Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – III • EXAMINATION – SUMMER • 2014

Subject code: 734501 **Date: 03-06-2014**

Subject Name: Application of Power Electronics to Power System

Time: 02:30 pm - 05:00 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)**	State the names of various shunt, series and hybrid type FACTS devices and write function of each in brief.	**07**
	(b)	Derive the ratio of reactive power compensation to be provided by a series compensator and a midpoint shunt compensator, to achieve the same change in active power transfer through a given transmission line. Assume identical voltages at respective ends of the line in both the cases. Calculate this ratio for a line operating with a 15° phase angle difference between the two ends.	**07**
Q.2	**(a)**	A STATCOM made of 3-phase converter with constant dc link voltage, is capable of providing pure sinusoidal terminal voltage while operating in linear modulation range of $0.05<m<0.95$, where m is amplitude modulation index. Find attainable lead and lag var compensation range of this STATCOM, when it is connected at mid-point of transmission line via a 0.2 per unit reactance. Assume the mid-point voltage being held constant at $1.0\angle 0°$ per unit. For synchronization of STATCOM with the line, the modulation index has to be kept at m=0.6.	**07**
	(b)	Explain the operation of Static Synchronous Series Capacitor (SSSC).	**07**
		OR	
	(b)	Give comparison of conventional shunt/series compensation schemes and FACTS schemes used in AC transmission systems.	**07**
Q.3	**(a)**	Explain how the series capacitive line compensation can cause subsynchronous resonance (SSR). Show that a TCSC compensated line cannot cause SSR.	**07**
	(b)	Explain the principle of operation of basic Thyristor-Controlled Series Capacitor (TCSC) scheme.	**07**
		OR	
Q.3	**(a)**	Explain steady-state operation of TCSC in capacitive region along with relevant waveforms of Capacitor voltage and current; and TCR voltage and current.	**07**
	(b)	Draw and explain reactance (X_{TCSC}) vs thyristor firing delay angle (α) characteristics of TCSC.	**07**
Q.4	**(a)**	Explain the "direct" output voltage control scheme based on internal voltage (magnitude and angle) control at a sustained dc capacitor voltage for implementation of STATCOM. Draw relevant schematic block diagram and waveforms.	**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 operation of FC-TCR.	**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) ï Thyristor Controlled Reactor (TCR) with and without voltage control.	**07**
	(b)	Explain operation of TCR.	**07**

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