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B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Fifth/Sixth/Seventh Semester

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Electrical and Electronics Engineering

EE3006 — POWER QUALITY

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Between voltage quality and current quality, which has a greater impact on overall power quality in a power system? Justify your answer.

2. Write the significance of distortion power in a power system network.

3. Write the difference between THD and TDD.

4. What is meant by nonlinear load and give two examples of domestic non-linear load.

5. Write the limitations of passive harmonic filters.

6. Distinguish the terms 'Displacement Power Factor' and 'True Power Factor'.

7. State the purpose of using p-q theory in active filters.

8. Why is compensation difficult under an unbalanced source voltage?

9. Write the basic principle of series capacitive compensation.

10. In terms of the following performance parameters, compare the rectifier-supported DVR and DC capacitor-supported DVR.
    - Stability
    - Reliability
    - Compensation duration
    - Control complexity

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PART B — (5 × 13 = 65 marks)

11. (a) Explain the causes and effects of the following power quality terms.

(i) Long-duration voltage variations (4)

(ii) Voltage imbalance (4)

(iii) Waveform distortion (5)

Or

(b) Describe the following power quality problem in a power system network.

(i) Poor load power factor (4)

(ii) Non-linear and unbalanced loads (4)

(iii) DC offset in loads (5)

12. (a) Analyze the effect of single-phase linear and non-linear loads on system power factor using a suitable power circuit diagram. Examine how non-linear loads influence the overall power quality and power factor of the system.

Or

(b) A three-phase unbalanced supply system has phase voltages Va = 1.1 ∟ 0° pu, Vb = 1.0 ∟230° pu, and Vc = 0.9 ∟ 120° pu and unbalanced load currents Ia = 0.75 ∟ 20° pu, Ib = 0.65 ∟ 270° pu and Ic = 0.35 ∟ 90° pu. Find

(i) the total complex power,

(ii) the positive-sequence component of power,

(iii) the negative-sequence component of power and

(iv) the zero-sequence component of power.

13. (a) Explain the basic principle of harmonic passive filters. With a suitable power circuit diagram and design equation, distinguish the performance of the following filters.

- Series-Tuned Filters
- Double Band-Pass Filters

Or

(b) Design a single-tuned harmonic filter for a three-phase 11 kV, 50 Hz system to eliminate the 5th harmonic. The filter is required to supply 500 kVAR of reactive power. Determine required values of inductance and capacitance.

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14. (a) Considering an ideal three-phase shunt compensator, derive the instantaneous p-q theory equations used for generating reference currents for shunt compensation. Illustrate how these equations enable harmonic and reactive power compensation.

Or

(b) Explain the control scheme of a DSTATCOM with a neat block diagram. Describe the generation of reference currents/voltages and the role of controllers in maintaining voltage regulation and reactive power compensation.

15. (a) With the help of a suitable vector diagram, explain the voltage restoration process of a series compensator under steady state and transient period.

Or

(b) Explain the principle of operation and V-I characteristics of the DC capacitor supported DVR.

PART C — (1 × 15 = 15 marks)

16. (a) A single-phase fully controlled bridge converter (shown in Figure 16.(a) is fed from a supply of 220 V at 50 Hz at a thyristor firing angle of $\alpha = 60°$. Consider a continuous load current of 20 A. Compute

(i) total harmonic distortion (THD) of AC mains current,

(ii) distortion index (DIN) of AC mains current,

(iii) total demand distortion (TDD) of AC mains current,

(iv) distortion factor (DF),

(v) displacement factor (DPF), and

(vi) power factor (PF).

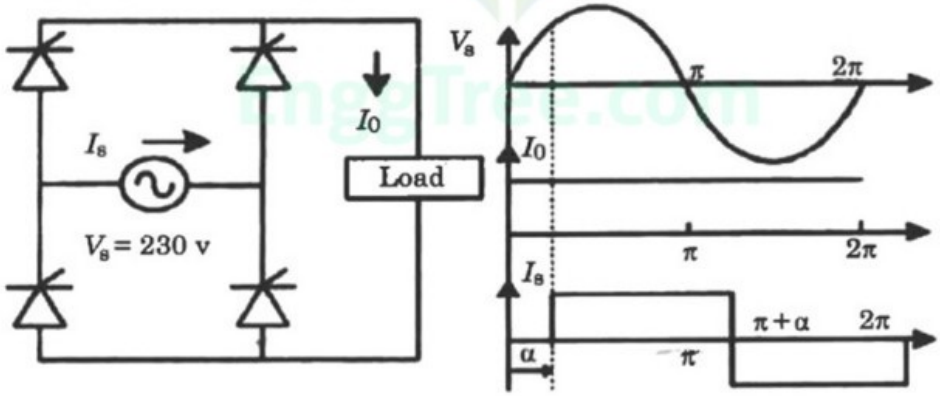


Fig. 16 (a)

Or

(b) Analyze the coordinated operation of series and shunt converters in a UPQC. With a neat block diagram, supporting equations and a vector diagram, justify how effective voltage restoration and current compensation are achieved.

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