

IFIP01: ADVANCED POWER ELECTRONICS

SECTION –A

Over view of power semiconductor device structure, characteristics , rating and protection (Thyristor , BJT , MOSFET , IGBT , MOS controlled Thyristor etc.) comparison of controlled switches .

Single phase and three phase line commutated converters – fully controlled, semi controlled, and dual phase cycloconverters. Performance with resistive and inductive loads Converters with improved performance. Single phase Cycloconverters. Three phase cycloconverters. Reduction of output harmonics.

Inverters, type (Hard/soft switch inverter, Voltage source inverter ,current source inverter). Operation with different types of loads, Performance parameters Harmonic elimination, control of output, voltage using different switching techniques.

SECTION- B

DC to DC switch mode converters , Basic concepts , analysis of switch on and Off transients types , DC to DC converters comparison , soft switching , close loop control .

Resonant converters , comparison of PWM and resonant converters , classification , Basic resonant circuit concepts , Analysis and design ofSRC (series), PRC (parallel) , SPRC(series -parallel) resonant converters , DC-DC as well as AC-DC resonant converter, application for induction heating and reduction in THD and P.F. improvement . Different methods to control the output voltage.

Electric utility application, various types of SVCs (static voltage compensator), Power conditioners and uninterruptible power supplies, protection of supply.

REFERENCE BOOKS :

1. Ned Mohan Tora M. Undeland , William P.Robbins , “ Power Electronics “ John Wiley & Sons .
2. M.H. Rashid “ Power Electronics Circuits and Application “ , Prentice Hall of India .
3. C.V. Lander, “Power Electronics “ , Mc Graw Hills, International Edition .
4. P.C. Sen “Modern Power Electronics “, A.H. Wheeler publication Co.

IFIP02: ADVANCED CONTROL THEORY

SECTION -A

Review of state variable analysis, controllability and absorbability

Digital control Systems : Modes of Digital Control Devices , State description of digital processors and sample continuous time plants.

Discrimination of continuous time state equations. Solution of state difference equation, controllability and observeability tests for Digital Control Systems.

Stability of discrete time Systems, pulse transfer function and its realization, Stability improvement by state feedback pole placement design and observers.

Phase plane analysis isoclines method delta method.

SECTION -B

Lyapunov stability Analysis. Basis concepts, Lyapunov's first and second methods Stability definitions, Stability theorems, Lyapunov functions for linear and non-linear systems .

Optimal Control , parameters optimization techniques , Language parameter techniques , Calculus of variation , unconstrained and constrained minimization of functional . Two point boundary value problems. Optimal Digital Control Systems.

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REFERENCE BOOKS:

1. Digital Control and state variable Method by M. Gopal Tata Mcgraw –Hill new Delhi , 1997
2. Optimal Control Theory by Kirk , Prentice Hall ,1970.
3. Digital Control Engineering by M.Gopal , Wily –Eastern 1988
4. Digital Conrol System Engineering by B.C. Kuo , Saunders College Publishing 1992

IFIP03: HVDC POWER TRANSMISSION

SECTION –A

Development of HVDC technology comparison between HVAC and HVDC. Application of HVDC transmission. Type of DC transmission . Selection of converter configuration.

Rectifier and inverter operation. Analysis of rectifier with two –valve conduction, Analysis of rectifier with two –three valve conduction , Analysis of inverter with two valve conduction. Analysis of inverter with two value conduction. Analysis of inverter with two-three value conduction.

Digital simulation of converters .Generalized equation for simulation of courses.

Derivation of converter equation with two valve conduction, three valve conduction. four valve conduction .

SECTION –B

Control of HVDC converters and systems:

Requirements from control systems of HVDC converters, rectifier compounding

Inverter compounding, converter control characteristics. Converter firing schemes individual phase control (IPC) , Equidistant pulse control (EPC)

Higher Level controls, power controllers, Characteristics & non- characteristics harmonics. Different methods to over come problems of non characteristics Harmonics.

Draw backs of individual phase control. Draw backs of EPC.

Fault development and protection. Interaction between AC DC power systems.

Over voltage on AC –DC side multiterminal HV –DC systems .Control of MTDC systems.

Modeling of HVDC systems. Per unit system representation for power flow solution. Representation for stability studies.

REFERENCE BOOKS:

1. J. A. arrilaga , high Voltage direct current transmission . “Peter Peregrinus Ltd. London, U.K.
2. E.W. Kimbark “ Direct Current Transmission (Vol. I) , Wiley Interscience 1971 .
3. K.R. Padiyar “HVDC Power Transmission Systems “Wiley Eastern Ltd. 1990.

IFIP04: SWITCHGEAR & PROTECTION:

SECTION- A

Switchgear: Interruption of Inductive & capacitive current. Restriking voltage arc control . Modern circuit breakers.

EHV Line Protection: Protection of EHV lines against short circuit and over voltages. Distance and carrier aided schemes. Stability of protection on power swing. Out of step blocking and tripping schemes. (With emphasis on implementation using static relays)

Transformer Protection:

Various fault occurring on transformer & complete protection against these fault.

SECTION -B

Machine Protection: Protection of Alternators and large motors.

Bus Protection: Schemes for complete protection on EHV bus bars.

Instrument transformer for relaying: performance of conventional CT/VT as well as capacitive voltage transformers. Principle of operation of magneto optic CT/ VT

Philosophy of Numerical relaying: Anti –aliasing Filters, sampling, Measurements principles using Fourier and other algorithms and its application for implementation of various numerical relays.

REFERENCE BOOKS:

1. English Electric Relay Application Guide.
2. Power Systems Protection : by Elmore (ABB)
3. Power system protection (Vol. I & Vol . II) by Warrington .
4. Art and science of protective relaying .: C.R. Mason
5. Power System Protection by Ungradetal (Marcel Dekkar pub.)
6. Transmission Network Protection by Y.G. Paithankar. (Marcel Dekkar Pub.)

IFIP05 POWER SYSTEM MODELING:

SECTION - A

Synchronous Machines:

Basic Models , Electric equations , Mechanical equations , Per unit system and Normalization , Perks transformation , Flux linkages equations Voltage & current equations , Formulation of state-space equations. Equivalent circuit sub transient and transient inductances and time constants. Simplified model of Synchronous Machines.

Steady state equations and phasor diagram. Determination of Machines parameters from manufactures data.
Linear model of single Machines infinite bus system.

SECTION - B

Load modeling for different types of loads.

Transformer on nominal ratios. Tap representation three –phase models of transformer

Transmission lines modeling equivalent ‘pi’ model .mutually coupled three lines, line sectionalisation. Overhead line parameters. Modeling of excitation .essentials elements of automatic feed back control system, concepts of voltage drop compensation and modeling Prime mover controllers.

REFERENCE BOOKS :

1. Anderson P.M. and A.A.Foud “Power System Control and stability” Galgotia Publication , 1981.
2. Padiyar K.R., “Power System Dynamics , Stability and control”, Interline Publishing Private Ltd . Bangalore.
3. Arrilaga J. and Arnold C.P. Computer Model ling of Electric Power Syatem “, John Wiley and Sons .
4. Murhy P.S. R., “Power System Operation and Control “, Tata Mc Graw Hill Publishers , New Delhi .
5. Bayerly and Kimbark (Editors) “ Stability of Large Power System “ IEEE Publication .