Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – III • EXAMINATION – SUMMER • 2013

Subject code: 734501 **Date: 13-05-2013**

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)**	Explain conventional shunt and series compensation schemes used for improved performance of AC transmission systems. State the benefits and limitations of each.	**07**
	(b)	Classify FACTS devices and mention their advantages.	**07**
Q.2	**(a)**	Find the ratio of var ratings of series and shunt capacitor to achieve the same level of active power transfer through a line operating at angular difference of δ=20° across its two ends. Derive the necessary equation. State the assumptions made if any.	**07**
	(b)	A 3-phase converter based STATCOM providing pure sinusoidal terminal voltage and operating in linear modulation region of $0.1<m<0.8$, is connected via a 0.2 per unit reactance at mid-point of transmission line having constant voltage of $1.0\angle 0°$ per unit. During synchronization of STATCOM with the line, the modulation index is adjusted at m=0.5. Find attainable var compensation range of STATCOM if its dc link voltage is kept constant by maintaining active power flow of 0.05per unit from line to STATCOM.	**07**
		OR	
	(b)	Explain the principle of operation of Static Synchronous Series Capacitor (SSSC) scheme.	**07**
Q.3	**(a)**	Explain operation of Thyristor-Controlled Series Capacitor (TCSC) in following modes: Bypassed Thyristor, Blocked Thyristor, Partially conducting Thyristor.	**07**
	(b)	Draw and explain compensating voltage vs line current and compensating reactance vs line current characteristics of TCSC in voltage control mode.	**07**
		OR	
Q.3	**(a)**	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**
	(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)**	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**
		OR	

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**
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**

OR

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**

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