SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
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QUESTION BANK (DESCRIPTIVE)
Subject with Code: (25EE2113) FACTS CONTROLLERS

Course & Branch: **M.TECH. IN POWER ELECTRONICS**

Year &Sem: I-M.Tech & II Sem **Regulation:** R25

UNIT –I
FACTS CONCEPTS, VSI AND CSI

1		Explain the impact of FACTS devices on the dynamic stability of a power system. How does a TCSC (Thyristor Controlled Series Capacitor) help in damping power oscillations?	**[L2][CO1]**	**[10M]**
2	a	Give detailed technical comparison between Voltage Source Converters (VSC) and Current Source Converters (CSC). Discuss why VSC is preferred for most modern FACTS applications.	**[L2][CO1]**	**[5M]**
	b		**[L2][CO1]**	**[5M]**
3	a	Show how the use of star-star and star-delta transformer connections eliminates the 5th and 7th harmonics.	**[L3][CO1]**	**[5M]**
	b	Explain the operation of a 12-pulse converter with a neat circuit diagram	**[L3][CO1]**	**[5M]**
4		Explain dynamic stability in power systems. Discuss rotor angle stability, voltage stability, and frequency stability.	**[L3][CO1]**	**[10M]**
5	a	Explain the operation of a 24-pulse converter with a neat circuit diagram	**[L3][CO1]**	**[5M]**
	b	Explain the operation of a 48-pulse converter with a neat circuit diagram	**[L4][CO1]**	**[5M]**
6	a	What are the controllable parameters in a transmission line?	**[L4][CO1]**	**[5M]**
	b	Explain power flow in an interconnected AC transmission system.	**[L3][CO1]**	**[5M]**
7		Classify basic types of FACTS controllers. Explain the working principle and applications of different types of FACTS controllers.	**[L3][CO1]**	**[10M]**
8		Discuss the benefits of FACTS controllers in modern power systems. Explain their role in congestion management, power flow control, voltage support, and enhancement of system security.	**[L2][CO1]**	**[10M]**
9		xplain the operation of a single-phase full wave bridge converter with neat circuit diagram and waveforms. Derive expressions for average output voltage for R and RL loads.	**[L2][CO1]**	**[10M]**
10	a	Describe the operation of a three-phase full wave bridge converter. Explain its input/output waveforms and derive the expression for average DC output voltage.	**[L2][CO1]**	**[10M]**

UNIT –II
SHUNT COMPENSATION

1	Explain the objectives of shunt compensation in a transmission system with neat $P-\delta$ curves.	**[L3][CO2]**	**[10M]**
2	Describe the operation of a Thyristor Controlled Reactor (TCR) and derive the expression for its effective inductance.	**[L3][CO2]**	**[10M]**
3	Compare and contrast SVC and STATCOM based on their V-I characteristics and transient stability performance.	**[L4][CO2]**	**[10M]**
4	Discuss the working principle of a STATCOM. How does it regulate reactive power exchange with the AC bus?	**[L3][CO2]**	**[10M]**
5	Explain the operation of a Thyristor Switched Capacitor (TSC) and why "transient-free switching" is critical.	**[L2][CO2]**	**[10M]**
6	Analyze the mid-point voltage regulation of a transmission line using shunt compensation.	**[L2][CO2]**	**[10M]**
7	Detail the architecture and advantages of Hybrid Var Generators in modern grids.	**[L2][CO3]**	**[10M]**
8	Explain how shunt compensation improves the surge impedance loading (SIL) of a transmission line.	**[L2][CO2]**	**[10M]**
9	Discuss the different types of Switching Converter type Var generators and their control strategies.	**[L4][CO2]**	**[10M]**
10	Elaborate on the "Loss of Voltage Support" phenomenon and how STATCOMs mitigate this better than SVCs.	**[L2][CO2]**	**[10M]**

UNIT –III
SERIES COMPENSATION

1	Explain the basic objectives of series compensation. How does it differ from shunt compensation in terms of power transfer enhancement?	**[L3][CO3]**	**[10M]**
2	Describe the operating principle of a GTO Thyristor Controlled Series Capacitor (GCSC). Provide the relevant waveforms.		
3	Discuss the circuit configuration and operation of a Thyristor Switched Series Capacitor (TSSC). What are its limitations?	**[L3][CO3]**	**[10M]**
4	With a neat circuit diagram, explain the various operating modes of a TCSC (Thyristor Controlled Series Capacitor).	**[L3][CO3]**	**[10M]**
5	Derive the expression for the effective impedance of a TCSC as a function of the thyristor firing angle.	**[L4][CO3]**	**[5M]**
6	Compare the performance and application of TSSC and TCSC in modern power systems.	**[L2][CO3]**	**[10M]**
7	Explain the Constant Current and Constant Reactance control schemes for a TCSC.	**[L3][CO3]**	**[10M]**
8	Analyze the phenomenon of Sub-Synchronous Resonance (SSR) and explain how TCSC can help in its mitigation.	**[L2][CO3]**	**[10M]**
9	Illustrate the V-I and X-I characteristics of a TCSC. Why is the "resonance region" avoided during operation?	**[L2][CO3]**	**[10M]**
10	Describe how series compensation improves the transient stability of a long transmission line using the Equal Area Criterion.	**[L2][CO3]**	**[10M]**

UNIT –IV

UNIFIED POWER FLOW CONTROLLER (UPFC) & INTERLINE POWER FLOW CONTROLLER (IPFC)

1	Describe the basic operating principle of a Unified Power Flow Controller (UPFC). Use a schematic diagram to show the arrangement of the two VSCs.	**[L2][CO3]**	**[10M]**
2	Explain how a UPFC can provide independent control of real (P) and reactive (Q) power flow in a transmission line.	**[L3][CO3]**	**[10M]**
3	Compare the conventional transmission control capabilities (like TCSC or Phase Shifters) with the capabilities of a single UPFC.	**[L3][CO3]**	**[10M]**
4	Draw and explain the functional control structure of a UPFC. Highlight the role of the DC link voltage regulator.	**[L2][CO3]**	**[10M]**
5	Discuss the Hybrid Arrangement of a UPFC combined with a Phase Shifting Transformer. What are the economic and technical benefits?	**[L3][CO3]**	**[10M]**
6	Explain the concept of an Interline Power Flow Controller (IPFC). How does it help in balancing power flow between two parallel lines?	**[L3][CO3]**	**[10M]**
7	Analyze the V-I characteristics of a UPFC and explain the constraints imposed by the ratings of the series and shunt converters.	**[L2][CO3]**	**[10M]**
8	Derive the mathematical equations for power flow in a line equipped with a UPFC, considering the injected voltage phasor V_{pq}.	**[L2][CO3]**	**[10M]**
9	Explain the application considerations for an IPFC in a multi-line transmission corridor. What are its practical limitations?	**[L2][CO3]**	**[10M]**
10	Define and discuss the concept of Generalized and Multifunctional FACTS Controllers. How does the UPFC fit this description?	**[L4][CO3]**	**[10M]**

UNIT –V

SPECIAL FACTS DEVICES

1	Explain the operating principle and circuit configuration of the Thyristor Controlled Phase Angle Regulator (TCPAR).	**[L2][CO4]**	**[10M]**
2	Discuss the phenomenon of Sub-Synchronous Resonance (SSR). How does the NGH Damper effectively mitigate this issue?	**[L2][CO4]**	**[10M]**
3	Describe the construction and working of a Thyristor Controlled Braking Resistor (TCBR) for improving transient stability.	**[L2][CO4]**	**[10M]**
4	Compare the roles and technical requirements of a STATCOM (Transmission level) vs. a D-STATCOM (Distribution level).	**[L2][CO4]**	**[10M]**
5	What is a Unified Power Quality Conditioner (UPQC)? Explain how it handles both voltage and current harmonics simultaneously.	**[L2][CO4]**	**[10M]**
6	Draw the schematic of an NGH SSR Damper and explain the logic behind its "adaptive" damping approach.	**[L2][CO4]**	**[10M]**
7	Illustrate how a TCPAR can be used to control the power flow in a loop-connected power system.	**[L2][CO4]**	**[10M]**
8	Explain the "Braking" action of a TCBR using the Equal Area Criterion during a three-phase fault.	**[L2][CO4]**	**[10M]**
9	Discuss the different control strategies used in a D-STATCOM for load compensation and voltage regulation.	**[L2][CO4]**	**[10M]**
10	Detail the architecture of a UPQC. Distinguish between the roles of the Series Active Filter and the Shunt Active Filter within it.	**[L2][CO4]**	**[10M]**