Ref.: EX/EE/5/T/522E/2018 (Old)

B. E. ELECTRICAL ENGG.(PART TIME) 5TH YEAR 2ND SEMESTER EXAMINATION
2018 (OLD)

ADVANCED TOPICS IN POWER SYSTEMS

Time: Three hours Full Marks: 100

(50 marks for each part)
Use separate answer script for each part.
PART I
Answer **any two** questions.
Figures in the margin indicate full marks

1.(a) A balanced 3-phase source having line to line voltage E_{LL} is supplying a 6-pulse converter through a transformer having turns ratio T:1 with the secondary side connected to the converter. If the converter operates with no ignition delay and no commutation overlap then, with necessary derivation, show (i) how the r.m.s. value of the fundamental a.c. current drawn from the source is related to the d.c. current delivered by the converter (ii) how the average d.c. voltage is affected when a delay angle α is introduced. (6+6)

(b) Deduce an expression for the voltage drop due to commutation overlap in a 6-pulse converter operating with a delay angle α and overlap angle μ. Also derive the expression for the fundamental power factor at such operating condition. (10+3)

2.(a) Explain how an SVC can maintain the voltage of a power system bus. (7)

(b) Explain clearly how a TCR can act as a variable susceptance. (6)

(c) Derive an expression for voltage magnitude at the mid-point of a lossless line when the voltage magnitudes at the two ends are held equal and constant. (6+6)
If the midpoint voltage is regulated with the help of an SVC, then deduce the expression for the line power flow to show the effect of SVC on it.

3.(a) What are the main objectives of control of an HVDC link? Discuss how the converters at the two ends of the link are controlled to fulfil those objectives. (10)

(b) A 12-pulse converter, fed from a 220KV bus through a 220/110 kV transformer, is delivering 515 MW at a d.c. voltage of 257.5 kV. If the equivalent commutating resistance of the converter is 11.3 ohm then calculate the firing angle and the overlap angle. Also calculate the r.m.s. value of the fundamental current and the reactive power drawn from the 230KV bus. The transformer is operating at nominal turns ratio. (8)

[Turn over

(c) A 3-phase, 50 Hz, 400KV, 900 km long line is operating with the voltage magnitudes at both ends maintained at 1.0 p.u. (at 400 KV base). An SVC with slope reactance X_{sl}=0.05 p.u.(at 300 ohm bqase) is connected at the midpoint of the line with its reference voltage set at 0.98 p.u. If the SVC operates at its capacitive limit when the line loading corresponds to $\delta=90°$ then calculate the capacitive susceptance of the SVC. Also calculate the increase in the amount of power transfer achieved by connecting the SVC. Given: Z_c = 300 ohms, $\beta = 0.06^0$/km (the symbols having their usual significance). (7)

Ref.: Ex/EE/5/T/522E/2018

B. ELE. ENGG. (PART TIME) FIFTH YEAR 2nd Semester (OLD) EXAMINATION 2018

ADVANCED TOPICS IN POWER SYSTEM

Time: Three hours Full Marks: 100

(50 marks for each part)
Use separate answer script for each part.
PART II
Answer **any three** questions.
Figures in the margin indicate full marks
Two marks reserved for well organized answers

1.(a)	What are the functions of Energy control centres in power system?	(6)
(b)	Why a dual computer configuration is used? Mention the functions performed by the on-line and the backup computer.	(6+4)
2.(a)	Why state estimation in Power System requires iterative solution? Why state estimation requires redundant measurements?	(3+3)
(b)	Discuss the steps involved in the state estimation of Power System.	(10)
3.(a)	Explain the necessity of security monitoring in Power System.	(5)
(b)	How the method based on contingency ranking can be used for security analysis?	(11)
4.(a)	Establish a relation between the phase sequence and harmonic orders for a Power System having distorted voltage waveforms.	(7)
(b)	Discuss the effects of harmonics on (i) Transformers (ii) Transmission lines.	(6+3)
5.(a)	Give a brief outline of the components used in digital relaying system.	(10)
(b)	Discuss a digital relaying algorithm and mention its shortcomings.	(4+2)