

B.Tech 8th Semester Exam., 2022

(New Course)

POWER QUALITY AND FACTS

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Answer any seven of the following questions :

2×7=14

- (a) What are the functions of STATCOM in the improvement of power system performance?
- (b) What are the characteristics of thyristor-based FACTS devices?
- (c) Compare the operation of series and shunt compensation.
- (d) Write the functions of different power electronics switching devices.

- (e) What are different types of compensation schemes?
- (f) How can voltage instability be prevented by using the FACTS controllers?
- (g) Draw the power angle curve of SMIB system with midpoint SVC compensation.
- (h) Draw the impedance vs. delay angle characteristics of TCSC and write your observations on the same.
- (i) What is meant by coordination and unified operation of FACTS controllers?

2. (a) Explain the working of STATCOM. Draw the V-I characteristics of SVC and STATCOM, and compare their performances. 6

(b) Derive the expression for active as well as reactive power flow in a lossless transmission line and draw its necessary phasor diagram. Also discuss the active as well as reactive power controlling by using FACTS controllers. 8

3. (a) Illustrate the power swing damping in a single-machine infinite bus system using a TCSC. 7

- (b) Compare HVDC and FACTS in the context of bulk power transmission. Illustrate the operation of a series FACTS controller by using a suitable example. Is back-to-back VSC-HVDC is considered as a FACTS device? 7
4. (a) Discuss different power quality problems in the distribution systems. Also discuss the applications of suitable compensators to mitigate the respective power quality problems. 7
- (b) Differentiate between voltage sourced converters (VSCs) and current sourced converters (CSCs) in FACTS applications. Illustrate the single-phase full-wave bridge VSC converter operation with the help of different operating waveforms. 7
5. (a) Explain the operation of DVR and UPQC in distribution systems. How can we use the FACTS devices to maintain the power flow between a two-area with different frequency between two generators? Explain with illustration. 7
- (b) Discuss various causes for second harmonic distortion between the thyristor-controlled reactor and the AC system. 7

6. (a) Describe the sub-synchronous resonance phenomenon and its impacts. Discuss the possible solution techniques for the same. Can we mitigate it by using variable impedance type or VSC type FACTS controllers? 7
- (b) With neat sketches, explain the configuration and operating characteristics of a fixed capacitor-thyristor controlled reactor (FC-TCR) with a step down transformer. 7
7. (a) Describe detailed functional control schemes of series and shunt converters in UPFC. Illustrate the performance of STATCOM and UPFC in order to improve the transient stability and power oscillation damping by using a suitable example. 10
- (b) Describe the applications of D-STATCOM. <https://www.akubihar.com> 4
8. (a) Explain power oscillation damping and functional requirements of thyristor switched series capacitor (TSSC). 7
- (b) Discuss the principle of operation of static synchronous series compensator (SSSC) and compare its performance with conventional series compensators. 7

(5)

9. Write short notes on any *two* of the following : 7×2=14

- (a) Multi-pulse and multi-level converters
- (b) Passive reactive power compensation
- (c) Thyristor-controlled braking resistor (TCBR)

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