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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016**

COURSE NAME : HIGH VOLTAGE ENGINEERING
COURSE CODE : BEF 45203
PROGRAMME : BEV
EXAMINATION DATE : JUNE / JULY 2016
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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- Q1** (a) Define high voltage term according to IEC Standard, 1983. (1 mark)
- (b) The main sources of High Voltage generation can be categorised into two main groups, external and internal. Briefly describe their nature and example. (4 marks)
- (c) Breakdown voltage measurement on a uniform-field gap in nitrogen at 293° K gave the following values of pd and E/p at breakdown as shown in Table Q1(c). Compute the breakdown voltage of a 1 cm gap at 2100 mmHg and 300° K. (10 marks)
- (d) Propose **two (2)** suggestions of what people do with high voltages and briefly explain each of them. (4 marks)
- (e) Recommend **one (1)** main international body that actively involved in High Voltage engineering field. (1 mark)
- Q2** (a) Name **four (4)** types of voltages that are generated in a high voltage testing laboratory. (2 marks)
- (b) Describe briefly, with the aid of suitable diagrams the cascade arrangement of transformers to obtain high alternating voltage for testing purposes. (6 marks)
- (c) Describe briefly, with the aid of suitable diagrams the operation of a voltage multiplier circuit to obtain high voltage direct current for testing purposes. (6 marks)
- (d) Describe the circuit arrangement for producing lightning impulse voltage waveforms in laboratories. (6 marks)

- Q3 (a) State **one (1)** reason for the measurement of high voltage voltages in industrial testing and research laboratories,
(2 marks)
- (b) Describe the use of sphere gap method to measure high voltage and also describe the method of implementing air density correction.
(5 marks)
- (c) Describe the method of operation of a peak voltmeter based on The Chubb-Fortescue Methods.
(5 marks)
- (d) Sketch and label one (1) circuit that can be used to obtain precision peak voltage measurement. Explain how the circuit can offset the voltage drop due to the diode use in the circuit. Assume the circuit is using diode(s).
(5 marks)
- (e) Show that the deflecting torque of an electrostatic voltmeter is proportional to the product of the square of the applied voltage and the rate of change of capacitance
(3 marks)
- Q4 (a) Explain briefly the difference(s) in the following mechanism in connection with aging of dielectric material;
- (i) failure due to tracking and erosion ,
 - (ii) thermal breakdown,
 - (iii) electrochemical breakdown, and
 - (iv) breakdown due to internal discharges.
- (10 marks)
- (b) The parameters that are being measured in relation to dielectric insulation of high voltage equipment are through the measurement of loss tangent ($\tan \delta$) and partial discharge in pico-coulomb(pC). Explain briefly with the aid of diagrams with proper labels the significant technology different between loss tangent and partial discharge.
(10 marks)

- Q5** (a) Explain how electrical current adversely affects the human body. (3 marks)
- (b) Describe the step and touch potential hazard. (3 marks)
- (c) Name five hazards of electricity. (2 marks)
- (d) Name functions of an electrical safety check list. (3 marks)
- (e) Discuss on the equipment grounding. (3 marks)
- (f) High voltage activities whether they are for industrial, commercial, residential applications as well for higher institution of learning and research may involve the use of static voltage for design, fabrication, testing and commissioning of electrical equipment and apparatus. The usage of static voltage can create problem with regard to static charge electrification and may cause hazards to personnel and equipment alike.
Describe the static discharge protection for the following electrical activities;
- (i) A company specializing in manufacturing of solid state wafer for computer network application uses static voltage for the production of solid state wafer. It creates an electrified surrounding in the production line section due to the static charges and due to this the department of electrical safety has requested the maintenance department to come out with techniques to save personnel from the hazards of high static voltage occurrences especially at the production section of the company. (3 marks)
- (ii) The High Voltage Laboratory of University of Manchester is conducting a test to study the high voltage DC insulation breakdown performance of a glass insulator string for a 500 kV HVDC transmission system. The 800 kV Cockcroft-Walton HVDC generator is used for this purpose. (3 marks)

-END OF QUESTIONS-

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Table Q1(c)

Pd (mm Hg-cm)	E/p (V/mm Hg-cm)
900	34.2
8100	30.6