

**GUJARAT TECHNOLOGICAL UNIVERSITY**

M.E Sem-III Regular Examination January 2011

Subject code: 730701

Subject Name: Power Quality Management

Date: 08 /01 /2011

Time: 02.30 pm – 05.00 pm

Total Marks: 70

**Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) What do you understand about power quality issues? Discuss all the power quality issues in brief. **07**
- (b) Explain the cause and effect with respect to power quality point of view? What is an immunity of the equipment? Discuss the treatment criteria for a machine. **07**

- Q.2** (a) Discuss the common power frequency disturbances with suitable examples. **07**
- (b) Explain the following with suitable diagrams **07**
- (i) Off line UPS (ii) On line UPS (iii) Rotary UPS units.

**OR**

- (b) What are CBEMA and ITIC graphs? Draw and discuss the ITIC graph in detail. **07**

- Q.3** (a) What is a transient? Discuss the causes of transients in power system. **07**
- (b) i. A 2000-kVAR, 13.8-kV, Y-connected capacitor bank is connected at the end of a 25-mile transmission line with an inductive reactance of 0.5  $\Omega$  per mile. Find the natural frequency of the current that would be drawn during turn on. Assume fundamental frequency is 60Hz. **07**
- ii. The resistance and inductance of a coil which are connected to d.c. supply of 200 V are 15 ohm and 0.5 H. Determine, (i) The rate of change of current at the instant switch is closed (ii) final steady value of the current (iii) Time taken by the current to rise to  $\frac{3}{4}$  of its final value (iv) voltage across the resistor at the initial stage after a lapse of 0.5 sec.

**OR**

- Q.3** (a) Define, displacement power factor and true power factor? Mention the advantages of power factor correction. Explain various methods of power factor improvement and discuss the methods with respect to power quality point of view. **07**
- (b) i. A three phase, 5kW Induction motor has a power factor of 0.75 lagging. A bank of capacitor is connected in delta across the supply terminals and power factor raised to 0.9 lagging. Determine the kVAR rating of the capacitors connected in each phase. **07**
- ii. A 5-MVA transformer is loaded to 4.5 MVA at a power factor of 0.82 lag. Calculate the leading kVAR necessary to correct the power factor to 0.95 lag. If the transformer has a rated conductor loss equal to 1.0% of the transformer rating, calculate the energy saved assuming 24-hour operation at the operating load. Assume cost of Rs 0.05/kWhr for energy calculation.

- Q.4 (a)** Discuss the effect of harmonics on a transformer. What is  $k$  rating of a transformer? Determine the  $k$  rating of a transformer required to carry a load consisting of 500 A of fundamental, 200 A of third harmonics, 120 A of fifth harmonics, and 90 A of seventh harmonics. Assume fundamental frequency is 60Hz. **07**
- (b)** Determine the current rating factor for a 300-kcmil copper conductor required to carry a nonlinear load with the following harmonic frequency content Fundamental = 250 A, 3rd harmonic = 25 A, 5th harmonic = 60 A, 7th harmonic = 45 A, 11th harmonic = 20 A. Assume fundamental frequency is 60Hz. Table.1. containing values of  $X$  and  $K$  are available from cable manufacturers. Take 0.0636 is a constant for copper conductors. The magnetic permeability of a nonmagnetic material such as copper is approximately equal to 1.0. The DC resistance of 300-kcmil cable = 0.17  $\Omega$  per mile. **07**

X	K
1.195	1.0106
2.069	1.089
2.672	1.220
3.161	1.372
3.963	1.664

Table:1: Cable Skin Effect Factor

**OR**

- Q.4 (a)** Discuss the harmonic sources like SMPS, Fluorescent lighting and adjustable speed drives with suitable waveform and harmonic spectrum. **07**
- (b)** Discuss the series and parallel resonance with respect to harmonics study. **07**
- Q.5 (a)** Explain the importance of grounding? Explain the typical wiring and grounding problems in detail. **07**
- (b)** Describe the objectives and procedures for performing power quality monitoring. **07**

**OR**

- Q.5 (a)** What is an electromagnetic interference (EMI)? Discuss the essential elements of EMI. **07**
- (b)** What do you mean by distributed generation? Discuss the distributed generation technologies in brief. Also discuss the power quality issues affected by distributed generation in brief. **07**

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