Ref: EX/PG/EE/T/1210C/2018

M.E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAMINATION 2018

POWER ELECTRONICS APPLICATION IN EHV TRANSMISSION

Time: Three hours | Full Marks: 100

Answer **any five** questions.
Figures in the margin indicate full marks

1.(a)	What do you understand by transient stability limit and steady state stability limit?	(6)
(b)	Derive the expressions for active and reactive power of sending end as well as receiving end in terms of mid-point voltage, load angle (δ) and system reactance in a two bus lossless power system?	(10)
(c)	What is the effect of midpoint compensation in active and reactive power transferred to receiving end? Is it possible to obtain flat voltage profile throughout the length of a transmission line using midpoint compensation?	(2+2)
2.(a)	Discuss about the HVDC converter characteristics both in rectifier and inverter mode.	(10)
(b)	With a schematic diagram describe the principle of operation of TCSC.	(10)
3.(a)	Explain the operating principle of a TSC-TCR SVC and a STATCOM with proper schematic diagram.	(5+5)
(b)	How many SVC models are available for load flow analysis in open literature? Discuss about firing angle model. Explain why there is a firing angle limit in SVC operation.	(10)
4.	Write the functions of a UPFC. Consider a UPFC between two buses i and j in a n-bus power system. Develop the linearised mathematical model of the system to implement it in a power flow program.	(2+18)
5.(a)	Develop an equivalent circuit model of a HVDC link with proper justification.	(6)
(b)	Consider that the rectifier is on CC control and the inverter is on CEA control mode of operation in a HVDC link. Write an algorithm along with relevant equations to perform load flow if the HVDC link is connected between bus i and j of a N-bus EHV AC power transmission system under normal operating conditions. State the assumptions made.	(14)

6.(a) How chording of windings in rotating machines results in reduction of harmonic voltages? A three phase 4 pole, 50 Hz, star connected synchronous generator has 120 stator slots with 11 conductors per slot. The fundamental flux is 0.09 Wb per pole with third, fifth and seventh harmonic components having amplitudes of 16%, 10% and 4% that of the fundamental. If the coil span is 8/9 pole pitch, determine the rms harmonic components for the phase and line voltages. Also determine the voltage total harmonic distortion. (3+12)

(b) Discuss how transformers can be operated in harmonic environment (5)

7.(a) Show that in balanced three phase distorted waves, individual harmonic components can be identified as positive, negative and zero sequence components. (6)

(b) Discuss switched mode power supply and three phase power converters as sources of harmonics. (4)

(c) Determine the Fourier series coefficients of the following waveform and calculate the rms value and total harmonic distortion of the waveform. (10)