Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	ELECTRIC POWER SYSTEM / THREE-PHASE AC ELECTRICITY
COURSE CODE	:	BNR 21003 / BNR 22803
PROGRAMME CODE	:	BND / BNE
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) The conventional electric grid is a web of interconnected circuits that move electricity to customers. Give **FOUR (4)** important part of electrical grid.

(2 marks)

(b) State the range of voltages levels mostly used for generation, transmission and distribution system.

(3 marks)

(c) One-line diagrams are widely used in three-phase power systems studies. Simplify the one-line diagram as shown in **Figure Q1(c)** into a reactance diagram.

(4 marks)

(d) A 100 MVA, 13.2 kV generator (G) having a synchronous reactance of 10 % is connected to a star-star transformer T1 which feeds a 132 kV line having an impedance per phase of 20+j50 Ω. At the receiving end of the line is a star-star step down transformer T2. A load drawing 60 MVA at 0.9 power factor lagging is connected to the secondary of transformer T2. The transformer ratings are as follows: Transformer T1: 120 MVA, 13.2/132 kV, X_{T1} = 12 % and Transformer T2: 100 MVA, 138/33 kV, X_{T2} = 15 %.

(i) Using a base of 100 MVA and a voltage base of 33 kV in the load side of the circuit, draw a one line diagram for the above power system showing all the equipment parameters and the voltage base in different sections of the system.

(4 marks)

(ii) Draw an impedance diagram of the system expressing all values in per unit.

(5 marks)

(iii) If the load voltage is maintained at 33 kV, calculate the current drawn by the load.

(2 marks)

Q2 (a) Describe the basic operation of nuclear power plant.

(3 marks)

(b) State the name and function of the hydropower generating station as shown in **Figure Q2(b)**.

(3 marks)

(c) A two winding transformer is rated at 60 kVA, 240/1200 V, 60 Hz. When operated as a conventional two winding transformer at rated load, 0.85 power factor, its efficiency is 0.95. This transformer is to be used as a 1440/1200 V step down autotransformer in a power distribution system.

(i) Assuming ideal transformer, find the transformer KVA rating when used as an autotransformer.

(3 marks)

(ii) Find the efficiency with the kVA loading of part **Q2(c)(i)** and 0.8 power factor.

(3 marks)

(d) One circuit of a single-phase transmission line is composed of three solid 0.35 cm (side Y) radius wires. The return circuit (side X) is composed of three 0.55 cm radius wires. **Figure Q2(d)** shows the arrangement of the conductors. Find the inductance due to the current in each side of the line and the complete line in H/m and mH/mile.

(8 marks)

Q3 (a) Describe **THREE (3)** types of power lines in electric power system.

(3 marks)

(b) The length of the line for medium transmission lines is in between 80 km – 240 km and the operating line voltage will be in between 21 kV – 100 kV. In this case the shunt capacitance can be assumed to be lumped at the middle of the line or half of the shunt capacitance may be considered to be lumped each end of the line. Draw the circuit diagram to explain the situation.

(3 marks)

(c) An 18 km, 60 Hz single circuit three phase line is composed of ACSR Drake conductors spaced with 20 ft between them. The resistance per phase is 4.24 Ω. The line delivers 2500 kW at 11 kV line-to-line to a balanced load. Given data from table, $Ds = 0.0373$ ft.

(i) Determine the per-phase series impedance of the line.

(3 marks)

(ii) Find the voltage line-to-line and power at the sending end when the power factor is 80 % lagging, unity and 90 % leading.

(9 marks)

(iii) Calculate the efficiency of the transmission line with 80 % lagging.

(2 marks)

Q4 (a) Define a substation in the electrical power system.

(2 marks)

(b) Describe **FOUR (4)** major components of the substation area.

(4 marks)

(c) A distribution system consists of all the facilities and equipment connecting a transmission system to the customer equipment.

(i) List down the classification of distribution systems.

(2 marks)

(ii) Circuit breaker, isolating switch, shunt capacitors and lightning arrestor are some of the typical equipment that available within the distribution systems. Differentiate the importance of those equipments to the distribution system.

(2 marks)

(d) With appropriate diagram and explanation, propose the alternatives which the primary distribution lines can be laid.

(6 marks)

(e) Draw the layout of distributions system to show the distribution process from 132 kV to 415 V end user.

(4 marks)

Q5 (a) List **TWO (2)** importance of power quality in electric power system.

(2 marks)

(b) **Figure Q5(b)** shows the power quality problem occurred from an electrical equipment.

(i) Define the problem of the equipment.

(2 marks)

(ii) Determine the total cycles of the waveform with fault.

(2 marks)

(c) List **TWO (2)** categories and **TWO (2)** examples of fault in power system.

(4 marks)

(d) When fault occurred in a system, it will produce large current to flow through the transmission line and will cause damage to the equipment located at the end of the network. As an engineering technologist, define the component that you will be used to protect the equipment from fault.

(2 marks)

(e) Based on **Figure Q5(e)**, find the fault current in ampere and the corresponding fault level in MVA. Take base of 200 MVA, 13.8 kV.

(8 marks)

- END OF QUESTIONS -

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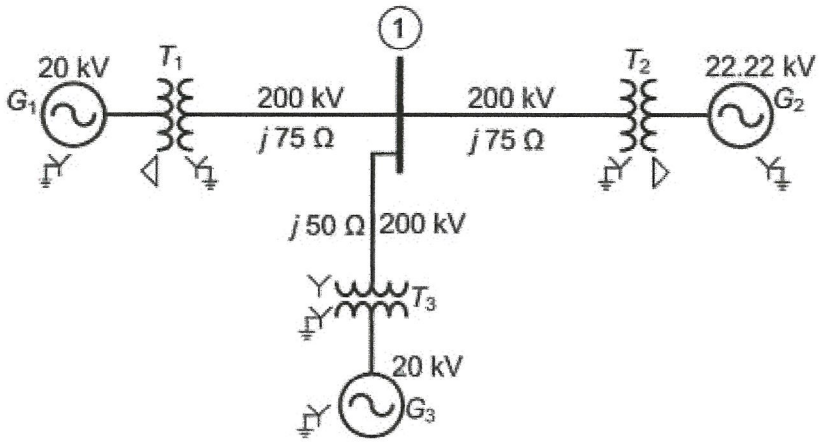

Figure Q1(c)

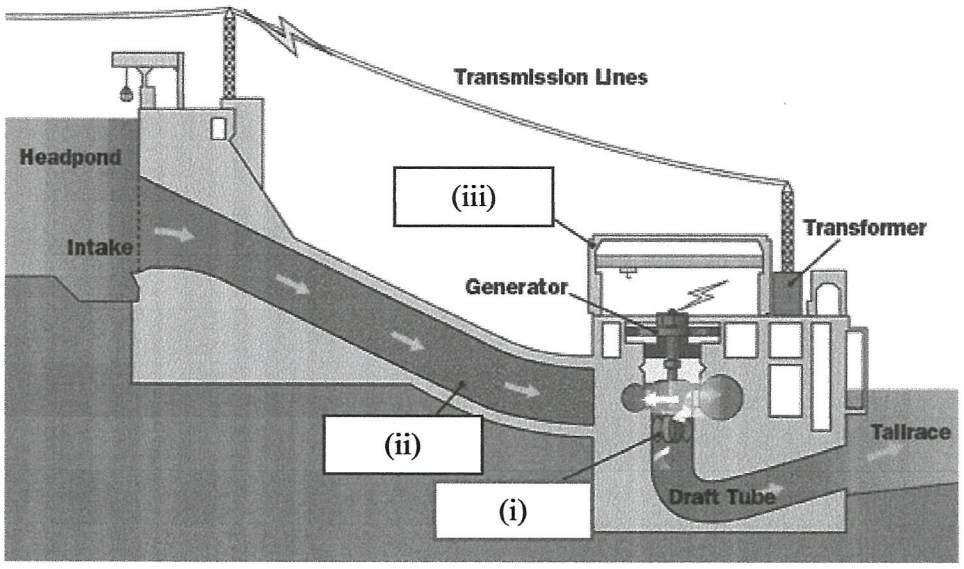

Figure Q2(b)

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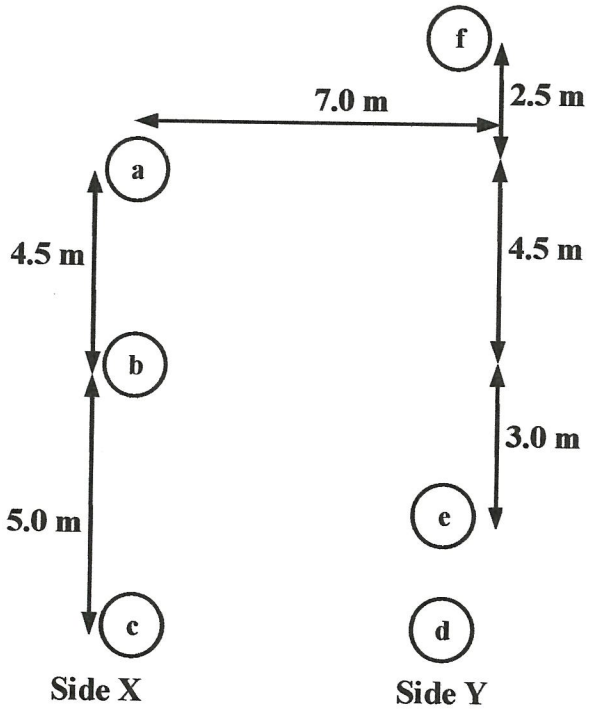

Figure Q2(e)

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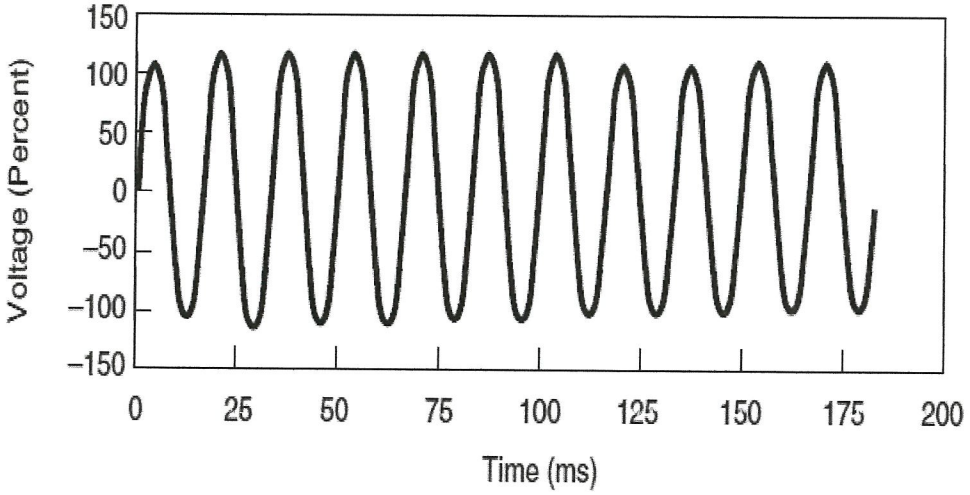
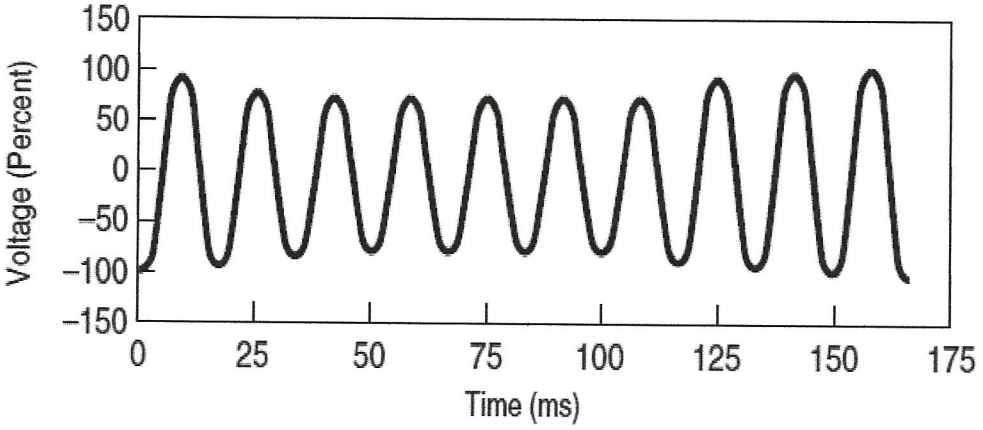


(i)



(ii)

Figure Q5(b)

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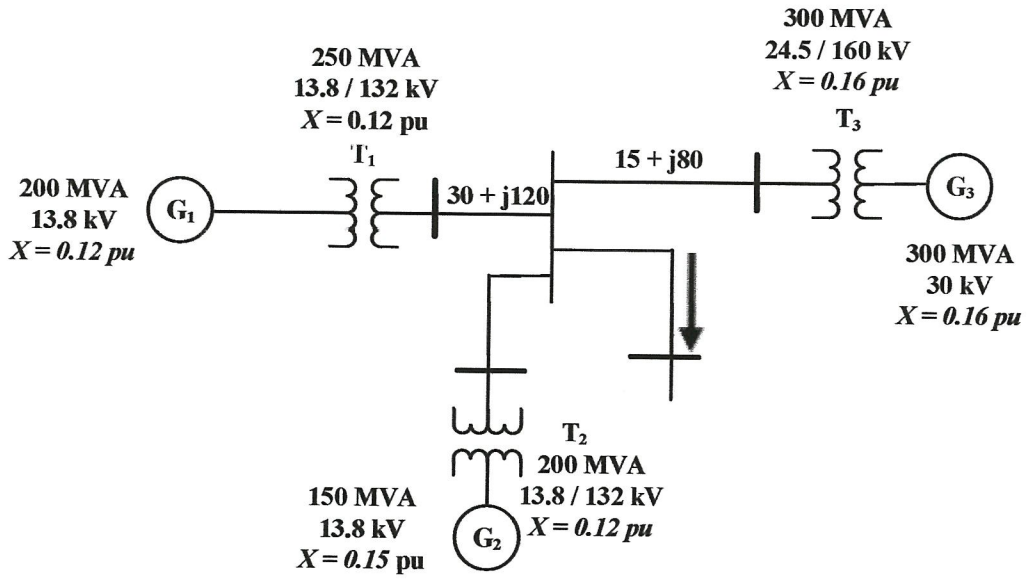

Figure Q5(e)