Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 11249

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023

Elective

Power Electronics and Drives

PX 4071 – POWER QUALITY

(Common to: M.E. Power Systems Engineering)

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. "Power quality is equal to voltage quality", Comment on this statement.
2. Distinguish the power quality terms voltage sag and interruptions.
3. List any four linear and non-linear domestic loads.
4. Write the difference between true power factor and displacement power factor.
5. What are the limitations of open loop load balancing method?
6. Define voltage regulation of a transmission system.
7. Write the possible benefits of using shunt compensator in a distribution system.
8. Why zero-sequence current does not exists in three-phase three wire system?
9. Draw the basic block diagram of rectifier supported and DC capacitor supported series compensator.
10. How the reverse power flow problem is mitigated in the rectifier-supported series compensator.

PART B — (5 × 13 = 65 marks)

11. (a) Explain the causes and effects of the following power quality issues. (7+6)
    (i) Transients
    (ii) Voltage imbalance

    Or

    (b) Write short notes on the following quality problems. (5+4+4)
    (i) Poor load power factor
    (ii) DC offset in loads
    (iii) Power quality standards

12. (a) (i) List out the power quality problems caused by non-linear loads. (4)

(ii) Give an example of three phase non-linear load, and explain the circuit operation with suitable power circuit and waveforms. (9)

Or

(b) (i) Write the significance of power factor in distribution system. (4)

(ii) With the help of suitable power circuit diagram, explain the power factor problem associated with three-phase three-wire and four- wire system. (9)

13. (a) A three-phase unbalanced supply system has the following phase voltages: $V = 0.9 \angle 0°$ pu, $V_b = 1.1 \angle 240°$ pu, and $V_c = 0.95 \angle 120°$ pu. find the positive, negative, and zero-sequence components of supply voltages. (suitable assumptions can be made with justification wherever necessary. (13)

Or

(b) With the relevant equations, explain the open loop and closed loop load balancing methods in three-phase distribution system. (13)

14. (a) Explain the following shunt compensator circuits. (6+7)

(i) Ideal single-phase shunt compensator circuit

(ii) Ideal three-phase shunt compensator with star connected load

Or

(b) Explain the generation of reference currents control algorithm for DSTATCOM using instantaneous PQ theory. (13)

15. (a) Using relevant sketches explain the operation of DC capacitor supported series compensator under the following conditions. (13)

(i) Transient operation of series compensator when the supply is balanced

(ii) Transient operation when the supply is unbalanced or distorted

Or

(b) Draw the general configuration of Unified Power Quality Conditioner (UPQC), with the help of necessary equation and vector diagram explain the control capabilities of UPQC. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A single-phase load having $Z_L = (4.0 + j1.0)$ pu is from an AC supply with an input AC voltage of 230 V at 50 Hz and a base impedance of 4.15 Ω. It is to be realized as a unity power factor load on the AC supply system using a shunt connected lossless passive element (L or C) as shown in Fig.16.a. Calculate (i) the value of the compensator element (In farad or henry) and (ii) equivalent resistance (in ohms) of the compensated load. (suitable assumptions can be made with justification wherever necessary)

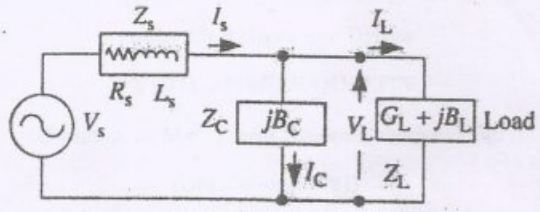

Fig.16.a

Or

(b) Consider a single-phase uncontrolled bridge converter shown in Fig.16.b with sinusoidal input supply Vs=230 V and constant DC load current of 15 A. Calculate (i) Crest Factor, (ii) distortion factor (DF) (iii) displacement factor (DPF), (iv) PF and (v) total harmonic distortion (THD). (suitable assumptions can be made with justification wherever necessary)

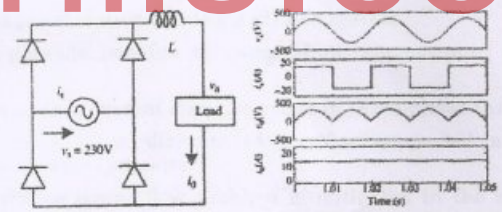

Fig. 16.b