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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(TAKE HOME)
SEMESTER I
SESSION 2020/2021**

COURSE NAME : RAILWAY ELECTRIFICATION
SYSTEM

COURSE CODE : BNT 30903

PROGRAMME CODE : BNT

EXAMINATION DATE : JANUARY/FEBRUARY 2021

DURATION : 3 HOURS 30 MINUTES

INSTRUCTION : ANSWER ALL QUESTIONS
OPEN BOOK EXAMINATION

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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- Q1** (a) Many countries in the world employ the 25kV A.C. 50 Hz electrification system for their rail network, including Malaysia for KTM Electric Train Service (ETS), KTM Komuter and as well as the Express Rail Link (ERL). From your understanding, explain 25kV A.C. 50 Hz electrification system in terms of its features, requirements and purposes. (8 marks)
- (b) **Figure Q1(b)** shows a common supply feeding arrangement for a 25kV electrified railway. Investigate how this circuit works to encounter:
- (i) Failure on one of the high voltage (HV) supplies. (3 marks)
 - (ii) Total loss of supply at feeder station. (5 marks)
- (c) **Figure Q1(c)** shows the 25-0-25 kV electrification autotransformer (AT) feeding arrangement.
- (i) Explain the application of this autotransformer system with regard to the railway electrification system. (10 marks)
 - (ii) Figure out the advantages and disadvantages of the 25-0-25 kV AT in comparison to the 25kV 'classic' system. (14 marks)
- Q2** (a) Describe **THREE (3)** types of DC feeding arrangements (9 marks)
- (b) One of the factors affecting the length of the DC feeding is the circuit breaker tripping current. The length of section fed by one substation must be such that its electrical resistance, including both outgoing and return conductors, does not exceed the minimum system voltage divided by the circuit breaker tripping current. Calculate the resistance with below parameters and suggest the length of track for substation intervals, based on your calculation result.
- Overhead system: 1500V DC
Voltage drop: 10%
Breaker setting: 4000 amps
Loop resistance: 0.0375 ohm per km (7 marks)

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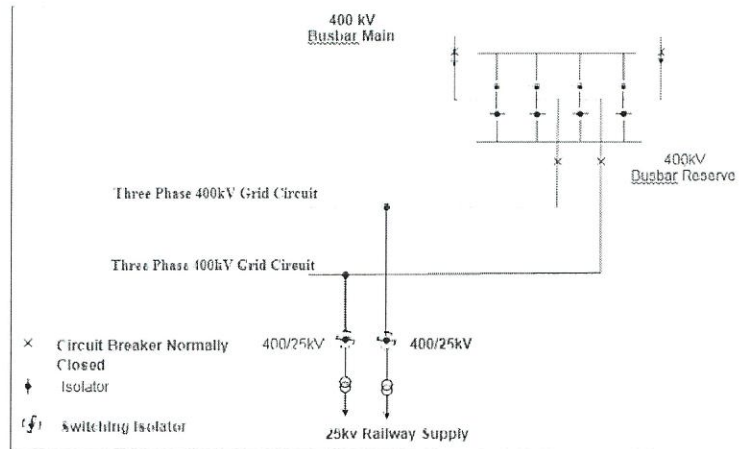
- (c) In order to design a trackside DC substation, determine the necessary factors that an engineer must put into consideration to ensure satisfactory performance
(7 marks)
- (d) A regenerative system allows the energy that being regenerated by the traction units to be returned to the DC electrification network, in which later utilized by other trains on the same network. One of the main system performance issue that need to address by the engineer to achieve system compatibility is the interference between the train and the electrification system. Based on this issue, explain in detail at least **THREE (3)** concerns and consideration at the designing stage.
(12 marks)
- Q3** Over voltages on railway electrification systems can happen due to lightning, switching circuits, earth faults, ferro resonance on the IIV system, equipment failure, age, wear and third parties.
- (a) Explain how the lightning strike would affect the railway electrification system.
(6 marks)
- (b) Propose **TWO (2)** approaches of lightning protection that can be used in railway electrification system.
(4 marks)
- Q4** (a) One of the power quality issues in high speed rail electrification is on the existence of harmonic and resonance. Discuss the impact of harmonic and resonance to the railway operation and as well as its impact to the operating expenses.
(9 marks)
- (b) Based on your overall understanding, summarise the AC system versus DC system for the railway electrification mainlines.
(6 marks)

END OF QUESTIONS

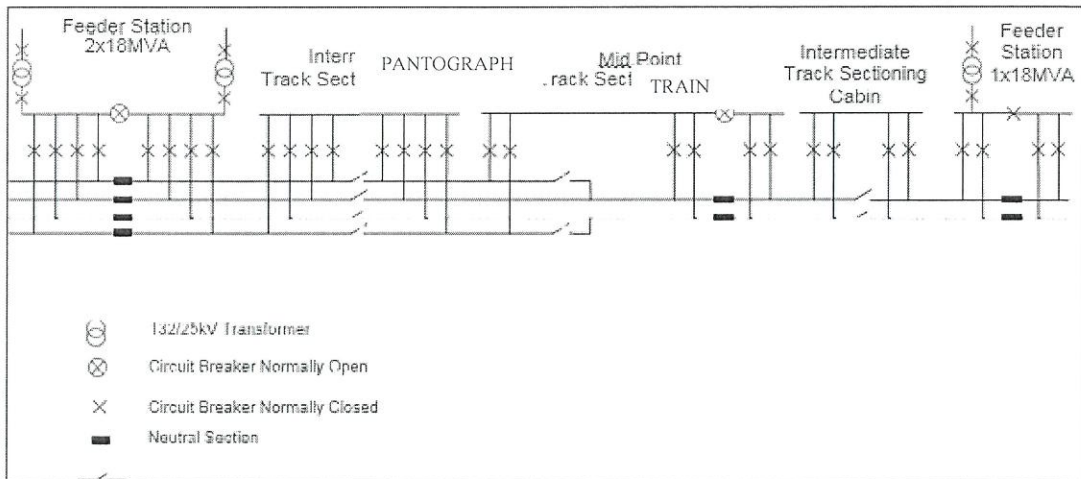
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Typical Supply Feeding Arrangement for a 25kV Electrified Railway



Typical 25kV Feeding Section - Reserved Service Capacity (RSC) - Normal Feeding

Figure Q1(b)

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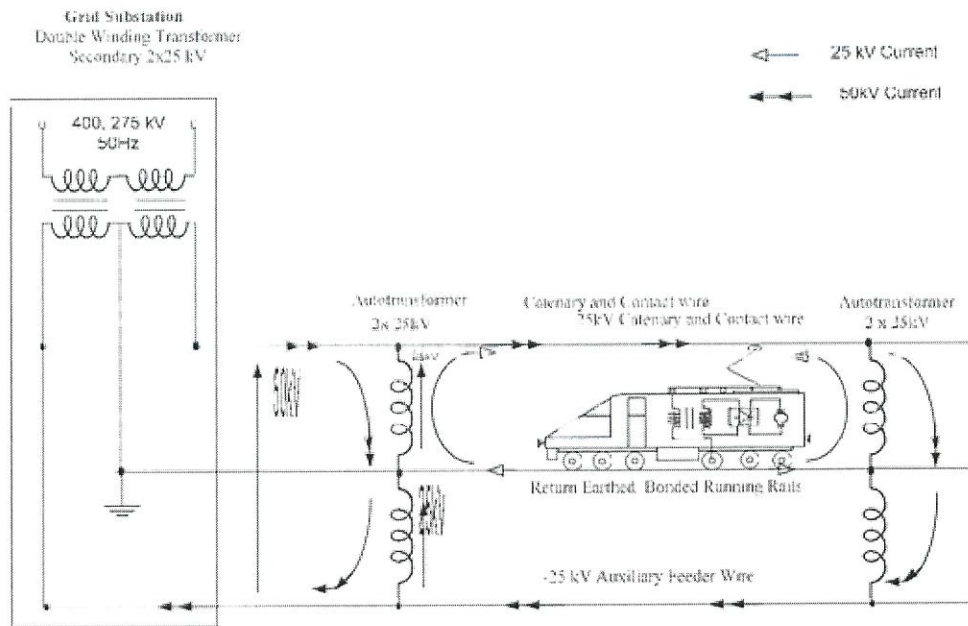


Figure Q1(c)

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