

POWER QUALITY

Full Marks: 70

Time: 3 hours

Answer SIX questions including Q No. 1 which is compulsory.
The figures in the right hand margin indicate marks. *Symbols carry usual meaning.*

- 1) Answer all questions 2x10
 - a) Classify voltage magnitude events on magnitude and time scale basis.
 - b) List-out the types of instruments used for PQ measurement.
 - c) What are the draw backs of commercial power quality monitors?
 - d) List out the various sources of harmonics in a distribution system.
 - e) What are harmonic filters? Classify them .
 - f) How the performance of voltage sag is estimated?
 - g) Discuss about equipment sensitivity to voltage sags.
 - h) List out the principles of over voltage protection.
 - i) Differentiate between voltage flicker and voltage unbalance.
 - j) What are the power quality problems that may arise due to end-user capacitors? Discuss.
- 2) a) What are the basis to select the locations for power quality monitoring? Discuss the same with the case of distribution sub-station. 5
b) What are the other options that would be suggested with permanent PQ monitoring equipment? 5
- 3) a) What is power quality? Is it a problem or solution? Define various power quality events. 5
b) Classify various power quality events defined as per IEEE and IEC standards. 5
- 4) a) i) Differentiate between voltage and current distortion. 5
ii) Explain various harmonic indices and their methods of determination. 5
b) Describe methods to locate harmonic sources. 5
- 5) Explain the harmonic sources from commercial loads with their characteristic waveforms. 10
- 6) a) What are the basic principles of protection against sags? Categorize the solutions at the end user level. 5
b) Discuss about motor starting sags. Estimate sag severity during full voltage starting. 5
- 7) a) Describe the various sources of over voltage phenomenon in systems. 5
b) Describe about the devices used for over voltage protection. 5
- 8) a) Explain the effects and mitigation techniques for voltage unbalance. 5
b) Describe the operation of the devices used for utility voltage regulation. 5