

CBCS SCHEME

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18EPS253



Second Semester M.Tech. Degree Examination, June/July 2019 Power Quality Problems and Mitigation

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain the state of art on power quality. Classify the power quality problem along with its causes. (10 Marks)
- b. Estimate the K-factor rating of a single phase transformer used to feed a single phase diode bridge rectifier with constant DC load current. (10 Marks)

OR

- 2 a. Explain the principle of operation of passive shunt and series compensators along with its classification. (10 Marks)
- b. A three phase three wire delta connected balanced load having $Z_L = (5 + j2)$ pu is fed from an AC supply with an input AC line voltage of 415 V at 50 Hz and a base impedance of 4.15Ω per phase. It is to be realized as a unity power factor load on the AC supply system using shunt connected lossless passive elements as shown in Fig.Q2(b). Calculate (i) supply line currents (ii) compensator currents (iii) the values of compensator elements (iv) KVA rating (v) equivalent per phase resistance of compensated load.

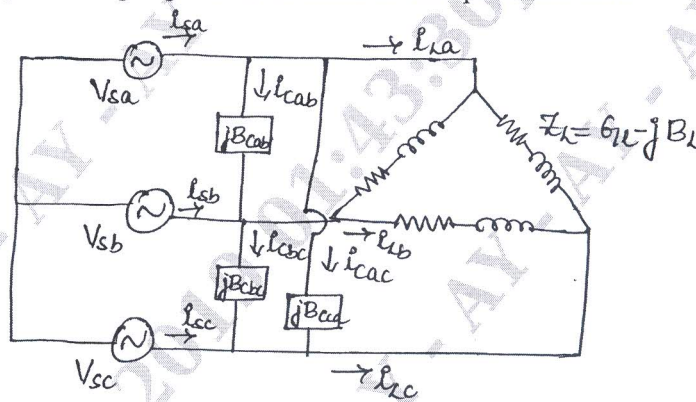


Fig.Q2(b)

(10 Marks)

Module-2

- 3 a. Explain with a suitable block diagram the unit template based control algorithm of DSTATCOM for ZVR mode of operation. (10 Marks)
- b. A single phase load having $Z = (9 + j3)$ pu is fed from an AC supply with an input AC voltage of 230 V at 50 Hz and a base impedance of 9.15Ω per phase. It is to be realized as a unity power factor load on the supply system using a PWM based DSTATCOM as shown in Fig.Q3(b). Calculate:
 - i) The value of compensator current
 - ii) Its VA rating
 - iii) Supply current
 - iv) Equivalent resistance (in Ω) of the compensated load.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

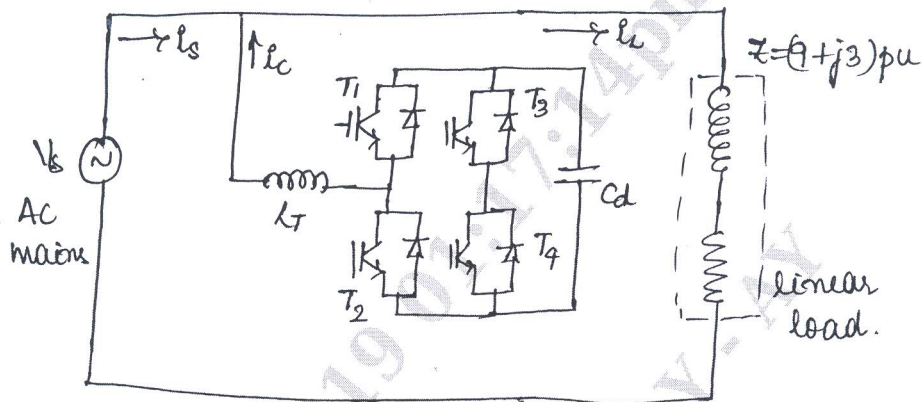


Fig.Q3(b)

(10 Marks)

OR

- 4 a. Mention clearly the design procedure of a three phase, three leg VSC based DSTATCOM. Also draw its schematic diagram. (10 Marks)
- b. With the help of a schematic diagram, explain $I_c \cos \phi$ based control algorithm of DSTATCOMs. (10 Marks)

Module-3

- 5 a. Discuss with the help of necessary block diagrams, the principle of operation of active series compensators. Explain the classification of active series compensators. (10 Marks)
- b. Describe in detail the analysis and design of active series compensators (VSC of DVRs). (10 Marks)

OR

- 6 a. With the help of a block diagram, discuss the control algorithm of BESS-supported DVR. (10 Marks)
- b. A single phase load having $Z_L = (5 + j2) pu$ has an input AC voltage of 230V at 50 Hz with a base impedance of 6.9Ω . It is to be realized as unity power factor load on the AC supply system while maintaining the same rated load terminal voltage using PWM based SSSC. Calculate:
 - i) Voltage rating of the compensator
 - ii) The current rating of the compensator
 - iii) Its VA rating. [Refer Fig.Q6(b)]

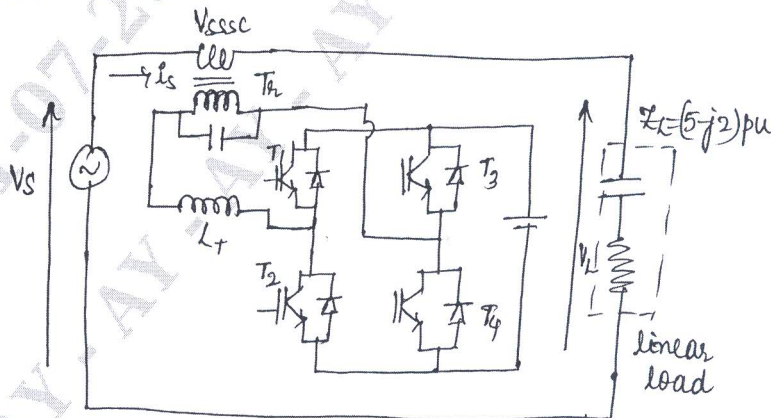
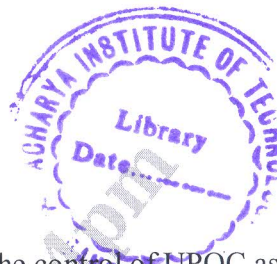


Fig.Q6(b)

(10 Marks)



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Module-4

- 7 a. Explain in brief the classification of UPQC. (10 Marks)
b. With the necessary phasor representation, explain the control of UPQC as UPQC-S. (10 Marks)

OR

- 8 a. Explain the principle of operation and control of unified power quality compensators. (10 Marks)
b. Describe in detail the analysis and design of UPQC. (10 Marks)

Module-5

- 9 a. With the suitable block diagram, explain the classification of non-linear loads. (10 Marks)
b. In a three phase, 415 V line voltage, 50 Hz four wire distribution system, three single phase loads have a single phase thyristor bridge converter drawing equal 20A constant DC current at a thyristor firing angle of 60° . Calculate:
i) Active power consumed
ii) Reactive power drawn
iii) Displacement factor (DPF)
iv) Distortion factor (DF)
v) THD of AC source current
vi) PF
vii) rms value of AC current source (I_s) and neutral current (I_{sn}) (10 Marks)

OR

- 10 a. What are the power quality problems caused by nonlinear load with suitable explanation? (10 Marks)
b. Consider a single phase uncontrolled bridge converter with sinusoidal input supply $V_s = 230$ V and constant DC load current of 15A. Calculate:
i) CF
ii) Distortion factor
iii) Displacement factor
iv) PF THD (10 Marks)
