Biju Patnaik University of Technology, Odisha B.E./B.Tech EE Sem 5 syllabus

Control System

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Module I: Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Negative Feedback. Block diagram algebra. Signal Flow Graph and Mason's Gain formula.

Module II: Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second- order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module III: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist stability criterion – gain and phase margins. Closed-loop frequency response: Constant M Circle, Constant N Circle, Nichols Chart.

Module IV: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Tuning of PID controllers, Lead and Lag and Lag-Lead compensator design.

Module V: Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and

observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Books:

[1] I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009.
[2] K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991
[3] M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
[4] B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.

Electrical Machines - II

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Module I:

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Module II:

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module III:

Three Phase Induction Motor Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Module IV:

Single Phase Induction Motor Constructional features, double

revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Module V:
Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine – two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text Books:
[1] Stephen J. Chapman-‘Electric Machinery and Fundamentals’- Mc Graw Hill International Edition, (Fourth Edition), 2015.
[2] M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.

Reference Books:
[1] A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, McGraw Hill Education, 2013.
[2] P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
[3] I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
[4] A. S. Langsdorf, “Alternating current machines”, McGraw Hill Education, 1984.
[5] P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 2007

Electric Power Transmission and Distribution

Electric Power Transmission and Distribution

Module I
Evolution of Power Systems and Present-Day Scenario. Structure of power system. Conventional sources of Electrical Energy, Hydroelectric Power Generation, Thermal Power Generation and Nuclear Power Generation.

Module II
Inductance of a Conductor due to Internal Flux, Flux Linkages between Two Points External to an Isolated Conductor, Inductance of a Single Phase Two Wire Line, Flux Linkages of one Conductor in a

Group, Inductance of Composite-Conductors, Concept of GMD, Transposition of lines, Inductance of a Three Phase Line with symmetrical and Unsymmetrical Spacing, Inductance Calculations for Bundled Conductors, Skin effect and Proximity effect. Capacitance of a Two Wire Line, Capacitance of a Three Phase Line with symmetrical and Unsymmetrical Spacing, Effect of Earth on the Capacitance of a Three Phase Line, Capacitance Calculations for Bundled Conductors, Parallel-Circuit Three Phase Lines, Corona.

Module III

Representation of Short, medium and long Transmission Line, Equivalent Circuit, Calculation and analysis of performance of transmission lines, Voltage Profile of
transmission lines, Ferranti Effect, Power Flow Through Transmission Line, Power Flow capability and Surge Impedance Loading, Series and Shunt Compensation of Transmission Line.
Overhead Line Insulators: Insulator Materials, Types of Insulators, Voltage Distribution over Insulator String, Methods of Equalizing the potential.
Mechanical Design of Overhead Transmission Lines: The catenary curve, Sag Tension Calculation, supports at different levels, Stringing chart, sag Template, Equivalent span, Stringing of Conductors, Vibration and Vibration Dampers.

Module IV

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

Module V

Classification of Distribution Systems, Primary and secondary distribution network, Voltage Drop in DC Distributors, Voltage Drop in AC Distributors, Kelvin’s Law, Limitations of Kelvin’s Law, Application of Capacitors to Distribution Systems.
Underground Cables: Type and construction, Classification of Cables, Parameters of Single Core Cables, Grading of Cables, Capacitance of Three Core Cable, Comparison of overhead lines with underground Cables, XLPE, PVC Cables.
Power System Earthing: Soil Resistivity, Earth Resistance, Tolerable Step and Touch Voltage, Actual Touch and Step Voltages. Single-wire

Earth Return Concept in distribution system.