EE 010 601: Power Generation and Distribution

Teaching scheme **Credits:** 4
2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart introductory knowledge of power systems*
- *To develop understanding of power generation systems and power distribution systems.*

Module I (12 hours)
Steam power plants: Rankine cycle (ideal, actual and reheat) – layout – components – alternators – excitation system – governing system.
Hydroelectric power plants: selection of site – mass curve – flow duration curve – hydrograph – classification of hydro plants – layout – components – classification of hydro turbines.
Nuclear power plants: layout – components – pressurized water reactor – boiling water reactor – heavy water reactor – gas cooled reactor – fast breeder reactor.
Gas power plants: gas turbine cycle – layout – open cycle, closed cycle and combined cycle gas power plants.
Diesel power plants: Thermal cycle – diesel plant equipment

Module II (8 hours)
Economic Aspects: Load Curve – Load duration curve – Energy load curve - Maximum demand – demand factor – Diversity factor – coincidence factor – contribution factor – load factor – Plant capacity factor – Plant use factor – Utilisation factor – power factor and economics of power factor correction.
Tariffs: Flat rate tariff – Two part tariff – Block rate tariff – maximum demand tariff – power factor tariff

Module III (10 hours)
Distribution Feeders: Primary and secondary distribution – Feeder loading – voltage drop in feeder lines with different loadings – Ring and radial distribution – Transformer Application factor – Design considerations of distribution Feeder – Kelvin's law

Module IV (15 hours)
Voltage drop in DC 2 wire system, DC 3 wire system, AC single phase 2 wire system, AC three phase 3 wire and 4 wire systems – voltage drop computation based on load density – voltage drop with underground cable system – power loss estimation in distribution systems – power factor improvement using capacitors – sub harmonic oscillations and ferro resonance due to capacitor banks – optimum power factor for distribution systems

Module V (15 hours)
Energy Management & Auditing: The need for energy management. – Demand side energy management – auditing the use of energy – types of energy audit – electrical load management and maximum demand control – distribution and transformer losses – energy savings in motors and lighting systems

Text Books

1. D P Kothari and I J Nagrath , *Power System Engineering*:, Tata McGraw Hill
2. S N Singh, *Electric Power Generation, Transmission and Distribution,* PHI

Reference Books

1. V Kamaraju, *Electrical Power Distribution Systems,* Tata McGraw Hill
2. M V Deshpande, *Elements of Electrical Power Station Design*, PHI
3. A Chakrabarthi, M L Sony, P V Gupta, U S Bhatnagar, *A Text Book on Power System Engg.* , Dhanpat Rai & Co.
4. Lucas M. Faulkenberry, Walter Coffer, *Electrical power Distribution and Transmission,* Pearson Education
5. P.S. Pabla, *Electric Power Distribution*, Tata Mcgraw Hill
6. Course material for energy managers – Beaureau of energy efficiency, Government of India http://www.bee.gov.in

EE 010 602 Induction Machines

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *Construction, principle of operation and performance of induction machines and special electrical machines*

.

Module1(16 Hours)

Three phase induction motor: Construction-squirrel cage and slip ring motors-principle of operation-slip and frequency of rotor current-mechanical power - developed torque- phasor diagram-torque-slip curve-pull out torque-losses and efficiency.

No load and locked rotor tests-equivalent circuit-performance calculation from equivalent circuit-circle diagram-operating characteristics from circle diagram-cogging and crawling and methods of elimination.

Module 2(14 Hours)

Starting of three phase squirrel cage induction motor-direct on line starting-auto transformer-star delta starting- starting of slip ring motors-design of rotor rheostat-variation of starting torque with rotor resistance.

Speed control-pole changing-rotor resistance control-frequency control-static frequency conversion-Deep bar and double cage induction motor –equivalent circuit -applications of induction machines-single phasing-analysis using symmetrical components.

Module3(10 Hours)

Induction Generator: Theory- phasor diagram-Equivalent circuit-Synchronous Induction motor-construction-rotor winding connections-pulling into step

Single phase Induction motor: Revolving field theory- equivalent circuit- torque-slip curve-starting methods-split phase, capacitor start-capacitor run and shaded pole motors.

Module 4(10 Hours)

Commutator motors-principle and theory-emf induced in a commutator winding- Single phase series motor :theory –phasor diagram-compensation and interpole winding-Universal motor-Repulsion motor: torque production –phasor diagram-compensated type of motors-repulsion start and repulsion run induction motor-applications-Reluctance motor-Hysterisis motor.

Module5(10 Hours)

Construction-principle of operation, operating characteristics of stepper motor, switched reluctance motor, BLDC motor, Permanent magnet synchronous motor, linear induction motor-principle-application-magnetic levitation

Text Books:

1. Alexander Langsdorf A S, *Theory of AC Machinery*, Tata McGraw-Hill
2. Dr. P S Bimbhra, *Electrical Machinery*, Khanna Publishers

Reference Books:

1. Say M G, *Performance and design of AC Machines*, ELBS
2. J B Gupta, *Electrical Machines* , S K Kataria and Son
3. Nagarath I J and Kothari D P, *Electrical Machines* ,4e, Tata McGraw- Hill Education, New Delhi, 2010
4. Vincent Deltoro, *Electrical Machines and Power System*, Prentice Hall
5. Venketaratnam, *Special Electrical Machines*, Universal Press

EE 010 603: Control Systems

Teaching scheme **Credits:** 4
2 hours lecture and 2 hours tutorial per week

Objectives

- *To provide knowledge in the frequency response analysis of linear time invariant systems*
- *To provide knowledge in the design of controllers and compensators.*
- *To provide knowledge in state variable analysis of systems.*

MODULE 1 (12 Hours)
Control system components – synchros, D.C servo motor, A.C servo motor, stepper motor, Tacho generator, Gyroscope.
Frequency domain analysis-. Bode plots, relative stability – gain margin and phase margin. correlation between time and frequency domain specifications. Static position error coefficient and static velocity error coefficient from bode plot. Gain adjustment in bode plot. Analysis of systems with transportation lag.

MODULE 2 (12 Hours)
Polar plots-phase margin and gain margin and stability from polar plot, Correlation between phase margin and damping ratio. Minimum phase and non-minimum phase systems. Log magnitude versus phase plots.
Nyquist plot – principle of argument , Nyquist stability criterion, conditionally stable systems

MODULE 3 (12 Hours)

Response of systems with P, PI and PID controllers.
Compensation Techniques – cascade compensation and feed back design, Lead, Lag and Lag-Lead design using Bode plots and root locus. Realisation of compensators using operational amplifiers.

Module 4 (12 Hours)
State variable formulation-concept of state variable and phase variable. State space representation of multivariable systems, Similarity transformation, invariance of eigen values under similarity transformation. Formation of Controllable canonical form, Observable canonical form. Diagnalisation, and Jordan canonical form from transfer function. Transfer function from state model.

Module 5 (12 Hours)
State model of discrete time systems. Solution of state equation – state transition matrix and state transition equation, computation of STM by canonical transformation, Laplace transform and cayley- Hamilton theorem. Discretization of continuous time system.

Text Books:

1. K.Ogatta, *Modern Control Engineering*- Pearson Education
2. I.J. Nagrath and M.Gopal, *Control Engineering*, TMH

Reference Books

1. D.Roy Choudhary, *Modern Control Engineering*, PHI
2. Richard C. Dorf and Robert H. Bishop, *Modern Control Systems*, Pearson Education
3. M.N. Bandyopadhay, *Control Engineering-Theory and Practice*, PHI,New Delhi,2009.
4 S. Hassan Saeed, *Automatic Control Systems* –Katson Books.
5. A. Anand Kumar, *Control Systems*, PHI
6. Franklin,Powell, *Feedback Control of Dynamic Systems*, Pearson.

EE 010 604 Digital Signal Processing

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide knowledge of transforms for the analysis of discrete time systems.*
- *To impart knowledge in digital filter design techniques and associated problems.*

Module 1 (14hrs)
Discrete time signals and systems: Basic principles of signal processing-Building blocks of digital signal processing. Review of sampling process and sampling theorem. Standard signals-delta, step, ramp. Even and odd functions. Properties of systems-linearity, causality, time variance, convolution and stability –difference equations-frequency domain representation – Discrete – time Fourier transform and its properties- Z transform and inverse Z transform-solution of difference equations.

Module 2 (14hrs)
Discrete fourier transform-inverse discrete fourier transform-properties of DFT-linear and circular convolution-overlap and add method-overlap and save method-FFT - radix 2 DIT FFT-Radix2 DIF FFT

Module 3 (12hrs)
Digital filter design: Design of IIR filters from analog filters - analog butter worth functions for various filters - analog to digital transformation-backward difference and forward difference approximations-impulse invariant transformation – bilinear transformation-frequency warping and pre warping-design examples- frequency transformations. Structures for realizing digital IIR filters-Direct form 1-direct form II-parallel and cascade structure-lattice structure.

Module 4 (12hrs)
Design of FIR filters-Properties of FIR filters-Design of FIR filters using fourier series method- Design of FIR filters without using windows- Design of FIR filters using windows-Design using frequency sampling-Design using frequency sampling method-Design using Kaiser's approach- realization of FIR filters .

Module 5 (8hrs)
Finite register length problems in digital filters-fixed point and floating point formats-errors due to quantization, truncation and round off. Introduction to DSP processors. Architecture of TMS 320C54 XX Digital Signal Processor. Principle of speech signal processing (Block Schematic only).

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing* ,PHI,New Delhi,1997V.
2. Mitra, *Digital Signal Processing* , 3e, Tata McGraw –Hill Education New Delhi,2007
3. P. Ramesh Babu- *Digital Signal Processing*-Scitech publication

Reference Books:

1. Alan V. Oppenheim, Ronald W. Schafer, *Discrete time Signal Processing* , PHI,New Delhi,1997.

2. Udayashankara , *Real Time Digital Signal Processing*, PHI, New Delhi, 2010.

3. Ganesh Rao, *Digital Signal Processing,* Sanguins

4. Haykin and Van Veen, *Signals and Systems,* John Wiley and sons Inc .,2010.

5. Li Tan, *Digital Signal Processing-Architecture Implementation and Applications*- Elsevier Publications

EE 010 605 Microcontrollers and Embedded Systems

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart knowledge about 8051 microcontroller programming and interfacing.*
- *To introduce students to advanced PIC 16F877 microcontroller and embedded systems*
- .

Module 1(14hrs)
Introduction to Embedded Systems (block diagram description)- Microcontrollers and Microprocessors - Comparison.
Intel 8051: Architecture–Block diagram-Oscillator and Clock-Internal Registers-Program Counter-PSW-Register Banks-Input and Output ports-Internal and External memory, Counters and Timers, Serial data I/O- Interrupts - SFRs.

Module 2 (14hrs)
Programming of 8051: Instruction syntax-Types of instructions–Moving data-Arithmetic Instructions-Jump and Call Instructions-Logical Instructions-Single Bit Instructions.
Arithmetic programs. Timing subroutines –Software time delay- Software polled timer-Addressing Modes – Application of Keil C in microcontroller programming.

Module 3 (10hrs)
I/O Programming: Timer/Counter Programming-Interrupts Programming- Timer and external Interrupts- Serial Communication- Different character transmission techniques using time delay, polling and interrupt driven-Receiving serial data – polling for received data, interrupt driven data reception-RS232 Serial Bus standard.

Module 4 (10hrs)
Microcontroller system design: External memory and Memory Address Decoding for EPROM and RAM. Interfacing keyboard. 7 segment display and LCD display. Interfacing of ADC (0808) and DAC (808) to 8051- frequency measurement – Interfacing of stepper motor.

Module 5 (12hrs)
Introduction to RISC Microcontrollers: Architecture of PIC 16F877 microcontroller- FSR – different Reset conditions – various oscillator connections- Internal RC, External RC, Crystal Oscillator and external clock. PIC memory organization – Program (Code) memory and memory map, Data memory and Data EEPROM.
Instruction set – Different addressing modes. Timers - Interrupt structure in PIC 16F877 microcontroller. Simple assembly language programs - square wave generation - reading/writing with internal data EEPROM.

Text books:

1. Muhammad Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems,* Pearson Education Asia.
2. Ajay V Deshmukh , *Microcontrollers- Theory and Applications* , Tata McGraw – Hill Education, New Delhi

Reference books

1. Kenneth J. Ayala, *The 8051 Microcontroller – Architecture, Programming and Applications*, Penram International Publishing (India), Second Ed.

2. K.V.Shibu, *Introduction to Embedded Systems*, 1e, Tata McGraw –Hill Education, New Delhi 2009

3. Dreamtech Software Team, *Programming of Embedded Systems* , Wiley Dreamtech

4. John B. Peatman, *Design with PIC Microcontrollers* , Pearson Education

5. Myke Predko, *Programming and Customizing the 8051 Microcontroller*, Tata McGraw Hill Education, New Delhi, 2009

6. Intel Data Book on MCS 51 family

EE 010 606 L01 High Voltage Engineering

Teaching scheme **Credits:** 4

2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart the basic techniques of high voltage AC, DC and Impulse generation and measurement.*
- *To develop understanding about different high voltage testing techniques performed on electrical equipment.*

Module I (14 hours)

Fundamentals of electric breakdown in gases

Gas as insulating medium - Types of ionization by collision - types of collision. Condition for ionization by electron/ion collision - Collision cross section - Electric fields of low E/P (electric field/pressure in a gas medium).

Ionization process in gaseous media - Townsend mechanism and criterion of breakdown in gases - Paschen's law and its application- Streamer theory of breakdown- Corona discharges- Different theories of breakdown in solid dielectrics- pure and commercial liquids.

Module II (12 hours)

Generation of High DC, AC and Impulse voltages

HVDC : Cockcroft Walton double circuits – Multipliers- Vande Graaff generator

HVAC : Generation of High AC voltages- Cascade connection of transformers – resonant transformers - Tesla coil.

Impulse generation: Definition of impulse wave – B.I.S specification – single stage and multi stage impulse generator circuits. Tripping methods of impulse generator circuits - Impulse current generator.

Module III (12 hours)

Measurement of High DC and AC

Peak voltage- Sphere gap for measurement of DC,AC and impulse voltages. Measurement of HVDC by generating voltmeter – Potential dividers. Measurement of HVAC - Series impedance and Capacitor meters – Capacitance Potential Dividers – CVT

Module IV (10 hours)

Measurement of Impulse voltage and current

Measurement of impulse voltages and currents- Potential dividers - Measurement of impulse current- Hall generators - Magnetic potentio devices – Low current resistive shunts (Peak)

Module V (12 hours)

High voltage testing techniques

Measurement of dielectric constant and loss angle – High voltage Schering Bridge – Partial discharge measurements in high voltage equipment. Power frequency and impulse testing of high voltage apparatus – B.I.S specification – HV testing of insulators, bushing, cables and transformers.

Text Books

1. Naidu & Kamaraju ,*High voltage Engineering* ,Tata Mc Graw Hill Publications.
2. E. Kuffel & W.S Zaengel ,*High Voltage Engineering Fundamentals*, Oxford Pergamon Press

Reference Books

1. L.Lalston , *High voltage Technology* , Oxford university press.
2. Ravindra Arora ,*High voltage insulation engineering* , New Age International (P) Ltd.
3. High voltage experimental Techniques, Dieter Kind, Vieweg &Sohn Verlagsgesellschaft mbH, Braunschweig/ Wiesbaden, 1978

EE 010 606 L02 VLSI Systems

Teaching scheme
2 hours lecture and 2 hours tutorial per week **Credits:4**

Objective:

- *To cater the needs of students who want a comprehensive study of the principle and techniques of modern VLSI Design and Systems.*

Module I (10 hours)
Process steps in IC fabrication: Silicon wafer preparation- Czochralski process- Diffusion of impurities- physical mechanism- Ion implantation- Annealing process- Oxidation process- Lithography- Chemical Vapour Deposition (CVD)- epitaxial growth- reactors- metallization- patterning- wire bonding and packaging.

Module II (12 hours)
Monolithic components: Isolation of components- junction isolation and dielectric isolation. Monolithic diodes- schottky diodes and transistors- buried layer- FET structures- JFET- MOSFET- PMOS and NMOS, control of threshold voltage (Vth)- silicon gate technology- Monolithic resistors- resistors in diffused regions-
MOS resistors- monolithic capacitors- junction and MOS structures- IC crossovers and vias.

Module III (13 hours)
CMOS technology: CMOS structures- Latch up in CMOS. CMOS circuits: combinational logic circuits:- Inverter-NAND, NOR gates, complex logic circuits, Full adder circuit. CMOS Transmission Gates (TG)- realization of Boolean functions using TGs. Complementary Pass Transistor Logic (CPL)- CPL circuits: NAND, NOR gates, 4bit shifter.

Module IV (13 hours)
CMOS sequential logic circuits: SR flip-flop, JK flip-Flop, D latch circuits.
BiCMOS technology- Structure- BiCMOS circuits: Inverter, NAND gate, NOR gate.
CMOS Logic systems- Scaling of MOS structures- scaling factors- effects of miniaturization.

Module V (12 hours)
Gallium Arsenide Technology-:- Crystal structure- Doping process- Channeling effect- MESFET. Comparison between Silicon and GaAS technologies.
Introduction to Programmable Logic Arrays (PLA) and Field Programmable Gate Arrays (FPGA).

Text Books

1. N Weste and K Eshrangian, "*Principles of CMOS VLSI Design: A systems perspective"*, Pearson Education.
2. Jan M Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "*Digital Integrated Circuits – A Design Perspective,* Prentice Hall

Reference Books

1. S M Sze, *VLSI technology*, Me Graw Hill.
2. Douglas Pucknell, *Basic VLSI design*, PHI.
3. S.M.Kang & Y.Leblebici,*CMOS digital integrated circuits*, Mcgraw Hill.
4. K R Botkar, *Integrated Circuits* , Khanna Pub.

EE 010 606 L03 Artificial Neural Networks

Teaching scheme **Credits:** 4
2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart the basic concepts and application of neural networks*
- *To give an introduction to MATLAB based neural network programming*

Pre-requisites: *Fundamental Programming Concepts.*

Module I (15 hours)
Fundamentals of ANN – Biological prototype – Neural Network Concepts, Definitions - Activation. Functions – single layer and multilayer networks. Training ANNs – perceptrons – Exclusive OR problem – Linear seperability – storage efficiency – perceptron learning - perceptron training algorithms – Hebbian learning rule - Delta rule – Kohonen learning law – problem with the perceptron training algorithm
Introduction to MATLAB Neural network tool box. Basic MATLAB transfer functions like purlin, hardlim, hardlims ,tansig, logsig etc and basic programming

Module II (15 hours)
The back propagation Neural network – Architecture of the back propagation Network – Training algorithm – network configurations – Back propagation error surfaces – Back propagation learning laws – Network paralysis _ Local minima – temporal instability.
Introduction to nntool. Basic supervised programming with nn tool.

Module III (10 hours)
Counter propagation Networks – Architecture of the counter propagation network – Kohonen layer – Training the Kohonen layer – preprocessing the input vectors – initialising the weight vectors – Statisitical properties. Training the Grossberg layer- Feed forward counter propagation Neural Networks – Applications.

Module IV (10 hours)
Statistical methods – simulated annealing – Bloltzman Training – Cauchy training -artificial specific heat methods. Application to general non-linear optimization problems – back propagation and cauchy training

Module V (10 hours)
Hopfield net – stability – Associative memory – statistical Hopfield networks – Applications – ART NETWORKS –Bidirectional Associative memories- retreiving stored information. Encoding the association – continuous BAMS
Application of neural network for load forcasting, image enhancement, signal processing, pattern recognition etc.

Text Books

1. Philip D.Wasserman, *Neural Computing (Theory and Practice*)
2. J.Zuradha, *Introduction to Artificial Neural System* ,Jaico *Publishers*

Reference Books

1. S. Rajasekaran and G.A.V.Pai, *Neural Networks, Fuzzy Logic and Genetic algorithms*, PHI, 2003.
2. Hung T. Nguyen,Nadipuram.R Prasad ,*Fuzzy and Neural Control, CRC Press, 2002.*
3. Neural Network Toolbox, www.mathworks.com.
4. Kalyanmoyi Deb, Multi-Objective Optimization using Evolutionary Algorithms,Wiley,2001
5. Robert Hecht-Nilson, *Neuro Computing*
6. Simon Haykin, "*Neural Networks- A comprehensive foundation*", Pearson Education, 2001.

EE 010 606 L04 Object Oriented Programming

Teaching scheme

Credits: 4

2 hours lecture and 2 hours tutorial per week

Objectives

- *To impart knowledge on concepts of object-oriented programming.*
- *To enable the students to master OOP using C++.*

Pre-requisites

- EE 010 406 Computer Programming

Module 1 (10 hours)
OOP concepts: Objects-classes-data abstraction-data encapsulation- inheritance- polymorphism-dynamic binding, comparison of OOP and Procedure oriented programming, object oriented languages.
OOP using C++: Classes and objects, class declaration-data members and member functions-private and public members-member function definition, inline functions, creating objects, accessing class members.

Module 2 (14 hours)
Arrays of objects, objects as function arguments-pass by value-reference variables/aliases-pass by reference, function returning objects, static class members.
Constructors and destructors -declaration, definition and use, default, parameterized and copy constructors, constructor overloading.

Module 3 (11 hours)
Polymorphism: function overloading-declaration and definition, calling overloaded functions. Friend classes, friend functions, operator overloading-overloading unary and binary operators-use of friend functions.

Module 4 (14 hours)
Inheritance: different forms of inheritance, base class, derived class, visibility modes , single Inheritance, characteristics of derived class, abstract class.
File handling in C++: file stream classes, file pointers and their manipulations, open (), close (), read (), write () functions, detecting end of file.

Module 5 (11 hours)
Dynamic memory allocation: pointer variables, pointers to objects, new and delete operators, accessing member functions using object pointers, 'this' pointer.
Run time polymorphism: pointers to base class, pointers to derived class, virtual functions-dynamic binding.

Text Book

1. Balagurusamy, *Object Oriented Programming with C++* , Tata McGraw Hill
2. D Ravichandran, *Programming with C++*, Tata Mc-Graw Hill

References

1. Robert Lafore, *Object Oriented Programming in Turbo C++*, Galgotia Publications
2. K R Venugopal, Rajkumar, T Ravishankar, *Mastering C++*, Tata Mc_Graw Hill
3. John R Hubbard, *Programming with C++*, Schaum's series, Mc_Graw Hill
4. Stanely B.Lippman, *C++ primer*, Pearson Education Asia
5. Bjame Stroustrup, *C++Programming Language,* Addison Wesley

EE 010 606 L05 Biomedical Engineering

Credits :4

Teaching Scheme
2 hours lecture+ 2 hours tutorial / Week

Objectives

- *To introduce the student to the various sensing and measurement devices of electrical origin.*
- *To provide the latest ideas on devices for the measurement of non-electrical parameters.*
- *To bring out the important and modern methods of imaging techniques.*
- *To provide latest knowledge of medical assistance / techniques and therapeutic equipments*

MODULE 1 (12 Hrs)
Cell and its structure – Action and resting potential - Propagation of action potential – Sodium pump –Nerve cell – Synapse –Different systems of human body- Cardio pulmonary system – Physiology of heart and lungs – Circulation and respiration – Man instrument system.Electrodes-Different types-Transducers – Different types – piezo-electric, ultrasonic, resistive, capacitive, inductive transducers
Safety instrumentation-Radiation safety instrumentation- Physiological effects due to 50 Hz current passage- Microshock and macroshock-Electrical accidents in hospitals-Devices to protect against electrical hazards-hospital architecture

MODULE 2 (12 Hrs)
Biopotential Recorders - Characteristics of recording system – Electrocardiography -Conducting system of heart - ECG lead configuration - Analysis of ECG signals - Heart sounds - Phonocardiography - Electroencephalography (EEG) - Placement of electrodes in EEG - Analysis of EEG – Electromyography - Electroretinography and Electrooculography

MODULE 3(12 Hrs)
Physiological Assist Devices- Pacemakers-Different modes of opreation- Pacemaker batteries-Artificial heart valves- Defibrillators –Different types- Heart Lung machine - Oxygenerators-Blood pumps- Kidney machine-Dialysis-Haemodialysis- Peritonial dialysis Blood pressure measurement (invasive and noninvasive)

MODULE 4 (12 Hrs)
Operation Theatre Equipment- Surgical Diathermy- Short wave diathermy-Microwave diathermy- Ultrasonic diathermy-Therapeutic effects of heat-Range and area of irritation of different diathermy techniques-Ventilators- Anesthesia machine- Blood flow meter-Pulmonary function analysers-Lung volumes and capacities- Gas analyser- Oxymeters-Elements of intensive care monitoring

MODULE 5 (12 Hrs)
Advances in Biomedical Instrumentation-X-ray tube-X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography – Block diagram of CT machine- Applications of CT- Ultrasonic imaging-Modes of display-US imaging instrumentation-Applications of US-Magnetic Reasonance Imaging- MRI instrumentation- Thermography-Block diagram of the thermographic equipment- Medical applications of thermography-LASER in Medicine–LASER instrumentation-Photo thermal and photochemical applications of LASERS

Text Books

1. Dr. M. Arumugam ,*Biomedical Instrumentation*, Anuradha Publishers
2. Prof. S.K.Venkata Ram, *Biomedical Electronics and Instrumentation* ,Galgotia Publishers

Reference Books

1. Carr and Brown, *Introduction to Biomedical Equipment Technology* ,Prentice Hall
2. John G. Webster, *Medical Instrumentation Application and Design*, John Wiley & Sons Pvt. Ltd
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer,*Biomedical Instrumentation and Measurements* ,Pearson Education
4. Richard Aston ,*Principles of Biomedical Instrumentation and Measurement* , Maxwell Macmillan International Edition
5. R. S. Khandpur ,*Handbook of Biomedical Instrumentation*, TMH
6. Tompkins ,*Biomedical Digital Signal Processing*, PHI Learning Pvt. Ltd

EE010 606 L06 Renewable Energy Resources

Teaching scheme **Credits: 4**

2 hours lecture and 2 hours tutorial per week

Objective

- *To understand the importance, scope, potential, theory and applications of non conventional energy sources*

Module I (10 hours)

Energy scenario in India, Environmental aspects of Electrical Energy Generation , Energy for sustainable development, Renewable Energy sources-Advantages and limitations.
Renewable Hydro –Power Equation-Small, Mini and Micro hydro power-Types of turbines and generators

Module II (11 hours)

Solar energy – Introduction to solar energy: solar radiation, availability, measurement and estimation.
Solar Thermal systems- Solar collectors(fundamentals only)- Applications -Solar heating system, Air conditioning and Refrigeration system ,Pumping system, solar cooker, Solar Furnace, Solar Greenhouse -Design of solar water heater

Module III (11 hours)

Solar photovoltaic systems- Photovoltaic conversion- Solar Cell, module, Panel and Array Solar cell- materials-characteristics- efficiency-Battery back up-PV system classification-Design of stand-alone PV system.

Module IV (13 hours)

Wind energy –-Introduction – Basic principles of wind energy extraction – wind data and energy estimation – site selection – Basic components of wind energy conversion system – Modes of wind power generation.-Applications
Fuel cells –characteristics-types and applications

Module V (15 hours)

Biomass Energy - Resources - Biofuels- Biomass conversion process-applications Tidal power-Energy estimation-site selection-Types-Important components of a tidal power plants- Wave energy- characteristics-energy and power from the waves, wave energy conversion devices
Geothermal energy – resources - estimation of geothermal power - geo thermal energy conversion - Applications

Text Books

1. D.P.Kothari, K.C.Singal, Rakesh Ranjan, *Renewable Energy Sources and Emerging Technologies*, Prentice Hall of India, New Delhi, 2009
2. B.H. Khan, *Non-Conventional Energy Resources, 2nd* ,Tata McGraw Hill, New Delhi, 2010
3. Chetan Singh Solanki, *Renewable Energy Technologies,* Prentice Hall of India, New Delhi, 2009

Reference Books

1. Godfrey Boyle, *Renewable Energy*, Oxford
2. Tasneem Abbasi, S.A.Abbasi, *Renewable Energy Sources*, Prentice Hall of India, New Delhi, 2010
3. Siraj Ahmed, *Wind Energy- Theory and Practice*, Prentice Hall of India, New Delhi, 2010

EE010 607 Power Electronics Lab

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To provide experience on design and analysis of power electronic circuits used for power electronic applications.*

Experiments

1. Study of VI characteristics of SCR and TRIAC.
2. Study of BJT, IGBT, GTO & MOSFET.
3. R, RC and UJT firing circuit for control of SCRs.
4. Design and Implementation of Ramp-Comparator and digital firing scheme for simple SCR circuits.
5. Automatic lighting control with SCRs and optoelectronic components.
6. AC phase control using SCR and TRIAC.
7. Speed control of DC motor using choppers and converters.
8. Generation and study the PWM control signal for single phase dc to ac inverter.
9. Study and use of single phase half controlled and fully controlled AC to DC converter and effect of firing angle control on load voltage waveforms.
10. Study and use of back to back connected SCR/TRIAC controlled AC voltage controller and its waveforms with variations of firing angle.
11. Study and use of chopper circuit for the control of DC voltage using
    (i) Pulse width control
    (ii) Frequency control
12. Study of single phase inverter and its waveforms.
13. Study of 3 phase firing circuit with synchronization and testing with 3 phase AC to DC bridge converter. Testing waveforms of digital firing modules.
14. Study and testing of 3 phase bridge inverter with different types of loads.
15. Simulation of gating circuits and simple converter circuits.
16. Harmonic Analysis of Power Electronic devices.
17. Simulation of firing circuits using Pspice.
18. Microprocessor based 3 phase fully controlled converter.

References:

1. Joseph Vithayathil , *Power Electronics-Principles and applications*, TMH, 2010
2. M.H. Rashid , *Power Electronics – Circuits, Devices and Applications*, PHI/Pearson 2005

EE 010 608: Microprocessor and Microcontroller Lab

Teaching scheme **Credits:** 2
3 hours practical per week

Objectives

- *To provide experience in the programming of 8085 microprocessor and 8051 microcontroller*
- *To familiarize with the interfacing applications of 8085 microprocessor and 8051 microcontroller.*

1. 8085 assembly language programming experiments

    a. 8-bit and 16 bit arithmetic operations
    b. Sorting
    c. BCD to binary and binary to BCD conversion
    d. Finding square root of a number
    e. Finding out square root of a number using look-up table
    f. Setting up time delay and square wave generation
    g. Interfacing of switch and LED
    h. Traffic control signals

2. 8051 programming

    a. Setting up time delay using timer and square wave generation
    b. Interfacing LEDs
    c. Interfacing Hex keyboard
    d. Interfacing LCD display
    e. Interfacing electromechanical and static relay
    f. Interfacing DC motor with MOSFET switches and opto-isolator

3. Mini Project
   The students are expected to do a mini project in the area of microprocessors /microcontrollers and should be evaluated separately and considered for internal assessment.

   Reference:
   Satish Shah, *8051 Microcontroller* , Oxford Higher Education

Note : Internal assessment mark for the laboratory work (Part 1 & Part2) is 60 % and for the mini project (Part 3) is 40 %.