

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – III • EXAMINATION – WINTER • 2013****Subject code: 734501****Date: 26-11-2013****Subject Name: Application of Power Electronics to Power System****Time: 10.30 am – 01.00 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) Give classification of FACTS devices and their advantages. **07**
(b) State the benefits and limitations of various conventional shunt and series compensation schemes used for performance improvement of AC transmission systems. **07**

- Q.2** (a) Explain the operation of Static Synchronous Series Capacitor (SSSC). **07**
(b) Find the ratio of active power transfer through a line for the same amount of lead var compensation through series and shunt compensators. The line is operating at angular difference of $\delta=20^\circ$ across its two ends. State the assumptions made if any. **07**

OR

- (b) A 3-phase converter based STATCOM with constant dc link voltage can providing pure sinusoidal terminal voltage while operating in linear modulation region of $0.2 < m < 0.85$. Find attainable var compensation range of the STATCOM when connected via a 0.15 per unit reactance at mid-point of transmission line having constant voltage of $1.0 \angle 0^\circ$ per unit. During synchronization of STATCOM with the line, the modulation index is adjusted at $m=0.55$. **07**
- Q.3** (a) Explain the principle of operation of basic Thyristor-Controlled Series Capacitor (TCSC) scheme. **07**
(b) Show that a TCSC compensated line could not cause or participate in a subsynchronous resonance. State the condition assumed for such property of TCSC based circuit. **07**

OR

- Q.3** (a) Draw and explain compensating voltage vs line current and compensating reactance vs line current characteristics of TCSC in voltage control mode. **07**
(b) Discuss the steady-state operation of TCSC in capacitive region along with relevant waveforms of Capacitor voltage and current; and TCR voltage and current. **07**
- Q.4** (a) Draw and explain the V-I characteristics of STATCOM and give a brief comparison with the V-I characteristics of TSC-TCR. **07**
(b) Explain the application of STATCOM for improving transient stability of a power system. Discuss the control strategy used. **07**

OR

- Q.4** (a) Explain the "indirect" output voltage control scheme based on variation of dc capacitor voltage for implementation of STATCOM. Draw relevant schematic block diagram and waveforms. **07**
(b) Explain principle of operation of UPFC with relevant phasor diagram and describe its implementation using back to back VSCs with schematic diagram. **07**

- Q.5 (a)** Explain operating characteristics of FC-TCR without step-down transformer. **07**
- (b)** Explain the basic working principle of Thyristor Controlled Transformer. **07**
- OR**
- Q.5 (a)** Draw and explain V-I characteristics of Mechanically Switched Capacitor (MSC) – Thyristor Controlled Reactor (TCR) with and without voltage control. **07**
- (b)** Explain operation of TCR. **07**
