



Program	Engineering
Specialization	Electrical Power Systems
Course Number	20304251
Course Title	High Voltage Technology
Credit Hours	3
Theoretical Hours	3
Practical Hours	0



□ **Brief Course Description:**

This Course focuses on; main concepts of breakdown, types of insulators , breakdown & conduction in insulators, applications of insulating materials, over voltage and lightning arrestors.

□ **Course Objectives:**

The student should be able to ;

1. Know the different types of insulators.
2. Know the application of insulating materials in the elements of electrical power system.
3. Explain the electrical field characteristics.
4. Describe internal & external over voltage.
5. Describe the breakdown in; gaseous, solid and liquid insulators.
6. Know methods of earthing of high voltage apparatus that used electrical power system.



□ Detailed Course Description:

Unit Number	Unit name	Content	Time Needed
1.	The insulating materials & their applications	<ul style="list-style-type: none"> ▪ Insulators, polarization, suscepility of polarization & dielectric constant. ▪ Electric field stress and effect of temperature on insulators. ▪ Electrical conductivity of insulators. ▪ Electrical breakdown of insulators. ▪ Applications of insulating materials in ; transformers, rotating machines, circuit breakers, cable & power equipments. 	
2.	Electric Field	<ul style="list-style-type: none"> ▪ Electric field stresses. ▪ Gaseous insulators. ▪ Liquid & solid insulators breakdown. ▪ Estimation and control of electric stresses in; parallel plats, concentric cylinders & parallel cylinders with equal diameters. ▪ Electric field in cominated insulators. ▪ Surge voltages; distribution & control. 	

3	Conduction and breakdown in Gases	<ul style="list-style-type: none"> ▪ Ionization processes. ▪ Townsend's equation & Townsend's criterion of breakdown. ▪ Breakdown in electro- negative. ▪ Streamer theory of breakdown in gases. ▪ Paschen's law; breakdown in non uniform fields and corona discharges. ▪ Post breakdown phenomena and applications. ▪ Practical consideration in using gases for insulating purposes. 	
4	Conduction and breakdown in liquid dielectrics	<ul style="list-style-type: none"> ▪ Pure liquids and commercial liquids. ▪ Purification and breakdown tests. ▪ Conduction and breakdown in pure liquids. ▪ Conduction and breakdown in commercial liquids suspended particle theory; thermal mechanism of breakdown, stressed volume theory. 	
5	Breakdown in solid dielectrics	<ul style="list-style-type: none"> ▪ Variation of breakdown strength with time. ▪ Intrinsic, streamer, electromechanical, electrochemical, thermal and chemical breakdown. ▪ Breakdown due to internal discharges. ▪ Breakdown of composite insulation. ▪ Solid dielectrics; paper, fiber, glass, ceramic, rubber, plastic and mica. 	

6	Over voltages phenomenon and Insulation coordination in Electrical Power Systems.	<ul style="list-style-type: none"> ▪ External overvoltage and lightning phenomenon. ▪ Charge formation in clouds. ▪ Mechanism of lightning strokes. ▪ Parameters and characteristics of lightning strokes. ▪ Internal overvoltage. ▪ Origin of switching surges and their characteristics. ▪ Control of overvoltage due to switching. ▪ Protection of transmission lines against over voltages. ▪ Protection devices; expulsion gabs, tubes & lightning arrestors. ▪ Principle of insulation coordination of high voltage and extra high voltage power systems. ▪ Insulation coordination of substations. 	
7	Earthing of high voltage apparatus	<ul style="list-style-type: none"> ▪ Definition of earthing, earthing resistance, electrical characteristics & electrical conductivity of soil. ▪ Types of earthing; working & safety earthing. ▪ Static resistance of simple earthing; tubular, flats, rings. ▪ Working and safety earthing in power stations & substations. 	



□ **Evaluation Strategies:**

		Percentage	Date
1. Exams			
	First Exam	20%	--/--/----
	Second Exam	20%	--/--/----
	Assignments	10%	
	Final Exam	50%	--/--/----
2. Homework and Projects			
3. Discussions and lecture Presentations			

□ **Teaching Methodology:**

1. Laboratory

□ **Textbook:**

Advanced in high voltage Engineering; M.Haddad & D. Warne, 2004.

□ **References:**

1. The lightning Flash; G.V. Cooray, 2003.
2. High voltage Engineering & testing; Hugh M.Ryan, 2001.
3. High voltage Engineering Fundamentals; E.Kuffel; 2000 .