

**CONFIDENTIAL**



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

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

**COURSE NAME : POWER QUALITY**  
**COURSE CODE : BEF 44803**  
**PROGRAMME : BACHELOR OF ELECTRICAL  
ENGINEERING WITH HONOURS**  
**EXAMINATION DATE : DECEMBER 2015 / JANUARY 2016**  
**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. (2 marks)
- (ii) Explain any **two (2)** types of loads that create PQ problems. (2 marks)
- (b) (i) List any **four (4)** standards that is available in PQ. (2 marks)
- (ii) Compare at least **one (1)** code for harmonic and sag in IEEE and IEC PQ standards. (2 marks)
- (c) (i) Demonstrate the significance of total harmonic distortion (THD) and mention the formula used to calculate it. (6 marks)
- (ii) Express the significance of total demand distortion (TDD) and mention the formula used to calculate it. (6 marks)
- Q2** (a) (i) With the help of a diagram, illustrate the effects of 5<sup>th</sup> harmonic on fundamental frequency. (2 marks)
- (ii) Describe **two (2)** causes of harmonics in distribution power system. (2 marks)
- (b) (i) State the full names of 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 K-factor transformer. (3 marks)

- (ii) Sketch a curve to highlight strength of disturbance versus its respective responsibility for PQ solution.  
(3 marks)
- (iii) Investigate **two (2)** examples of PQ problem originated through conduction and radiation.  
(6 marks)
- Q3** (a) Summarize any **two (2)** PQ problems along with their respective voltage amplitude, time periods, causes/sources, effects and the solutions.  
(4 marks)
- (b) (i) Recommend any **four (4)** PQ mitigation methods.  
(2 marks)
- (ii) Summarize any **two (2)** of the mitigation methods written in **Q3(b)(i)**.  
(2 marks)
- (c) (i) Elaborate **three (3)** advantages of computer analysis tools for PQ analysis.  
(6 marks)
- (ii) Describe the features of PSCAD and EMTP for transient studies.  
(6 marks)
- Q4** (a) (i) Examine any **four (4)** applications of active filter in PQ.  
(2 marks)
- (ii) Explain the use of oscilloscope and spectrum analyzer for monitoring the PQ problem.  
(4 marks)
- (b) (i) Construct a neat flow chart to show a case study follow up from a consumer complaint until an economical solution established by a PQ engineer.  
(7 marks)
- (ii) Sketch and explain the block diagram of advanced PQ monitoring systems.  
(7 marks)

- Q5** (a) A “stiff” 14.4 kV, 3-phase system serves at 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  $10+j5 \Omega/\text{phase}$ .  
(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 power system 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-**