National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2018-19**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EE 421	**High Voltage Engineering**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes	
This course introduces the fundamental aspects of insulation breakdown	CO1	**Able to explain the breakdown mechanism of solid, liquid, gas insulators**
This course provides adequate information about the design, testing and assessment of electrical equipment	CO2	**Able to apply and analyse generation and measurement of high voltage and high current for testing**
This course illustrates the knowledge on insulating materials, test techniques and over-voltage phenomena	CO3	**Able to analyse and design non-destructive testing techniques for insulators**
	CO4	**Able to analyse and assess the effect of transient overvoltages on electrical system**
	CO5	**Able to choose, classify and make use of insulators and testing methodology based on electrical equipments**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	**3**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**
2	CO2	**3**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**
3	CO3	**0**	**3**	**2**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**2**
4	CO4	**0**	**3**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**2**
5	CO5	**3**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **Generation and Transmission of Electrical Energy, Voltage Stresses, Testing Voltages such as power frequency voltage, Impulse voltage, DC voltage, Electric field distribution, Gas, Liquid & Solid as Insulator, Application of Insulating materials.**	**03**	**All CO's**

II	**Breakdown in Gaseous, Liquid and Solid Insulators** **Mechanism of breakdown of gases –Townsend's criteria, Streamer theory; Paschen's Law, Penning effect, Corona discharges, Post breakdown phenomena, Vacuum Insulation breakdown mechanism. Breakdown mechanism in pure and commercial Liquid dielectrics. Mechanism of breakdown in homogeneous and composite solid dielectrics.**	**08**	**CO1** **CO5**
III	**Generation of High Voltage and current** **High DC voltage – Rectifier circuit, Voltage doubler circuit, Cockroft-Walton Voltage Multiplier Circuit. High AC voltage – Cascaded Transformer, Series Resonant circuit. High Impulse voltage and current – Impulse generator circuit, Marx circuit, Impulse current generator.**	**06**	**CO2** **CO5**
IV	**Measurement of High Voltage and Current** **High DC voltage – series resistance micro-ammeter, resistance potential divider, sphere gap. High AC voltage– series impedance ammeter, potential divider (resistance and capacitance type), potential transformer (CVT), Electrostatic Voltmeter, Sphere Gap, Chubb-Fortesque method. High Impulse voltage – Voltage divider (resistive or capacitive type), peak voltmeters, sphere gap. High current– resistive shunt with miliammeter, Hall effect generators, resistive shunts, rogowski coil**	**06**	**CO2** **CO5**
V	**Non-Destructive Insulation Test Techniques** **Measurement of DC resistivity, Measurement of Dielectric constant and loss factor – Schering bridge, Transformer ratio arm bridge, Partial Discharge Measurement**	**05**	**CO3** **CO5**
VI	**Overvoltage Phenomenon and Insulation Coordination** **Overvoltage due to lightning, Overvoltage due to switching surge, faults or other abnormalities, Methods of Protection against HV surge, Insulation coordination in HV apparatus.**	**05**	**CO4** **CO5**
VII	**Laboratory Testing of High Voltage Apparatus** **Standard test procedures, Laboratory test procedures, Testing of – Insulators, Bushings, Circuit breakers, Isolators, Transformer, Cables, surge diverters.**	**03**	**CO5**
Total Hours		**36**	

Essential Readings

1. M. S. Naidu & V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill Education, 5th Edition, 2013
2. C.L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 3rd Edition, 2012

Supplementary Readings

1. E. Kuffel, W. S. Zaengl & J. Kuffel, "High Voltage Engineering - Fundamentals", Newnes Publisher, 2nd Edition, 2000
2. Subir Ray "An Introduction to High voltage Engineering", PHI Learning Pvt. Ltd., 2nd Edition, 2014
3. A. Haddad & D.F. Warne, "Advances in High Voltage Engineering", Institution of Engineering and Technology, 1st Edition, 2004