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P.E.S. College of Engineering, Mandya - 571 401
(An Autonomous Institution affiliated to VTU, Belagavi)
Seventh Semester, B.E. - Electrical and Electronics Engineering
Semester End Examination; February - 2022
High Voltage Engineering

Time: 3 hrs   *Max. Marks: 100*

Course Outcomes

The Students will be able to:
***CO1:** Analyse Breakdown phenomenon in gaseous, solids and liquid Dielectrics.*
***CO2:** Understand generation of HVAC and HVDC in High Voltage Laboratory.*
***CO3:** Understand generation of Impulse Voltage and Current in High Voltage Laboratory.*
***CO4:** Understand and Analyse measurement principles for HVAC, HVDC and Impulse Voltages.*
***CO5:** Understand Non-Destructive and Destructive Techniques of various High Voltage Insulation and Electrical apparatus.*

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*Note: I) **PART - A** is compulsory. **Two** marks for each question.*

*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	Mention the need for generating high voltages in laboratory.	2	L1	CO1	PO1
b.	Mention the methods of generation of high voltage DC.	2	L1	CO2	PO1
c.	Define standard switching impulse voltage wave.	2	L2	CO3	PO1
d.	Mention the factor affecting the measurements with resistive potential dividers.	2	L1	CO4	PO1
e.	Mention the factor affecting the partial discharge detection.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	i) Explain briefly the thermal breakdown mechanism in solids.	6	L2	CO1	PO2
	ii) What are the limitations of Townsend's theory?	3	L2	CO1	PO2
b.	i) Explain Paschen's law for a given '*pd*' condition.	5	L2	CO1	PO3
	ii) In an experiment in a certain gas it was found that the steady state current is 4×10^{-8} A at 8 kV at a distance of 0.4 cm between the plane electrodes. Keeping the field constant and reducing the distance to 0.1 cm results in a current of 4×10^{-9} A. Calculate Townsend's primary ionization coefficient. If the breakdown occurred, when the gap distance was increased to 0.8 cm? What is the value of Townsend's secondary ionization coefficient?	4	L2	CO1	PO3
c.	i) Explain the suspended particle theory breakdown phenomenon of liquid dielectrics.	6	L2	CO1	PO2
	ii) What is time lag of breakdown? Explain the two time lags of breakdown.	3	L2	CO1	PO2

	UNIT - II	**18**			

2 a. With a neat diagram, explain the cascaded voltage doubler circuit for generating HVDC. — 9 L2 CO2 PO2

b. With a neat circuit diagram, explain the principle of operation of a series resonant circuit used for the generation of high voltage AC. Enumerate its advantages and disadvantages. — 9 L2 CO2 PO2

c. A ten stage Cockcroft Walton circuit has all capacitors of 0.08 µF. The secondary voltage of the supply transformer is 150 kV at a frequency of 200 Hz. If the load current is 2 mA, Determine;

i) Ripple voltage (Peak-to-Peak)

ii) %Ripple — 9 L3 CO2 PO3

iii) Voltage regulation

iv) Average output voltage

v) Optimum number of stages

vi) Maximum output voltage

UNIT - III — **18**

3 a. With a neat sketch, explain the construction and working of Marx generator. How is the basic arrangement modified to accommodate the wave time control resistors? — 9 L2 CO3 PO2

b. i) With a neat sketch, explain the generation of high impulse current. — 5 L2 CO3 PO3

ii) An impulse current generator has a total capacitance of 20 µF. The charging voltage is 30 kV to give an output current of 10 kA with 8/20 µs waveform. Calculate circuit inductance and dynamic resistance. — 4 L2 CO3 PO3

c. i) A 12-stage impulse generator has 0.126 µF condensers. The wave front and wave tail resistances connected are 800 Ω and 500 Ω. If the load capacitance is 1000 pF, find the front and tail time of impulse wave produced. — 4 L3 CO3 PO3

ii) Explain the tripping of a multistage impulse generator. — 5 L3 CO3 PO3

UNIT - IV — **18**

4 a. With a neat sketch, explain the construction and working principle of generating voltmeters. Discuss the merits and demerits. — 9 L2 CO4 PO3

b. With a neat sketch, explain the construction and working of an electrostatic voltmeter? State its advantages and limitations. — 9 L2 CO4 PO3

c. Explain the factors influencing the spark over voltage of sphere gaps. — 9 L2 CO4 PO2

UNIT - V		**18**			
5 a.	With a neat sketch, explain partial discharge measurement using straight detection method.		9	L2 CO5 PO3	
b.	Explain the various test conducted on circuit breakers.		9	L2 CO5 PO3	
c.	The various arms of a high voltage Schering bridge at balance are: standard capacitor of 500 pF, Resistance branch is 800 Ω. Branch in parallel combination of resistor and capacitor has values of 180 Ω and 0.15 μF. Determine the value of capacitance (sample). Its parallel equivalent loss resistance, power factor and loss angle.		9	L3 CO5 PO3	

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