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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

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**FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017**

COURSE NAME : POWER QUALITY
COURSE CODE : BEF 44803
PROGRAMME CODE : BEV
EXAMINATION DATE : DECEMBER 2016 / JANUARY 2017
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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- Q1** (a) (i) Define the power quality (PQ) problem from measurement parameter and end user perspective. (2 marks)
- (ii) With the help of their respective sources, explain any **two (2)** types of PQ problems. (2 marks)
- (b) (i) As a PQ engineer, list any **two (2)** major concerns in this field. (2 marks)
- (ii) Briefly discuss the **two (2)** major concerns in PQ related to the development of technology. (2 marks)
- (c) (i) Demonstrate the significance of total harmonic distortion (THD) with the formula used to calculate it. (6 marks)
- (ii) Express the significance of total demand distortion (TDD) with the formula used to calculate it. (6 marks)
- Q2** (a) (i) Compare the codes for harmonic (environment, measurement and practice) and sag (environment, measurement and mitigation) in IEEE and IEC PQ standards. (2 marks)
- (ii) Differentiate between definitions of IEEE standard 11598, IEEE 100 authoritative dictionary of IEEE standard terms, and standard handbook of electrical engineers. (2 marks)
- (b) (i) State the full names of any **two (2)** of the following abbreviations:
- CBEMA,
- SARFI,
- ITIC,
- FIPS. (2 marks)
- (ii) Summarize the significance of point of common coupling (PCC). (2 marks)
- (c) (i) Demonstrate the significance of special purpose transformers. (3 marks)

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- (ii) Sketch a curve to highlight strength of disturbance versus its respective responsibility for PQ solution (in terms of transmission, distribution, service entrance, building wiring, and equipment).
(3 marks)
- (iii) Investigate by tabulating the symptom, problem, cause, and solution of any **one (1)** example for each of the PQ problem originated through conduction and radiation.
(6 marks)
- Q3** (a) Summarize the significance of PQ standards.
(4 marks)
- (b) (i) Compose any **two (2)** organisations responsible for developing PQ standards from inside and outside of the US.
(2 marks)
- (ii) Recommend any **two (3)** power conditioning equipments.
(2 marks)
- (c) (i) With the help of respective diagrams, demonstrate the significance of grounding and its solution in the field of PQ.
(8 marks)
- (ii) Describe the features of PSCAD and EMTP for transient studies.
(4 marks)
- Q4** (a) (i) Enumerate any **two (2)** basic PQ measurement tools for investigating PQ issues.
(2 marks)
- (ii) Explain the importance and capabilities of harmonic and spectrum analyzers for monitoring the PQ problem.
(4 marks)
- (b) (i) Construct a neat flow chart to resolve PQ issue from a consumer complaint until an economical solution established by a PQ engineer.
(7 marks)
- (ii) Sketch the block diagram of advanced PQ monitoring system.
(7 marks)
- Q5** (a) A 14.4 kV, 3-phase system feeder serves a distribution line. If it has an impedance of $1.2 + j6 \Omega$, calculate the voltage sag in percentage in the line due to a balanced 3-phase load of $10 + j5 \Omega$ /phase.
(4 marks)

- (b) A small scale industrial plant in Malaysia is supplied through a 3-phase power supply. It has a total system impedance of $0.003 + j0.006 \Omega$. If the PS supplies a 500 kVA load that produces harmonics (harmonic spectrum) of (250 Hz, 350 Hz, and 550 Hz at current ratings of 65 A, 40 A, and 25 A) respectively. Analyse the percentage of THD of the bus voltage without the power factor correction connected to the line.
(6 marks)
- (c) A 3-phase 415 V commercial installation has a total loading of $(88 + j42.38)$ kVA with the total system impedance of 8 percent at 0.6 power factor lagging.
- (i) Analyse the total reactive power to be supplied by a capacitor bank in order to improve the overall power factor to 0.95 lagging.
(5 marks)
- (ii) If a total reactive power of 100 kVAr is accidentally injected into the system, evaluate the percentage of voltage rise due to the severe over-correct event.
(5 marks)

- END OF QUESTIONS -

