

HVDC Transmission

Hours Per Week :

L	T	P	C
4	1	-	4

Total Hours :

L	T	P
50	16	0

WA/RA	SA	SSH	S	BS
5	8	40	5	5

Course Description and Objectives:

This course deals with the characteristics of solar radiation, its global distribution, and conversion methods of solar energy to heat and power, design and application of solar photovoltaic systems for power generation on small and large scale electrification.

Course Outcomes:

Upon successful completion of this course, the student should be able to:

- Understand the HVDC advantages and types of HVDC links.
- Understand the Rectifier and inverter operation and characteristics.
- Understand the DC power flow and firing angle control methods.
- Understand the concept of MTDC systems and Harmonics
- Understand the concept of over voltages and protection.

SKILLS ACQUIRED:

- ✓ Able to understand importance of HVDC transmission over HVAC transmission.
- ✓ Able to understand the operation and control of converters.
- ✓ Able to acquire a knowledge of harmonics and elimination in HVDC systems
- ✓ Able to understand the converts faults and protection.

ACTIVITIES:

- Draw the Complete Diagram of HVDC system.
- Draw the wave forms and characteristics of Rectifier and Inverter
- Draw the Firing Angle Control diagram of HVDC system.
- Design Low and High pass filters.
- Draw the over voltage and over current protection diagrams.

UNIT – I

L- 10

Title: Introduction & types of HVDC Links

Introduction to HVDC transmission, Comparison between HVAC and HVDC systems - Economic, technical- Power Handling Capabilities of HVDC Lines and reliability, limitations, Types of HVDC links - Monopolar, Bipolar and Homopolar links, Components of HVDC transmission system. Applications of HVDC lines, Basic Conversion principle.

UNIT – II

L- 10

Title : Converter Operation & Analysis

Analysis of HVDC Converters- Rectifier and Inverter operation of Graetz circuit without and with overlap angle. Complete Equivalent circuit of HVDC link. Complete characteristics of converter as Rectifier and Inverter. Analysis of 12-pulse converter. Power flow in HVDC Links.

UNIT – III

L- 10

Title: Control of HVDC Converter & systems

Basic principles of HVDC system control, necessity of control in HVDC link, power reversal, Basic controllers - constant current and constant extinction, power control, high level controllers. Firing angle control- Individual phase control and equidistant firing angle control. Summary of converter control.

UNIT – IV

L- 10

Title: MTDC Systems, Harmonics and Filters

Multi-terminal DC links and systems- series, parallel and series parallel systems, their operation. Harmonics in HVDC system - Characteristic and uncharacteristic harmonics - Troubles due to harmonics – Harmonic filters - Active and passive filters - Reactive power control of converters.

UNIT – V

L- 10

Title: Over voltages, Converter faults and protection in HVDC Systems

Over voltages due to disturbances on DC side, AC side & internal converter side. Converter faults- misfire, arc through, commutation failure, over current protection - valve group, and DC line protection. Over voltage protection of converters, surge arresters.

TEXT BOOKS:

1. Padiyar, K.R., 'HVDC transmission systems', Wiley Eastern Ltd., 2010.
2. Kamakshiah, S and Kamaraju, V, 'HVDC Transmission', 1st Edition, Tata McGraw Hill Education (India), Newdelhi 2011.

REFERENCES:

1. Kimbark, E.W., 'Direct Current Transmission-vol.1', Wiley Inter science, New York, 1971
2. Arrilaga, J., 'High Voltage Direct Current Transmission', 2nd Edition, Institution of Engineering and Technology, London, 1998.
3. Vijay K. Sood, 'HVDC and FACTS Controllers', Kluwer Academic Publishers, New York, 2004.
4. E.Uhlman, "Power Transmission by Direct Current", Springer Verlag, Berlin Helberg, 1985.