Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	POWER QUALITY
COURSE CODE	:	BNE 32603
PROGRAMME CODE	:	BNE
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Summarize any **FIVE (5)** Power Quality (PQ) problems along with their respective voltage and time periods, causes/sources and effects.

(10 marks)

(b) List **THREE (3)** problems with conductors and connectors, as well as the possible causes of the problems to occur.

(6 marks)

(c) Many power quality variations that occur within customer facilities are related to wiring and grounding problems. Suggest **TWO (2)** grounding solutions for sensitive equipment.

(4 marks)

Q2 (a) **Figure Q2(a)** shows the problem occurred from an electrical equipment.

(i) State and describe the problem.

(2 marks)

(ii) With a proper diagram, illustrate the circuit on how the problem mention in **Q2a(i)** occurs.

(2 marks)

(b) Calculate the percent voltage unbalance using maximum deviation method, if the voltage measurements carried out between the different phases of a three-phases supply gave the following readings:

$$\text{R-Y} = 479\ V$$
$$\text{Y-B} = 472\ V$$
$$\text{B-R} = 450\ V$$

(6 marks)

(c) List **TWO (2)** harmonic current sources in the AC line. Explain the functionality of each harmonic current sources and draw the respective circuit diagram.

(6 marks)

(d) Classify **FOUR (4)** indicators that are used to quantify and evaluate the harmonic distortion in current and voltage waveforms.

(4 marks)

Q3 (a) Three equipments used for PQ monitoring are general-purpose spectrum analyzer, special-purpose power system harmonic analyzers and simple meters. Compare the function of these three devices in monitoring and analysing harmonics problems in power system.

(6 marks)

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(b) PQ industry recognizes that PQ standards are critical to the viability/possibility of the industry.

(i) Suggest suitable standard codes and names for voltage sag, surge, fluctuation and harmonic.

(4 marks)

(ii) Draw and explain the Computer and Business Equipment Manufacturers' Association (CBEMA) curve in PQ.

(4 marks)

(iii) Describe how an American standard is different from an International standard.

(6 marks)

Q4 (a) Briefly discuss what are the linear loads and non-linear loads used in harmonic studies.

(2 marks)

(b) Discuss how current distortion due to nonlinear loads can cause voltage distortion in an electrical distribution system.

(2 marks)

(c) With the help of formula, explain why twelve pulses rectifier have low current harmonics compared to six pulses rectifier.

(4 marks)

(d) **Figure Q4(d)** shows the single line diagram of a small industrial plant where a variable speed drive rated 100 *HP*, 415 *V*, 50 *Hz* is supplied by a transformer rated at 500 *kVA*. The line current drawn by the load is given by the expression:

$i = 100Cos(\omega t - 30.37°) + 20Cos(5\omega t + 28.08°) + 14Cos(7\omega t - 32.66°) + 8Cos(11\omega t + 25.78°) + 6Cos(13\omega t - 34.78°)$.

Predict the percentage of load voltage harmonic at the point of common coupling if 5.65 % impedance is applied to the diagram.

(12 marks)

Q5 (a) Passive filters are composed of only passive components. Differentiate between low-pass filter and high-pass filter. Please add diagram to support your answers.

(4 marks)

(b) Discuss how active filters overcome the drawbacks of passive filters in controlling harmonics.

(4 marks)

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(c) Design a simple 7^{th} harmonic notch filter for a 415 *V*, three phases, 50 *Hz* system where harmonics are produced due to a five converted supply loads. The power factor correction approach indicates a need for a 56 *kVAR* shunt capacitor.

(7 marks)

(d) Furnish a neat flow chart to show a case study follow up from a consumer complaint until an economical solution established by a PQ technologist.

(5 marks)

- END OF QUESTIONS -

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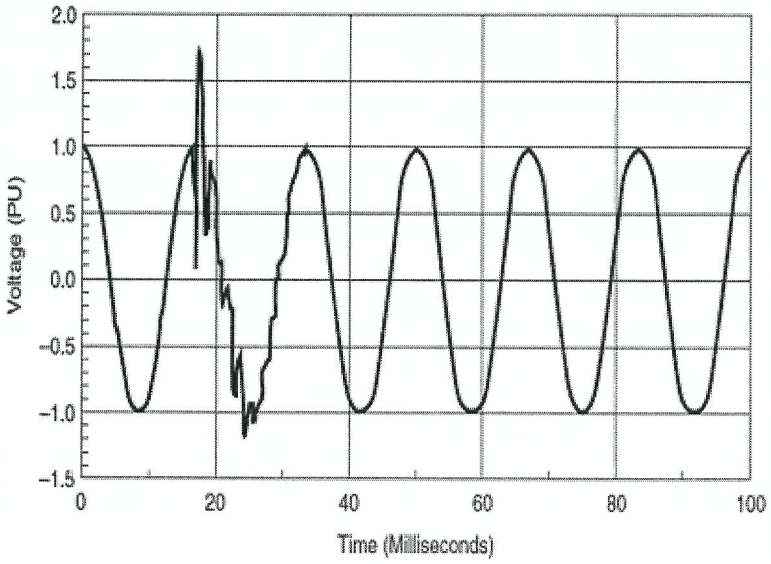

Figure Q2(a)

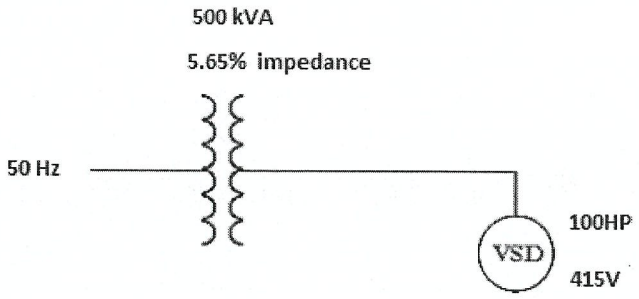

Figure Q4(d)

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