Ex/EE/PE/B/T/421E/2024

Bachelor of Electrical Engineering, 2024
4th year 2nd Semester Examination
Advanced Topics in Power Systems

Time: 3 hours Full marks: 100

50 marks for each part

Use separate answer scripts for each part

Part I

Answer all the questions

1. Answer any two of the following questions: (12 X2 =24)
   (a) Why Energy control centres are important in the operation and control of present day Power Systems? Show the typical Computer configuration of an Energy Control centre. Also list the major data collected at the Energy control centres.
   (b) How State Estimation is different from Load flow? Why State estimation of Power System needs an iterative solution? Explain the steps of such solution with the help of flow chart.
   (c) Why standard load flows are not suitable for contingency analysis? Explain how active and reactive power contingencies may be ranked.
2. Answer any two questions from the following: (9X2=18)
   (a) How Power factor correcting capacitor may cause resonance problem in power system with distorted supply?
   A three phase, 11 kV, 2.5 MVA capacitor bank causes a voltage rise of 210 V when switched on. Determine the harmonic order at which resonance would take place.
   (b) How power system harmonics may be associated with the various sequence components? How high voltage grids may be modeled for harmonic analysis?
   (c) Why harmonic problem is a concern for Distribution systems? Discuss the effects of harmonics on transformers.
3. Answer any one question: (8)
   (a) Mention the features of digital relaying which are not available in the conventional relays.
   (b) Explain how the transmission line model may be used to develop a distance relaying algorithm.

[Turn over

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B. E. ELECTRICAL ENGG. 4th YEAR 2ND SEMESTER EXAM 2024

ADVANCED TOPICS IN POWER SYSTEM

Time: Three hours Full Marks 100 (50 marks for each part)

Use a separate Answer-Script for each part

Part II

Answer any two questions. All the symbols have their usual meaning.

1.(a) A 12-pulse converter, fed from a 230 kV bus through a 220/110KV transformer operating at nominal turns ratio , is drawing a fundamental R.M.S. line current of 1.56 kA and a total 3-phase reactive power of 300 MVAr from the h.t. bus. Calculate the values of the delay angle, the overlap angle, and the equivalent commutation resistance of the converter. Derive the formulae you use to solve the problem. 20

(b) With necessary diagram show how two 6-pulse converter can be connected to form a 12-pulse converter. 5

2.(a) Showing the necessary operating characteristics explain briefly the principle of control of the converters in an HVDC link. Discuss how reversal of roles of the converters are achieved, and also explain the importance of current margin in this context. 13

(b) Choose the correct answers for the followings and justify your answer with necessary derivation.

(a) For a loss less transmission line operating with $V_S = V_R = V$ and $P_R > P_0$, the midpoint voltage will be

(i) higher than V (ii) less than V (iii) equal to V 6

(b) With $P_R = P_0$ for a loss less transmission line operating with $V_S = V_R$

(i) $Q_R > 0$ and $Q_S < 0$ (ii) $Q_R < 0$ and $Q_S > 0$ (iii) both> 0 (iv) both< 0 (v) both=0 6

3.(a) Explain how an SVC can maintain the voltage of a power system bus. Also discuss how the operating range of an SVC can be extended with the application of switched capacitors. 10

(b) 'A TCR acts as a variable susceptance'- explain clearly. 7

(c) A 3-phase, 50 Hz, 400KV, 900 km long loss-less 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 base) is connected at the midpoint of the line with its reference voltage set at 0.985 p.u. If the SVC operates at its capacitive limit when the line loading corresponds to $\delta=90°$ then calculate the value of the capacitance used in the SVC. Given: $Z_c = 300$ ohms, $\beta = 0.06^0$/km. 8