RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Electrical Engineering, IV-Semester

Electrical Machine-I

COURSE OBJECTIVE

The objective of this foundational course is to develop fundamentals, physical concepts and systematic development of circuit models analysis of transformers, induction motors and special machines.

COURSE CONTENT

Transformer-I: Working principle, e.mf. equation, construction, phasor diagrams, equivalent circuit, voltage regulation, losses, separation of hysteresis and eddy current losses, efficiency, tests: open circuit and short circuit, load, Sumpner's test, Condition for maximum efficiency and regulation, Power and distribution transformer, allday efficiency, Excitation phenomenon. Autotransformer: working, advantages, its equivalent circuit and phasor diagram.

Transformer-II: Three phase transformer: its construction, groups and connections, their working and applications; Scottconnection; Parallel operation of Transformers: application, advantages, requirement and load sharing; Tap changers, cooling, conservator and breather. Pulse and high frequency transformers.

Three phase Induction Motor- I: Working principle, construction, comparison of slip ring and squirrel cage motors, steady state analysis, phasor diagram and equivalent circuit, power flow diagram, torque-speed and power-speed characteristics, Losses and efficiency, No load and block rotor test, circle diagram

Three phase Induction Motor-II: Starting of squirrel cage and slip ring motors, power factor control, Cogging & Crawling, Double cage &Deep bar Indication Motor, impact of unbalanced supply and harmonics on performance, speed control, braking, Induction Generator. Applications

Single Phase Motors: Single Phase Induction motor; double revolving field theory, equivalent circuit and its determination, performance calculation, starting methods and types of single phase Induction motors: their working principle and applications, comparison with three phases Induction Motor. Single phase A.C. series motor, Servo motors, Linear Induction Motor

List of Experiments (expandable)

Experiments can cover any of the above topics, following is a suggestive list:

1. Perform turn ratio and polarity test on 1-phasetransformer
2. Perform load test on a 1-phase transformer and plot its loadcharacteristic
3. Perform OC and SC tests on a 1-phase transformer and determine its equivalent circuit. Also find its efficiency and regulation at different load and powerfactor.
4. Perform OC and SC tests on a 3-phase transformer and determine its equivalent circuit. Also

find its efficiency and regulation at different load and powerfactor.

5. Perform Sumpner's test on two 1-phase transformer and determine its efficiency at variousload.
6. Perform No-load and block rotor test on a 3- phase IM and determine its equivalentcircuit.
7. Perform load test on a 3- phase IM and plot its performancecharacteristics.
8. Study various types of starters used for 3- IMs.
9. Perform No-load and block rotor test on a 1- phase IM and determine its equivalentcircuit.

COURSE OUTCOME:

After the completion of course, students must learn the foundation to the theory of electromechanical devices with specific emphasis on transformers and induction motor.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment. Laboratory assessment will be based on external assessment, assignments, presentations, and interview of each candidate.

TEXT BOOKS

1. Electrical Machines by Nagrath and Kothari, McGraw-Hill
2. P.S.Bimbhra, Electrical Machines,Khanna Publishers

REFERENCES

1. V.Del Toro, "Electrical Machines & Power Systems", 1985, Prentice-Hall, Inc., EnglewoodCliffs
2. S K Bhattacharya, Electrical Machines, McGraw-Hill
3. Ashfaq Hussain, Electrical Machines, Dhanpat Rai & Co
4. Langsdorf, A.C. Machines, McGraw-Hill
5. Samarajit Ghosh, Electrical Machines, Pearson

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Electrical Engineering, IV-Semester

Digital Electronics Logic Design

COURSE OBJECTIVE

This course covers the basics of digital logic circuits and design. It provides Boolean algebra concepts and their application in digital circuitryand elaborates on both combinational and sequential circuits.Memory circuits are also covered.

COURSE CONTENT

Number Systems and Codes: Digital number systems, base conversion, Binary, Decimal, octal, Hexadecimal, number system with radix r, Gray codes.Alphanumeric codes – ASCII code and BCD codes, concept of parity, complementr's& (r-1)'s, subtraction with complements, signed Binary numbers, Error Detecting & Correcting codes. Basic Theorems & Properties of Boolean algebra: AND, OR, NOT operators, laws of Boolean algebra, Demorgon's theorem, Boolean expression & logic diagram. Negative logic, Alternate logic gate representation (concept of bubbled gates) canonical and standard Forms (Minterms&Maxterms), sum of minterms& product of maxterms, conversion between canonical forms. Truth table & maps, 2,3,4,5 and 6 variable maps, solving digital problems using Maps, Don't care conditions, Tabular minimization. Sum of product & product of sum reduction, Exclusive OR & Exclusive NOR circuits, Parity generator &checkers.

Combinational Circuits: Design procedure, Adders (half and Full), subtractor (half and full) code convertors, Analysis of design, Universal building blocks, Implementation of any logic circuit with only NAND gates or with only NOR gates, Binary serial adder, parallel adder, serial/parallel adder, look ahead carry generator, BCD adder, Binary multiplier, Magnitude comparator, Decoder, Demultiplexer, Encoders, priority encoder, Multiplexers & implementation of combinational logic diagram.

Sequential Logic Circuit : Latches, SR latch with NAND & NOR gates, D latch, edge triggered flip flop, J-K flip flop, T flip flop, Master slave flip flop, Analysis of clocked sequential circuit, state table, state diagram, state reduction state equations, state assignments, flip flop excitation table & characteristic equations, Design procedure for sequential circuits, Design with state reduction, Applications of flipflop.

Registers and Counters : Asynchronous and Synchronous counter, counters with MOD numbers, Down counter, UP/DOWN counter, propagation delay in ripple counter, programmable counter, Pre- settable counter, BCD counter, cascading, counter applications, Decoding in counter, Decoding glitches, Ring Counter, Johnson counter, Rotate left & Rotate right counter, Registers – Buffer, Shift left, shift right, shift left/Right registers, parallel in parallel out, serial in serial out, parallel in serial out, serial in parallel out registers.

Random Access Memory, Timing waveform, Memory Decoding, Internal Construction, Coincident decoding, Addressmultiplexing, Read only memory – Combinational circuit implementation, Type of ROMs, combinational PLDs, Programmable Logic Array (PLA), Programmable Array Logic (PAL), sequential programmable device. Analog todigital conversion – Ramp type, dual slope, integration, successive approximation, parallel conversion, parallel/ serial conversion, convertor specifications, Digital to Analog convertors – Binary weighted & R/2R D to A convertors.

List of Experiments (Expandable):

1. Verification of all the logicgates.
2. Design of BCD to Excess-3 codeconverter.
3. Implementation of NAND & NOR as Universalgate.
4. Design of RS, JK, T& D Flipflop.
5. Multiplexer /Demultipexer based boolean function
6. Design of combinational circuit forthe

(i) Halfadder
(ii) Fulladder
(iii) Half subtractor
(iv) Fullsubtractor

7. Design various A-D & D-Aconvertors.
8. Verify the truth table of SR flip flop
9. Verify BCD to seven segment decoder.

COURSE OUTCOME:

Student after successful completion of course must possess an understanding of numerical values in various number systems and perform number conversions between different number systems and Understand the importance and need for verification, testing of digital logic and design for testability. The student will be able to design, simulate, built and debug complex combinational and sequential circuits based on an abstract functional specification.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment. Laboratory assessment will be based on external assessment, assignments, presentations, and interview of each candidate.

References:

1. A. Anand Kumar, Fundamentals of digital circuits, PHI
2. A K Maini, Digital Electronics, Wiley India
3. Thomas Blakeslee; Digital Design with standard MSI and LSI; Wiley Interscience
4. Jain RP; Modern digital electronics; TMH
5. M Mano; Digital Logic & Computer design; PHI
6. Tocci ; Digital Systems Principle & applications; Pearson EducationAsia

7. Gothmann; Digital Electronics;PHI
8. Malvino, Leech; Digital Principles and applications–(TMH)
9. Floyad; Digital Fundamentals(UBS)
10. Nripendra N. Biswas; Logic Design Theory(PHI)
11. D.C. Green; Digital Electronics (Pearson EducationAsia)
12. SubrataGhoshal; Digital Electronics, Cengage

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Electrical Engineering, IV-Semester

Power System-I

COURSE OBJECTIVE

The objective of this course is to get an overview of the power systems and its changing landscape. It covers the characteristics of various power system loads, analysis of transmission line along with its performance.

COURSE CONTENT

An overview of Electrical Energy Generation General background, structure and components of power network. Power generation – Introduction to conventional, non-conventional & distributed generation, Effect of transmission voltage on power system economy. Selection of size of feeder. Comparison of isolated versus interconnected power system. Problems associated with modern large interconnected power system. Power Plant Economics - Load curves, base load, peak load, load factor, demand factor, diversity factor, capacity factor, utilization factor, cost of electricity, capital cost, fuel and operation cost.

Transmission Line Components & Under Ground Cabling:
Inductance resistance and capacitance of transmission line, Calculation of inductance for 1-Φ and 3- Φ, Single and double circuit line, Concept of GMR and GMD, Symmetrical & asymmetrical conduction configuration, Calculation of capacitance for 2 wire and 3 wire systems, Effect of ground or capacitance, Capacitance calculation for symmetrical and asymmetrical 1-phase and three phase, Single and double circuit line, Charging current, Transposition of line, Composite conductor, Skin and proximity effect, bundle conductor. Underground Cable Comparison of cables and overhead transmission lines, Classification of cables, requirement of cable construction, capacitance of single and multi-core cable, economic core diameter, dielectric stress in cable, Grading of cables, ionization of Heating of cables, Phenomena of dielectric losses and sheath loss in cables, Thermal resistance of cables.

Transmission systems & performance of transmission line:
Various systems of transmission, effect of system voltage, comparison of conductor materials required for various overhead systems. Short, Medium & long transmission line and their representation, Nominal T, Nominal Л, Equivalent T and equivalent Л, network models, ABCD constants for symmetrical &asymmetrical network, Mathematical solution to estimate regulation & efficiency of all types of lines. Surge Impedance, loading, Interpretation of long line equation

and its equivalent equation. Tuned power lines. Power flow through transmission line, Circle diagram, Method of voltage control, Static & rotating VAR generator, transformer control.

Insulator & Mechanical design, types of conductors used in overhead transmission line, Types of line supports and towers, Distribution of conductors over transmission towers, Spacing between conductors, Length of span and sag tension calculation for transmission line, Wind & ice loading, support of line at two different levels, string chart, Sag template, Stringing of conductor, Vibration and Vibration dampers. Insulator Materials used for transmission line insulations, Types of insulator for overhead transmission line failure of insulator, Voltage distribution of suspension insulator, String efficiency, Shielding and grading.

Voltage control & Distribution system:
AC single phase, 3 phase, 3wire & 4 wire distribution, Kelvin's law for most economical size of conductor Substation layout showing substation equipment, bus bar single bus bar and sectionalized bus bar, main and transfer for bus bar system, sectionalized double bus bar system, ring mains.

COURSE OUTCOME

Student after successful completion of course must possess an understanding of Power generation, Transmission Line Components, Underground Cables, transmission lines and their representation, conductors and insulators.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

REFERENCES

1. John Grainger and William Stevenson, Power system Analysis, McGraw Hill.
2. C.L. Wadhwa, Electrical Power System Analysis, New Age International.
3. D.P. Kothari, I.J. Nagrath, Power System Engineering TMH II Ed. Reprint 2009.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Electrical Engineering, IV-Semester

Control Systems

COURSE OBJECTIVE

This course introduces students to foundation of frequency-domain design methods for analysis and design of continuous-time control systems, which form the essentials for industrial practice.

COURSE CONTENT

Modeling of dynamic systems: Electrical, Mechanical and hydraulic systems, Concept of transfer function, Laplace Transform, State space description of dynamic systems: Open and closed loop systems, Signal flow graph, Mason's formula, Components of control systems: Error detectors (Synchros& Potentiometer), Servomotors (AC & DC), tacho-generators, power amplifier, steeper motors.

Time – domain analysis of closed loop systems: Test signals, time response of first and second order systems, Time domain performance specifications, Steady state error & error constants Feedback control actions: Proportional, derivative and integral control.
Solution of state equation: Eigen values & eigenvectors digitalization state transitive matrix, stability Routh-Hurwitz stability analysis.

Characteristics equation of closed loop system root loci, construction of loci, Effect of adding, poles and Zeros on the loci, Stability by root loci.

Frequency, Domain analysis, Bode plots, Effect of adding, poles and Zeros, Polar plot, Nyquist stability analysis, Relative stability: Gain and phase margins.

Design of control systems with PD/PI/PID Control in time domain and Frequency domain, lead-lag, Lag-lead compensation, Design of compensating networks

List of experiments (Expandable)

1. Time response of second order system.
2. Characteristics of Synchros.
3. Effect of feedback on servomotors.
4. Determination of transfer function of A-C servomotor
5. Determination of transfer function of D-C motor.
6. Formulation of PI & PD controller and study of closed loop responses of 1st and 2nd order dynamic systems.

7. State space model for classical transfer function using MATLAB.
8. Simulation of transfer function using operational amplifier.
9. Design problem: Compensating Networks of lead and lag.
10. Temperature controller using PID.
11. Transfer function of a DC generator.
12. Characteristics of AC servomotor.
13. Use of MATLAB for root loci and Bode plots of type-1, type-2 systems.
14. Study of analog computer and simulation of 1st orderand 2nd order dynamic equations.
15. Formulation of proportional control on 1st order and 2nd order dynamic systems.
16. Feedback control of 3rd order dynamic Systems
17. Study of lead and lag compensating networks.
18. Effect of adding poles & zeros on root loci and bode plots of type-1, type-2 systems through MATLAB.

COURSE OUTCOME

After successful completion of course, Students are expected to possess an in-depth understanding andknowledge about the practical control system designs.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment. Laboratory assessment will be based on external assessment, assignments, presentations, and interview of each candidate.

REFERENCES

1. B.C. Kuo and FaridGolnaraghi, ‘Automatic Control Systems’, Wiley India.
2. M. Gopal, ‘Control system engineering’, McGraw Hill
3. K. Ogata, ‘Modern Control Engineering’, Pearson
4. D. Roy, Chaudhary,‘Modern Control Systems’, PHI.
5. S. Salivahanan, R. Rengaraj, G.R. Venkatakrishnan, ‘Control System Engineering’, Pearson.
6. Stefani ShahianSavant,Hostetter, ‘Design of feedback control systems’ Oxford
7. B.S.Manke, Control system Engineering, Khanna Publishers

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Electrical Engineering, IV-Semester

Residential load simulator lab

COURSE OBJECTIVE

COURSE CONTENT

Graphical interfaces to model and study smart: Thermostats, Air conditioners, Furnaces, Water heaters, Refrigerator, Stoves, Dish washers, Cloth washers, Dryers, Lights, Poolpumps. Wind, solar, and battery sources of power generation in residential houses; Impact of different variables such as ambient temperature, solar radiation, and household activity levels that considerably contribute to energy consumption

REFERENCES

1. Hemant Joshi, Residential Commercial and Industrial Electric Systems; McGraw Hill

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Electrical Engineering, IV-Semester

Material Science

COURSE OBJECTIVE

The primary objective of the course is to introduce concepts about the properties, characteristics, applications and limitations of engineering materials emphasis on material available locally.

COURSE CONTENT

Introduction to material science and engineering: Atomic structure and bonding in materials. Types of material, Recent advances and future trends: (Smart & Nano materials) Crystal structure of materials, crystal systems, unit cells and space lattices, crystalline solids and their role in influencing various properties.

Metals & Alloys: Mechanical behavior of metals and alloys, Tensile & compressive stress-strain relations, fracture toughness,fatigue, creep, wear and abrasion. Microstrcture, properties and applications of ferrous and non-ferrous alloys, low alloy steels, aluminum alloys, copper alloys, stainless steels, cast irons, superalloys.

Introduction to SF6: Physical properties, Electrical properties, SF6as a dielectric and insulating material, Specification of SF6 gas for GIS application, Handling of SF6 gas before use, Equipment for handling the SF6 Gas, Advantages and Applications of SF6.

Ceramics, Polymers, Composites: Structure, defects and properties of Ceramics materials, processing and applications of traditional and advanced ceramics. Thermal, electrical, magnetic, optical and mechanical behavior of ceramics.

Classification of Polymers, Polymerization, Structure and Properties, additives for polymer products, Homo polymers and co-polymers, Elastomers and Thermoplastic elastomers, Polymer Blends and Alloys, Liquid crystal polymers, Polymer foams, Properties and applications of polymers.

Properties and applications of various composites, metal matrix and ceramic matrix composite, Bone-a natural composite materials. Classification of composite materials, Laws of mixtures, Factors affecting composite properties, Interfacial bonding, Mechanical Behavior of Composites: Young’s Modulus and strength considerations for continuous FRCs and short FRCs.

Electrical Properties: Electrical conduction in metals, Concept of energy band diagram for materials - conductors, semiconductors and insulators, electrical conductivity, effect of temperature on conductility, intrinsic and extrinsic semiconductors, dielectric properties. Compound semiconductors, Electrical properties of ceramics, Nano-electronics.

Magnetic and optical properties: Origin of magnetism in metallic and ceramic materials, Para-magnetism, diamagnetism, anti-ferro magnetism, ferromagnetism, ferrimagnetism, magnetic hysteresis, effect of temperature, soft and hard magnetic materials and their properties. Reflection, refraction, absorption and transmission of electromagnetic radiation in solids.

Advanced Materials and Tools: Smart materials, exhibiting ferroelectric, piezoelectric, opto-electric, semiconducting behavior, lasers and optical fibers, photoconductivity and superconductivity, nanomaterials, synthesis, properties and applications, biomaterials, photoconductivity and superconductivity, nanomaterials, Ultra-light Materials and Metallic Foams: Definition and processing, characterization of cellular metals, properties.

COURSE OUTCOME

Student after successful completion of course must possess an understanding of the basics of materials, in terms of their structural, optical, electrical, magnetic and mechanical properties.

EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

Text Book:

1. William D. Callister, David G. Rethwisch 'Callister's Material Science and Engineering', Willey.
2. William F Smith, Javad Hashemi, Ravi Prakash 'Material science and engineering', McGraw Hill.

References:

1. L. Solymar, D. Walsh & R. R.A. Syms 'Electrical Properties of Materials', Oxford university press.
2. James F. Shackelford, Madanapalli K. Muralidhara 'Introduction to Materials Science for Engineers', Pearson
3. V. Rajendran ' Materials Science' McGraw Hill education Pvt. Limited.
4. Ian P. Jones ' Materials Science for Electrical and Electronics Engineers' Oxford university press.
5. Asleland, Fulay, Wright, Balani 'The Science and Engineering of Materials', Cengage learning.
6. K. M. Gupta and Nishu Gupta 'Advanced Electrical and Electronics Materials' Willey.
7. M. S. Naidu, "Gas Insulated Substations", IK International Publishing House.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL

Choice Based Credit System

Electrical Engineering, IV-Semester

System Engineering

COURSE OBJECTIVE

This course in systems engineering examines the principles and process of creating effective systems to meet application demands. The course is organized as a progression through the systems engineering processes of analysis, design, implementation, and deployment with consideration of verification and validation throughout.

COURSE CONTENT

What is System Engineering, Origin, Examples of Systems requiring systems engineering,Systems Engineer Career Development Model, Perspectives of Systems Engineering, Systems Domains, Systems Engineering Fields, SystemEngineering Approaches.

Structure of Complex Systems, System Building Blocks and Interfaces, Hierarchy of Complex Systems, System Building Blocks, The System Environment, Interfaces and Interactions, Complexity in Modern Systems.

Concept Development and Exploration, Originating a New System, Operations Analysis, Functional Analysis, Feasibility, System Operational Requirements, Implementation of Concept Exploration.

Engineering Development, Reducing Program Risks, Requirements Analysis, Functional Analysis and Design, Prototype Development as a Risk Mitigation Technique, Development Testing, Risk Reduction.

Integration and Evaluation, Integrating, Testing, And Evaluating The Total System, Test Planning And Preparation, System Integration, Developmental System Testing, Operational Test And Evaluation, Engineering For Production, Transition From Development To Production, Production Operations.

COURSE OUTCOME

After successful completion of the course, students would be able to Plan and manage the systems engineering process and examine systems from many perspectives (such as software, hardware, product, etc.) Students can distinguish critical functions, diagnose problems, and apply descoping strategies and judge the complexity of production and deployment issues.

EVALUATION

Evaluation will be a continuous and integral process comprising classroom and external assessment.

REFERENCES:

1. Alexander Kossiakoff, William N Sweet, “System Engineering Principles and Practice, Wiley India
2. Blanchard Fabrycky, Systems engineering and analysis, Pearson
3. Dennis M. Buede, William D.Miller, “The Engineering Design of Systems: Models & Methods” Wiley India
4. JeffreyL Whitten, Lonnie D Bentley, “System Analysis and Design Methods”
5. Richard Stevens, Peter Brook,” System Engineering – Coping with complexity, Prentice Hall