

GUJARAT TECHNOLOGICAL UNIVERSITY**ME - SEMESTER-IV • EXAMINATION- SUMMER • 2014****Subject Code: 740701****Date: 04-06-2014****Subject Name: Harmonic Measurement and Filtration Techniques****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)** Define and explain following terms: **08**
- i. Effectiveness of filter
 - ii. Minimum filter
 - iii. Performance analysis of harmonic filter
 - iv. Detuning of filter
- (b)**
- i. Explain why capacitors are called as voltage-vulnerable element in design of passive filter. **06**
 - ii. Draw and explain the effect of Q-factor on impedance-frequency characteristics of a harmonic filter.
- Q.2 (a)** For a given installation with following specifications, **07**
- Harmonic current to filter: Fifth
System phase-to-phase voltage: 11 kV
Power factor capacitor bank size: 2 MVAR @15kV
Plant load: 8000 kVA
Verify whether capacitor current is within acceptable limit or not (IEEE-18 limit is less than 1.35 p.u.). The magnitude of 5th order harmonic current is 85A. Consider 5% voltage tolerance in inductor. The actual harmonic current is 120% of designed value. Comment on result.
- (b)** What is K-factor? What is its significance? Arrange and mention K-factor for following load in ascending order. **07**
- i. Filament Lamp
 - ii. Induction heating equipment
 - iii. Healthcare facility
 - iv. Variable motor drives
- OR**
- (b)** Explain following terms and their significance in harmonic analysis **07**
- i. Total demand distortion
 - ii. Displacement power factor
 - iii. Distortion power factor
- Q.3 (a)** Enlist the traditional sources of harmonics and explain any three in detail. **07**
- (b)** Explain the significance of waveform distortion measurement. **07**
- OR**
- Q.3 (a)** Draw and explain the frequency-impedance characteristics of system comprising multiple single-tuned filters. **07**
- (b)** Explain how harmonic producing loads affect **07**
- (i) Protective device and
 - (ii) Power system transformers
- Q.4 (a)** Explain working principle of shunt active filter. **07**
- (b)** What do you mean by stiffness of source? How does it affect the immunity to harmonics in power system? How can the stiffness of source be improved? **07**

OR

- Q.4** (a) Compare hybrid filter with pure active filter. **07**
(b) Explain the objectives of harmonic flow study and compare it with power flow study. **07**
- Q.5** (a) Explain the sinusoidal current control strategy for three phase three wire shunt active filter with necessary block diagram. **07**
(b) Explain PWM converter topologies for three phase four wire shunt active filter with necessary block diagrams. **07**

OR

- Q.5** (a) Explain three phase three wire shunt active filter with the help of block diagram and explain significance of each block. **07**
(b) Explain functional block diagram of PLL circuit. Also explain the significance of positive sequence voltage detector circuit in shunt active filter design. **07**
