EE601C	POWER SYSTEM ANALYSIS	3L:1T:0P	4 Credits
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Pre-Requisites: Power systems-2

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Analyze symmetrical and unsymmetrical faults.
2. Apply the load flow techniques and carry out load flow study of power systems.
3. Study and analyze the transient and steady state stability of power systems

UNIT-I

Fault studies: Per unit system, Introduction to symmetrical fault analysis-short circuit capacity of a bus-The short circuit currents and the reactance of synchronous machines-Internal voltages of loaded machines under transient conditions-Expressions for fault MVA in terms of per unit and percentage quantities-Need for current limiting reactors and their location-selection of circuit breakers.

UNIT-II

Sequence Networks: Symmetrical Components-phase shift of symmetrical components in Star-Delta transformer banks -Power in terms of symmetrical components - Sequence impedances and sequence networks-Sequence impedances of generators-Sequence impedances of transmission lines-Sequence impedances of transformers.

Unsymmetrical fault Analysis: Fault current calculations for single line to Ground fault, Line to Line fault and Double line to Ground fault, open conductor faults.

UNIT-III

Load flow studies: Need for load flow studies in a power system-Formation of Bus admittance matrix-Classification of types of buses in a power system-Formulation of load flow equations-Gauss-Seidel, iterative method for load flow studies-Treatment of PV bus-Acceleration factors-Newton-Raphson method for load flow solution with rectangular and polar coordinates-formulation of load flow equations-Decoupled and fast decoupled load flow.

UNIT-IV

Stability studies: Classification of stability studies-The power flow equations of round rotor and salient pole synchronous machine connected to infinite bus through a transmission system under

steady state and transient state - Power flow equations of a two-machine system - Power flow equations in terms of ABCD constants-Power angle diagrams-Derivation of swing equation, Inertia constant. steady state stability analysis: Steady state stability and steady state stability limits.

UNIT-V

Transient stability analysis: General considerations and assumptions-Transient stability and stability limits-Reduction of two finite machine system to one machine system-Solution of swing equation of one machine system by point-by-point method-Digital solution by numerical methods- Equal area criterion-Limitations of equal area criterion- Determination of critical clearing angle. methods for improving power system stability.

Text Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education,1994.
2. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
3. Hadi Saadat, "Power System Analysis", Tata McGraw-Hill Education, 2nd Edition,2002.

Reference books:

1. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
2. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
3. Power System Analysis and design by B.R.Gupta, S.Chand publications.

EE602C	ELECTRICAL AND ELECTRONICS MEASUREMENTS	3L:0T:0P	3 Credits
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Pre Requisites: Electrical Circuits

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the working principle of different measuring instruments.
2. Select appropriate measuring instruments for measuring various parameters in their laboratory courses.
3. Study and correlate the significance of different measuring instruments, recorders and oscilloscopes.

UNIT–I

Measurements – Errors & classification, Deflecting, control, and damping torques in instruments Measurement of voltage & current - permanent magnet moving coil and moving iron meters, dynamometer type instruments.

UNIT–II

Measurement of potential difference, current, and resistance – DC bridges, A.C & DC potentiometers.

Measurement of inductance, capacitance, and resistance- AC bridges.

UNIT–III

Instrument transformers – Current and Potential Transformers, Ratio and phase angle errors.

Measurement of power – Electrodynamic instruments, Induction instruments.

Measurement of energy – Single phase and three phase energy meters.

UNIT–IV

Power factor meters**,** Synchronoscopes, Ratiometers, Frequency meters, Q-meters, Digital Voltmeters, Multimeters.

UNIT – V

Transducers – Position transducers, Force transducers, Piezo-electric transducers, Hall effect transducers. Temperature measurement.

Signal sources – Oscillators, Function generator & pulse generators.

Oscilloscopes - CRO, Digital storage and Analog storage Oscilloscope. Analog & Digital Recorders, error analysis.

Text Books:

1. A. K. Sawhney, 'A Course in Electrical and Electronic Measurements and Instrumentation', Dhanpat Rai & Co., 9 th Edition, 2015.
2. W. D. Cooper," Electronic Instrumentation and Measurement Techniques", Prentice Hallof India Publications, 1st Edition, 2009.
3. C.T.Baldwin, "Fundamentals of Electrical Measurements".

Reference Books:

1. Deobelin, 'Measurements Systems', Tata McGraw Hill Publications, 2nd Edition, 2010.
2. John P.Bently, "Principles of Measurement Systems", 3rd edition.

EE603C	MICRO PROCESSORS AND MICRO CONTROLLERS	3L:0T:0P	3 Credits
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Pre-Requisites: Digital Electronics

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Do assembly language programming.
2. Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
3. Understand the architecture and features of 8051 microcontroller.

UNIT-I

Development of microprocessors, 8086 microprocessor – Architecture, Instruction set, Addressing modes, Interrupt system. Minimum mode 8086 system and timings, Maximum mode 8086 system and timings.

UNIT-II

Assembler directives, Assembly language programs (8086) with Assembler directives for addition, subtraction, multiplication, division etc., sorting and searching, bit manipulation, Programs using look–up tables, Delay subroutines. Stages of software development.

UNIT-III

Data transfer schemes – Synchronous, Asynchronous, Interrupt driven and DMA type schemes, Programmable interrupt controller (8259) and its interfacing, Programmable DMA controller (8257) and its interfacing, Programmable Interval Timer (8253) and its interfacing, Programmable Communication Interface (8251 USART) and its interfacing.

UNIT-IV

Memory interfacing to 8086 – Interfacing various types of RAM and ROM chips, 8255 PPI and its interfacing, ADC and DAC Interfacing, Data acquisition, Waveform generation, Traffic light controller, Stepper motor control, temperature measurement and control.

UNIT-V

8051 Microcontroller – Architecture, register set, Instruction set, Interrupt structure, timer and serial port operations, Memory and I/O interfacing, Simple Assembly language programs.

Text Books:

1. A.K. Ray and K.M. Bhurchandi, "Advanced Microprocessors and Peripherals", TMH.
2. Douglas V. Hall, "Microprocessors and interfacing: Programming and hardware", TMH, 2nd edition.
3. Kenneth J Ayala, "The 8051 Micro Controller Architecture, Programming and Applications", Pernam International / Thomson Publishers, 2nd Edition, 2005.
4. Ajay V. Deshmukh, "Microcontrollers – theory applications", Tata McGraw-Hill Company

EE604C	UTILIZATION OF ELECTRICAL POWER	3L:0T:0P	3 Credits
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Pre-Requisites: D.C. Machines and Transformers, Induction Motors and Synchronous Machines

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. To provide students basic practical knowledge of illumination and to get general ideas about street lighting, building lighting.
2. To provide students' knowledge about the various electric heating methods and their advantages.
3. To make students to learn electrical welding methods and their advantages
4. To provide students basic practical knowledge of electric drives and to learn the characteristics of different mechanical loads.
5. To provide students' knowledge about the electric traction &their advantages.

UNIT–I

Illumination: Nature of light, definitions, Laws of illumination, different types of lamps, construction and working of incandescent lamp, fluorescent lamp and discharge lamps, Illumination schemes; indoor and outdoor, Illumination levels. General ideas about street lighting, building lighting.

UNIT–II

Electric Heating: Advantages of electrical heating, Heating methods: Resistance heating, Induction heating, Electric arc heating, construction and working of arc furnace, Dielectric heating, Infra-red heating, Microwave heating, design problems of resistance heating element.

UNIT –III

Electric Welding: Advantages of electric welding, Welding methods, Principles of resistance welding, welding equipments used, Principle of electric arc welding, carbon arc, metal arc, hydrogen arc welding methods and their applications. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits.

UNIT –IV

Electric Drives: Introduction, Advantages of electric drives, Characteristics of different mechanical loads, Types of motors used in electric drive, types of braking, Methods of power transfer, selection of motors for different types of domestic loads.

UNIT –V

Electric Traction: Advantages of electric traction, Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main lines and their speed-time curves, pentagraph, Factors affecting scheduled speed, types of motors used for electric traction, Starting and braking of traction motors.

Text Books:

1. Art and Science of Utilization of Electrical Energy by H Partap, Dhanpat Rai &Sons, Delhi.
2. Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana.
3. A.Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi.
4. Modern Electric Traction by H Partap, Dhanpat Rai & Sons, Delhi.
5. Utilization of Electrical Energy by OS Taylor, Pitman Publications.
6. Generation, Distribution and Utilization if Electrical Power by CL Wadhwa, Wiley Eastern,Ltd., New Delhi

EE605C.i	ADVANCED CONTROL SYSTEMS	3L:0T:0P	3 Credits
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Pre Requisites: Linear Control Systems

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the need of compensators and controllers for design aspects
2. Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
3. Understand the state space analysis and build system matrix for stability purpose.
4. Understand system Controllability and Observability.

UNIT- I

Compensators: Introduction to Compensators – Need for compensators – Types of Compensators – Lead, Lag, Lead lag compensators – Transfer function of compensators – Comparison of compensators – Applications of compensators.

UNIT- II

Controllers: Introduction to controllers – Need for controllers – Types of Controllers – Proportional, Integral and Derivative Controllers – Transfer function of controllers - PI, PD, PID Controllers – Design of controllers using frequency domain analysis – Comparison of controllers – Applications of controllers.

UNIT-III

State variable descriptions: Introduction – Comparison of advanced control theory and classical control theory – concepts of state, state variables, state vector, state space representation of physicalsystems – representation in state variable form, phase variables and canonical variables.

UNIT-IV

Controllability and Observability: Definition of controllability and Observability – Controllability and Observability tests for continuous time systems – Duality Principle of Controllability and Observability – Pole placement by state feedback design – State observers – Full order and reduced order observers

UNIT-V

Time response of linear system: Introduction – Solution of state equations – Homogenous and Non-homogenous – State Transition matrix – Properties of STM – Computation of STM

Non linear systems – Introduction – common physical non linearities – Dead Zone, Jump Resonance, Stiction, Friction, Hysteresis etc

Text Books:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.
2. Benjamin C. Kuo, "Automatic Control system", Prentice Hall, 1995.
3. A Nagoor Khani, "Advanced Control Theory", CBS Publications, 2020.

EE605C.ii	ENERGY AUDITING AND MANAGEMENT	3L:0T:0P	3 Credits
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Pre-Requisites: D.C. Machines and Transformers, Induction Motors and Synchronous Machines, Power systems-1

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand energy audit of industries and management of energy systems
2. Analyze the methods of improving efficiency of electric motors, power factor and design a good illumination system
3. Evaluate and analyze economic aspects of energy saving equipment

UNIT-I

Energy Management: Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

UNIT-II

Basic Principles of Energy Audit: Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT-III

Energy Efficient Motors: Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, variable duty cycle systems, RMS hp-voltage variation-voltage unbalance- over motoring- motor energy audit.

UNIT-IV

Power Factor Improvement, Lighting and Energy Instruments: Power factor – methods of improvement, location of capacitors, pf with nonlinear loads, effect of harmonics on power factor, power factor motor controllers – Good lighting system design and practice, lighting control, lighting energy audit – Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's.

UNIT-V

Economic Aspects and Analysis: Economics Analysis-Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

Text Books

1. "Energy management", W.R. Murphy and G. Mckay Butter worth, Heinemann publications.
2. "Energy management", Paul o' Callaghan, Mc-graw Hill Book company-1st edition,1998

References:

1. "Energy efficient electric motors", John.C. Andreas, Marcel Dekker Inc Ltd-2nd edition,1995-
2. "Energy management hand book",W.C.Turner, John wiley and son
3. "Energy management and good lighting practice: fuel efficiency- booklet", 12-EEO

EE605C.iii	SPECIAL MACHINES	3L:0T:0P	3 Credits
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Pre Requisites: D.C. Machines and Transformers, Induction Motors and Synchronous Machines

Course Outcomes: At the end of the course, student will be able to

1. Understand field aspects of electrical machines
2. Understand the operation and control of
   a. Stepper motors
   b. BLDC motors
   c. SR motor

UNIT-I

Field aspects of electrical machines: Review of Maxwell's equations and solution of Laplace's and Poisson's equations. Concept of magnetic vector potential. Eddy current braking. Linear motors: Basic principle of operation and types. End effects & transverse edge effects. Field analysis & Propulsion force; equivalent circuit.

UNIT-II

Stepper motors: Construction and operation of Stepper Motors: variable reluctance, permanent magnet, hybrid stepper motors, characteristics of stepper motors. Drive Circuits for Stepper motors: Block diagram of stepper motor controller, logic sequence generator, power drivers, current suppression circuits, and acceleration and deceleration circuits.

UNIT-III

Microprocessor control of stepper motors: microprocessor-based stepper motor controller, PC based stepper motor controller. Micro-stepping Control of Stepper motors: the micro-stepping principle, advantages of micro stepping, design of basic micro-stepping controller. Applications of stepper motor

UNIT-IV

Brushless DC motor: principle of operation of BLDC motor, square wave permanent magnet brushless motor drives, sine wave permanent magnet Brushless DC motor drives, phasor diagram, torque speed characteristics, controllers for BLDC motors, alternating current drives with PM and synchronous reluctance hybrid motors.

UNIT-V

Switched Reluctance Motor Drives: Types of SR motors, principle of operation, static torque production, energy conversion loop, dynamic torque production. Converter Circuits, Control of SR motors: current regulation, commutation, torque speed characteristics, shaft position sensing.

Text Books:

1. "V .V.Athani, "Stepper Motors Fundamentals, Applications, and Design", New Age.
2. TJE Miller, "Brushless Permanent-Magnet and Reluctance Motor Drives" Clarendon Press,Oxford .

EE607L	**MICRO PROCESSORS AND MICRO CONTROLLERS LAB**	**0L:0T:3P**	**1.5 Credits**
Sessional Marks: **40**		End Semester Examination Marks: **60**	

Pre-Requisites: Micro Processors and Micro Controllers

Course Outcomes: At the end of the course, students will be able to:

1. Demonstrate program proficiency using the various instructions of the 8086microprocessor.
2. Demonstrate program proficiency using the various instructions of the 8051microcontroller
3. Design systems for different applications by interfacing external devices

LIST OF EXPERIMENTS

Part-1: 8086 programs:

1. Program to demonstrate data transfer operation
2. Program to demonstrate arithmetic operation
3. Program to demonstrate logical operation
4. Program to demonstrate shift operation
5. Program to demonstrate string operation
6. Program to demonstrate looping operation
7. Program to demonstrate decision making operations

PART-2: 8051 PROGRAMS:

1. Program to demonstrate data transfer and arithmetic operations
2. Program to demonstrate logical and shift operations
3. Program to demonstrate looping operations
4. Programming timer / counter.
5. Programming Serial communication application.
6. Programs to demonstrate bit-manipulation operations.

PART-3: INTERFACING PROGRAMS (using 8086 & 8051 Kits)

1. Interfacing ADC
2. Interfacing DAC.
3. Interfacing stepper motor.
4. Interfacing 7-segment display.
5. Interfacing Traffic light controller.
6. Waveform generation

EE608L	ELECTRICAL AND ELECTRONICS MEASUREMENTS LAB	0L:0T:3P	1.5 Credits
Sessional Marks: **40**		End Semester Examination Marks: **60**	

Pre-Requisites: Electrical and Electronics Measurements

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Design and validate DC and AC bridges.
2. Analyze the dynamic response and the calibration of few instruments.
3. Learn about various measurement devices, their characteristics, their operation and their limitations.
4. Understand statistical data analysis.
5. Understand computerized data acquisition.

Lectures/Demonstrations:

1. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
2. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, C_p, C_{pk}.
3. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
4. Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope.

Experiments

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter. Measurement of C using a bridge technique as well as LCR meter.
3. Measurement of Low Resistance using Kelvin's double bridge.
4. Measurement of High resistance and Insulation resistance using Megger.
5. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
6. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
7. Usage of DSO to capture transients like a step change in R-L-C circuit.
8. Current Measurement using Shunt, CT, and Hall Sensor.

EE609S	JAVA PROGRAMMING	1L:0T:2P	2 Credits
Sessional Marks: **40**		End Semester Examination Marks: **60**	

Pre Requisites: Basics of JAVA

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the software's for writing Java programming and code to accept an integer and print its factorial.
2. Develop the Java code for different applications.

List of Modules

1. Downloading and installing JDK and JRE. Executing simple java program which prints Helloworld.
2. Program to accept an integer and prints its factorial.
3. Develop a java program to create class, which contains data and methods (private and public), create an object to access those members.
4. Develop a java program which demonstrates method over loading.
5. Develop a java program which demonstrates constructor and constructor over loading use thiskeyword.
6. Develop a java program which creates and Access Static and Non-static members of a class.
7. Develop the java program to study different methods provided in String and String Bufferclasses.
8. Develop a java program that demonstrates single inheritance, use super keyword.
9. . Develop a java program for abstract class to find areas of different shapes.
10. Develop a java program to achieve multiple inheritance using interfaces.
11. Develop a java program to create an interface named Vehicle which contains two abstract methods. (Specifications (), Display ()). Provide two classes named Two-wheeler, Four-wheeler that is implemented by that interface.
12. Develop a java program to create a package and accesses it.
13. Develop a java program that demonstrates try, catch and finally.
14. Develop a java program that displays a frame with two Labels, two Text Fields and Two Buttons.

MC610A	PROFESSIONAL ETHICS IN ENGINEERING	2L:0T:0P	0 Credits
Sessional Marks: **100**		End Semester Examination Marks: **NIL**	

Pre-requisites/co-requisites: None.

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

1. Discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.
2. Learn the moral issues and problems in engineering; find the solution to thoseproblems.
3. Learn the need for professional ethics, codes of ethics and roles, concept of safety, risk assessment.
4. Gain exposure to Environment Ethics & computer ethics; know their responsibilities and rights.

UNIT I

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

UNIT II

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

UNIT III

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

UNIT-IV

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

UNIT V

Global Issues: Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct – Corporate Social Responsibility.

TEXT BOOKS:

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

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.