. Mahan and R. J. Meyers University Chemistry, 4th Edition, Pearson publishers. (2009).
2. PeterW.Atkins,JuliodePaula,andJamesKeele.PhysicalChemistry,11th Edition,Oxford publishers. (2018).
3. M. J. Sienko and R. A. Plane. Chemistry: Principles and Applications, 3rd Edition, McGraw-Hillpublishers.(1980).
4. C. N. Banwell. Fundamentals of Molecular Spectroscopy, 5th Edition, McGraw-Hill publishers. (2013).

5. B.L. Tembe, M.S. Krishnan and Kamaluddin. Engineering Chemistry (NPTEL Web Course)
6. Shashi Chawla. A Textbook of Engineering Chemistry. Dhanpat Rai & Co, New Delhi.(2013).

19-200-0103A ENGINEERING GRAPHICS

Course Outcomes:

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

1. Prepare drawings as per Indianstandards
2. Produce orthographic projection of straight lines andplanes.
3. Draw orthographic projection ofsolids.
4. Understand development of surface of different geometricshapes
5. Construct isometric scale, isometric projections andviews.

Module I

Introduction to engineering graphics. Drawing instruments and their use. Familiarisation with current Indian Standard Code of Practice for general engineering drawing.

Scales- plain scale, Vernier scale, diagonal scale.

Conic sections- Construction of ellipse, parabola, hyperbola - construction of cycloid, involute, Archimedian spiral and logarithmic spiral- drawing tangents and normal to these curves.

Module II

Introduction to orthographic projections- plane of projection- principles of first angle and third angle projections, projection of points in different quadrants.

Orthographic projection of straight lines parallel to one plane and inclined to the other plane- straight lines inclined to both the planes- true length and inclination of lines with referenceplanes- traces oflines.

Projection of plane laminae of geometrical shapes in oblique positions.

Module III

Projection of polyhedra and solids of revolution- frustum, projection of solids with axis parallel to one plane and parallel or perpendicular to other plane- projection of solids with axis inclined to both the planes- projection of solids on auxiliary planes.

Section of solids by planes inclined to horizontal or vertical planes- true shape of sections.

Module IV

Development of surface of cubes, prisms, cylinders, pyramids and cones

Intersection of surfaces- methods of determining lines of intersection - intersection of prism in prism and cylinder in cylinder.

Module V

Introduction to isometric projection- isometric scales, isometric views- isometric projections of prisms, pyramids, cylinders, cones and spheres.

Introduction to perspective projections: visual ray method and vanishing point method- perspective of circles- perspective views of prisms and pyramids.

References:

1. John, K.C. Engineering graphics. PHI Learning, NewDelhi.(2013)
2. Bhat, N.D. Elementary engineering drawing. (Forty ninth edition). Charotar Publishing House,Anand.(2010)
3. Gill P.S. Geometric drawing. B.D Kataria &Sons,Ludhiana.(2012)

19-200-0104A BASIC ELECTRICAL ENGINEERING

Course Outcomes:

On completion of this course the student will be able to:

1. Analyse and solve electriccircuits
2. Understand the principles of electromagnetic induction and identify meters for measuring electricalquantities
3. Recognise the basic elements and phases in ACcircuits
4. Identify the type of electrical machine for a givenapplication

Module I

Basic principles of Electric circuits: Review of Ohm's law - Definition of Resistance, Current, Voltage and Power - Series and Parallel circuits- Constant voltage source and Constant current source.

Network Theorems: Kirchhoff's laws- Network analysis by Maxwell's circulation currents - Superposition theorem -Thevenin's theorem - Norton's theorem - simple illustrative problems on network theorems.

Review of electrostatics - Coulomb's Law- Electric field strength and electric flux density, Capacitance.

Module II

Review of electromagnetic induction -Faraday's Law- Lenz's Law - Mutually induced emf. Magneticcircuits-Magneticfieldofacoil-Ampereturnscalculation-Magneticflux-Fluxdensity - Field strength.

Measuring instruments: Working principle of galvanometer, Ammeter, Voltmeter, Watt meter & Energy Meter (elementary concepts).

Module III

AC Fundamentals: Sinusoidal Alternating Waveforms - Sinusoidal AC Voltage characteristics and definitions — General representation of voltage or current – Phase Relations – Average value – Effective (Root mean square) value.

The Basic Elements and Phasors: Response of basic R, L and C elements to a sinusoidal voltage orcurrent–Phasordiagrams,Frequencyresponseofthebasicelements–Averagepowerandpower factor – Complex representation of vectors (Rectangular & polarforms)

Series and Parallel ac Circuits: Series & parallel impedances and admittances, Analysis of RL, RC & RLC circuits, Resonance in series and parallel circuits- Variation of impedance and admittance in series and parallel resonant circuits. Power in ac circuits: active, reactive &apparent power.

Introduction to 3 phase Systems: Star& Delta connection, Power in three phase circuits

Module IV

Electrical Machines: Principle of operation, Types and applications of DC machines, Transformers and Induction Machines. (Only an elementary qualitative treatment is envisaged.)

ElementaryConceptsofGeneration,Transmission,andDistribution: Conventionalsourcesof electrical energy: Hydro, Thermal, Nuclear and Diesel power station, Non-conventional Sources: Solar energy, wind energy & energy from oceans, Various levels of power transmission, introduction to primary and secondarydistribution

References:

1. Robert L. Boylestad. Introductory circuit analysis. (Twelfth edition). Pearson Education, New Delhi.(2012)
2. Cotton, H. Electrical technology. (Seventh edition). CBS Publishers and Distributors, New Delhi. (2005)
3. LeonardS.Bobrow.Fundamentalsofelectricalengineering.OxfordUniversityPress,New Delhi. (1996).
4. Rajendra Prasad. Fundamentals of electrical engineering. (Second edition). PHI Learning, NewDelhi.(2009)
5. Edward Hughes. Electrical technology. Addison Wesley Longman, Boston.(1995).

19-200-0105A BASIC ELECTRONICS ENGINEERING

Course Outcomes:

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

1. Develop an understanding of the behaviour of semiconductor junctions, diodes andBJTs
2. Familiarize with the applications of Diodes in rectification andregulation
3. Relate the role of BJTs in amplification andswitching
4. Identify various measuring instruments and theirfunctions
5. Gain knowledge on the fabrication of semiconductor devices andICs

Module I:

Basic Semiconductor and PN Junction Theory: Atomic Theory, Conduction in Solids, Conductors, Semiconductors and Insulators, n-Type and p-Type semiconductors, Semiconductor conductivity
The p-n Junction, Biased Junctions. Junction Currents and Voltages

Module II:

Semiconductor Diodes and Applications: PN Junction Diode, Characteristics and parameters, Diode Approximations, DC Load Line Analysis, Temperature Effects, Diode AC Models, Diode Specifications, Diode Testing, Zener Diodes
Half wave rectification, Full wave rectification, RC and LC Filters, Shunt Voltage Regulators, Power supply - performance and Testing
Optoelectronic Devices-LED, LCD, Seven segment displays

Module III:

Bipolar Junction Transistors and Electronic measuring instruments: BJT Operation, BJT voltages and currents, BJT Amplification and Switching, Common Base, Common Emitter and Common Collector Characteristics, Transistor Testing
Electronic measuring instruments – Power Supply, Function Generator, CRO, Multimeter.

Module IV:

Fabrication of Semiconductor Devices and ICs: Processing of Semiconductor materials, Diode Fabrication and Packaging, Transistor construction and Performance, Transistor Fabrication, Integrated Circuits, IC components and circuits, Transistor and IC packaging, Transistor Data sheets, Power measurement in dB

References:

1. DavidABell,ElectronicDevicesandCircuitsOxfordHigherEducation,5th Edition,(2017).

2. NN Bhargava, DC Kulshreshtha, SC Gupta, Basic Electronics and Linear circuits, TataMcGrawHill Publishing Company, 2nd Edition,(2013).

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19-200-0106A ENVIRONMENTALSTUDIES

Course Outcomes:

On completion of this course the student will be able to:

1. Identify the natural resources and suitable methods for conservation and sustainable development
2. Realise the importance of eco system and biodiversity for maintaining ecologicalbalance
3. Identify environmental pollutants and abatementmechanisms
4. Understandenvironmentalproblemsarisingduetodevelopmentalactivitiesandpopulation growth

Module I

Multidisciplinary nature of environmental studies. Definition, scope and importance, need for public awareness.

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Module II

Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and functionofthefollowingecosystems:-Forestecosystem,Grasslandecosystem,Desertecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans,estuaries)

Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. Inida as a mega-diversity nation. Hot-sports of biodiversity. Threats to biodiversity: habitatloss,poachingofwildlife,man-wildlifeconflicts.EndangeredandendemicspeciesofIndia. Conservation of biodiversity: In-situ and Ex-situ conservation ofbiodiversity.

Module III

Environmental Pollution: Definition. Cause, effects and control measures of: - a. Air pollutionb. 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 urban and industrial wastes. Role of an individual in prevention of pollution. Pollution casestudies.

Diaster management: floods, earthquake, cyclone and landslides.

Environmentallegislation:EnvironmentProtectionAct.Air(PreventionandControlofPollution) Act. Water (Prevention and control of Pollution) Act. Wildlife ProtectionAct. Forest Conservation Act. Issues involved in enforcement of environmentallegislation.

Module IV

Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation. Consumerism and waste products.

Social Issues and the Environment: From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case Studies. Public awareness.

Human Population and the Environment: 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.

Field work: Visit to a local area to document environmental assets river/ forest/grassland/hill/mountains. Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds.

Study of simple ecosystems-pond, river, hill slopes, etc.

References:

1. Rajagopalan,R.Environmentalstudies:Fromcrisistocure.OxfordUniversityPress,New Delhi.(2005).
2. Erach Bharucha. Textbook of environmental studies and ethics. Universities Press(India), Hyderabad.(2005).
3. Jayashree A. Parikh. Balsaraf, V.M. and Dwivedi, P.B. Environmental studies. Ane Books Pvt. Ltd, New Delhi.(2010)
4. Anindita Basak. Environmental studies, Pearson, New Delhi.(2009).
5. Misra, S.P. (2011). Essential environmental studies. (Third edition). Ane Books Pvt. Ltd., New Delhi.(2011).
6. Benny Joseph. Environmental science & engineering, Tata McGraw Hill Education Pvt. Ltd., New Delhi.(2010).

19-200-0107A ELECTRICAL ENGINEERING WORKSHOP

Course Outcomes:

On completion of this course the student will be able to:

1. Apply basic electrical engineering knowledge for house wiringpractice

Experiments:

1. One lamp controlled by oneswitch
2. Series and parallel connections oflamps.
3. Stair casewiring.
4. HospitalWiring.
5. Godownwiring.
6. Fluorescentlamp.
7. Connection of plugsocket.
8. Different kinds ofjoints.
9. Winding oftransformers.
10. Solderingpractice.
11. Familiarisation ofCRO.
12. Single Phase Distribution BoardWiring.

19-200-0108A COMPUTER PROGRAMMING LABORATORY

Course Outcomes:

On completion of this course the student will be able to:

1. Solve problems efficiently by choosing loops and decision making statements in C programming.
2. Implement different operations onarrays.
3. Solve problems using functions andrecursion.
4. Design and implement C programs using the concepts of structure, pointers andfiles.

Cycle I

Application Packages:

Text Editor

1. To create a word document like an advertisement.

SpreadSheet

2. To create a spread sheet to analyse the marks of the students of a class and also to create appropriate charts.

Presentation Software

3. To create a presentation for the department using PowerPoint.

C Programming Basics:

4. To write a program to calculate and display areas of rectangle andtriangle.

Decision Making:

5. To write a program for electricity billpreparation.
6. To write a program to find the roots of a quadraticequation.
7. To write a simple menu driven calculator program using switchstatement.
8. To write a program to find the sum of digits of a givennumber.

Cycle II

Looping:

9. To write a program to print all the prime numbers of a givenrange.
10. To write a program to print the sine and cosineseries.
11. To write a program to print Pascal'striangle.

Arrays:

12. To write a program to print the sum and average of elements in anarray.
13. To write a program to sort the given numbers using bubblesort.
14. To write a program to perform Matrix addition and matrixmultiplication.

String:

15. To write a program to perform string manipulation functions like string concatenations, Comparison, find the length and string copy without using libraryfunctions.
16. To write a program to arrange names in alphabeticalorder.

Cycle III

Functions:

17. To write a C program to calculate the mean, variance and standard deviation using functions.
18. To write a C program to perform sequential and binary search usingfunctions.

Recursion:

19. To write a program to print the Fibonacci series using recursivefunction.
20. To write a program to print the factorial of the given number using recursivefunction.

Structure:

21. To print the mark sheet of n students usingstructures.

Pointers:

22. To write a program using pointers to access the elements of an array and count the number of occurrences of the given number in thearray.

Files:

23. To write a program to count the number of characters,lines in afile.

References:

1. PradipDeyandManasGhosh,ComputerFundamentalsandProgramminginC,SecondEdition, Oxford University Press,(2013).
2. Smarajit Ghosh, All of C, PHI Learning Pvt. Ltd,(2009).
3. Byron Gottfried, Programming with C, 2 nd edition, Tata McGraw-Hill,(2006).
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Pearson Education, (2001).
5. Sukhendu Dey, Debobrata Dutta, Complete Knowledge in C, Narosa PublishingHouse, New Delhi, (2009).

19-200-0201A CALCULUS

Course Outcomes:
On completion of this course the student will be able to:

1. Recall the methods of differentiation andintegration.
2. Solve ordinary differential equations and linear differential equations of higher orders with constant coefficient and apply them in engineeringproblems
3. Estimate the maxima and minima of multi variablefunctions.
4. Evaluateareaasdoubleintegralsandvolumeastripleintegralsinengineeringapplications.
5. Illustrate the application and physical meaning of gradient, divergence andcurl.

Module I

Ordinary differential equations:
First order differential equations - exact differential equations, Bernoulli's equations--Methods of solution and Simple applications.
Linear differential equations of higher orders with constant co-efficient-Methods of solution of these equations. Cauchy's linear differential equations. Simultaneous linear differential equations- Simple applications of linear differential equations in engineering problems –Electrical Circuits, Mechanical Systems.

Module II

Partial differentiation: Partial differentiation-Concept of partial derivative - Chain rule- Total derivative-Euler's theorem for homogeneous functions, Differentials and their applications in errors and approximations, Jacobians - Maxima minima of functions of two variables(Proof of the result not required)-Simple applications.
Co-ordinate systems: Rectangular co-ordinates-Polar co-ordinates-In plane and in Space- Cylindrical polar co-ordinates-Spherical polar co-ordinates.

Module III

Integral calculus:
Application of definite integrals: Area, Volume, Arc length, Surface area.
Multiple integral: Evaluation of double integrals-Change of order of integration. Evaluation of triple integrals-Change of Variables in integrals.
Applications of multiple integrals. Plane Area, Surface area &Volumes of solids

Module IV

Vector calculus: scalar and vector point functions, gradient and directional derivative of a scalr pointfunction,divergenceandcurlofvectorpointfunctions,theirphysicalmeaning.Evaluationof line integral, surface integral, and volume integrals, Gauss's divergence theorem, Stoke's theorem (No proofs), conservative force fields, scalarpotential.
References:

1. Sastry, S.S. Engineering mathematics: Vol1. (Fourth edition).PHI Learning, New Delhi. (2008).
2. Erwin Kreyzig. Advanced engineering mathematics (Tenth edition). John Wiley&Sons, Hoboken,NJ.(2011)
3. Veerarajan, T. Engineering mathematics.(third edition). Tata McGraw Hill Publishers, New delhi. (2011)
4. Grewal, B.S. Higher engineering mathematics. (Forty third Edition). Khanna Publishers, New Delhi.(2013).

19-200-0202A ENGINEERING PHYSICS

Course Outcomes:

On completion of this course the student will be able to:

1. Interpret modern devices and technologies based on lasers and opticalfibres.
2. Explain the basic principles of crystal physics and applications of liquidcrystals.
3. Summarise the characteristics and applications of nano materials and superconducting materials
4. Explainthefactorsaffectingtheacousticsofbuildingsandapplicationofultrasonicsinnon-destructivetesting.

Module I

Laser-introduction—properties-interaction of radiation with matter-absorption- spontaneous and stimulated emission-principle of laser--Einstein coefficients- conditions for getting laser-population inversion- metastable state -Basic components of a laser- Differenttypesoflasers-construction,workingandapplicationsofRubylaser-Neodymium YAG laser- He-Ne laser - Applications of laser in medicine, industry, science and communication.

Holography-basic principle-Comparison with ordinary photography-Recording and reconstruction of holograms -applications.

Fibre optics - Basic structure of an optical fibre - propagation of light in an optical fibre-classifications-step-index fibre and graded index fibre- single mode and multimode- Numerical aperture of a step-index fibre, graded index fibre---acceptance angle and acceptance cone-modes of propagation - Applications.

Module II

Crystallography – Space lattice- Basis- Unit cell- Unit cell parameters- Crystal systems- Bravais lattices-Three cubic lattices-sc, bcc, and fcc- Number of atoms per unit cell- Co- ordination number- Atomic radius-Packing factor- Relation between density and crystal latticeconstants-LatticeplanesandMillerindices-Separationbetweenlatticeplanesinsc- Bragg's law- Bragg's x-rayspectrometer.

Liquid crystals- Liquid crystals, display systems-merits and demerits- Metallic glasses- Types of metallic glasses (Metal-metalloid glasses, Metal-metal glasses) – Properties of metallic glasses (Structural, electrical, magnetic and chemical properties). Shape memory alloys- Shape memory effect.

Module III

Introduction to nanoscale science and technology- nanostructures-classifications- nanoring, nanorod,nanoparticle,nanoshells,fullerence- surface occupancy-quantum confinement effect-Properties of nanoparticles- optical, electrical, magnetic and mechanical properties-Applications of nanotechnology.

Superconductivity-Introduction--transition temperature-Meissner effect-effect ofcurrent-entropy-specific heat-isotope effect-penetration depth-.Types of superconductors-type 1 andtype2-cooperpair-BCStheory(briefly)-ACJosephsonseffect-DCJospehsonseffect- Applications of superconductivity.

Module IV

Quantum mechanics-Introduction- quantum theory-black body radiation and Photoelectric effect (brief ideas only)-matter waves- de broglie wavelength-wave packet- uncertainty principle-wave function -Physical intrepretation -Time dependent Schrodinger equation for a free particle- Time independent schrodinger equation.

Ultrasonics-production of ultrasonics -piezo electric effect-Magnetostriction effect-properties of ultrasonics- Application of ultrasonics in non-destructive testing - Acoustics of building- reverberation-Absorption Coefficient- Sabines formula for reverberation time (no derivation)- Accoustic intensity-loudness-decibel-phon-conditions for good acoustics(Qualitative study).

References:

1. S. Mani Naidu, AText book of Engineering Physics, Pearson. (2010)
2. A.S. Vasudeva, Modern Engineering Physics, S. Chand & Co.(2013)
3. Prabir K. Vasu and Hrishikesh Dhasmana, Engineering Physics, Ane books Pvt.Ltd. (2010)
4. S.O.PillaiandSivakami,AppliedPhysics,NewAgeInternational(P)Ltd.,SecondEdition. (2008)
5. G.S. Raghuvanshi, Engineering Physics, Prentice Hall ofIndia.(2008)

19-200-0203A ENGINEERING MECHANICS

CourseOutcomes:
On completion of this course, a student will be ableto

1. Understand the principles of mechanics (statics and dynamics), the concept of free body diagrams and resolution offorces.
2. Apply the principles of mechanics, concept of free body diagrams and resolution of forces and equations of equilibrium or motion to given engineering or physicalapplications.
3. Analyse given engineering or physical applications and calculate the required parameters like forces, moments, various motion parameters like, displacement, velocity, acceleration, etc.
4. Ascertain the physical and mathematical meaning of quantities, like centroid, moment of inertia and their applications in engineering and locate centroid and calculate the moment of inertia or second moment of area of typical sections used inengineering.

Module I
Introduction to Mechanics: Definition and classification of mechanics – rigid body (statics and dynamics) and deformable body mechanics.
ForcesandForcesystems:Forceanditscharacteristics,Principlesofstatics–conceptofresultant and equilibrant, Composition and resolution of forces, forcesystems.
Coplanar Concurrent force system: Equilibrium of two, three and more than three forces, Moment of a force, Varignon's theorem of moments, Equations of equilibrium, Friction and its effects on bodies, Engineering applications.
Coplanar Parallel force System: Two parallel forces, General case of parallel forces in a plane, Centreofparallelforces,Centreofgravity,Centreofmass,Centroidsofcurves,areasandvolumes – regular and composite, Pappus's theorems, Equilibrium of distributed forces in a plane, Applications of the concept of centroid in engineeringpractice.

Module II
Moment of Inertia: Concept of moment of inertia and second moment of area, Moment of inertia of regular and composite solids, Second moment of area of regular and irregular surfaces, Polar moment of inertia / second moment of area, Product of inertia, Principal moments of inertia and principal axes, Applications of the concepts in engineering practice.

Coplanarnon-concurrentforcesystemandAnalysisofPlanetrussesandframes:Resultantof a general case of force system in a plane, Equilibrium equations, Concept of load carrying mechanism in trusses and frames – internal (axial) forces, two force and multi force members, AnalysisofplanetrussesbyMethodofjointsand Methodofsections,AnalysisofPlaneframesby Method ofmembers.

Module III
Principleofvirtualwork:Conceptofvirtualworkandtheprincipleofvirtualwork,Applications in engineering, Equilibrium of ideal systems, Stable and unstableequilibrium.
Introduction to Dynamics: Definitions, Units, Divisions – Kinematics, Kinetics.
Rectilinear translation: Kinematics of rectilinear motion – displacement, velocity, acceleration, Kinetics– Differentialequationsofmotion,D'Alembert'sprincipleinrectilineartranslationandits applications, Motion of a particle due to a constant force, Motion of a particle due to a force proportional to displacement – Simple harmonic motion, Momentum and impulse, Work and energy, Conservation of energy, Collision of two bodies – direct centralimpact.

Module IV
Curvilinear translation: Kinematics of curvilinear translation – components of displacement, velocity and acceleration, normal and tangential acceleration, Kinetics – Differential equations of motion, Motion of a projectile – projection on horizontal and inclined surfaces, D'Alembert's principle in curvilinear motion and its applications, Moment of momentum, Work and energy in curvilinear motion.
Rotationofarigidbody:Kinematicsofrotation–angulardisplacement,velocityandacceleration, RPM, Relations of kinematic parameters of linear and angular motions, Kinetics – Differential equations of

motion of a rigid body rotating about a fixed axis, Rotation under the action of a constant moment, Rotation proportional to angular displacement – Compound pendulum, D'Alemberts principle in rotation, Resultant inertia force in rotation, Principle of angular momentum in rotation, Energy equation for rotatingbodies.

References

1. TimoshenkoandYoung.Engineeringmechanics.McGrawHillBookCompany,Singapore. (1956)
2. Beer, F. P. and Johnston, E. R. Mechanics for engineers (Vol. 1: Statics and Vol.2: Dynamics). Tata McGraw Hill, NewDelhi.(2004).
3. Merriam,H.L.andKraige,L.G.(2003).Engineeringmechanics(Vol.1:StaticsandVol.2: Dynamics*)*. John Wiley and Sons, Somerset,N.J.(2003)
4. Hibbeller, R.C. Engineering mechanics. Vol. 1: Statics, Vol. 2: Dynamics. (Twelfth edition). Pearson Education Asia Pvt. Ltd., NewDelhi.
5. Rajasekaran,S.and Sankarasubramanian,.G. Fundamentals of engineering mechanics. (Third edition). Vikas Publishing House Pvt. Ltd., NewDelhi.(2010)

19-200-0204A BASIC CIVIL ENGINEERING

Course outcomes

At the end of the course students will be able to

1. Summarize the types, uses and properties of various buildingmaterials
2. Explain the different components of building and types offoundations
3. Illustrate the fundamental aspects of civilengineering
4. Discuss about the surveying techniques and to solve problems related withlevelling
5. Recognize the various modern services emerging in the field of civilengineering
6. Prepare site plan based up on the Kerala Municipality BuildingRule

Module I

Engineering Materials: Cement - varieties and grade of cement and their uses. Cement mortar- Steel- types of steel for reinforcement bars, steel structural sections. Brick- varieties and strength, tests on bricks. Aggregates-types&requirements.Concrete-gradesofconcreteasperIScode,watercementratio, workability, mixing, batching, placing, compaction andcuring.

Module II

Construction : Components of a building-Foundation- types of foundations- isolated footing, combined footing, raft, pile & well foundations- Foundation for Machinery

Super structure: Brick masonry, English bond and Flemish bond, Stone masonry-Ashlar masonry- Rubble masonry. Roofing- Steel trusses, roofing for industrial buildings

Module III

Surveying: Basic Principles of surveying, instruments, methods and measurements- linear measurements- reconnaissance, selection of surveystations.

Leveling: Leveling instruments, different types, temporary adjustments, reduced level of point, booking of field notes, and reduction of levels by height of collimation method.

Introduction to Total Station.

Module IV

Site planning and Building Rules-Selection of site-Site plan preparation for buildings-Kerala Municipal Building Rules prevailing, general provisions regarding site and building requirements- Coverage and Floor Area Ratio-Basic concepts of Intelligent Buildings and Green Buildings Roads- Classification of Rural and urban Roads.

Sources of Water - Water Supply-Quality of Water.

References:

1. Chudley, R., Construction Technology, Vol. I to IV, Longman Group, England(2011).
2. Chudley, R. and Greeno, R., Building Construction Handbook, Addison Wesley, Longman Group, England(1998)
3. Mamlouk,M.S.,andZaniewski,J.P.,MaterialsforCivilandConstructionEngineering,Pearson Publishers(2011)
4. McKay, W. B. and McKay, J. K., Building Construction, Vol. 1 to 4, Pearson India Education Services. (2013)
5. Rangwala,S.C and Dalal,K.B.,Building Construction, Charotar Publishing House(2017).
6. Kerala Municipal Building Rules (latestrevision)

19-200-0205A BASIC MECHANICAL ENGINEERING

Course Outcomes:

On completion of this course the student will be able to:

1. Understand basics of thermodynamics and working of steamturbines
2. Understand basics of internal combustion engines, refrigeration and airconditioning
3. Gain knowledge on the working of hydraulic turbines and centrifugalpumps
4. Identify manufacturing methods encountered in engineering practice and understand mechanism of powertransmission

Module I

Thermodynamics: Thermodynamics systems – open, closed and isolated systems, equilibrium state of a system, property and state, process, cycle, Zeroth law of thermodynamics- concept of temperature, temperature scales. First law – internal energy, enthalpy, work and heat, Different processes (isobaric, isochoric, isothermal, adiabatic and polytropic processes). Second law – Kelvin-plank and Claussius statements and their equivalence, Carnot Cycle (Elementary problems only).
ThermodynamicpropertiesofSteam,SteamGenerator.DifferenttypesofboilersboilermountingsandaccessoriesFormationofsteamatconstantpressure,workingofsteamturbines,compounding of turbines.

Module II

InternalCombustionEngines:Airstandardcycles–OttoandDieselcycles,workingoftwostroke andfourstrokePetrolandDieselengines,CarburettedandMPFIengines,fuelpump,fuelinjector, ignition system, cooling system, lubricatingsystem.
Refrigeration & Air-conditioning: Introduction to refrigeration and air -conditioning, Rating of refrigerationmachines,Coefficientofperformance,Simplerefrigerationvapourcompressioncycle (Elementary problems only), Summer and winter airconditioning.

Module III

Hydraulic Turbines & Pumps: Introduction, Classification, Construction details and working of Pelton Wheel, Francis and Kaplan turbines, Specific speed (Definition and significance only), Classification of water pumps, working of centrifugal pumps and reciprocating pumps (Theory of working principles only)
Power plants: Hydro-electric power plants, Thermal power plants, Nuclear power plants, Diesel power plants, Wind mills, solar energy (Working principles using schematic representations only)

Module IV

Introduction to Manufacturing Systems: Welding- different types of welding, resistance welding, arc welding, gas welding, Brazing and soldering, Different welding defects. Casting- different casting processes, sand casting, casting defects, Rolling- hot rolling and cold rolling, two high, three high , cluster rolling mills, wire drawing, forging, extrusion, Heat treatment of steel, elementary ideas of annealing, hardening, normalizing, surface hardening.
Power Transmission Methods and Devices: Introduction to Power transmission, Belt, Rope, ChainandGeardrive.Lengthofbeltopenandcrossed.Ratioofbelttensions(Elementaryproblems only). Different types of gears (Elementary ideas only). Types and functioning ofclutches.

References

1. Nag, P.K. Engineering thermodynamics. (Fifth Edition). McGraw Hill Education (India) Pvt. Ltd, New Delhi.(2013).
2. Gill, J.H. Smith Jr. and Ziurys, E.J. Fundamentals of internal combustion engines, Oxford & IBH, NewDelhi.(1959)
3. Stoecker, W. F. Refrigeration and air conditioning. Tata McGraw Hill, NewDelhi.(1980).
4. JagadishLal. Hydraulic machines. Metropolitan Book co, NewDelhi.(1994)
5. Raghavan, V. Material science and engineering, Prentice Hall of India, NewDelhi.(2004)
6. Rajendar Singh.Introduction to basic manufacturing processes and workshop technology, New

Age International, New Delhi.(2006).

19-200-0206A SOFT SKILLS DEVELOPMENT

Course Outcomes:

On completion of this course the student will be able to:

1. Speak English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate.
2. Read,comprehendandanswerquestionsbasedonliterary,scientificandtechnologicaltexts
3. Develop self-motivation, raised aspiration, belief in one's own abilities and commitmentto achieving one'sgoal
4. Demonstrate emotional maturity and emotionalhealth.

Module I

Role and importance of verbal communication, Everyday active vocabulary, Common words used in transitions, enhancing vocabulary, affixes and changes in pronunciation and grammatical functions, words often confused in pronunciation and usage. Passage comprehension- skimming, scanning techniques, note making, note taking and summarizing. Deciphering meaning from contexts. Two types of meaning- literal and contextual. Constructive criticism of speeches and explanations.

Module II

Fundamental grammar, Simple structures, passivizing the active sentences, reported speech, the judicious use of tenses and moods of verbs, forming questions and conversion from questions to statements and vice versa, forming open –ended and close- ended questions. Words and style used for formal and informal communication. Practice converting informal language to formal, the diction and the style of writing. Dealing with the nuances of ambiguous constructions in language. Learningauthoritativewritingskills,politewritingandgoodnetiquette.Writingforinternshipsand scholarships.

Module III

Kinesics, Proxemics, Haptics, and other areas of non-verbal communication, fighting communication barriers, positive grooming and activities on the same.

Different types of interviews, and presentation - oral, poster, ppt. Organizing ideas for group discussions, the difference between GD and debates.

Effective listening and seeking to understand others' perspectives.Non-violent negotiation and persuasion, communicating across age groups, cultures or identity groups.

Higher order thinking and evaluation, information-seeking, research, and independent learning, synthesis, creativity, problem analysis and problem solving. Decision making, Self-reflection and learning from experience.

Module IV

Developing positive self: Understanding oneself, A realistic awareness of oneself and one's abilities, strengths and potential, Self-esteem, Self-efficacy, steps for improvement.

Intra-personal skills – Self-control, emotional regulation and self-discipline, conscientiousness, dutifulness, reliability, truthfulness, honesty and trustworthiness. Goal orientation and initiative. Time management – prioritising work.

Interpersonal skills – cross cultural competence and valuing diversity of perspectives, respecting and expressing concern for others. Empathy and ability to notice the effect of one's actions on others, tolerance for disagreement, conflict management and resolution.

Civic engagement and social responsibility – Global and local awareness (issues, challenges, priorities). Vision, ability to imagine something new or improved. Social responsibility and willingness to take constructive action.

References:

1. Duck, Steve and David T. Macmahan. Communication in Everyday Life. 3rd Ed. Sage, (2017).
2. Gamble, Kawl Teri and Michael W. Gamble. The Public Speaking Playbook. Sage,(2015).
3. Raman, Meenakshi and Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press,(2015).

4. Coleman,D.Emotionalintelligence:Whyitcanmattermorethan IQ,BantamBooks,New York(2006).
5. Devadas Menon. Stop sleep walking through life, Yogi Impressions Books Pvt. Ltd, Mumbai(2012).
6. Barun K Mitra. Personality Development and Softskills, Oxford University Press(2012).

ASSESSMENT

1. 'SoftSkillsDevelopment'isapracticalandactivityorientedcoursewhichhascontinuousassessmentfor50marksbasedonclass roominteraction,activities,andassignments.Theactivitiesmayinclude'JustaMinute'(JAM)sessions,groupdiscussion,roleplay, debate, and extemporespeech.

The weightages for the different components shall be as follows:

Class room interaction – 10 marks
Activities – 30 marks
Assignments (mainly from Modules I and II) – 10 marks
2. Semester End Examination is notenvisaged.
3. A student should secure a minimum of 50% marks in continuous assessment for a pass in thecourse.

19-200-0207A CIVIL ENGINEERING WORKSHOP

Course Outcomes:

On completion of this course the student will be able to:

1. Identify simple plumbing and sanitary fittings and state itsuse
2. Identify the various methods used in buildingconstruction.
3. Construct brick walls using English Bond and FlemishBond
4. Set out a building as per a given building plan using surveyinginstruments
5. Compute the various quantities of materials required for abuilding

Plumbing:
Introduction to simple plumbing and sanitary fittings.

Building Materials:
Familiarization of building materials and their testing.

Masonry:
Construction of English bond and Flemish bond – wall junction – one brick – one and a half brick –and two brick thick

Surveying:
Surveying and levelling instruments
Setting out of building (single room only) as per the given building plan using surveying instruments
Compute the area and/or volume of various features of a building/structure such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows etc. (to create an awareness of measurements and units)
Demonstration of Total Station

Assignment:

Students shall collect the list of various building materials used for the construction of a building including their market rate.

Note : 50% marks is earmarked for Continuous Evaluation, and 50% marks for Semester End Examination. The Semester End Examination to be conductedbyaminimumoftwoexaminers– one,notbelowtherankofanAssociateProfessor.Acandidateshallsecureaminimumof50%marks in the aggregate and 40% minimum in the Semester End Examination for apass.

19-200-0208A MECHANICAL ENGINEERINGWORKSHOP

Course Outcomes:

On completion of this course the student will be able to:

1. Identify and use tools, and make different types of joints used in carpentry, fitting, and sheet metalshop.
2. Compare basic fabrication techniques of different types ofwelding.

Preliminaryexercisesforbeginnersinallthefollowingshops.Specificmodelsmaybedesignedby theteachers.

1) FittingShop.
2) Sheet MetalShop
3) FoundryShop
4) WeldingShop
5) CarpentryShop

Assignment:

Students shall collect the list of various building materials used for the construction of a building including their market rate.

Note : 50% marks is earmarked for Continuous Evaluation, and 50% marks for Semester End Examination. The Semester End Examination to be conductedbyaminimumoftwoexaminers– one,notbelowtherankofanAssociateProfessor.Acandidateshallsecureaminimumof50%marks in the aggregate and 40% minimum in the Semester End Examination for apass.

19-200-0209A LANGUAGE LAB

Course Outcomes:

On completion of this course the student will be able to:

1. Test pronunciation skills through stress on word accent, intonation, and rhythm.
2. Use English language effectively for writing business letters, resume, minutes of meeting andreports.
3. UseEnglishlanguageeffectivelytofaceinterviews,groupdiscussions,andpublicspeaking.

Following course content is prescribed for the **Language Laboratory** sessions:

1. Introduction to the Sounds of English- Vowels, Diphthongs &Consonants.
2. Introduction to Stress andIntonation.
3. Preparing businessletters
4. Preparing aresume
5. Conducting a meeting and writing theminutes
6. Writing areport
7. Situational Dialogues / RolePlay.
8. Oral Presentations- Prepared andExtempore.
9. 'JustAMinute'Sessions(JAM).
10. Describing Objects / Situations /People.
11. Debate
12. Groupdiscussion

Note : 50% marks is earmarked for Continuous Evaluation, and 50% marks for Semester End Examination. The Semester End Examination to be conductedbyaminimumoftwoexaminers– one,notbelowtherankofanAssociateProfessor.Acandidateshallsecureaminimumof50%marks in the aggregate and 40% minimum in the Semester End Examination for apass.

19-200-0210A NSS/NATURE CONSERVATIONACTIVITIES

NATIONAL SERVICE SCHEME (NSS)

Course Outcomes:

On completion of this course the student will be able to:

1. Recognize the community in which theywork
2. Utilize their knowledge in finding practical solution to individual and community problems

A student enrolling as member of NSS will have to complete 10 hours of training / social service.

NATURE CONSERVATION ACTIVITIES

Course Outcomes:

On completion of this course the student will be able to:

1. Practice and spread the message of sustainable lifestyles
2. Understand the importance of green plants in mitigating global environmentalproblems
3. Identify suitable waste management practices for the localcommunity

A student enrolling as member of the Nature Conservation Club will have to complete 10 hours of campus cleaning and greening activities.

19-200-0301 LINEAR ALGEBRA & TRANSFORM TECHNIQUES
(Common for all branches)

Course Outcomes:
On completion of this course the student will be able to
1. Solve linear system of equations and to determine Eigen values and vectors of a matrix.
2. Understand the concept of vector space and sub space.
3. Determine Fourier series expansion of functions and transform.
4. Solve linear differential equation and integral equation using Laplace transform.

Module I.
Linear Algebra 1:Rank of a matrix, solution of linear system of equations- existence, uniqueness, general form-Eigen values and Eigen vectors- properties of Eigen values - Diagonalization of a matrix - Cayley Hamilton theorem (without proof) Verification-Finding inverse and power of a matrix using it-Quadratic form-orthogonal reduction of quadratic form to Canonical form.

Module II
Linear Algebra 2: Vector space-subspace-Linear dependence and independence-Spanning of a subspace- Basis and Dimension. Inner product- Inner product spaces - Orthogonal and Orthonormal basis –Gram- Schmidt Orthogonalization process. Linear Transformation.

Module III
Fourier Analysis: Periodic function, Fourier series, Functions of arbitrary period, Even and odd functions, Half Range Expansion, Harmonic analysis, Complex Fourier Series, Fourier Integrals, Fourier Cosine and Sine Transform, Fourier Transform.

Module IV
Laplace Transforms: Gamma functions and Beta function-Definition and properties, Laplace transforms. Inverse Laplace Transform, Shifting theorem, Transform of Derivative and Integrals, Solution of differential equation and integral equation using Laplace transform, Convolution, Unit step function, Second Shifting theorem, Laplace transform of periodic function.

References:

1. Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
2. Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.
3. Hsiung,C.Y and Mao, G. Y. (1999). *Linear algebra*. World Scientific, New Jersey.
4. Hoffman, K. and Kunze, R. (1971). *Linear algebra*. Prentice Hall of India, New Delhi.
5. Venkataraman,M.K. (1999). *Linear algebra*. The National Publishing Co, Chennai.

19-209-0302 ELECTRICAL MACHINES I

Course Outcomes:
On completion of this course the student will be able to

1. Describe construction and principle of operation of DC machines and transformers
2. Compute performance parameters and analyse characteristics of dc machines
3. Identify starting methods and speed control techniques for DC motor
4. Conduct various tests on transformer and analyse their performance parameters

Module I
DC generators: Principle of DC generators, constructional details, field, armature and commutator or magnetic circuits, field flux distribution. Armature windings – pole pitch, coil span, winding pitch and commutator pitch. Simplex lap and wave windings, parallel paths, equalizer ring connections, dummy coils – methods of setting brushes in d.c machines. Methods of excitation – separately excited, shunt, series and compound machines. Induced e.m.f – e.m.f. equations. Armature m.m.f. – Magnitude and direction, armature reaction – air gap flux distribution under load conditions, effect of saturation, demagnetizing and cross-magnetizing armature m.m.f. – variation with brush position – compensating winding connections.

Module II
Commutator: Time of commutation, e.m.f. In the coil undergoing commutation, reactance e.m.f. – effect of brush shift, interpoles – polarity and winding connections. Type of d.c. generators – characteristics – open circuit characteristics, condition for self-excitation, critical resistance, critical speed. Load characteristics, effect of compounding. Parallel operation – parallel operation of shunt series and compound generations, equalizer connections.

Module III
DC Motors: Principles of operation, back e.m.f, production of torque, torque equation, developed and shaft torque, performance characteristics of shunt, series and compound motors, applications of various types of DC motors. Starting – need of the starter, face plate starters – three point and four point starters, calculation of resistance elements for shunt meter starter, Speed control – field control, armature control – Ward Leonard speed control. Testing of d.c. machines – losses and efficiency, separation of losses – Swinburne's test, Hopkinson's test, Fields Test, retardation test.

Module IV
Transformers: Single-phase transformer - constructional details – core, winding, insulation and brushing. Principles of operation, turns ratio, emf equation. Operation on load - magnetizing and core loss components – phasor diagram – equivalent circuit. Regulation – losses and efficiency.
Testing of transformers: OC test, SC test, Sumpner's back to back test, separation of losses, three phase connections – star and delta connections using single phase transformers. Three phase transformers – oscillating, neutral, tertiary winding, Scott connection –open delta connection – six phase connections. Parallel operation, load sharing, distribution transformers – all day efficiency, autotransformers - single phase.

References:

1) Clayton A.E.,Hancock N.N.- *Performance and Design of DC machines*,ELBS/CBS Publishers, Delhi, 1990
2) Theraja B.L.- *A text book of Electrical Technology Vol II*, S. Chand &Co.,New Delhi, 1992
3) Bhimbra P.S. - *Electrical Machinery*, Khanna Publishers, NewDelhi, 1992
4) M.G. Say- *Performance and Design of AC machines*, ELBS & Pitman, Third Edition, 1980**.**

19-209-0303 CIRCUITS AND NETWORKS

Course Outcomes:

On completion of this course the student will be able to

1. Analyse various DC networks using theorems.
2. Solve complex electrical networks
3. Analyze transient as well as steady state parameters of complex electric circuits
4. Model two-port networks using network parameters.

Module I

Review of network theorem – steady state AC analysis-mesh and node analysis, mesh and node analysis by inspection, superposition theorem, reciprocity theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem.

Module II

Network topology – definition of graph, tree, incidence matrix, tie-set matrix, cut-set matrix, application of graph theoretic methods to formulation of network equation, current variable and voltage variable methods.

Coupled circuit – self and mutual inductance analysis of coupled coils, dot rule, conductively coupled equivalent circuits, coupling coefficient, linear transformer and ideal transformer.

Module III

Polyphase systems – balanced and unbalanced loads – unbalanced three wire and four wire star connected load, displacement neutral method, power measurement using wattmeter.

Circuit transients – direct current transients - RL, RC, RLC transients, alternating current transients – application of Laplace transform for transients analysis.

Module IV

Two port networks - characterization in terms of impedance, admittance, hybrid and transmission parameters – inter relationship among parameter sets – reciprocal and symmetrical two port networks – inter connection of two port network – I and II equivalent of a two port network – image impedance – characteristic impedance and propagation constant of a symmetrical two port network.

Text Books:

1. Van Valkenburg M.E: Network Analysis, Prentice Hall India, 1989
2. A Sudhakar, Shyammohan S Pally, "Circuits and Networks Analysis and synthesis", Tata McGraw Hill.
3. Joseph. A.Edminister, "Theory & problems of electric circuit", Schaum's outline series, Tata McGraw Hill.

References:

1. D. Roy Choudhury, "*Networks and Systems*", New Age International
2. C.P.Kuriakose ,"*Circuit Theory Continuous and Discrete-Time Systems*, Elements of Network Synthesis",PHI.
3. K. S. Suresh Kumar, *Electric Circuits and Networks*, 1st Ed, Pearson Education, 2009

19-209-0304 ELECTRICAL MEASUREMENTS & MEASURING INSTRUMENTS

Course outcomes:

On completion of this course the student will be able to

1. Comprehend the principle of measuring instruments.
2 Identify the various methods of power and energy measurement
3. Identify the various methods for measurement of R,L and C
4. Choose transducers for various applications

Module I

General Principles of Measurements : Concepts of absolute and working standards, Calibration of Meters, Qualities of Measurements - accuracy - precision - sensitivity - resolution -loading effects, Errors in Measurement and its Analysis- combination of component errors.

Direct Deflecting Instruments. Principle, construction, operation, torque equation ,calibration and application of D'Arsonval Galvanometer. Moving Coil - Moving Iron, Dynamo Meter, Induction and Electrostatic Type meters - Shunts and Multipliers,

CRO - Theory and working –measurements using CRO - Types of CRO - Dual Beam CRO- Dual Trace Oscilloscope - Time base generator circuit.

Concepts of digital measurement- Operating principles of DVM using successive approximation – V/F conversion and integrating principles, electronic multimeter.

Module II

Measurement of Power and energy : Concepts, connections , impedance features and errors due to connections in Wattmeters - Measurement of three phase power (active and reactive) – Two wattmeter method- Single and Three Phase Energy Meters (Induction Type) – Calibration- phantom loading.- Trivector Meter

Current transformer and potential transformer: Construction, theory , operation, and its application.

Module III

DC Potentiometer – Crompton Potentiometer- Vernier Potentiometer

A.C. Potentiometers – Applications of AC Potentiometers.

Measurement of Resistance: Wheatstone bridge –problems with measurement of low & high resistance- Kelvin Double Bridge - Carey Foster Slide Wire Bridge - Bridge Current Limitations - Insulation Resistance, Earth Resistance, Earth Tester - Localization of Cable Fault by Murray and Varley Loop Test

Measurement of Inductance & Capacitance: AC bridges –Maxwell's bridge, Anderson bridge, Hay's bridge, Schering bridge, Wein bridge.

Module IV

Magnetic Measurements: Classification – Magnetometer measurement, Ballistic Galvanometer Flux Meter-
B.H. Curve - Permeability and Hysteresis measurement– Hibbert's Magnetic Standard - Core Loss Measurement.

Illumination - Definition of solid angle, Candella, Luminous flux, Luminous intensity, illumination, luminance -
Laws of illumination - Inverse square law and Lamberts Cosine Law - Measurement of Candle power -
Bunsen and Lummer Brodhun Photometer heads - Determination of mean spherical candle power by Rosseau's construction - Integrating spheres

Transducers: Basic principle and working of piezoelectric, photoelectric, thermoelectric transducers, thermistors, strain gauge, LVDT , Measurement of temperature, pressure, velocity, flow, pH, liquid level (Basic idea only)
Need for instrumentation system and data acquisition system.

Text/Reference Books:

1: Golding E.W *Electrical Measurements & Measuring Instruments*, 5e, Reem Publications,2009.
2: Cooper W.D, *Modern Electronics Instrumentation*, Prentice Hall of India, 1996.
3: Stout M.B, *Basic Electrical Measurements*, Prentice Hall, 1986.
4: Oliver, Cage, *Electronic Measurements & Instrumentation,* McGraw Hill, 1979.
5: Sawhney A. K., *Electrical and Electronic Measurements and Instrumentation*, DhanpathRai& Co.,2007

19-209-0305 ELECTRONIC DEVICES AND CIRCUITS

Course Outcomes:

On completion of this course the student will be able to

1. Analyse various electronic circuits
2. Design small signal amplifiers and power amplifiers
3. Analyse sinusoidal and non - sinusoidal oscillators
4. Develop wave shaping circuits for specialised applications

Module I

Special semiconductor devices*:* Principles and operation of photodiodes, PIN diodes, phototransistors, LED, UJT, FET. MOSFET- Enhancement and depletion type NMOS, PMOS AND CMOS - basic principles and characteristics.
Dual power supplies - zener diodes and zener voltage regulator.
Pulse Circuits:-Different types Pulse circuits - pulse characteristics - Pulse shaping using RC circuits - Differentiating and integrating circuits –applications. Clipping and clamping circuits using diodes.

Module II

Small Signal amplifiers: Bipolar junction transistor– configurations, characteristics - current amplification factors - relations between alpha & beta – comparison.
BJT amplifiers: Biasing techniques of BJT- stabilization of operating point - h-parameters - CE RC coupled amplifier - concept of load lines- frequency response of RC coupled amplifier - frequency response of R C coupled amplifier - lower cut-off frequency - upper cut-off frequency - 3 db bandwidth.
FET Amplifiers: Principle of operation, characteristics, Common source amplifier- design, frequency response- applications

Module III

Power amplifier- classification - class A, B, AB and C power amplifiers-tuned amplifier- pushpull and complementary symmetry power amplifier –Harmonic distortion.
Feed-back amplifiers: concept of Negative and positive feedback – Bark Hausen criteria -low frequency sinusoidal oscillators
High frequency oscillators– types- LC, Crystal oscillators –circuit diagram-description-applications

Module IV

Transistor as a switch– simple sweep circuits-bootstrap sweep, Miller sweep
Multivibrators- astable, monostable and bistable circuits using BJTs-applications. UJT Relaxation oscillator, Schmit trigger.

References:

1. Boylestead, Neshelsky: *,"Electronic Devices & Circuit Theory",* PHI2003
2. Millman, Halkias, "*Electronic Devices & Circuits*", TMH, New Delhi.1996
3. Taub,Schilling, *Pulse, Digital and Switching ciruits,* TMH, New Delhi
4. Bapat Y N, "*Electronic Devices & Circuits*", Tata McGraw Hill, New Delhi.1995
5. Allan Mottorshed, "*Electronic Devices & Circuits",* PHI, New Delhi.
6. Schilling ,Belove "*Electronic Circuits, Discrete & Integrated",* TMH, New Delhi 1989
7. Theodore F.Bogart: "*Electronic Devices & Circuits"* Universal Book Stall, New Delhi 1992

19-209-0306 ELECTRICAL ENGINEERING MATERIALS

Course Outcomes:

On completion of this course the student will be able to

1. Identify conducting, semi conducting and magnetic materials
2. Describe dielectric polarization and its characteristics.
3. Identify material used for solar power.
4. Comprehend techniques for material studies.

Module I

Conducting materials: Review of metallic conduction on the basis of free electron theory- Fermi-Dirac distribution – variation of conductivity with temperature and composition, Materials for electric resistances- general electric properties: brushes of electrical machines, lamp filaments, fuses and solder.

Semiconductors: Compound semiconductors – basic ideas of amorphous and organic semiconductor – preparation of semiconductor materials – zone-refining technique – fabrication of p-n-p junction.

Magnetic materials: Classification of magnetic materials – origin of permanent magnetic dipoles – ferromagnetism - hysterisis curve – hard and soft magnetic materials – magnetic material used in electrical machines, instruments and relays.

Module II

Dielectrics: dielectric polarization under static fields – electronic, ionic and dipolar polarizations – behavior of dielectrics in alternating fields – mechanism of breakdown in gases, liquids and solids - factors influencing dielectric strength – capacitor materials Insulating materials – complex dielectric constant – dipolar relaxation dielectric loss insulator materials used – inorganic materials (mica, glass, porcelain, asbestos) – organic materials (paper, rubber, cotton silk, fibre, wood, plastics, bakelite)- resins and varnishes – liquid insulators (transformer oil) – gaseous insulators (air, SF6, and hydrogen) – ageing of insulators.

Module III

Solar energy and Materials: Solar radiation, spectrum, UV, VIS, IR Solar constant, optical response of materials, optical band gap. Photo thermal conversion – use of coatings for enhanced solar thermal energy collection – Solar selective coatings – Cold mirror coatings – Heat mirror coatings – Anti reflection coatings. Photovoltaic conversion – Solar cells – cell efficiency, characteristics, equivalent circuit–Silicon , Cadmium sulphide and Gallium arsenide. Planner PN Junction. I-V curve of dark and illuminated junction. Solar cell parameters.

Module IV

Modern techniques for Material Studies: optical microscopy – electron microscopy – photoelectron spectroscopy – atomic absorption spectroscopy – magnetic resonance – nuclear magnetic resonance – electron spin resonance – ferromagnetic resonance.

Textbooks:

1. Indulkar , C.S. Thirivengadam , S *An Introduction to Electrical Engineering Materials, S Chand Co, 1998.*

2. A.J Dekker *Electrical Engineering Materials, Prentice Hall of India*.

3. Arumugam , M *Materials Science, Anuradha Publishers, 1990.*

References:

1. Yu Koristky*, 1970,Electrical Engineering Materials, MIR*
2. MeinalA.B ,Meinal M.P- *Applied Solar Energy An Introduction,* Addition Wesley Publications.
3. Kapoor P.L Electrical *Engineering Materials,* Khanna Publications.
4. Tiwari, G. N. ,*Solar Energy,* Narosa Publication
5. AgnihotriO.P , Gupta B. K.,*Solar Selective Surfaces,* John Wiley

19-209-0307 ELECTRONIC CIRCUITS LAB

Course Outcomes:

On completion of this course the student will be able to

1. Identifythe characteristics of semiconductor devices
2. Design and setup amplifier, oscillator and Multivibrator circuits.
3. Design and setup different waveshaping circuits
4. Measure various electrical quantities using multimeter and CRO

List of Experiments:

1. Study of Multimeter, Signal generators, CRO etc. and measurement of electrical quantities
2. Testing of Passive and Active components - Resistors, Capacitors, inductors, Transformers, diodes, Transistors, etc.
3. Characteristics of Active devices
    1. Transistor characteristics CE Configuration
    2. Transistor characteristics CB Configuration
    3. UJT Characteristics
    4. FET Characteristics
4. Pulse circuits
    1. Clipping
    2. Clamping
    3. Integrator
    4. Differentiator
5. Amplifying Circuits
    1. RC Coupled Amplifier
    2. FET Amplifier
6. Oscillators
    1. RC Phase shift Oscillator,
    2. UJT Relaxation Oscillator
7. Sweep Generator
8. Multivibrators
    1. Astable Multivibrator
    2. Monostable Multivibrator

19-209-0308 ELECTRICAL MEASUREMENTS LAB

Course outcomes:

On completion of this course the student will be able to

1. Describe different types of measuring instruments and instrument transformers
2. Verify different laws and theorems in electric circuits.
3. Measure power and energy in single phase and three phase circuits.
4. Calibrate various types of instruments using potentiometers.
5. Summarise the resistance classification and measurements.

List of Experiments

1. Study of PMMC & MI voltmeters and ammeters, dynamometer type wattmeter, clip on ammeter, standard symbols on the dials of the meters
2. Determination of the voltage-current characteristics of linear and nonlinear resistance.
3. Verification of Kirchoff's laws, Thevenin's theorem, superposition theorem etc.
4. RLC series parallel circuit – Measurement of current in various branches and verification by calculation – drawing Phasor diagram.
5. Single-phase power measurement using wattmeter
6. Measurement of power in three-phase circuits using
   a) Single wattmeter
   b) Two wattmeters
   c) Three phase wattmeter
7. Measurement of resistance using Wheatston's bridge
8. Measurement of resistance using Kelvin's double bridge
9. Measurement of insulation resistance using megger.
10. Measurement of self and mutual inductance of coupled coils
11. Calibration of ammeter using slide wire potentiometer
12. Calibration of Voltmeter using slide wire potentiometer
13. Measurement of internal resistance of battery using vernier potentiometer
14. Measurement of resistance of earth electrode using earth megger.
15. Calibration of single phase energy meter by direct loading
16. Calibration of single-phase energy meter at 0.5 & 0.866 p.f. without using phase shifting transformer.
17. Calibration of 3-phase energy meter.
18. Extension of instrument range using CT and PT.
19. a. Measurement of candle power of different light sources

b. Verification of laws of illumination

c. Determination of MSCP of lamps.

19-200-0401 COMPLEX VARIABLES AND PARTIAL DIFFERENTIAL EQUATIONS
(Common to all branches)

Course Outcomes:

On completion of this course the student will be able to:

1. Transform a region to another region using conformal mapping
2. Evaluate real integrals using residue theorem
3. Form and solve partial differential equation
4. Determine solution of partial differential equation for vibrating string and heat conduction

Module I

Analytic function- Cauchy-Riemann equation (Cartesian and polar)-Harmonic function- construction of analytic function given real or imaginary parts- Conformal mapping of standard elementary function and bilinear transformation.

Module II

Cauchy's integral theorem, Cauchy's integral formula and for derivatives-Taylor's and Laurent's expansion (without proof) - Singularities-Residues-Cauchy's Residues theorem- Contour integration involving unit circle.

Module III

Formation of partial differential equation eliminating arbitrary constants and function—Solution of first order equation-four standard types- Lagrange's equation—Linear homogeneous partial differential equation with constant coefficient.

Module IV

One dimensional wave equation, Alembert's solution and one dimensional heat flow equation—solution by the method of separation of variables- application of Fourier series solution. Solution of Laplace's equation over a rectangular region by the method of separation of variables.

References:

1. Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
2. Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.

19-209-0402 CIRCUITS, SIGNALS & SYSTEMS

Course Outcomes:

On completion of this course the student will be able to

1. Classify basic signals – Impulse, step, ramp, exponential and sinusoidal signals, operations of signal and properties of continuous time systems.
2. Analyse one sided and two sided frequency spectrum of periodic signals using Fouriermethod ofwaveform analysis
3. Design passive filters.
4. Synthesize L-C and R-C circuits using Foster and Cauer Forms.

Module I

Signals – classification – continuous-time/discrete-time, deterministic/non-deterministic, periodic/aperiodic, even/odd, energy/power signals – elementary signals – exponential, sinusoidal, unit step, impulse, ramp – time-shifting, scaling, folding . Systems – classification – continuous time/discrete-time, static/dynamic, linear/non-linear, time-invariant/variant, causal/non- causal, stable/unstable, distributed/lumped. Analysis of LTI system – Impulse response – Convolution, differential equation representation.

Module II

Fourier method of waveform analysis – frequency spectrum of periodic signals, trigonometric Fourier series, exponential Fourier series.

Fourier transform and inverse Fourier transform – properties of Fourier transforms, continuous amplitude and phase spectra.

Module III

Passive filters- Filter fundamentals, Classification of Filters- Low pass, High pass, Band Pass & Band reject Filters, image parameters, characteristic impedance, design of filter networks - T and n sections of constant K low pass filter, constant K high pass filter, m-derived low pass filter, m-derived high pass filter, composite filters.

Module IV

Review of Network Functions - Network functions for one port and two port networks – Poles and Zeros of network functions – Restrictions on pole and zero locations for driving–point functions – Restrictions on pole and zero locations for transfer functions – Concept of stability

Elements of Realizability - Hurwitz polynomials – properties - Brune's positive real functions – Properties of positive real functions - Necessary and sufficient conditions for positive real functions – Sturm's test for positive real functions – Synthesis of L-C and R-C circuits using Foster and Cauer Forms.

Text Books:

1. Openheim , Wilsky, *Signals &Systems* , PearsonEducation
2. Ramesh Babu,P ,*Signals and Systems*, SciTechPublications
3. Sudhakar, A ,Shyammohan Pillai, S.,*Circuits and Networks Analysis and synthesis*, Tata McGrawHill.

References:

1. NagoorKani, A ,*Signals and Systems*, TataMcGraw-Hill.
2. Suresh Kumar.,K..S,2009, *Electric Circuits and Networks*, 1st Ed, PearsonEducation
3. Roy Choudhury,D, *Networks and Systems*, New Age International.
4. David Cheng , K. , 1977, *Analysis of Linear System*s, AddisonWesley
5. Lathi, B.P, *Signal Processing and Linear Systems*, Oxford UniversityPress.

19-209-0403 ELECTRICAL MACHINES II

Course outcomes:

On completion of this course the student will be able

1. To summarise the construction and principle of operation of synchronous machines and induction machines
2. To analyze the parallel operation of alternators and the performance of synchronous motors
3. To determine the voltage regulation of alternators
4. To identify starting techniques of three phase induction motor

Module I

Alternators- constructional features of high speed cylindrical rotor and low speed salient pole machines, synchronous speed. AC windings - different types (detailed drawing not required) emf equation- distribution factor- coil span factor.

Theory of cylindrical rotor machines- armature reaction- synchronous impedance- voltage regulation-determination of regulation by mmf, emf and Potier methods-determination of Xd, Xq by slip test.

Module II

Parallel operation of alternators - performance of two machines in parallel-synchronising power - effect of speed regulation on load sharing -methods of synchronizing- synchroscope

Synchronous motor-torque and power relationship-phasor diagram starting of synchronous motors-losses and efficiency calculations-V curves-synchronous condenser-load angle, damper windings.

Module III

Three phase induction motor - constructional details - slip ring and squirrel cage types- Theory of the induction machine with constant mutual flux - slip phasor diagram - mechanical power and developed torque - Torque slip curves - variation and starting torque with rotor resistance- pull out torque - losses and efficiency - approximate and exact equivalent circuits - circle diagram - No load and blocked rotor tests - performance calculations from the equivalent circuit.

Starting - starting of squirrel cage motors- direct on-line starting auto transformer and star - delta starter - starting current and torque - starting of slip ring motors - design of rotor rheostat.

Module IV

Special rotor construction - Deep bar, equivalent circuits and torque curves of double cage motors.

Methods of speed control - pole changing methods - rotor rheostatic control, principle of speed regulation and improvement of power factor by rotor injected emf.

Single phase induction motor - revolving field theory equivalent circuit - torque slip curve- starting methods - split phase, capacitor start, capacitor run motors shaded pole motor - repulsion start and repulsion induction motor.

Synchronous induction motor- construction and theory

Induction generator – construction –theory-applications.

Text Book:

1. Nagrath , I.J. , Kothari, D.P. *Theory of AC machines,* Tata McGraw Hill

2. Bimbra , P.S,*Electrical Machinery,* Khanna Publications

References:

1) Say, M.G, *Performance and design of AC Machines,*ELBS, Pitman

2) Langsdorf , A.S, *Theory of AC machines,* Tata McGraw Hill

3) Gupta B.R ,VandanaSinghal *,1990, Fundamentals of Electrical Machines,* New Age International

19-209-404 POWER ELECTRONICS

Course Outcomes :

On completion of this course the student will be able to

1. Identify the switching characteristics various power semiconductor devices.
2. Analyse the characteristics of different uncontrolled and controlled rectifiers.
3. Design various inverter circuit topologies based on application and knowledge of PWM technique.
4. Analyse the working of different switched mode converters.

Module I

Power Semiconductor Devices

Basic Structure, Static and dynamic characteristics of Power diodes, Power Transistors, IGBT, MOSFET

Thyristors – DIAC, TRIAC (principle of operation), Silicon Controlled Rectifier, -Structure- Characteristics- methods of turning on - gate triggering circuit R and RC- Methods of turning off - commutation schemes- device specifications and ratings -Thyristor protection – Series and parallel operation ofSCR.

Module II

AC-DC converters

Phase controlled rectifiers using SCR

Performance measures of rectifiers: ripple factor, TUF, rectification efficiency, Distortion factor, Displacement factor, over all PF, THD.

Single Phase – Half wave rectifier with R, RL and RLE loads – Full wave half controlled and fully controlled converters with continuous and discontinuous currents – Output voltage and waveforms - Effect of source inductance.

Three Phase - Half wave rectifier with R and RL loads - Full wave half controlled and fully controlled converters with continuous and discontinuous currents - Output voltage and waveforms

Module III

DC-AC converters

Inverters - Voltage Source Inverters - Single phase inverters – series, parallel and bridge inverters. Single Phase Pulse Width Modulated (PWM) inverters – Basic circuit and operation of single pulse, multiple pulse, unipolar & bipolar sinusoidal PWM. Single phase current source inverter. Three phase bridge inverters - 120 and 180 conduction mode.

AC Voltage controllers - single phase ac regulator with R and RL loads

Cycloconverters- basic principle of operation.

Module IV

DC-DC converters

Choppers - principle of operation - step-up & step-down choppers - Four quadrant operation of a chopper with motor load **Switching regulators** - Buck regulators - Boost regulators - Buck-boost regulators - Switched mode power supply -principle of operation

UPS: functional block diagrams and features of on line, off line & line interactive UPS

References:

1. Ned Mohan , *1995,Power Electronics.,* 2nd edition, John Wiley and Sons
2. Rashid *, 2004, Power Electronics, Circuits Devices and Applications*, 3rd edition, Pearson Education
3. Dubey, G.K. *, 1993,Thyristorised Power Controllers*, Wiley Eastern Ltd
4. Sen, . P.C, *Power Electronics*, Tata Mc Graw Hill
5. Singh, Khanchandani , *Power Electronics*, *2nd ed.*, Tata Mc Graw Hill

19-209-0405 DIGITAL ELECTRONICS

Course Outcomes:
On completion of this course the student will be able to
1. Understand number systems and codes and fundamentals of Boolean algebra .
2. Design various types of registers and counters using latches and flip-flops.
3. Design and realise logical circuits for mathematical operations
4.Understandvarious memories and logic families and its characteristics.

Module I
Number System and binary codes: Binary, Octal and Hexadecimal number systems – binary arithmetic, binary codes, excess-3 code, Gray code error detection and correction – Boolean algebra – minimisation of Boolean functions using Karnaugh map and Quine-Mclusky methods – formation of switching functions from word statements, realisation using NAND, NOR & XOR gates.

Module II
Combinational circuits – multiplexer, demultiplexer, decoder, encoder.
Arithmetic circuits: Half adder, full adder, subtractor, serial and parallel addition – carry look ahead adder – binary multiplication – multivibrators – monostable, astable and bistable multivibrators using discrete gates.

Module III
Sequential circuits: flip-flops – RS, JK, T & D flip-flops, shift registers – counters – design -asynchronous and synchronous counters, up-down counters, Modulo counter, ring counter, Johnson counter – sequence generators – analysis of sequential circuits – state table and diagrams
Memories – ROM, RAM, EPROM, EEPROM Programmable logic array, devices – basic ideas – PLD architecture – PAL and PLA – programmable examples with software tools.

Module IV
Logic families: Standard logic levels - Current and voltage parameters - fan in and fan out - Propagation delay, noise consideration. Basic idea of DCTL, RTL and DTL families. TTL family NAND gate working principle, need for totem pole configuration, TTL inverter characteristics, Open collector gate and tri- state logic gate. CMOS: characteristics of basic CMOS inverter - interfacing of CMOS to TTL and interfacing of TTL to CMOS, Merits and demerits of TTL family and CMOS family. ECL family OR-NOR gate working principle.

References:

1. Taub , Schilling, *Digital Integrated Electronics*
2. Anand Kumar, 2010, *Fundamentals of Digital Circuits*, , 2nd edition, PHI learning
3. Thomas Floyd, L., 2011, *Digital Fundamentals*, 10th edition Pearson
4. Jain , R.P ,2009,*Modern Digital Electronics*, 4th edition, Tata McGraw Hill

19-209-0406 ELECTROMAGNETIC FIELD THEORY

Course Outcomes:

On completion of this course the student will be able to

1. Apply the basic concepts of Coulombs law and Gauss' law and analyze the boundary conditions
2. Calculate the force, electric field intensity and capacitance of different charge distributions
3. Calculate the inductance of co-axial cables and overhead transmission lines making use of the boundary conditions for different media.
4. Apply the basic knowledge of electromagnetic waves in real life situations such as wave propagation in transmission lines.

Module I

Overview of vector analysis – Co-ordinate systems – rectangular, cylindrical, spherical - transformations. Divergence theorem, Stokes theorem, Div, Grad, Curl.

Static Electric field: Coulomb's law, superposition, electric flux, electric field, electric scalar potential, dipole, method of images – Gauss law for electric flux, boundary conditions – capacitance of isolated sphere, concentric sphere, co-axial cylinder/cable two wire transmission line- energy stored in electric field / capacitor, energy density. Laplace equation, Poisson's equation, Uniqueness theorem.

Module II

Static magnetic field of steady electric currents – magnetic flux, Biot -Savart law, Ampere's law, Gauss law for magnetic flux –boundary conditions, magnetic vector potential, inductance of a coaxial cable, two wire transmission line, solenoid, toroid. Electromagnetic induction – Faraday's law, self & mutual inductance. Continuity equation – displacement current – Maxwell's equations integral & differential form.

Module III

Uniform plane waves –general solution –TEM waves – relation between electric and magnetic fields, phase and group velocity – plane waves in lossy medium, skin depth, propagation constants and intrinsic impedance – Harmonically varying field, Poyntings theorem-interpretation, application. Wave polarization – linear, elliptic and circular polarization, wave guides – rectangular - cylindrical wave guides.

Module IV

Reflection of plane waves at boundaries – normal and oblique incidence – refraction – transmission – Snell's law – critical angle – Brewster angle – total internal reflection.

Transmission lines: - Uniform transmission line – VI solution- characteristic impedance – VSWR – impedance matching – quarter wave and half wave length transformer – stub matching – single and double – Smith chart.

References:

1. Sadiku,M. N. O(2002), *Elements of Electromagnetics*, Addison Wesley
2. Premlet, B (2002), *Electromagnetic theory with applications*, Phasor Books
3. Hayt, W. H. (2001)-*Engineering Electromagnetics*, McGraw Hill
4. NannapaneniNarayana Rao - *Elements of Engineering Electromagnetics*Prentice –Hall
5. Cheng D.K (2002) - *Electromagnetic Fields & Wave*, Addison Wesley .

19-200-0407 UNIVERSAL HUMAN VALUES

Course outcome:

On completion of the course, a student will be able to:

1. Have more awareness of themselves and their surroundings (family, society, nature).
2. Be more responsible in life in handling problems with sustainable solutions
3. Keep human relationships and human nature in mind.
4. Have better critical ability and would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Apply what they have learnt to their real life.

Module I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values1

Self-Exploration-what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration

Continuous Happiness and Prosperity- A look at basic Human Aspirations

Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority

Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.

Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

Module II

Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentiment 'I' and the material 'Body'.

Understanding the needs of Self 'I' and 'Body' - happiness and physical facility.

Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).

Understanding the characteristics and activities of 'I' and harmony in 'I'.

Understanding the harmony of 'I' with the Body: Sanyam and Health; correct appraisal of Physical

Needs, meaning of Prosperity in detail.

Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

Module III

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship.

Understanding values in human-human relationship: meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.

Understanding the meaning of Trust; Difference between intention and competence.

Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity. fearlessness (trust) and co-existence as comprehensive Human Goals.

Visualizing a universal harmonious order in society— Undivided Society. Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from student's lives.

Module IV

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature. Understanding Existence as co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human Values. Definitiveness of Ethical Human Conduct.

Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

Competence in professional ethics: (a) Ability to utilize the professional competence for augmenting universal human order (b) Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, (c) Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems

Strategy for transition from the present state to Universal Human Order: (a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers ,(b) At the level of society: as mutually enriching institutions and organizations.

Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Readings:

1. Human Values and Professional Ethics by R. R. Gaur, R.Sangal, G. P. Bagaria, Excel Books.New Delhi, 2010

References:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

19-209-0408 DIGITAL ELECTRONICS LAB

Course Outcomes:

On completion of this course the student will be able

1. To design and setup sequential and combinational circuits.
2. To design and setup synchronous/asynchronous counters and shift registers using D and J –K flipflops.
3. To design and setup astable and monostable multi- vibrators using TTL gates
4. To realize sequence generators

List of experiments:

1. Half adder and full adder using NAND gates.
2. Code converters - Binary to Gray and gray to Binary using mode control
3. Binary addition and subtraction (a) 1's complement (b) 2's complement (using 7483)
4. BCD adder using 7483.
5. Study of MUX, DeMUX&Decoder Circuits and ICs
6. Set up R-S & JK flip flops using NAND Gates
7. Asynchronous and Synchronous UP / DOWN counter using JK Flip flops
8. Design and realization of sequence generators.
9. Study of shift registers and Implementation of Johnson and Ring counter using it.
10. Study of IC counters 7490, 7492, 7493 and 74192 or the CMOS equivalent.
11. Astable and monostable multi- vibrators using TTL gates.
12. Transfer characteristics and specifications of TTL gates

19-209-0409 ELECTRICAL MACHINES LAB I

Course Outcomes:

On completion of this course the student will be able to

1. Select range of apparatus based on the ratings of DC Machines and Transformers.
2. Design and Connect the electrical circuit
3. Determine equivalent circuit parameters of transformers
4. Evaluate the efficiency of the machine by analyzing test results

List of experiments

DC machines

1**.** Open circuit characteristics of the given DC shunt generator.

2. Load test on the given DC shunt generator and compound generator

3. (a) Brake test on DC shunt and series motor

   (b) Study of 3 point and 4 point starters for DC shunt motor

4.(a) Swinburne's test on DC shunt machine

   (b) Hopkinson's Test on a pair of DC Machines and pre-determining of the efficiency of the machine working as motor and as a generator under various conditions of load on the generator.

5. Separation of losses in DC. shunt machine

Transformers

1.(a)Polarity test on single phase transformers.

  (b)O.C and S.C test on the single phase transformer

2. Separation of losses of single phase transformer

3. Sumpner's test on a pair of identical single phase transformers

4. Scott connection of the single phase transformers

Student shall present his/her fair record, notebook duly certified by the Head of the Department, to the examiners at the time of University practical examination.

19-200-0501 NUMERICAL AND STATISTICAL METHODS
(Common to all branches)

Course Outcomes:

On completion of this course the student will be able to:

1. Solve algebraic and transcendental equations by numerical methods
2. Perform numerical differentiation and integration
3. Find the mean and variance of a probability distribution including the binomial distribution.
4. Use statistical tests in testing hypotheses on data

Module1

Numerical solution of algebraic and transcendental equation by - Regula-Falsi method, Newton Raphson's method. Gauss Seidal iteration method to solve a system of equations and convergence (without proof) Newton's forward and backward interpolation formula. Lagrange interpolation, Newton's divided difference and central differences.

Module2

Numerical differentiation at the tabulated points with forward, backward and central differences. Numerical integration with trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. Taylor series method. Euler method, Modified Euler method, Runge–Kutta method of second and fourth order for solving 1st order ordinary differential equation.

Module3

Random variable (discrete and continuous) Expectation-mean and variance of probability distribution. Binomial, Poisson and Normal distribution and Fitting of this Distribution to the given data. Curve fitting-fitting of straight line, parabola, exponential.

Module4

Population and Sample-Sampling Distribution (of mean and variance) Testing of Hypothesis-level of significance, Z-test statistic, Chi square test for variance, for goodness of fit and F-test.

References:

Erwin Kreyzig. (2010). *Advanced engineering mathematics*. (tenth edition). John Wiley & Sons, Hoboken, N.J
Grewal, B.S. (2013). *Higher engineering mathematics*. (forty third edition). Khanna Publishers, New Delhi.
Kandaswamy, P. Thilagavathy, K. andGunavathy, K. (2007) *Numerical methods*. S Chand &Co, New delhi.
Richard A. Johnson. Irvin Miller and John E. Freund. (2010). *Probability and statistics for engineers*. (eighth edition). Pearson, New Delhi.

19-209-0502 CONTROL SYSTEMS I

Course Outcomes:

On completion of this course the student will be able to**:**

1. Model and represent electrical, mechanical systems..
2. Understand the response to standard test inputs analyze the systems in time domain and study the effects of additional pole and additional zero, static error constants and system type number.

3. Solve and Evaluate frequency domain analysis using various techniques viz. Bode, Polar and Nyquist plots and stability using Routh's Hurwitz criterion.

4. Analyze time domain using root locus technique

Module I

Principle of Automatic control- Open loop and closed loop systems – examples-Differential equation and transfer function model of systems - Development of models for Electrical, Mechanical, Electromechanical etc-force voltage and force-current analogy -Block diagram representation of systems-Block diagram reduction. Signal flow graph-signal flow graph from equations. Maison's gain formula.

Control system components: Synchros, DC and AC servomotor, Stepper motor, Tacho generator.

Module II

Time domain analysis for linear systems: Response to standard inputs, impulse response-step ramp and acceleration inputs- time domain performance measures of second order system-under damped and over damped systems.

Time domain specifications-static error constants-steady state error.

Module III

Concept of stability of LTI systems -BIBO stability- Characteristic equation-Effect of pole locations in s-plane- type and order of a system-effects of additional pole and additional zero - Routh's Hurwitz criterion**.**

Basic theory and properties of root locus, rules for construction of root locus, complete root locus diagram , effects of addition of poles and zeros.

Module IV

Frequency domain analysis, sinusoidal frequency response. Polar plots and logarithmic plots – Bode plots –Nyquist plots – Principle of argument-Nyquist stability criterion-absolute stability and relative stability from Bode and Nyquist plots.

Text Books:

1. K Ogata. - "*Modern Control Engineering*", Low PriceEdition.
2. M.Gopal,"C*ontrol Systems Principles and Design*", Tata McGrawHill.

References:

1. *A.Nagoorkani, "Control Systems", RBAPublication*
2. *S Palani "Control Systems Engineering", Tata McGrawHill.*
3. *Joseph J. Distefano, III.Allen R. Stubberud, Ivan J. Wililams, "Schaum's Outline of Feedback and Control Systems", Tata McGrawHill.*
4. *S. Hassan Saeed , Automatic Control Systems , Katson Books*
5. *I.J. Nagrath and M.Gopal, Control Engineering, TMH*

19-209-0503 MICROPROCESSOR AND MICROCONTROLLER BASED SYSTEMS

Course Outcomes:

On completion of this course the student will be able to

1. Describe the architecture of 8085 microprocessor and 8051 microcontroller.
2. Interface memory and I/O devices with 8085 microprocessor and 8051 microcontroller
3. Develop programs based on 8085 microprocessor and 8051 microcontroller.
4. Interface ADC, DAC and alphanumeric LCD with microcontroller

Module I

Basics of 8085 Microprocessor

Architecture- pin description-Features-Interrupt system-Stack and subroutine Memory Interfacing-Decoding techniques-Absolute and Partial decoding-System Design-Mapping techniques I/O mapped I/O-Memory mapped I/O-Serial Communication-Synchronous and Asynchronous communication, USART-DMA features

Module II

Programming with 8085

Basic instruction set-Addressing modes-Timing diagram-Assembly language programs- Delay routines

Peripheral Interfacing

8255-Programmable Peripheral Interface –Interfacing of Matrix Keyboard (4*4) and seven segment LED display.
8253-Programmable Interval Timer –Modes of operation-Functional Block diagram-Interfacing with 8085
8279-Programmable Keyboard & Display Controller –Functional block diagram –Interfacing with 8085

Module III

8051-Architecture -Internal Memory organization-Counters Timers-Serial data input and output –Addressing modes-Simple Programs with -External memory interfacing.

Module IV

Interfacing of 8051 with I/O devices- ADC0808, DAC0800, 16*2 alphanumeric LCD.

Introduction to Embedded systems – Characteristics -Application areas-examples (block diagram)-Real time systems-Application Specific Processors.

Reference:

1. Gaonker R.S. - Microprocessor Architecture, Programming and applications
2. Ghosh and Sridhar, 0000 to 8085 Microprocessors for Engineers and Scientists, Prentice-Hall India, 2nd edition
3. Kenneth Ayala, The 8051 Microcontroller ,West Publishing Company.
4 .Muhammed Ali Mazidi :The 8051 Microcontrollers & Embedded Systems, Pearson Education
5. A.NagoorKani,:Microprocessors,architecture and programming,RBA Publications
6. Douglas V Hall : Microprocessors and Interfacing, , Tata Mc Gram Hill
7. R. S. Kaler: A Textbook of Microprocessors and Microcontrollers
8.VUdayashankara M S Mallikarjunaswamy 8051 Microconroller : Hardware, Software and Applications

19-209-0504 POWER SYSTEMS I

Course outcomes:

On completion of this course the student will be able to

1. Get familiarized with generation of electricity based on conventional and nonconventional energy sources
2. Analyse different types of tariffs.
3. Identify various mechanical and electrical design aspects of transmission and distribution systems.
4. Calculate power flow in transmission lines.

Module I

Conventional sources of electrical energy- renewable energy sources- Distributed generation-power plant economics – operating costs- load factor- demand factor- diversity factor- plant factor. Types of tariffs, power factor improvement

Module II

Overhead transmission systems- arrangement of conductors- sag and tension- transmission line supports and their location, economic span- design of feeders.-Kelvin's Law -choice of transmission voltage- line insulators- string efficiency- impulse ratio- arcing horns and rings- failure of insulation- corona- underground cables- different types- capacitance of single core and three core cables- grading of cables.

Module III

Distribution systems- classification and arrangement of distribution systems- distribution substation layout and arrangement- economic loading of distribution transformers- - considerations in primary and secondary distribution system design- current distribution and voltage drop in single-phase and three-phase four-wire distribution systems- voltage drop calculation and design of distributors in ring system- improvement of existing distribution systems- LT capacitor installation- size and connection- system and equipment earthing- energy management in electrical systems- distribution automation- Power quality.

Module IV

Performance of transmission lines- calculation of transmission line inductance and capacitance- GMD and GMR- bundled conductors- transposition- short, medium & long transmission lines-equivalent circuit representation-ABCD constants- effect of capacitance- nominal T and π methods of calculations- power flow through a transmission line. Methods of voltage control.

Reference:

1. Soni, Gupta, Bhatnagar - A course in Electric Power, DhanapatRai& Sons New Delhi, 1996.

2. A.T Star, - Generation, Transmission & Utilization of Electric Power, Sir. Issac Pitman and Sons, 1961.

3. Turan, Goren - Electric Power Transmission System Engineering, John Wiley,1988.

4. S.L Uppal - Electric Power, Khanna Publishers, 1992.

5. A.S Pabla - Electric Power Distribution System, Tata McGraw Hill, 1992.

6. M N Bandyopadhyay, "Electrical Power Systems- Theory and Practice", Prentice Hall of India, 2006.

7. Weedy B M, Cory B J, "Electric Power Systems", John Wiley Publication, 4 ed., 1998.

19-209-0505 LINEAR INTEGRATED CIRCUITS

Course Outcomes:
On completion of this course the student will be able to:
1. Comprehend the fundamentals of the integrated circuits
2. Design specific OPAMP circuits suitable for various applications.
3. Analyze Op-Amp based comparators, waveform generators, VCO and PLL operation and its application
4. Recognize the feasibility of using s of special function Op-Amp ICs in various applications

Module I
Basics of Difference Amplifiers, common mode & difference mode gains, CMRR – basic BJT differential amplifier – dual input balanced output and unbalanced output – Internal block schematic of op amp - Biasing used in IC – Constant current source - current mirror Circuits – Features of ideal op amp, Open loop operation of OPMAP, Static & dynamic limitations of practical OPAMP – Input bias current – off set – drift, SVRR, Slew rate, frequency response, typical data sheet of IC 741, Review of negative feedback-basic feedback configurations of two port networks, effect of negative feedback on various performance measures of amplifiers.

Module II
Elementary closed loop configurations OF OPAMP-inverting & non inverting amplifiers & their performance measures, Effect of finite gain bandwidth on inverting & non inverting amplifiers, effect of static & dynamic limitations of OPAMP on the performance of inverting & non inverting amplifiers, Voltage follower, V/I converters, I/V converters, Difference amplifiers with one op amp and 3 op amps, Instrumentation amplifier, Summer, Sub tractor, OPAMP as Integrator & differentiator, use of OPAMP for the solution of differential equations, transfer functions of elementary first & second order LP/HP/BP/BS/AP Filters.

Module III
First & Second Order LP/HP/BP/BS/AP Filters with OPAMP, Multiple feedback filters, Universal Active Filter, Filter Design. Comparators-use of comparator for PWM signal generation of power electronic circuits, threshold detector, ZCD, window detector, inverting & non inverting Schmitt trigger, window detector, Astable, monostable & bistable multivibrators – Triangular and sawtooth wave generators – RC phase shift and Wien bridge oscillators, Linear & non-linear VCO, Functional block diagram of 555 timer, 555 timer as astable & mono stable multivibrator, Sample and hold circuit - peak detector, Precision rectifiers.

Module IV
Voltage regulators – 723 (block diagram, typical low voltage regulator circuit). 78XX, 79XX, 371, Log amplifier/Antilog amplifiers & their use in analog computing, multiplier, phase detector, multiplier as a phase detector, applications of PLL-three phase PLL for grid synchronization, performance measures of PLL, ADC and DAC – performance Measures – binary weighted resistor & R – 2R ladder type DACs, flash, counter based, successive approximation & integrating type ADCs, Digital Voltmeter/Ammeter/Wattmeter/Energymeter.

References:
1. Coughlin R.F., Op amps and Linear Integrated circuits :– Pearson Education /PHI
2. SargioFranko, Design with operational Amplifiers Analog Ics:– 2nd Edition McGraw Hill
3. Roy Chaudary D., Shail B Jain Linear Integrated Circuits
4. Botkar K.R, Integrated circuits
5. Gray John, Analog Integrated Circuits : Wiely 2nd edition 6. Godse and Bakshi ,Analog Integrated Circuits

19-209-0506 (IE)INTRODUCTION TO MACHINE LEARNING

Course outcome

1. Describe the fundamental concepts in machine Learning
2. Develop programming basics of python
2. Identify machine learning techniques suitable for a given problem
4. Design and implement the machine learning algorithms to real-world applications.

MODULE I

Introduction to Machine Learning-Aspects of developing a learning system: training data, concept representation, function approximation, When to apply Machine Learning, Types of Machine Learning-Supervised, Un-supervised, Reinforcement (basic difference only), Applications of Machine Learning

Introduction of python and its libraries suitable for Machine Learning, Numpy and pandas,scikit-learn, Filtering and sorting, Loops and functions, Python libraries, Visualization libraries like matplotlib and seaborn

MODULE II

Learning about data- Types of Features, Feature Engineering, Curse of Dimensionality- Feature Selection and Extraction, Dimensionality Reduction using Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA)

Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning

MODULE III

Supervised Learning: Regression - Linear Regression, Non-linear Regression, Logistic Regression
Classification - K-Nearest Neighbour, Decision Trees, Support Vector Machines , Random Forest, Artificial Neural Networks

MODULE IV

Un-supervised Learning: Clustering - K-Means Clustering , Hierarchical Clustering, Density-Based Clustering
Machine Learning Metrics: Classification Accuracy, Logarithmic Loss, Confusion Matrix, Area under Curve, F1 Score, Mean Absolute Error, Mean Squared Error

Churn Analytics: A case study (Structured data classification), SMS spam detection: A case study (Unstructured data classification)

References

1. Python for data analysis, Wes McKinney,O'reilly
2. Ethem Alpaydın, "Introduction to Machine Learning", Second edition, MIT Press, 2010.
3. Tom M Mitchell, "Machine Learning", McGraw-Hill Science.
4. Stephen Marsland, Machine Learning, An Algorithmic Perspective, 2e, CRC Press, 2015
5. Giuseppe Bonaccorso, Machine Learning Algorithms, 1e, Packt Publishing Limited, 2017
6. Ethem Alpaydin, Machine Learning- The New AI, MIT Press, 1e, 2016

19-209-0507 SPECIAL ELECTRIC MACHINES

Couse Outcomes:
On completion of this course the student will be able to
1. Describe the construction and principle of operation of certain special electrical machines
2. Analyse the characteristics and parameters of these machines
3. Select the machine suitable for a particular application
4. Compare the electrical parameters of these machines

Module 1
Stepper Motors: Basic principle, different types, Variable reluctance, permanent magnet, hybrid type, comparison, theory of operation.
Reluctance motor: Principle of operation, torque equation, Torque slip characteristics, applications. **Switched reluctance motor**: Principle of operation, different types, Comparison, applications

Module 2
AC Servomotors- Construction, principle of operation, performance characteristics, damped AC Servomotors, drag cup servomotor, applications
DC Servomotors: Field and armature controlled DC servomotors, permanent magnet armature controlled , series split field dc servomotor.

Module 3
Permanent magnet DC motors: Construction, principle of working, **Brushless DC motor**: Construction, Trapezoidal type and sinusoidal type-comparison ,applications
HysterisisMotor: Constructional details, principle of operation, torque slip characteristics, applications

Module 4
Single phase special electric machines: AC series motor - construction, principle of working, phasor diagram, universal motor
Linear motors: Different types, linear reluctance motor, linear synchronous motors, construction, comparison. Linear induction motors- applications

REFERENCES:

1. E.G Janardhanan, Special Electrical Machines, PHI learning private limited
2. Irving L Kosow, Electrical machinery and transformers, Oxford Science Publications
3. T.J.E Miller, Brushless PM and Reluctance Motor Drives, C. Larendon press, Oxford
4. Theodore Wildi, Electric Mcahines: Drives and Power Systems, Prentice Hall India Ltd.
5. Veinott& Martin, Fractional & Sub fractional hp Electric motors, McGraw Hill International Edn.

19-209-0508 ADVANCED POWER ELECTRONICS

Course Outcomes:

On completion of this course the student will be able to

1. Identify the various PWM techniques of inverters
2. Analyse different types of Multi Level Inverter Topologies and derived converters
3. Design driver and control circuit for power electronic converters.
4. Distinguish various soft switching techniques.

Module 1

PWM strategies of inverters – Review of sinusoidal PWM – Advanced modulation techniques – trapezoidal modulation, Staircase modulation, Stepped modulation, Space vector modulation

Multi-Level Inverters - Diode Clamped Type - Flying Capacitor Type – Cascade type –Applications –Reactive power compensation, Back to back intertie, Adjustable speed drives

Module 2

Review of Buck, Boost, Buck-Boost regulators - SMPS Topologies - Basic Operation- Push-Pull and Forward Converter - Basic Operation - Waveforms - Half and Full Bridge Converters - Basic Operation and Waveforms- Flyback Converter discontinuous and continuous mode operation – waveforms

Module 3

Design concepts – Magnetic circuits and design – transformer design – core selection – winding wire selection – temperature rise calculations –inductor design - Power semiconductor selection and its drive circuit design – snubber circuits – closing the feedback loop – control design – stability considerations.

Module 4

Introduction to Resonant Converters – Basic Resonant circuit concepts – Classification of Resonant Converters – Series and parallel resonant circuit –load resonant converters – resonant switch converters – ZVS resonant converter – ZCS resonant converter.

Text / Reference books :

1. M.H. Rashid, Power Electronic circuits, Design and Applications, Pearson Education
2. Abraham I Pressman – Swithching power supply design – 2nd edition 1998 Mcgraw hill Publishing Company
3. Ned mohan, Undeland , Robbins, “Power Electronics converters, Applications and Design”, Pearson education
4. B K Bose “Modern Power Electronics and AC Drives” Pearson Education
5. G K Dubey& C R Kasaravada “Power Electronics & Drives” Tata McGrawHill
6. Daniel.M.Mitchell” DC-DC Switching Regulator Analysis” McGrawHill
7. Dewan&Straughen “Power Semiconductor Circuits” John Wiley & Sons.1975
8. L.Umanad, “Power Electronics Essentials and Applications”,Wiley

19-209-0509 ELECTRICAL SAFETY

Course outcomes:
On completion of this course the student will be able to

1. Describe the need and statutory requirements for electrical safety
2. Analyse the causes of accidents due to electrical hazards
3. Identify various protection systems in Industries from electrical hazards
4. Distinguish the various hazardous zones and applicable fire proof electrical devices

Module 1
Concepts And Statutory Requirements: Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardio pulmonary resuscitation(CPR).

Module 2
Electrical Hazards : Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

Module 3
Protection Systems: Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection. FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.

Module 4
Selection, Installation, Operation And Maintenance : Role of environment in selection-safety aspects in application - protection and interlock-self diagnostic features and fail safe concepts-lock out and work permit system-discharge rod and earthing devices safety in the use of portable tools-cabling and cable joints-preventive maintenance. **Hazardous Zones** : Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies

REFERENCES
1. ”Accident prevention manual for industrial operations”, N.S.C., Chicago, 1982.
2. Indian Electricity Act and Rules, Government of India.
3. Power Engineers – Handbook of TNEB, Chennai, 1989.
4. Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt. Ltd., England, 1988.
5. Fordham Cooper, W., “Electrical Safety Engineering” Butterworth and Company, London, 1986.

19-209-0510 FLUID MACHINERY & HEAT ENGINES

Course Outcomes:
On completion of this course the student will be able to
1. Understand the basic principles of fluid statics and dynamics
2. Get insight into the working principle of turbines.
3. Understand the working principle of pumps.
4. Learn about the performance of internal combustion engines.

Module I
Fluids and their properties: Fluids, shear stress in a moving fluid, viscosity, Newtonian and non-Newtonian fluids, viscosity. Fluid statics - pressure, variation of pressure in a static fluid, absolute and gauge pressure, measurement of gauge pressure.
Kinematics of fluid flow: Eulerian and Langragain approaches, classification of fluid flows, Path line, stream line, streak line, velocity and accelerations in steady and unsteady flows, Ideal fluids, equations of continuity in the differential form, rotational and irrotational flow, Stream function, Velocity potential, one dimensional flow along a stream line, Bernoulli's equation and its limitations, venturi meter, orifice meter, notches, Laminar flow in circular pipes, Darcy-Weisbach equation, friction factor, minor losses in pipes.
Module II
Dynamic action of fluid: Momentum equation applied to a control volume, impact of jets, flow of an incompressible fluid over fixed and moving vanes, work done and efficiency.
Hydraulic turbines: velocity triangles, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine, constructional features and performance characteristics, non-dimensional parameters for comparative study of turbine performance, theory of draft tubes, speed regulation of turbines, selection of type and speed of turbines.
Module III
Pumping machinery: general features of positive displacement and rotodynamic pumps, centrifugal pumps, classification, principle of working, velocity diagrams, losses in pumps, circulatory flow, multistage pumps, priming, cavitation and its significance.
Reciprocating pumps: Discharge through a reciprocating pump, Work done, Acceleration head, Effect of friction, Indicator diagram, Effect of acceleration and friction in suction and delivery pipes, Air vessels, efficiencies, pump characteristics.
Module IV
I C Engines: Spark Ignition and Compression Ignition engines, mean effective pressure, characteristic curves, Brake power, Indicated power, efficiencies, performance test, Morse test, Retardation test, Heat balance test, Governing of I C Engines.
Gas turbines: Classifications, Ideal gas turbine cycle, work output, efficiency, Effect of Compressor and Turbine efficiency, Optimum pressure ratio for maximum specific work output, Open cycle analysis, simple cycle with regeneration, inter cooling, reheating, Performance of gas turbines.
References:

1. Frank M. White, Fluid Mechanics, Tata Mc Graw Hill, 7th Ed., (2008).
2. Massey, Fluid Mechanics, English Language Book Society, (2006)
3. Kumar, K. L., Engineering fluid mechanics, Eurasia publishing house, 6th Ed., (1995).
4. Stepanoff, A. J., Centrifugal and axial flow pumps, John Wiley & Sons, (1958).
5. Shepherd, D. G., Principles of turbo machinery, Mac Millan publishing Co. Inc., (1957)
6. Som S. K., and Biswas G., Fluid Mechanics and Fluid Machines, Tata Mc Graw Hill, 2nd Ed., (2004).
7. Govinda Rao, N. S., Fluid flow mechanics, Tata Mc Graw Hill, (1983).
8. Agarwal, Fluid Mechanics & Machinery, Tata Mc Graw Hill, (2001).
9. Bansal, R. K., Fluid Mechanics & Hydraulic Machines, Laxmi Publications, (2005).
10. Rajput, R. K., Thermal Engineering, Laxmi Publications, (2010).
11. Ganesan, V., Fundamentals of I.C. engines, Tata Mc Graw Hill, (2000).
12. Ganesan, V., Gas Turbines, Tata Mc Graw Hill, (2003).

19-209-0511 ELECTRICAL MACHINES LAB II

Course outcomes:

On completion of this course the student will be able to**:**

1. Determine the performance of three phase induction motor and single phase induction motor by load test
2. Determine the voltage regulation by direct loading and indirect loading of 3-phase alternator
3. Perform synchronizing of alternator to mains
4. Predetermine the equivalent circuit parameters of induction motor

Synchronous Machines

1. Regulation of alternator by direct loading
2. Regulation of alternator by emf and mmf methods.
3. Regulation of alternator by potier method
4. Slip test and regulation of salient pole alternator using two - reaction theory
5. Synchronizing of alternator to mains by dark lamp & bright lamp method and control of reactive power.

Induction machines

6. Variation of starting torque with rotor resistance in slip ring induction motor.
7. Direct load test on induction motor.
8. Pre determination of Characteristic and equivalent circuit of induction motor from no load and blocked rotor test.
9. Synchronous induction motor V- curves, pre determination of field current.
10. Pre determination of characteristic of pole changing motor
11. Test on Induction generator. Determination of rotor hysterisis.

Special experiments

12. V/f control of induction motor.
13. Characteristic of single-phase induction motor.
14. Complete torque slip characteristic of induction motor.
15. Characteristic of double cage induction motor.
16. Slip power recovery schemes:
17. Cascade operation of induction motor. Determination of slip and load shared by each motor and overall efficiency of the test.
18. Methods using converter/inverter operations

    From the above list, maximum number of experiments may be conducted subject to facility available.

19-209-0512 MICROPROCESSOR & MICROCONTROLLER LAB

Course outcomes:

On completion of this course the student will be able to**:**

1. Program microprocessor and microcontroller to perform various operations.
2. Interface input output devices to perform specific operations.
3. Design and setup microcontroller/microprocessor based system for various applications
4. Interface ADC and DAC

Part A

1) Study of a typical microprocessor trainer kit and its operation

a) Programming examples using 8085 instruction set. To understand the use of various instructions and addressing modes.
b) Interfacing and programming of 8255 (eg: traffic light control)
c) Interfacing and programming of 8253/8254 (Stop watch , Real Time Clock etc.)
d) Interfacing and programming of 8279.

Part B

8051 Microcontroller

a) Basic arithmetic operations
b) Interfacing with ADC0808 and DAC0800
c) Interfacing with Stepper motor
d) Interfacing with Multidigit LED Display
e) Interfacing with 16*2 LCD Display

19-209-0601 ELECTRIC DRIVES

Course Outcomes:
On completion of this course the student will be able to**:**

1) Analyse four quadrant operation of drives
2) Design and analyse drives for DC motors
3) Design and analyse drives for induction motors
4) Design and analyse drives for synchronous motors

Module I
Concept of Electric Drives –parts of electrical Drives – Dynamics of electric drive – torque equation –Four quadrant operation of electric drives– Loads with rotational and translational motion – Steady state stability- components of load torques – nature and classification of load torques –load equalization – control of electrical drives – closed loop speed control – current limit control – closed loop torque control –Phase Locked Loop control- Energy conservation of electrical drives

Module II
Dc motor drives – basic equations – constant torque and constant power control – single phase semi converter and single phase fully controlled converter drives - continuous and discontinuous operation - Three phase-semi converter and fully controlled converter drives. Dual converters– Four quadrant operation of drive using dual converter- Chopper fed dc drives- closed loop control scheme for control below and above base speed

Module III
Three phase induction motor drives-AC Voltage controlled drives - stator voltage control, stator frequency control.- variable frequency control -V /f control - Rotor chopper speed control - Space Vector Modulation - Slip Power recovery schemes- rotor frequency control -VSI fed induction motor drive- CSI controlled induction motor drives

Module IV
Synchronous motor drives –Cylindrical rotor motors - Salient pole motors - Reluctance motors - Permanent Magnet ac motor drives-sinusoidal PMAC-Brushless DC (Trapezoidal PMAC) motor drives – Switched reluctance motors-closed loop control of synchronous motors - Stepper motor control. Traction: Important features of traction drives-Conventional DC and AC traction drives – DC & AC traction using PWM VSI SCIM drives

Text/Reference Books:
1. Dubey G. K., Fundamentals of Electric Drives
2. M. H. Rashid, Power Electronics Circuits, Devices and Applications, Prentice Hall of India
3. Sen P. C., Thyristor DC Drives, Tata McGraw Hill
4. B. K. Bose, Modern Power Electronics and AC Drives, Pearson Education
5. R. Krishnan, Electric Motor Drives- Modelling, Analysis and control, Pearson education
6. M. D. Singh & K. B. Khanchandani, Power Electronics, McGraw Hill

19-209-0602 DIGITAL SIGNAL PROCESSING

Course Outcomes:

On completion of this course the student will be able to**:**

1. Analyse the discrete time signals and properties of systems in Z domain.
2. Analyse discrete time systems with DTFT, DFT and FFT.
3. Design FIR and IIR digital filters with prescribed frequency response functions.
4. Analyse finite word length effects in signal processing

Module 1

Discrete time signals and systems – Sampling theorem, Nyquist rate-aliasing, classification of signals-power & energy signals, deterministic & random signals, one, two, three & multidimensional signals, impulse, step, exponential and sinusoidal signals, representations of signals, operations on signals, properties of DT sinusoidal & exponential signals, comparison between CT & DT sinusoids, Discrete time systems: Properties- Linearity, stability, causality, static, dynamic, invariability, time invariance. Representation of systems- Impulse response – Difference equation representation. Z Transform: Properties, analysis of LTI system using Z transform, inverse Z transform, systemfunction.

Module 2

Periodic & non periodic signals, Frequency domain representation of discrete time signals- Discrete Fourier Series (DFS) & properties, Discrete Time Fourier Transform (DTFT) & properties, Discrete Fourier Transform (DFT) & properties, Fast Fourier Transform (radix 2 FFT) Decimation in Time &Decimation in Frequency algorithms, overlap save and overlap add methods.

Module 3

Frequency response of ideal LP, HP, BP & BS digital filters, Poles & Zeroes of LTI DT Systems, Simple first/second order FIR & IIR low pass, high pass, band pass, band stop filters/Notch Filters, Moving Average/Comb Filters, All pass filters, Relation between poles & zeroes of all pass filters, Group Delay & Phase delay, Type-1/2/3/4 FIR filters, Restrictions on zero locations of linear phase FIR filters, Pole Zero Placement method for designing simple FIR/IIR digital filters, frequency response shaping with filter cascades

Design of LP/HP/BP/BS FIR filters by Windowing (Rectangular, Bartlett, Hamming, Hanning)

Design of LP IIR Filter Design-Butterworth & Chebyshev Approximations, Analog to digital Transformation techniques – Impulse invariant and Bilinear Techniques

Direct/Tapped delay line, cascade realization & liner phase structures of FIR filters, Direct form I, Direct form II, Cascade & Parallel form structures of IIR Digital Filters, Transposed Structures.

Module 4

Finite word length effects in digital filters- fixed point arithmetic -Floating point arithmetic –Representation of numbers in 1's complement, 2's complement & sign- magnitude form, Truncation-Rounding - Quantization error in analog to digital conversion-effect of finite register length on the poles/zeroes of digital filters, Zero input & Overflow Limit cycle oscillations in IIR filters, General DSP architecture- features – Comparison with general purpose microprocessor–Features & general architecture of TMS320C55X fixed point processor.

Applications of DSP: Two sample method of phasor estimation, DFT of complex exponential/sinusoidal signals & its use in amplitude & phase estimation, relation between DFT & fourier series coefficients of a signal & its use in spectralestimation.

Text Books:

1. Oppenheim & Ronald W Schafer: "Digital Signal Processing", Prentice HallIndia
2. John G Proakis& Dimitris G Manolakis : "Digital Signal Processing", PHI, NewDelhi

References:

1. Cristi, Modern Digital Signal Processing, NelsonEngineering.
2. Ashok Ambardar, Analog and Digital Signal Processing, Brooks/Cole PublishingCompany.
3. Steven W. Smith, "The Scientist and Engineer's Guide to Digital SignalProcessing"
4. Sanjit K. Mithra," Digital Signal Processing", Tata Mc- GrawHill

19-209-0603 POWER SYSTEMS II

Course outcomes:
On completion of this course the student will be able to**:**

1. Represent the power system in single line, impedance and reactance diagram .
2. Carry out load flow studies using different algorithms.
3. Determine the fault currents for symmetrical and unbalanced faults
4. Assess the steady state and transient stability studies in the power system network

Module I

Representation of power system – one line diagrams – impedance and reactance diagrams
Per unit quantities-single phase and three phase-selection of base quantities -advantages of per unit system –changing the base of per unit quantities-Simple problems
Load flow studies – Introduction-types-network model formulation - formation of bus impedance and admittance matrix Gauss-Siedel (two iterations), Newton-Raphson (Qualitative analysis only) and Fast Decoupled method (two iterations)

Module II

Economic Operation – System Constraints - Distribution of load between units within a plant - transmission loss as a function of plant generation - distribution of load between plants - Method of computing penalty factors and loss coefficients
Automatic Generation Control: Load frequency control: single area and two area systems - Automatic voltage control.

Module III

Circuit breaker – Types - rating - Selection - Neutral earthing - Lightning and protection - Protective Relays– Functions - Types of Relays - protection schemes
Faults on power systems - short circuit capacity of a bus and circuit breaker ratings-current limiting reactor sequence impedances and sequence network - symmetrical component methods of analysis of unsymmetrical faults

Module IV

Power system stability-Electrical stiffness - swing equation - inertia constant - equal area criterion - multi machine stability analysis- power system deregulation-smart grid-microgrid

References:

1. Stevenson W.D *Elements of Power System Analysis* (Tata McGraw Hill).
2. I.J Nagrath& D.P Kothari *Modern Power System Analysis*, (Tata McGraw Hill).
3. S.L.Uppal - *Electrical Powe*r (Khanna Publication).
4. S.S Rao - *Switch gear & Protection* (Khanna Publication)
5. Soni, Guptha, Bhatnagar - *A course in Electric Power* (DhanapatRai& Sons).
6.John J. Grainger & W.D. Stevenson: Power System Analysis – McGraw Hill International 1994.
7. C.L. Wadhwa: Electrical Power Systems – New Age International Pub. Co.Third Edition, 2001.
8. HadiScadat: Power System Analysis – Tata McGraw Hill Pub. Co. 2002

19-209-0604 ELECTRICAL DRAWING

Course Outcomes:

On completion of this course the student will be able to

1. Design armature windings of dc machines
2. Design different types of windings of ac machines
3. Identify the different parts of AC machines
4. Design different types of electrical installations

Module I

Familiarization of CAD Environment - Simple drawing commands Edit commands Modify commands Preparation of 2D drawings **Electrical CAD**- Symbol libraries, Electrical User interface, icon menus,PCB drawing, Help system, Basic work flow, Project manager- opening, activating and closing projects.

Module II

DC simplex Lap and Wave windings- Schematic wiring, Wires, Ladders, Wire numbering, Signal arrows etc., three phase ac double layer Lap winding and single layer Mush winding

Module III

Electrical Machine (2D) dimensioned drawings- Half sectional elevation and end view of Induction motor, Synchronous machine and DC machine.

Module IV

Circuits- Multiple phase circuits, Electrical Schematic drawing of an 11kV indoor Sub-station, HT/LT panels with Circuit Breakers-Electrical Schematic drawings of MSB with supplies from a Transformer and Standby DG set, relays, indication lamps, metering etc.

References

1. Auto CAD reference manual (Release 2008 or later)
2. A text book computer aided machine drawing: S. Trymbaka Murthy
3. CAD/ CAM principle, practice and manufacturing management: Chris McMahon, Jimmie Browne

19-209-0605 CONTROL SYSTEMS II

Course Outcomes:

On completion of this course the student will be able to

1. Represent a system and check its stability in state space.
2. Design various controllers and compensators using Bode plot and Rootlocus.
3. Design compensating networks and cascade compensation using Bodeplots.
4. Analyze non-linear systems using phase plane and describing function.

Module I

State space models for linear systems: Concepts, state space, linear systems in state space, state diagram, state models from transfer functions, phase variable and canonical forms--solution of state equations- state transition matrix,-properties & computation, controllability and observability, control system design by pole placement, state observers.

ModuleII

Linear discrete time systems: Sampling Theorem-pulse transfer function, stability using Jury'stest,state space representation of discrete time systems.

Basic control actions and Root locus technique: Modes of control- Proportional(P) , Integral(I), Derivative(D) and combinations of P, I and D. and its effects on system performance. PID controller tuning in process control.

Module III

Design of control systems: Cascade and feedback compensations, design principles, compensating networks-lead, lag, lag lead-realisation, design of compensators using Bode plots and root locus.

Module IV

Nonlinear systems analysis. Non-linear systems behavior, nonlinearities in control systems, describing function of common nonlinearities, stability analysis by describing function, Phase plane and phase trajectories, Lyapunov stability-Asymptotic stability-Instability.

Text Books:

1. K Ogata. - *Modern Control Engineering,* Prentice Hall.
2. M.Gopal, *Control Systems Principlas and Design*, Tata McGrawHill.
3.MGopal, *Digital Control and State Variable Methods*, Tata McGraw Hill.
4. K.P .Mohandas, *Modern Control Engineering, Revised Edition, Sanguine Pearson, 2010*.

References:

1. A.Nagoorkani "*Advanced Control Theory*", RBA Publication
2.SPalani "*Control Systems Engineering*", Tata McGraw Hill.
3.Benjamin C. Kuo : "*Automatic Control Systems"*, John Wiley & Sons
4. *I.J. Nagrath and M.Gopal, Control Engineering, TMH*

19-203-0606 (IE) INDUSTRIAL AUTOMATION

Course outcomes

On completion of this course the student will be able to:

1. Describe the basic concepts in industrial automation.
2. Identify types of Industrial Sensors
3. Demonstrate the design aspects of industrial automation
4. Identify the practical applications of Programmable Logic Controller DCS, SCADA and CNC in an industry

Module 1

Introduction to Industrial Automation and control- Architecture of industrial automation system Introduction to sensors and measurement systems - limit switches, proximity sensors, Flow, level, temperature sensors - Introduction to Process Control- Proportional, Integral, Derivative controllers and controller tuning, Control devices- Solenoid valves, control valves, actuators, relays, contactors and drives.

Module 2

Design aspects - Preparation of Input / output list, List of Instruments for Hardwired Control, List of Field Instruments- Preparation of Schemes - Open Loop Schemes, Closed Loop Schemes, Power Supply Distribution Schemes, Measurement Schemes.

Module 3

Introduction to Sequential control, Programmable Logic Controllers (PLC)- Overview, Functions & Features, Typical areas of Application, Logic Contact Symbols, Input / output addressing- PLC Hardware – Fundamentals of PLC programming – Configuration, Ladder Logic (LD), Function Block Diagram (FBD), Instruction List (IL), Structured Text (ST), Sequential Function Chart (SFC), Arithmetic Functions, Logic Functions, Timers and Counters, PID Function Blocks, - Programming- Motor control starter circuits, Elevators, conveyors.

Module 4

Introduction to numerical relays, Familiarisation of control circuits, Communication network architecture Supervisory Control & Data Acquisition (SCADA) – Introduction, SCADA Architecture, Introduction to communication protocols, Creation of Database, Interfacing with PLC, Alarms, Trends & Bar graphs, Historical Data Management Distributed Control System (DCS)- Concept of DCS, Basics of Data Acquisition and Data Control, DCS Architecture, Advantages & Limitations, Overview of configuration & programming Basic concept of CNC Machines.

References:

1. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A.K. Deb, Jaico Publishing House, 2013
2. Chemical Process Control, An Introduction to Theory and Practice, George Stephanopoulos, Prentice Hall India, 2012
3. Electric Motor Drives, Modelling, Analysis and Control, R. Krishnan, Prentice Hall India,2003

19-209-0607 EMEDDED SYSTEMS

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able to

1. Analyze the circuit design capability for answering some of the real lifeproblems
2. Acquire embedded system programmingskills.
3. Design an embeddedsystem.
4. Comprehend embedded firmware & operating systems

Module I

Overview of Embedded System: - Embedded System, Categories of Embedded System, Requirements of Embedded Systems, Challenges and Issues in Embedded Software Development, major application areas of embedded system. Typical embedded system- Core of the embedded system, memory, sensors and actuators, Communication Interface, reset circuit, Brown-out protection circuit, oscillator circuit, Watchdog timer .Overview of the 8051 family. 8051 architecture- memory organization, registers and I/O ports. Addressing modes, instruction sets, and assembly language programming. Programming timer/counter. Interrupts- handling and programming. Introduction to C programming in 8051.

Module II

8051 interfacing - keyboard, stepper motor, ADC, DAC, LED and LCD module interface. Applications – frequency counter and temperature measurement. Bus architectures & protocol of I2C, SPI, CAN, RS232.

Module III

Memory-Technology & devices -Flash memory-NAND Flash -NOR Flash-DRAM-SDRAM/ DDR/ DDR2. Introduction to embedded CPUs: Basic architecture of ARM core family-features of ARM 926EJS core. Basic architecture of MSP430-features ofMSP430.

Module IV

Introduction to embedded firmware & operating systems: Boot loader -Realtime kernel-Embedded OS-Tasks, Processes and Threads, Multiprocessing and Multitasking, Task scheduling, Task communication and synchronisation, Device Drivers.

References:

1. Shibu K.V*, Introduction to Embedded Systems*, Tata McGraw Hill,(2009)
2. K Uma Rao, Andhe Pallavi ,*The 8051 and MSP430 Microcontroller Architecture Programming and Applications*,Pearson,(2010)
3. Rajkamal, *Microcontrollers - Architecture, programming, Interfacing and system Design*, Pearson Education,(2005)
4. Daniel W. Lewis, *Fundamentals of Embedded Software where C and Assembly Meet*, PHI Ltd, (2003)
5. Steve Heath, *Embedded system design* ,second edition ,Elsevier,2/e,(2002)
6. Kantha Rao, *Embedded systems*, PHI, ISBN:978-81-203-4081-7
7. Subrata Ghoshal, *8051 Microcontroller internals, instructions, programming and Interface*, Pearson,ISBN:9788131731437
8. Steve Furber, ARM System on Chip Architecture, Pearson,2/e,(2009)
9. Andrew Sloss, Dominic Symes , Chris Wright -*ARM Developers Guide, Designing & Optimizing systemsoftware*
10. Tammy Noergaard, *Embedded System Architecture , A comprehensive guide for Engineers and Programmers*, Elsevier ,(2005), ISBN-10: 0750677929, ISBN-13:978-0750677929

19-209-0608 SOFT COMPUTING

.

Course outcomes:

On completion of this course the student will be able to

1. Comprehend fundamental concepts of ANN, Fuzzy Logic and Genetic Algorithm.
2. Identify application of soft computing techniques for real-world problems
3. Apply various leaning rules in solving engineering problems.
4. Develop various optimization algorithms

Module I

Introduction to Neural Network**:** Concept, biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise &Unsupervise) and activation function, Models of ANN-Feed forward network and feed back network, Learning Rules- Hebbian, Delta, Perceptron Learning and Windrow-Hoff, winner take all.

Module II

Supervised Learning**:** Perceptron learning,- Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN. Application of Neural network in forecasting, data compression and image compression.
Unsupervised learning**:** Kohonen SOM (Theory, Architecture, Flow Chart, Training Algorithm) Counter Propagation (Theory , Full Counter Propagation NET and Forward only counter propagation net), ART (Theory, ART1, ART2). Application of Neural networks in pattern and face recognition, intrusion detection, robotic vision.

Module III

Fuzzy Set: Basic Definition and Terminology, Set-theoretic Operations, Member Function, Formulation and Parameterization, Fuzzy rules and fuzzy Reasoning, Extension Principal and Fuzzy Relations, Fuzzy if-then Rules, Fuzzy Inference Systems. Hybrid system including neuro fuzzy hybrid, neuro genetic hybrid and fuzzy genetic hybrid, fuzzy logic controlled GA. Application of Fuzzy logic in solving engineering problems.

Module IV

Genetic Algorithm: Introduction to GA, Simple Genetic Algorithm, terminology and operators of GA (individual, gene, fitness, population, data structure, encoding, selection, crossover, mutation, convergence criteria). Reasons for working of GA and Schema theorem, GA optimization problems including JSPP (Job shop scheduling problem), TSP (Travelling salesman problem), Network design routing, timetabling problem. GA implementation using MATLAB.

References:-

1. S.N. Shivnandam, "*Principle of soft computing",* Wiley.
2. S. Rajshekaran ,G.A.V. Pai, "*Neural Network , Fuzzy logic And Genetic Algorithm*", PHI.
3. Jack M. Zurada, "*Introduction to Artificial Neural Network System"*JAico Publication.
4. Simon Haykins, "*Neural Network- A Comprehensive Foudation"*
5. Timothy J.Ross, "*Fuzzy logic with Engineering Applications*", McGraw-Hills 1.

19-209-0609 ELECTRICAL MACHINE DESIGN

Course outcomes:
On completion of this course the student will be able to
1. Identify different design aspects of D.C machines.
2. Design transformer windings, cooling tanks and tubes etc
3.Designthe parameters of Alternator
4. Design a induction machines according to the given specifications.

Module I
D C Machines:-Output equation – main dimensions choice of specific electro magnetic loadings – choice of speed and number of poles. Design of armature conductors, slots and windings – design of airgap, field system, commutator, interpoles, compensating winding and brushes – Carter's co-efficient – real and apparent flux density. Design examples.

Module II
Transformers; - Single phase and Three phase transformers – output equation - main dimensions – specific electric and magnetic loadings – design of core, LV winding, HV winding – cooling of transformers – design of cooling tank and tubes. Temperature rise time curve – short time and continuous rating.

Module III
Alternators:- Salient pole and turbo alternators – output equation – main dimensions – choice of specific electric and magnetic loadings – choice of speed and number of poles – design of armature conductors, slots and winding – design of air-gap, field system and damper winding – prediction of open circuit characteristics and regulation of the alternator based on design data – design examples.

Module IV
Induction machines:- Output equation – main dimensions – choice of specific electric and magnetic loadings – design of stator and rotor windings, stator and rotor slots and air-gap of slip ring and squirrel cage motors – calculation of rotor bar and end ring currents in cage rotor – calculation of equivalent circuit parameters and prediction of magnetising current based on design data – design examples.

References:
1. Clayton , Hancock - *Performance and Design of DC Machines*, ELBS.
2. Sawhney - *Electrical Machine Design*, DhanapathRai.
3. Say M.G - *Performance and Design of AC Machines*, Pitman, ELBS.

19-209-0610 LINEAR INTEGRATED CIRCUITS LAB

Course Outcomes:

On completion of this course the student will be able to

1. Design and setup different waveform generation and oscillator circuits using Op-amp
2. Design Op-amp based circuit for real time applications
3. Simulate in various software tools like PSpice/LTspice
4. Design filters

Experiments:

1. Study of Op-amps
2. OP-amp Inverter-scale changer-summer-integrator-differentiator-comparator and instrumentation amplifier
3. Design and setup of Low pass-High-pass and Band pass filters using Op-amps
4. Voltage regulation 723
5. PLL 565 - Lock range and capture range
6. Circuits using Op-amps for waveform generation
7. 555 Timer based Astable, Monostable Multivibrators and PWM circuits
8. Wien bridge oscillator
9. Triangular and square waveform generation
10. Precision rectifiers
11. Schmitt Trigger using Op-amps
12. Inverting and Non –Inverting amplifier based on 741-frequency response
13. Precision comparator and window detector using IC311
14. VCO 566
15. Simulation of some above experiments using PSpice/LTspice.

19-209-0611MINI PROJECT

Course Outcomes:
On completion of this course the student will be able to
1. Work independently on a specific problem relevant to research or industry.
2. Develop team work skills to work in group
3. Design models based on the knowledge acquired in a specific area
4. Explore the wider aspects of product development

Each batch comprising of 3 to5 students shall design, develop and realize an electronic product. Basic elements of product design must be considered. Fully software/simulation projects are not allowed. Each student shall submit a project report at the end of the semester. The project report should contain the design and engineering documentation including the Bill of Materials and test results. Product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations and aesthetics / ergonomic aspects taken care of in the project shall be given due weight.

Guidelines for evaluation:

Attendance and Regularity	5
Work knowledge and Involvement	15
End-Semester presentation & Oral examination	10
Level of completion and demonstration of functionality/specifications	10
Project Report	10
Total	*50*

***Note**: External projects and R&D projects need not be encouraged at this level. Points (i) & (ii) to be evaluated by the project guide & co-ordinator and the rest by the final evaluation team comprising of 3 teachers including the project guide*

19-209-0701 PRINCIPLES OF MANAGEMENT

Course Outcomes:

On completion of this course the student will be able to:
1. Understand the basic principles underlying in the management of organizations.
2. Get exposure in all industrial management functions .
3. Get knowledge to analyse the financial accounts and ratios .
4. Understand the principles of economics and IPR aspects.

Module I

Basic concept of Management: Introduction, definitions of managements, characteristics ofmanagement, levels of management, management skills, Scientific management - Contributions of
Gilbreth and Gantt.
Functions of Management: Planning, forecasting, organizing, staffing, directing, motivating,controlling, co-coordinating, communicating, decision making.
Organization: Introduction, definition of organization, elements of organization, process oforganization, principles of organization, formal and informal organization, organization structure,types of organization structure.
Forms of Business Organization: Concept of ownership organization, types of ownership,Individual ownership, partnership, joint stock company, private and limited company, co-operativeorganizations, state ownership, public corporation

Module II

Production planning and control: Objectives and functions.
Production management: Structure, objectives, productivity index, modern productivityimprovement techniques.
Inventory Management: Functions, classifications of inventory, basic inventory models, inventorycosts, Economic order quantity (EOQ). Materials Requirement Planning – Objectives, Functionsand methods.
Project Management: Functions, Characteristics, Feasibility studies, Project network analysis –PERT/CPM.

Module III

Human Resource Management: Introduction, definition, objectives, characteristics, functions, principles and organization of HR management, Recruitment, selection process and training methods, Wages and incentives, Job evaluation and merit rating, Industrial accidents-causes and related issues Marketing Management: Introduction, Functions and objectives, Marketing environment and Information, Market segmentation, Distribution channels, Consumer and Industrial markets, Consumer behaviour, Pricing methods, Sales promotion and Advertisement. Market research: Objectives and methods.

Module IV

Financial Management: Basic functions, Capital-classifications, Sources of funds, Financial accounts-types, basic concepts and importance, Financial ratios and its significance, Types of budgets and budgetary controls, Overheads, Standard costing, Marginal costing.
Economics: Principles of economics, problem of scarcity, demand, supply, utility, time value of money, inflation and deflation, Consumer Demand Curve.
IPR Aspects: General introduction to IPR, eligibility for patent, patent information and prior art search, procedure for filing patent application, rights of patent owner and duration, ownership of patent and commercialization.

References:

1. Fraidoon Mazda, Engineering Management, Addison-Wesley, (1997).
2. Koontz and O'Donnell, Essentials of Management, Mc Graw Hill, (1978).
3. Kotler P., Marketing Management, Prentice Hall, (2011).
4. Prasanna Chandra, Finance Management, Tata Mc Graw Hill, (2008).
5. Monks, J. G., Operations Management, Mc Graw Hill, (1982).
6. Production and Operations Management,PHI(2010).

19-209-0702 HVDC & FACTS

Course outcomes:

After successful completion of course student will be able

1.Analyse HVDC transmission system.

3. Identify control methods for HVDC converters

3. Design the technology of flexible AC transmission systems.

4.Dsitinguish static & shunt compensation in power system using FACTS controllers

Module I

HVDC Transmission-Need for power system interconnections, Evolution of AC and DC transmission systems, Comparison of HVDC and HVAC Transmission systems, Types of DC links, relative merits, Components of a HVDC system, Modern trends in DC Transmission systems

Module II

EHV DC Transmission: Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of dc link control, converter controls characteristics, firing angle control, current and excitation angle control, power control, starting and stopping of dc link.

Module III

FACTS concepts and general system considerations: Power flow in AC systems - Definition of FACTS - Power flow control -Constraints of maximum transmission line loading - Benefits of FACTS Transmission line compensation-Uncompensated line -shunt compensation - Series compensation -Phase angle control.

Static shunt compensators-SVC and STATCOM - Operation and control of TSC, TCR and STATCOM - Compensator control - Comparison between SVC and STATCOM.

Module IV

Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators - TCVR and TCPAR- Operation and Control -Applications.

Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPFC- Basic Principle of P and Q control- independent real and reactive power flow control- Applications - Introduction to interline power flow controller.

References:

1. Padiyar K. R., "*HVDC Power Transmission Systems: Technology and System Reactions*" New Age International.

2 Arrillaga J.," *High Voltage Direct current Transmission" IFFE Power Engineering Series 6*, Peter PeregrinusLtd,London.

3. Kimbark,E.W., `*Direct current transmission-Vol.1'*,Wiley Interscience, New York, 1971

4.Arrilaga,J., `*High Voltage Direct current transmission',Peter Pereginver Ltd.,* London,UK.,1983

5. Kundur P., "*Power System Stability and Control*", McGraw-Hill, 1993.

6..NarainG.Honorani, Laszlo Gyugyi "*Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems"*

7.. Padyar K.R. *"FACTS controllers in power transmission & distribution*" New age international publications

8..Sood V. K, "*HVDC and FACTS controllers- Applications of Static Converters in Power System*", Kluwer Academic Publishers, 2004

9.A.T.John, "*Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE*), 1999.

10.Mohan Mathur, R., Rajiv. K. Varma, "*Thyristor – Based FACTS Controllers for Electrical Transmission Systems*", IEEE press and John Wiley & Sons, Inc, 2002.

19-209-0703 COMMUNICATION ENGINEERING

Course Outcomes:

On completion of this course the student will be able to

1. Paraphrase the fundamentals of radiation and propagation of electromagnetic waves
2. Be to apply analog communication systems and frequency spectrum.
3. Identify fundamentals of sampling techniques and multiplexing
4. Distinguish the essentials of wireless communication and fiber optic communication system

Module 1

Radiation and Propagation of Waves: - (analysis not required) - Electromagnetic Radiation- Waves in free space- polarization - reception- effects of Environment- Propagation of waves:- Ground waves- Sky-wave propagation - space waves- antennas- Basic consideration - wire radiator in space - common terms and definitions- Effects of ground on Antennas- Directional High frequency Antennas - UHF Micro wave antennas - Wide band and special purpose antennas.

Module II

Amplitude modulation – principles – visual concepts, modulation factor and percentage of modulation, mathematical relationship, component phasors, frequency spectrum, band selection. Amplitude modulators – ISB modulators – VSB modulation. AM transmitters – low level, high level – SSB systems – comparisons,

SSB generation –SSB transmitters-filter method, phase shift method, third method. AM receivers – TRF receivers, Super heterodyne receiver, Double Super heterodyne receiver – SSB receiver

Angle Modulation-principles, waveforms, frequency deviation, frequency analysis, bandwidth requirement, phasor representation–pre-emphasis, de-emphasis. FM modulators – direct, indirect, Phase modulators – direct. FM transmitters – direct FM, indirect FM; FM receivers-block diagram– demodulators

Comparison of AM, FM & PM

Module III

Sampling Process: Sampling theorem, Interpolation Formula, Quadrature sampling of band pass signals, Reconstruction of a message process from its samples, signal distortion in sampling, practical aspects. PAM, PPM, PWM, Multiplexing-TDM, FDM. Frequency domain analysis

Waveform Coding Techniques: PCM, Quantization Noise & Signal to noise ratio, effect of sampling on quantization noise, uniform and nonuniform quantization companding- A Law and μ Law characteristics DPCM, Delta Modulation.

Module 1V

Multiple access techniques for Wireless Communications – FDMA,TDMA and CDMA – Wireless systems and standards – AMPS – Global System for Mobile(GSM) – CDMA – General Packet Radio Service – DECT System .

Fiber optic communication: light wave communication systems- Fiber optic cable - optical transmitter and receiver.

Satellite Communication – Orbit of communication satellite – Satellite Constellation – Orbital parameters – Orbital perturbations – Geostationary orbits – Low Earth and Medium Orbits – Look Angles – Frequency selection RF Links – Propagation characteristics – Modulation methods- coding – multiple access

References:

1. Electronic Communication Systems : Kennedy & Davis - Fourth Edition-TMH
2. Communication Electronics :Frenzel, McGraw Hill, International Editions.
3. Simon Haykin, *Communication Systems*, Wiley India, 4/e, 2010
4. George Kennedy, *Electronic communication systems*, McGraw Hill ,4thed.
5. *Wayne Tomasi, Electronic Communications Systems (Fundamentals through Advanced), Pearson Education 5th Ed.*
6. *Taub& Schilling, Principles of Communication Systems, Tata McGraw Hill, 1991*

19-209-0704 (IE) ELECTRIC AND HYRID VEHICLES

Course outcomes:
On completion of this course the student will be able to

1. Design and develop basic schemes of electric vehicles and hybrid electric vehicles
2. Choose proper energy storage systems for vehicle applications
3. Design sizing of inverter and propulsion motor
4. Identify various communication protocols and technologies used in vehicle networks

MODULE 1

Introduction to hybrid electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive trains on energy supplies.

Conventional Vehicles: Basics of vehicle performance, vehicle power sourcecharacterization, transmission characteristics, mathematical models to describevehicle performance.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive train topologies, Comparison of Power flow control and fuel efficiency analysis

MODULE 2

Electric Drive-trains: Basic concept of electric traction, introduction to variouselectric drive-train topologies, power flow control in electric drive-traintopologies, fuel efficiency analysis.

Electric propulsion unit: Introduction to electric components used in electric and hybrid vehicles, Configuration and control of DC motor drives, Configuration and control of Induction motor drives, configuration and control of PermanentMagnet Motor drives, Configuration and control of Switch Reluctance Motordrives, drive system efficiency.

MODULE 3

Energy storage: Introduction to energy storage requirements in hybrid and electric vehicles, Analysis of battery based energy storage and fuel cell based energy storage. Introduction toSuper Capacitor based energy storage and Flywheel based energy storage.

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, Sizing the power electronics, Selecting the energy storage technology, Communication and supporting subsystems in vehicle networks

MODULE 4

Energy management strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, Comparison of different energy management strategies.

Introduction to OTA updates in automobiles, Standards of EV charging stations & functional block diagram of fast EV charging stations

References:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design fundamentals, CRC Press,2003
2. James Larminie, john Lowry, Electric Vehicle Technology Explained, Wiley 2003
3. MehrdadEhsani, YimiGao, Sebastian E Gay, Ali Emadi, Modern Electric Hybrid Electric and Fuel cell Vehicles:

Fundamentals , Theory and Design, CRC Press, 2004

19-209-0705 DIGITAL CONTROL SYSTEMS

CourseOutcomes:
On completion of this course the student will be able to

1. Formulate a good knowledge on digital controllers.
2. Discover Time responses of discrete data systems.
3. Originate PID controllers by using bilinear transformation-
4. Relate state variable model of discrete data systems

Module 1
Basic digital control system- Examples - mathematical model-ZOH and FOH- choice of sampling rate principlesOf discretisation -Mapping between s-domain and z-domain-Pulse transfer function- Differentconfigurations for the design- Modified z-transform- Multi-rate discrete data systems.

Module 2
Time responses of discrete data systems- Correlation between time response and root locations in the z-plane-Steady state performance- Disturbance Rejection- Robustness and Sensitivity -Jury's stability test – Routhstability criterion on the r-plane -Root locus- Polar plots-Nyquist stability criterion- Bode plot- Bilineartransformation method .

Module 3
Cascade compensators using Root Locus- Design of PID controllers by using bilinear transformation- Digitalcontroller design using bilinear transformation- Dead-beat response design- Deadbeat controller without andwith prescribed manipulated variable-Choice of sample time for deadbeat controller-Realization of digitalcontrollers- Computer based simulation.

Module 4
State variable model of discrete data systems with S/H devices- State transition equations- state diagrams-Transfer function- Transformation to Jordan canonical form and phase variable form- Computation of statetransition matrix using Cayley-Hamilton theorem and z-transform method- Response between sampling instants-Controllability, Observability, stabilizability and reachability- Loss of controllability and observability due to sampling- Pole placement design using state feedback for SISO systems- Computer based simulation.

References:

1. M.Gopal,*Digital control and State Variable methods*, Tata McGraw –Hill , 1997
2. B.C.Kuo, *Digital Control Systems*, 2nd Ed., Oxford University Press,1992.
3. Constantine H. Houpis,Gary B. Lamont, *Digital control systems Theory, hardware software,*Mc-Graw Hill Book Company, 1985.
4. R.Isermann, *Digital control systems, Volume 1, Fundamentals , Deterministic control,(*2nd revised edition),Springer Verlag, 1989.
5. R.G.Jacquot, *Modern digital control systems,* (second edition),Marcel Dekker, Inc., 1995.
6. Philips, Nagle, *Digital control system analysis and design,* Prentice Hall, 1984.
7. G.F.Franklin, J.DavidPowell ,M.Workman,*Digital Control of Dynamic Systems,* 3rd Ed.,,Addison Wesley, 2000.

19-209-0706 ENERGY AUDITING & ANALYSIS

Course outcomes:
On completion of this course the student will be able to
1. Summarize fundamental knowledge of different types of Electricity tariff
2. Inspect efficient starting ,control and loading of motor.
3. Distinguish Peak Demand controls and Transformer Loading/Efficiency
4. Relate Energy conservation measures, types of electric loads like refrigerators etc.

Module I
System approach and End use approach to efficient use of Electricity: Electricity tariff types; Energy auditing: Types and objectives-audit instruments- ECO assessment and Economic methods-specific energy analysis-Minimum energy paths-consumption models-Case study.

Module II
Electric motor: Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis- Energy efficient /high efficient Motors-Case study; Load Matching and selection of motors.
Variable speed drives: Pumps and Fans-Efficient Control strategies- Optimal selection and sizing -Optimal operation and Storage; Case study

Module III
Transformer Loading/Efficiency analysis, Feeder/cable loss evaluation, case study.
Reactive Power management**:** Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-Placement-Maintenance, case study.
Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study.
Lighting- Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballast-Power quality issues-Luminaries, case study.

Module IV
Cogeneration: Types and Schemes-Optimal operation of cogeneration plants-case study;
Electric loads of Air conditioning & Refrigeration-Energy conservation measures- Cool storage. Types-Optimal operation-case study; Electric water heating-Gysers-Solar Water Heaters- Power Consumption in Compressors, Energy conservation measures; Electrolytic Process; Computer Controls- software-EMS .

References:

1. Y P Abbi ,Shashank Jain *Handbook on Energy Audit and Environment Management*, TERI, 2006
2. William J. Younger , Terry Niehus, Albert Thumann*Handbook of Energy Audits*, , 2009
3. Howard E. Jordan, .*Energy-Efficient Electric Motors and Their Applications*., Plenum Pub Corp; 2nd edition (1994)
4. Albert Thumann , .*Handbook of Energy Audits.,* Fairmont Pr; 5th edition (1998)
5. Albert Thumann, P.W, -.*Plant Engineers and Managers Guide to Energy Conservation*. - Seventh Edition-TWI Press Inc, Terre Haute, 2007
6. *IEEE Recommended Practices for Energy Management in Industrial and Commercial Facilities*
7. Donald R. Wulfinghoff, *Energy Efficiency Manual: for everyone who uses energy, pays for utilities, designs and builds, is interested in energy conservation and the environment*, Energy Institute Press (March 2000)

19-209-0707DYNAMICS OF ELECTRIC MACHINES

Course outcomes

After successful completion of the course student will be able to

1. Develop the basic elements of generalized theory
2. Develop dynamic model of AC machines
3. Develop small signal model and perform steady state analysis induction machines
4. Perform dynamic analysis of synchronous machines

Module 1

BASIC CONCEPTS OF MODELLING: Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.

DC MACHINE MODELING: Mathematical model of separately excited D.C motor – Steady State analysis-Transient State analysis Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt motor.

Module 2

REFERENCE FRAME THEORY: Real time model of a two phase induction machine- Transformation to obtain constant matrices-three phaseto two phase transformation-Power equivalence

DYNAMIC MODELING OF THREE PHASE INDUCTION MACHINE:Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly usedInduction machine models- Stator reference frame model-Rotor reference frame model-Synchronouslyrotating reference frame model-Equations in flux linkages-per unit model**.**

Module 3

SMALL SIGNAL MODELING OF THREE PHASE INDUCTION MACHINE: Small signal equations of Induction machine-derivation-DQ flux linkage model derivation-control principleof Induction machine.

SYMMETRICAL AND UNSYMMETRICAL 2 PHASE INDUCTION MACHINE: Analysis of symmetrical 2 phase induction machine-voltage and torque equations for unsymmetrical 2 phase induction machine-voltage and torque equations in stationary reference frame variables for unsymmetrical 2 phase induction machine-analysis of steady state operation of unsymmetrical 2 phase induction machine

Module 4

MODELLING OF SYNCHRONOUS MACHINE: Synchronous machine inductances –voltage equations in the rotor's dq0 reference frame-electromagnetic torque-current in terms of flux linkages-simulation of three phase synchronous machine- Modeling of PM Synchronous motor.

DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINE: Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics.

Text books and References

1. D.P. Sengupta& J.B. Lynn, Electrical Machine Dynamics, The Macmillan Press Ltd. 1980

2. R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education., 2001

3. P.C. Kraus, Analysis of Electrical Machines, McGraw Hill Book Company, 2nd edition, 2002

4. I. Boldia & S.A. Nasar, Electrical Machine Dynamics, The Macmillan Press Ltd. 1992

5. C.V. Jones, The Unified Theory of Electrical Machines, Butterworth, London 1967

6. Generalized Theory of Electrical Machines – P.S.Bimbra – Khanna publications 5th edition-1995

7.. Dynamic simulation of Electric machinery using Matlab / Simulink - Chee Mun Ong- Prentice Hall

19-209-0708 UNIVERSAL HUMAN VALUES- UNDIVIDED SOCIETY & HUMAN ORDER

Course Outcomes:

After successful completion of the course student will be able to:

1. Have a clear understanding about the importance and types of relationships.
2. Express the right feelings in relationships
3. Develop the competence to think about the conceptual framework of undivided society as well as universal human order.
4. Have better exposure for transition from current state to the undivided society and universal human order.

Module 1: Introduction to the course:

Basic aspiration of a Human Being and program for its fulfillment, Need for family and relationship for a Human Being, Human-human relationship and role of behavior in its fulfillment, Human-rest of Nature relationship and role of work in its fulfillment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order, an appraisal of the Current State, Appraisal of Efforts in
this Direction in Human History.

Module 2: Understanding Human-Human Relationship & its fulfillment:

Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfillment, Expression of feelings, Types of relationship and their purpose, mutual evaluation in relationship, Meaning of justice in relationship, Justice leading to culture, civilization and Human Conduct.

Module 3: Justice from family to world family order:

Undivided Society as continuity and expanse of Justice in behavior – family to world family order, continuity of culture and civilization, Universal Order on the basis of Undivided Society, Conceptual Framework for Universal human order, Universal Human Order as continuity and expanse of order in living: from family order to world family order, a conceptual framework for universal human order.

Module 4: Undivided Society and Universal Human Order:

Education – Sanskar, Health – Self Regulation, Production-work, Exchange – storage, Justice preservation
Scope and Steps of Universal Human Order, Human Tradition (Ex. Family order to world family order), Steps for transition from the current state, Possibilities of participation of students in this direction, Present efforts in this direction, Sum up.

Reference Books:

1. *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. *B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.*
3. *PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.*
4. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak
5. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
6. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers

19-209-0709 NEW AND RENEWABLE SOURCES OF ENERGY

Course outcomes:

After successful completion of the course student will be able to

1. Analyze the fundamentals of solar energy and its radiation, collection, storage and application.
2. Identify the characteristics of photovoltaic cells and different Instruments for measurement of solar radiation
3. Identify the fundamentals of the wind energy, Biomass energy, geothermal energy and Ocean energy as alternative energy sources.
4. Recognize the techniques for biomass conversion and types of fuel cells

Module I

Renewable and non-renewable sources of energy – brief review of conventional sources of energy – energy production and world energy consumption – green house effect and global warming. Solar energy option. Thermal conversion – design fabrication and performance of flat plate collectors – description of solar thermal devices (stills water heater, furnaces cookers and refrigerators) – Solar thermal power generation systems – thermal storage.

Module II

Photovoltaic conversion – conceptual description of photo voltaic effect – electrical characteristic of silicon PV cells and modules – solar cell material and prospects – Instruments for measurement of solar radiation – Empirical equations for predicting availability of solar radiation.

Module III

Wind energy – wind turbines – Horizontal axis and vertical axis with turbines – Power and energy from wind turbines – wind characteristics. Energy from oceans: wave energy – Physical principles – wave characteristics and wave power – wave energy technology. – fixed devices – floating devices

Module IV

Biomass – classification – biomass – conversion process – application – ocean thermal energy conversion systems – Tidal & wave power application – fuel cells – types – losses in fuel cell - application – MHD generators – application of MHD generation - micro and mini hybrid power.

References:

1. John W, Twidell , Antony D. Wier – *Renewable energy sources* –ELBS Publication
2. Renewable Energy - *Power for sustainable Future* – Edited by Godfrey Boyle – Oxford University Press in association with the Open University, 1996.
3. Meinel A B ,Meinel MP *Applied solar Energy* -, Addison Wesley Publications.
4. SL Sah, *Renewable and Novel energy sources MI Publications*, New Delhi, 1995.
5. George Sutton *Direct Energy Conversion* – McGraw hill Publications.

19-209-0710IoT SYSTEM DESIGN

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able

1. To analyse the circuit design capability for practical IOT applications
2. To identify various protocols for IoT
3. To acquire technical skills for a prototyping an IoT
4. To analyse the programming of the IoT devices

Module I

Introduction to IOT: Definition of IoT, Application Areas, Characteristics, IoT stack, Enabling Technologies, Challenges, IoT levels,

Introduction to sensors and Interfacing: Types of sensors, LDR sensor, ultrasound sensor, Obstacle sensors, Heartbeat sensors, GPS, Color sensor, pH sensor, Gyro sensor and its interfacing with microcontrollers.

Module II

Protocols for IoT: Messaging Protocol- MQTT, CoAP, Transport protocol- Bluetooth low energy(BLE), Light Fidelity(LiFi) , Protocol for Addressing and Identification- Ipv4, Ipv6, URI

Cloud for IoT: Challenges, Selection of cloud service provider, Introduction to fog Computing, security aspects of cloud computing, Case study on cloud.

Module III

Prototyping and Designing Software for IoT Applications: introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development.

Module IV

Introduction to Python Programming, Programming Raspberry Pi with Python, Python Web application Framework-Django, Amazon web services for IoT.

Text Books:

1. Shriram K Vasudevan, Abhishek S Nagarajan & RMD Sundaram, 'Internet of Things' , Wiley
2. Arshdeep Bahga and Vijay Madisetti "Internet of Things: A Hands-on Approach", Universities Press

References:

1. Adrian McEwen and Hakim Cassimally ,'Design of internet of Things' , Wiley
2. Pethuru Raj, Anupama C. Raman, 'The Internet of Things: Enabling Technologies, Platforms, and Use Cases'
3. Raj Kamal, 'Internet of Things : Architecture And Design Principles' , MG

19-209-0711 RESEARCH METHODOLOGY

Course outcomes

On successful completion of teaching-learning and valuation activities, a student would be able

1. Designsteps in research procedure
2.Formulate research problem
3.Develop a sample research proposal
4.Develop simulation model for a specific research problem

Module 1

Introduction; Scientific Method; Research Problem Identification; Research Problem Definition; Research Design; Research Design Process; Decisional Research with Mathematical Models.

Module 2

General Problem Solving; Logical Approach; Soft System Approach; Creative Approach; Group Problem Solving Techniques for Idea Generation; Exploration Problem Identification; Hypothesis Generation; Formulation of the Problem.

Module 3

Research Proposal; Purpose of a Research Proposal; Types of Research Proposals; Development of the Proposals; Requirements of the Sponsoring Agent; Evaluation of Research Proposals; Some Implicit Considerations.

Module 4

Mathematical Models; Development of Models; Solutions of Models; Composite Modelling Methods; Heuristic Optimisation; Heuristic Problem-Solving Approaches; Advantages and Limitations of Heuristic Methods; Simulation Modelling.

Text books and Reference :

1. K.N Krishnaswamy,AppaiyerSivakumar&M. Mathirajan, Management Research Methodology.Pearson Education.

2. C R Kothari, Research Methodology: Methods and Techniques,New Age International.

19-209-0712 POWER ELECTRONICS LAB

Course Outcomes:

On completion of this course the student will be able to

1. Identify firing techniques and experimental procedures in Power Electronics
2. Design power electronics circuits to meet the desired specification
3. Design various power electronics converters using Matlab Platform
4. Analyse controlling motor drive using power electronics.

List of Experiments

1. Study of V-I characteristics of SCR
2. Study of V-I characteristics of Triac
3. Study of V-I characteristics Diac
4. SCR firing Circuits.
5. AC voltage Controller
6. Design and set up a Single Phase half wave rectifier and study its performance for R and RL loads
7. Design and setup a single-phase full-converter and study its performance for R and RL loads.
8. Design and setup a single-phase semi-converter and study its performance for R and RL loads.
9. Design and set up a Single Phase square wave inverter and harmonic analysis of PWM waveforms using the Powergui/FFT tool.
10. Three-phase six-pulse thyristor converter and harmonic analysis using the Powergui/FFT tool.
11. GTO buck Converter and AC-DC-AC PWM Converter
12. Chopper-Fed DC Motor Drive (Continuous)

19-209-0713 ADVANCED ELECTRICAL ENGINEERING LAB

Course Outcomes:

On completion of this course the student will be able to

1. Perform industry based main project
2. Adapt the various process in an industry
3. Find solutions to problems in industry/research with latest software tools.
4. Analyse process control and automation.

List of Experiments

1. MATLAB – I – experiments using MATLAB toolbox.
2. Determination of transfer function of DC motor (a) armature control (b) field control.
3. Study and experiments on (a) DC servo motor (b) AC servomotor.
4. Experiments on synchros (a) characteristics (b) data transmission (c) error detection (d) differential synchro.
5. Design and experimental determination of frequency response of lag, lead and lag-lead networks.
6. Static and dynamic performance evaluation of transducer (a) resistance thermometer (b) vibration pick up (c) Temperature Sensor
7. Study and performance evaluation of transducers (a) strain gauge (b) inductive pick up (c) capacitive pick up (d) LVDT.
8. Study and experiments on pneumatic control system.
9. Simulation of Tank level control in LabView.
10. Harmonic Analysis Simulation using Lab View
11. Measurement and recording of a physical quantity (temperature/pressre etc.) using Lab view with suitable Data Acquisition System
12. Power flow analysis of the system with the given single line diagram, using the given power flow analysis package.
13. Fault analysis of the system with given single line diagram, using the given fault analysis package.
14. Determination of relay characteristics.

19-209-0714 ENTREPRENEURSHIP DEVELOPMENT

Course Outcomes:

On completion of this course the student will be able to

1. Develop awareness about the importance of entrepreneurship opportunities available in the society
2. Get acquainted with the challenges faced by the entrepreneur
3. Become aware of various stress management techniques
4. Conduct a break even analysis of a project

Exercises:

1. To study the types of entrepreneurs and the factors affecting entrepreneurial growth.
2. To make an assessment of the major motives influencing an entrepreneur
3. To make an overview of the various stress management techniques
4. How to identify and select a good business opportunity?
5. Preparation of a techno economic feasibility report for a given project
6. Preparation of a preliminary project report for a given project
7. To identify the various sources of finance and management of working capital
8. Carry out the costing and break even analysis of a proposed project
9. Preparation of a PERT / CPM chart for the various activities involved in a project
10. To make a study of the various causes and consequences of sickness in small business and identify corrective measures.

References:

1. Roy Rajeev, Entrepreneurship, Second edition, Oxford Latest Edition, 2011.
2. E. Gordon , K. Natarajan, Entrepreneurship Development, Fourth edition, Himalaya, 2007.
3. Coulter, Entrepreneurship in Action, Second edition, PHI, 2008.
4. P. C. Jain, Handbook for New Entrepreneur, Oxford University Press, 2003.
5. S. S. Khanka, Entrepreneurial Development, Fifth edition, S. Chand and Co, 2013.

Note: There will only be continuous evaluation for this course. The evaluation will be based on the performance of the student in the exercises given above. A minimum of 50% marks is required for a pass.

19-209-0715 PROJECT PHASE I

Course Objectives:
To identify a research/industry related problem for the undergraduate project work with the guidance of therespectivefacultyand prepareadesignandworkplanforarelevantproblemofrealworldapplication.

CourseOutcomes:
On successful completion, a student would be able to

I. Conduct literature survey in a relevant area of one's course of study and finally identify and concentrate on a particularproblem.
2. Formulate a project proposal through extensive study of literature and / or discussion with learned resource persons in industry andaround.
3. Generate a proper execution plan of the project work to be carried out in Phase II through thorough deliberations and improve presentationskills
4. To understand and analyse a technically solvable socialproblem

PROJECT PHASE I

Each batch comprising of 3 to 5 students shall identify a project related to the curriculum of study. At the end of the semester, each student shall submit a project synopsis comprising of thefollowing.

-Application and feasibility of the project

- Complete and detailed designspecifications.
- Block level designdocumentation
- Detaileddesigndocumentationincludingcircuitdiagramsandalgorithms/circuits
- Billofmaterialsinstandardformatandcostmodel,ifapplicable
- Projectimplementationactionplanusingstandardpresentationtools

Guidelines for evaluation:

AttendanceandRegularity	10
Theoretical knowledge and Involvement in study or project	30
End-Semester presentation & Oral examination	20
Level of completion of design as per specifications	20
Project Phase 1 Report	20
Total	100

Note: *Points (i)-(iii) to be evaluated by the respective project guides and pro}ect coordinator based on continuous evaluation (iv)-(v) to be evaluated by the final evaluation team comprising of 3 internal examiners including the pro}ect guide, coordinator & a senior faculty member*

The project phase I includes the literature survey, schematic block or algorithms, design of the project and implementation of the initial phase of the project by approximately 30%. A report on the work done in this phase shall be submitted by each student by the end of the VIII semester. There will be an internal examination of the project that includes oral presentation regarding the overall project and demonstration, if any, of the completed work. The evaluation panel shall consist of at least three faculty members including the projectguide.

19-209-0716: INDUSTRIAL INTERNSHIP

Course Outcomes:

On completion of this course the student will be able to:

1. Work safely in industrialenvironment.
2. Work with various interest groups, disciplines, professionals, managers, technicians etc.
3. Polish the engineering skills by applying the knowledge in day-to-day operation, troubleshooting andminor-modifications.
4. Build relations with University and Industry that will help mutual cooperation overlong-term.

Every Student shall undergo a summer internship program of minimum two weeks duration in an Electrical/Electronics industry/ allied engineering industry/ R&D organization after 4th Semester and before the commencement of 7thsemester and submit a report on the activities performed.Evaluation of internship will be conducted along with Project - Phase- I.

19-209-0801 ELECTRICAL SYSTEM DESIGN

Course outcomes:

On completion of this course the student will be able to

1. Illustrate the basic principle of design, estimation and costing of different electrical installations.
2. Develop estimate of electrical installations for domestic, commercial, industrialestablishments indoor and outdoor substations
3. Design illumination schemes for different applications.
4. Categorize types of lamps based on the requirement

Module I

Role of national electrical code in the design of electrical installation – electrical symbols and diagrams – design considerations of electrical installations – electric supply systems – protection and protective devices for electric installation against overload – short circuit and earth fault – electric services in building – service connections – service mains – reception and distribution of main supply – sub- circuits – neutral and earth wire – earth bus – guideline for installation of fittings – design, selection, layout, drawing and location of distribution boards and panel boards – control and switch gears – criteria for selection of HT and LT underground cables.

Module II

Design of illumination schemes – various types of light sources – different types of lighting arrangement – energy efficiency in lamps and illumination – design considerations of good lighting schemes – design of lighting schemes for various purposes – lighting calculations – design of flood lighting and street lighting – electrical aspects and considerations for lifts, escalator services and standby generators, hospitals, hotels, recreational and assembly buildings and cinema theatre – design and safety aspects of electrical installations for residential buildings.

Module III

Electrical installations of high rise buildings – design – schematic diagram – layout – estimation and testing of rising main – main supply board and distribution boards for high rise buildings – lighting protection – electrical system design – estimation and costing of commercial buildings – design considerations of electrical installations in Industries – design, estimating and costing of electrical installations for small industries.

Module IV

Selection of EHV and HV power and distribution transformers and switchgears – case studies – design – layout – schematic diagram –estimation– (a) 16MVA – 110/11KV outdoor substation having one or two incoming and 8 or less outgoing – (b) 11KV/415V outdoor substations up to 630KVA – (c) 11KV/415V indoor substation up to 630KVA – (d) bus bar trunking above 630KVA – design of earthing system – plate and pipe earthing

References:

1. Raina, Battacharya, *Electrical System Design, Estimation & costing,* Wiley Eastern
2. Gupta J.B, *Electrical Installating, Estimating & Costing*, Kataria& Sons
3. ISI, *National Electric Code, Bureau of Indian Standard Publications*
4. Cinema Regulation (Rules) & Act
5. IEEE Standards, IEEE
6. Relevant Indian Standard Specifiactions, IS Publication.

19-209 -0802 ELECTRONIC INSTRUMENTATION

Course outcomes:
On completion of this course the student will be able to

1. Distinguish the characteristics of various transducers
2. Apply modulation techniques for signals.
3. Select suitable transducers/sensors for specific applications.
4. Develop PLC Programming.

Module I
Transducers – definitions – classifications – resistance transducers- strains gauge – types –construction – temperature effect - circuitry, semi conductor strain gauge – load cell.
Resistance thermo meter – types – circuits – errors. Thermistor – advantage of thermistor.
Inductive transducers – LVDT – applications – LVDT load cell – LVDT pressure transducer – resolver – capacitive transducer – principle of operation – applications – capacitor microphone.
Piezoelectric transducer – materials – equivalent circuit – d, g, coefficients – thermocouple – principle – applications – magnetostrictive transducers – materials, applications, Hall effect transducer – application – elastic transducers (brief study) – Bourdon tubes – diaphragms – Bellows –Optical transducers – digital transducers – shaft encoder.

Module II
Signal conditioning – instrumentation amplifiers – differential amplifiers – filters – law and high pass, band pass and band rejection filters –transducer bridges – null type and deflection bridges – AC bridges using push pull transducers – general telemetry systems – sampling process – principles of time division and frequency division multiplexing, different types of modulation techniques as applied to telemetry (general idea)

Module III
Instrumentations systems – basic measuring systems – analog and digital data acquisition systems – generalized input-output configuration of measuring systems – dynamic characteristics.
Digital instruments – operating principles of DVM using successive approximation – V/F conversion and integrating principles – counter digital method for frequency, phase, time and period measurements – digital RLC meters – Q-meter – vector impedance meter – electronic multimeter- display systems and recorders

Module IV
Programmable logic controller- Ladder diagram-relay sequencers, motor control starter circuits, Timer on/off delay
Block diagram of PLC system, programming of PLC-Ladder Programming of simple systems-Elevators, Conveyers etc.

References:
1. A.K Sawhney - *A course in electrical and electronic measurements and Instrumentation*, DhanapathRai& Co. 2001 eddition.
2. Ernest O.Doeblin - *Measurements systems application & design,* McGraw Hill International edition 1984.
3. Albert D. Helfric , William D. Cooper - *Modern Electronic Instrumentation & Measurements Techniques*
(Prentice Hall)

4. Dr. S. Renganathan - *Transducers Engineering* (Allied Publishers Ltd. Delhi
5. K.B Kalaasen - *Electronic measurement and instrumentation*, Cambridge University press 1996.

19-209-0803 ARTIFICIAL INTELLIGENCE AND ROBOTICS

Course Outcomes

On completion of this course the student will be able to

1. Analyse problem oriented in depth knowledge of Artificial Intelligence and Robotics.
2. Address the underlying concepts, methods and application of different Artificial Intelligence and Robotics
3. Solve problems related to AI
4. Apply various analytical techniques of NLP

Module I:

Scope of AI-Introduction to Artificial Intelligence. Applications- Games, theorem proving, natural language processing, vision and speech processing, robotics, expert systems. AI techniques- search knowledge, abstraction.

Module 2:

Problem Solving-State space search; Production systems, search space control: depth first, breadth-first search, heuristic search - hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis

Module 3

Knowledge Representation: Knowledge Representation issues, first order predicate calculus, Horn Clauses, Resolution, Semantic Nets, Frames, Partitioned Nets, Procedural Vs Declarative knowledge, Forward Vs Backward Reasoning.

Understanding Natural Languages: Introduction to NLP, Basics of Syntactic Processing, Basics of Semantic Analysis, Basics of Parsing techniques

Module 4

Fundamentals of Robotics, Robot Kinematics: Position Analysis, Dynamic analysis and Forces, Robot Programming languages & systems: Introduction, the three levels of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.

References

1. Russell Stuart, Norvig Peter*, "Artificial Intelligence Modern Approach"*, Pearson Education series in AI, 3rd Edition, 2010.
2.Dan.W.Patterson, "*Introduction to Artificial Intelligence and Expert Systems*", PHI Learning, 2009.
3. Donald.A.Waterman, "*A guide to Expert Systems*", Pearson, 2002
4. N.J. Nilsson, "Principles of AI", Narosa Publ. House, 2000.
5. Robin R Murphy, Introduction to AI Robotics PHI Publication, 2000

19-209-0804 SOLAR PV SYSTEMS

Course Outcomes:

On completion of this course the student will be able to

1. Demonstrate characteristics of solar radiation
2. Explore he operation of PV cell and associated systems
3. Design Solar PV system and integrate with grid
4. Estimate PV module power

MODULE 1

Solar Radiation: Extra-terrestrial and terrestrial solar spectrum, clear sky direct beam radiation , total clear sky insolation on a collecting surface, calculation of average monthly insolation from measured data

Solar photovoltaic: Solar cell Parameters, iv and pv characteristics, Solar PV module, Efficiency of PV module, Connection of PV module in series and parallel**,** Estimation and measurement of PV module power, Selection of PV module

MODULE 2

Batteries and Charge controller: Function, Types, Selection, Batteries for photovoltaic systems, Battery installation for PV system, Battery maintenance and measurements, Battery fault detection and test, Battery charge controller

MODULE 3

MPPT and Inverter: schemes for Maximum power point tacking, Power electronic converters used in single phase PV systems, transformer less inverters, centralized grid connected three phase inverters for large PV installations

MODULE 4

Solar PV system Design and integration: Solar radiation energy measurements, types of solar PV system, Design methodology for SPV system, Case study on off grid and grid interactive PV system

Design related issues: grounding, dc arcing, islanding, harmonics, electromagnetic interference, energy yield and economics of a PV installation

References:

1. Gilbert M Masters: Renewable and Efficient Electric Power Systems, John Wiley and sons, 2004
2. Roger A messenger and Jerry Ventre: Photovoltaic Systems Engineering, CRC Press, 2004, 2nd edition
3. Solanki: Solar Photovoltaic: Fundamentals, Technologies and Applications, PHI learning Pvt Ltd 2009
4. Non-conventional Energy Sources, G.D Ray , Khanna Publications
5. Solar Energy, fundamentals and Applications, Garg, Prakash, Tata McGraw Hill

19-209-0805 POWER QUALITY

Course outcomes:

After successful completion of the course students will be able to

1. Identify the sources of different power quality issues
2. Evaluate the severity of voltage sag, voltage swell, harmonics, and transients in distribution networks
3. Analyse the effect of PQ issues on various equipments
4. Demonstrate the various PQ monitoring instruments

Module I

Introduction: Definition of Power quality, Power Quality Voltage & Current Quality, Importance of Power Quality, Power quality Evaluation.IEEE guide lines, standards and recommended practices

Terms and Definitions: General Classes of Power quality Problems, Transients, Long Duration Voltage Variations, Short Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage fluctuation, Power Quality Terms, CBEMA and ITI Curves.

Module II

Voltage Sags and Interruptions: Sources of Sags and Interruptions, Estimating voltage Sag Performance, Fundamental-Principles of Protection, Solution at the End User Level, Motor -Starting Sags.

Transient over Voltages: Sources of Transient Over voltages, Principles of Over voltage protection, Devices for over voltage Protection, Utility Capacitor- Switching transients, Utility System Lightning Protection,Managing Ferro resonance, Switching Transient Problems with Loads, Computer Tools for Transients Analysis

Module III

Fundamentals of Harmonics: Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads, Locating Harmonic Sources, Effects of Harmonic distortion, Inter harmonics, Harmonic distortion Evaluations, Principles for Controlling Harmonics,

Long Duration Voltage Variations: Principles of Regulating the Voltage, Devices for Voltage Regulation, Utility Voltage Regulator application, Capacitors for Voltage Regulation, End - Users Capacitors Application, and Regulating Utility Voltage with distributed Resources Flicker.

Module IV

Power Quality Monitoring : Power line disturbance analyser, power quality measurement equipment, Harmonic spectrum analyser, Assessment of Power Quality Measurement Data

Power Qualiy management in smart grid: Power quality issues of grid connected renewable energy sources, Power Quality conditioners for smart grid, Electromagnetic interference

References :

1. Roger C Dugan , Mark F Mcgranaghan, Surya Santoso, H. Wayne Beaty, *Electrical Power Systems Quallity*, McGraw-Hill Professional
2. HeydtG.T., *Electric power quality,* McGraw-Hill Professional, 2007
3. Math H. Bollen, *Understanding Power Quality Problems*, IEEE Press,2000
4. Arrillaga J., .*Power System Quality Assessment*., John wiley,2000
5. Arrillaga J., Smith B.C., Watson N.R. Wood A. R ,.*Power system Harmonic Analysis*., Wiley,1997

6. Angelo Baggini (Ed.)*Handbook of Power Quality,*Wiley, 2008
7. C. Sankaran,*'Power Quality',*CRC Press, 2002
8. G. T. Heydt,***'Power Quality',***Stars in circle publication, Indiana, 1991
. *IEEE and IEE Papers from Journals and ConferenceRecords*

19-209-0806 UTILISATION OF ELECTRIC POWER

Course outcomes:
On completion of this course the student will be able to
1. Design illumination requirements for different applications
2. Discuss principles of electric heating and welding
3. Identify the technical aspects of electric traction
4. Develop air conditioning & refrigeration

Module I
Illumination: radiant energy-terms and definitions- laws of illumination- polar curves- photometry-MSCP-integrating sphere- luminous efficacy- electrical lamps- Color values of illuminates and color effects:
colorimeter, artificial daylight, design of interior and exterior lighting systems- illumination levels for various
purposes- light fittings- factory lighting- flood lighting-street lighting-energy conservation in lighting.
Module II
Electric heating: classification- heating element-losses in oven and efficiency- resistance furnace- radiant heating- induction heating- high frequency eddy current heating- dielectric heating- arc furnace- heating of
buildings.
Electric welding: methods and equipments- electric supply for arc welding, Electrolysis and Electroplating applications.
Module III
Electric Traction: Features of an ideal traction system-systems of electric traction- mechanism of train movement- speed-time curve, Power and Power Measurement, traction supply system- transmission line to
substation- feeding and distributing system on an ac traction- system of current collection-traction motors tractive effort and horse power- Speed control Schemes-Electric braking.
Module IV
Air conditioning and refrigeration: Control of temperature - protection of motors - simple heat load and motor
calculations. Air-conditioning - function of complete air conditioning system - type of compressor motor. Cool
storage - estimation of tonnage capacity and motor power..
References:
1. Taylor E Openshaw, "*Utilization of Electric Energy*", Orient Longman,1986.
2. J B Gupta, "*Utilization of electric power and electric traction*", S K Kataria& Sons, 2002.
3. Wadhwa. C.L., "*Generation, Distribution and utilization of electrical energy*", Wiley Eastern Limited,1993.
4. Soni, Gupta, Bhatnagar, *"A course in electric power",*DhanapatRai& sons, 2001.
5. S.L.Uppal, "*Electrical Power",* Khanna pulishers,1988.
6. Partab H., "*Art and Science of Utilisation of Electrical Energy",*DhanpatRai and Sons, New Delhi. Second
edition

7. Tripathy S.C., "*Electric Energy Utilization And Conservation",* Tata McGraw Hill,1993 .
8.. William Edward Barrows, "*Light, Photometry and Illumination*", BiblioBazaar, LLC, 2009
9.R.K.Rajput,"*Utilisation of electric power*"Lakshmi Publications Private Ltd.
10.N.V. Suryanarayana: "*Utilisation of Electrical power including Electric drives and Electric Traction*", New Age Publishers, 1997.

19-209-0807 POWER SYSTEM OPERATION AND CONTROL

Course outcomes:
On completion of this course the student will be able to

1.Design the techniques to control power flows, frequency and voltage
2. Perform Security Analysis and Contingency Analysis
3. Perform system state estimation and explore its importance
4. Analyze the working of energy control center using SCADA

Module 1
Characteristics of power generation units, Hydro thermal co-ordination- Problem definition and mathematical model of long and short term problems. Dynamic programming – Hydro thermal system with pumped hydro units – Solution of hydro thermal scheduling using Linear programming.

Module 2
Uses and types of production cost programs, probabilistic production cost programs – Sample computation – No forced outages – Forced outages included – interchange of power and energy and its types. System operating states by security control functions – Monitoring, evaluation of system state by contingency analysis – Corrective controls (preventive, emergency, and restorative) – Islanding scheme.

Module 3
Least square estimation – Basic solution – Sequential form of solution – Static State estimation of power system by different algorithms – Tracking state estimation of power system – Computer consideration – External equivalencing – Treatment of bad data.

Module 4
Energy control center – Various levels – National – Regional and state level SCADA system – Computer configuration – Functions – Monitoring, data acquisition and controls – EMS systems.

References:
1. Allen J Wood, Bruce F Wollenberg, "Power Generation, Operation and Control", John Wiley& Sons, New York, II Edition, 1984.
2. Krichmayer L, "Economic operation of power system", John Wiley & Sons, New York, II Edition, 1959.
3. Léger OI, "Electrical Energy System Theory – An Introduction", Tate McGraw-Hill Pub. Co. Ltd., New Delhi, II Edition, 1971.
4. Mahalanabis AK, Kothari DP and Ahson SI, "Computer Aided Power System Analysis and Control", McGraw Hill Publishing Ltd., 1984.
5. Kundur P, "Power System Stability and Control", McGraw Hill, 2006.

19-209-0808 DIGITAL SIMULATION OF POWER ELECTRONIC SYSTEMS

Course outcomes:

On completion of this course the student will be able to

1. Model power electronic systems using different approaches
2. Formulate the state equations of power electronic systems
3. Analyse circuit using various software tools like ORCAD, PSpice etc
4. Simulate the converters in MATLAB

Module 1

Principles of Modeling Power Semiconductor Devices - Macro models versus Micro models - Thyristor model - Semiconductor Device modeled as Resistance, Resistance-Inductance and Inductance-Resistance-Capacitance combination - Modeling of Electrical Machines.

Modeling of Control Circuits for Power Electronic Switches. Computer Formulation of Equations for Power Electronic Systems –Review of graph theory as applied to Electric networks- Systematic method of Formulating State Equations - Computer Solution of State Equations - Explicit Integration method - Implicit Integration method.

Module 2

AC equivalent circuit modeling: Basic AC modeling approach-State space averaging-circuit averaging and averaged switch modeling-Modeling the PWM.

Module 3

Analysis Using Software Tools Circuit Analysis Software ORCAD- PSpice - Simulation Overview - Creating and Preparing a Circuit for Simulation - Simulating a Circuit with PSpice - Simple Multirun Analyses - Statistical Analyses - Simulation Examples of Power Electronic systems- Creating Symbols - Creating - Models - Analog Behavioral Modeling - Setting Up and Running analyses – Viewing Results- Examples of Power Electronic Systems.

Module 4

Dynamic modeling and simulation of DC-DC converters using MATLAB - Simulation of State Space Models –Modeling and simulation of inverters using MATLAB

References

1. V Rajagopalan, Computer Aided Analysis of Power Electronic Systems, Marcel Dekker, Inc.
2. Erickson, Maksimovic, Fundamentals of Power Electronics - 2nd edition, Springer
3. Randall Shaffer, Fundamentals of Power Electronics with MATLAB, Firewall Media, India
4. Mohan, Undeland, Robbins, Power Electronics, 3rd edition, John Wiley
5. Jai P Agrawal, Power Electronic Systems-Theory and Design, Pearson 6. ORCAD PSpice Basics: Circuit Analysis Software, User's Guide, ORCAD

19-209-0809 SMART GRID TECHNOLOGIES AND APPLICATIONS

Course outcomes:
On completion of this course the student will be able to
1. Identify features and scope of smart grid technology.
2. Assess the role of automation in substation.
3. Analyze the operation of demand side management, voltage and frequency control in smart micro grid
4. Conduct case study for peak load saving

Module 1
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits , Present development & International policies in Smart Grid. Indian Smart Grid. Components and Architecture of Smart Grid Design,
Introduction to Smart Meters, Real Time Pricing- Models, Smart Appliances, Automatic Meter Reading(AMR), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation

Module 2
Smart Substations, Substation Automation, Introduction to IEC 61850, Feeder Automation. Geographic Information System(GIS)
Intelligent Electronic Devices(IED) & their application for monitoring & protection, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU)

Module 3
Smart energy efficient end use devices-Smart distributed energy resources- Energy management-Role of technology in demand response- Demand Side Management
Load Curves-Load Shaping Objectives-Methodologies-Barriers. Peak load saving-Constraints-Problem formulation- Case study

Module 4
Load Frequency Control (LFC) in Micro Grid System – Voltage Control in Micro Grid System
Reactive Power Control in Smart Grid
I Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication
Cloud computing in smart grid. Private, public and Hybrid cloud. Cloud architecture of smart grid

References
1.A Stuart Borlase, “Smart Grids, Infrastructure, Technology and Solutions”, CRC Press, 2013
2.AliKeyhani, Mohammad N. Marwali, Min Dai “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley
3. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”,CRC Press
4.JamesMomoh, “Smart Grid:Fundamentals of Design and Analysis”, Wiley, IEEE Press,• 2012.

5.A.G. Phadke and J.S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer Edition, 2010.
6.Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.
7.JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley 2012.
8.Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications [ISBN: 978-0521137355]

19-209-0810 STATISTICAL METHODS FOR ENGINEERS

Course outcomes:
On completion of this course the student will be able to
1.Evaluate various quantities for probability distributions and random variables
2. Perform statistical computations.
3. Apply statistical methods to problems in engineering
4. Apply parametric as well as non-parametricmethods in engineering problems

Module 1
Review of Probability and Distributions: Rules for probability, random variables and their distributions, moments, special discrete and continuous distributions, laws of large numbers and central limit theorem, sampling distributions.

Module 2
Parametric Methods: Point estimation – unbiasedness, consistency, UMVUE, sufficiency and completeness, method of moments, maximum likelihood estimation and method of scoring. Bayes, minimax and admissible estimators. Interval estimation - confidence intervals for means, variances and proportions. Testing of Hypotheses - tests for parameters of normal populations and for proportions, goodness of fit test and its applications.

Module 3
Multivariate Analysis: Multivariate normal, Wishart and Hotelling's T 2 distributions and their applications in testing of hypotheses problems. Classification of observations, principal component analysis, canonical correlations and canonical variables.

Module4
Nonparametric Methods: Empirical distribution function, asymptotic distributions of order statistics, single sample problems, problems of location, prediction intervals, Kolmogorov Smirnov one sample statistics, sign test, Wilcoxon signed rank statistics, two sample problems, Mann-Whitney-Wilcoxon tests, scale problems, Kolmogorov Smirnov two sample criterion, Hoeffding's U-statistics.

References:
1. An Introduction to Probability and Statistics by V.K. Rohatgi& A.K. Md.E.Saleh.
2. Modern Mathematical Statistics by E.J. Dudewicz& S.N. Mishra
3. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross
4. An Introduction to Multivariate Analysis by T. W. Anderson
5. Nonparametric Statistical Inference by J.D. Gibbons & S. Chakraborti

19-209-0811 OPTIMIZATION TECHNIQUES & ALGORITHM

Course Outcomes:
On completion of this course the student will be able to**:**

1. Formulate linear Programming Problems
2. Determine the optimum solution to constrained and unconstrained problems
3. Solve using Unconstrained n dimensional optimization techniques
4. Apply dynamic programming principle to Linear programming problems

Module I
Linear programming: Formulation-Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems.

Module II
Unconstrained one dimensional optimization techniques: Necessary and sufficient conditions - Unrestricted search methods-Fibonacci and golden section method-Quadratic Interpolation methods, cubic interpolation and direct root methods.

Module III
Unconstrained n dimensional optimization techniques**:** Direct search methods -Random search -pattern search and Rosen brooch's hill claiming method- Descent methods-Steepest descent, conjugate gradient, quasi -Newton method.

Module IV
Constrained optimization Techniques**:** Necessary and sufficient conditions -Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method.
Dynamic programming- principle of optimality- recursive equation approach-application to shortest route, cargo-loading, allocation and production schedule problems.

References :
1. Rao,S.S.,'Optimization : Theory and Application' Wiley Eastern Press, 2nd edition 1984
2. Taha,H.A., Operations Research -An Introduction,Prentice Hall of India,2003
3. Fox, R.L., 'Optimization methods for Engineering Design', Addition Welsey, 1971
4. A. Ravindran , K. M. Ragsdell , G. V. Reklaitis, Engineering Optimization Methods And , Wiley, 2008
5. Godfrey C. Onwubolu , B. V. Babu , New optimization techniques in engineering , Springer, 2004

19-209-0812 SUSTAINABILITY ENGINEERING

Course Outcomes:

On completion of this course the student will be able to

1. Identify the concept of sustainable development
2. Describe the global environmental issues
3. Develop the different aspects of green Technology
4. Conduct lifecycle analysis for achieving sustainability

Module 1

Sustainability - Introduction, Need and concept of sustainability, Social environmental and economic sustainability concepts.

History and emergence of the concept of Sustainable Development – Challenges for Sustainable Development-Framework of Sustainability, economic dimensions- environmental dimension assessment of sustainable performance

Industrialization – Globalization and Environment

Module 2

Global environmental issues: - desertification– green house gases, greenhouse effect, ozone layer depletion, global warming–acid rain– deforestation

Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concept, 3 R concept.

Module 3

Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking, Environment Impact Assessment (EIA) - Procedures of EIA in India.

Waste land reclamation-Resource degradation, carbon credits and Carbon trading-International summits-conventions-agreements-trans boundary issues- Carbon footprint

Module 4

Green Engineering, Sustainable Urbanisation, industrialisation and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis

References:

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. S.S Purohit ,Green Technology-An approach for sustainable environment, Agrobios publication, India, 2008. 6. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS). Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998

5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
6. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).

19-209-0813 SELF AWARNESS & INTEGRAL DEVELOPMENT

Course Outcomes:

On successful completion of teaching-learning and valuation activities, a student would be able to:

1. Have a clear understanding of one's self
2. Take decisions effectively
3. Resolve conflicts in relationships
4. Develop leadership skills

Module I

Self-awareness: Introduction to self-assessment tools - identify strengths and weaknesses, impact on leadership style, developing statement of life purpose, self actualisation and beyond

Creativity - Out of box thinking, Lateral Thinking

Attitude- Factors influencing Attitude, Challenges and lessons from Attitude, Etiquette Motivation - Factors of motivation, Self talk, Intrinsic & Extrinsic Motivators Spirituality and perfection in work.

Module II

Decision making: Individual vs. Group Decisions, steps of decision making, effective decision making, importance and necessity of decision making, the process and practical way of decision making, weighing positives and negatives

Module III

Integral development: Conflicts resolution-conflicts in human relation, approaches to conflicts resolution Stress management – causes of stress and its impacts, how to manage and distress, stress busters, Gratitude, time management

Module IV

Leadership skills: Leadership Styles - Personal Attributes, Myths About Leaders and Leadership, Becoming a Successful Leader, Personal Leadership Plan, Leadership Trait, Abilities, and Skills Group Leadership and Teamwork, Communication Skills

References:

1. Goleman, Daniel. *Emotional Intelligence: Why It Can Matter More Than Iq*. New York: Bantam Books, 1995.
2. Covey, Stephen R., and Sean Covey. *The 7 habits of highly effective people*. Simon & Schuster, 2020.
3. HARRIS, Thomas Anthony. *The Book of Choice. I'm OK, You're OK*. Pan Books, 1973.

4. Kahneman, Daniel. *Thinking, fast and slow*. Macmillan, 2011.
5. Menon, Devdas. *Stop Sleepwalking Through Life!: 9 Lessons to Increase Your Awareness*. Yogi Impressions, 2004.
6. Carnegie, Dale, and Brent Cole. *How to win friends and influence people in the digital age*. Simon and Schuster, 2011.
7. Harari, Yuval Noah. *21 Lessons for the 21st Century*. Random House, 2018

19-209-0814 CONSTITUTIONAL LAW

(Common to all branches)

Course Outcomes:

On completion of this course the student will be able to:

1. Configure the preamble and fundamental rights.
2. Actuate the governance and functioning of constitutional functionaries.
3. Describe the functions of legislative bodies.
4. Decipher the judiciary system and its role in governance.

Module I: Introduction

Constitution Law – Constitutional Assembly Debates – Constitution of India – Basic Features of Indian Constitution – Preamble – Structure and Content of Indian Constitution

Module II: Fundamental Rights

Rights – Fundamental Rights – Definition of State – Fundamental Rights under Indian Constitution – Right to Equality – Untouchability – Title – Right to Life Cultural and Educational Rights of Minorities - Enforcement of Fundamental Rights

Module III: Directive Principles of State Policy & Fundamental Duties

DPSP's – Relationship between DPSP and Fundamental Rights – Conversion of DPSP into Fundamental Rights – Role of Judiciary – Judicial Activism – PIL - Fundamental Duties

Module IV: Constitutional Organs

Legislative Organs – Parliament – Lok Sabha, Rajya Sabha - State Legislatures - Executive Organs - President, Vice President, Council of Ministers - Judicial Organs – Supreme Court and High Courts – Other Constitutional Bodies – Election Commission - Comptroller and Auditor General of India, etc.

References:

1. Durga Das Basu, Introduction to the Constitution of India, 24th Edition. Prentice – Hall of India Pvt. Ltd. New Delhi, 2019.
2. D.C. Gupta, Indian Government and Politics, 8th Edition. Vikas Publishing House, 2018.
3. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes. Universal Law Publication, 2015.

19-209-0815 SEMINAR

Course Outcomes:
On completion of this course the student will be able to:

1. Identify and familiarize with some of the good publications and journals in their field of study.
2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and reference identifying their intended meaning and style.
3. Understand effective use of tools of presentation, generate confidence in presenting a report before an audience and improve their skills in the same.
4. Develop skills like time management, leadership quality and rapport with an audience.

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of Electronics & Communication Engineering. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks, technical reports and URLs. The references shall be incorporated in the report following IEEE standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 30 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

19-209-0816 PROJECT PHASE II

Course Outcomes:

On completion of this course the student will be able to

1. Work independently on a specific problem relevant to research or industry.
2. Develop team work skills to work in group
3. Apply the knowledge gained in particular area selected
4. Explore wider aspects of product development

Each batch of students shall develop the project designed during the VII semester. The implementation phase shall proceed as follows:

- For hardware projects, practical verification of the design, PCB design, fabrication, design analysis and testing shall be done.
- For software projects, a proper front end (GUI) if applicable, shall be designed. A detailed algorithm level implementation, test data selection, validation, analysis of outputs and necessary trial run shall be done.
- Integration of hardware and software, if applicable, shall be carried out.
- A detailed project report in the prescribed format shall be submitted at the end of the semester. All test results and relevant design and engineering documentation shall be included in the report.
- The work shall be reviewed and evaluated periodically

The final evaluation of the project shall be done by a team of minimum 3 internal examiners including the project guide and shall include the following.

- Presentation of the work
- Oral examination
- Demonstration of the project against design specifications
- Quality and content of the project report

Guidelines for evaluation:

i.	Regularity and progress of work	40%
ii.	Work knowledge and Involvement	40%
iii.	End semester presentation and oral examination	40%
iv.	Level of completion and demonstration of functionality/specifications	40%
v.	Project Report – Presentation style and content	40%
	Total	200 marks

Note: *Points (i) and (ii) to be evaluated by the respective project guide and the project coordinator based on continuous evaluation. (iii)-(v) to be evaluated by the final evaluation team comprising of 3 internal examiners including the project guide.*

19-209-0817 COMPREHENSIVE VIVA-VOCE

Course Outcomes:

On completion of this course the student will be able to refresh all the subjects covered during the programme to

1. gain good knowledge of theory and practice
2. develop oral communication skills and positive attitude
3. face technical interviews with confidence

Each student is required to appear for a viva-voce examination at the end of the complete course work. The examination panel shall comprise of one internal examiner and one external examiner, both appointed by the University. The examiners shall evaluate the students in terms of their conceptual grasp of the course of study and practical/analysis skills in the field.