

COLLEGE OF ENGINEERING, PUNE -411005

(An Autonomous Institute of Government of Maharashtra)

End- Semester Examination EE 5107: FACTS and HVDC

Programme: First Year M. Tech – Electrical (Sem. II)

Year: 2011-12

Date: 6th May 2012

Duration: 3 Hours (9 Hr to 12 Hr)

Max. Marks: 50

Instructions: 1. All questions are compulsory.

2. Assume suitable data if necessary. Justify assumptions.

3. Irrelevant writing may invoke negative marking. Be specific.

4. Correct approach may provoke additional credits.

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- 1) Some of the 400 kV lines are provided fixed shunt reactors. What could be the limitations of these systems? A large number of thyristers may have to be connected in series to convert the fixed reactor to TCR. Hence, this scheme is not a practical one. However, is desired to have a variable inductor instead of fixed shunt reactor at the transmission voltage level. Suggest a power electronic equipment which presents variable inductance to the source. The switching devices should be SCRs. If required you may use electro-magnetic equipment. What are the limitations of TCR? (05)
- 2) A SSSC is connected at midpoint of transmission line. Considering equivalent circuit of line, derive the equation for power transmitted. (05)
- 3) Six TCSC modules are connected in series. Each TCSC module is designed to operate between 1.3 to 4.0 Ω in the capacitive region and at -0.2 in the bypass mode (inductive vernier range is not used). Compute the composite range for six TCSC module. (03)
- 4) IPFC is installed at sending end between two identical parallel lines. The voltages at both the end are 1 p.u. The line current is 0.5 p.u. (in each line). Calculate the three phase power drawn from line 1, when line 2's series transformer injected voltage is (a) 0.1 p.u., 90° lagging (b) 0.1 p.u., 90° leading (c) 0.025 p.u., in phase with line current. (03)
- 5) What are the different modes of operation of TCSC? What is current and voltage inversion? How it affects distance relaying? (05)
- 6) Derive the mathematical model for 12-pulse inverter with the source inductance. (05)
- 7) In a AC-DC interconnected system, can we enhance the transient stability using HVDC system? Justify your answer. (02)
- 8) What are SCR and ESCR of an AC-DC system? How it affects on the operation of HVDC system? What is their significance? (06)
- 9) What are the various aspects of HVDC system control? Explain the converter and inverter control of HVDC transmission system. (06)
- 10) Fig. shows a bipolar dc link with a rating of 1,000 MW, ± 250 kV. The line resistance is 10 Ω /line. Each converter has a 12- pulse bridge with $R_c = (3/\pi)X_c = 12 \Omega$ (6 Ω for each of 6 pulse bridges).

The performance of the bipolar link is to be analyzed by considering it to be a mono-polar link of +500 kV. The rectifier ignition delay angle limits (α min) is equal to 5°. The effect of converter station losses and forward voltage drop across the valves may be neglected.

The dc link is initially operating with rectifier on CC control with $\alpha_0 = 18.167^\circ$, and the inverter on CEA control with $\gamma_0 = 18.167^\circ$. The current margin I_m is set at 15%, and the transformer turns ratio at each converter is 0.5. At the inverter, the dc power is 1,000 MW, and the dc voltage is 500 kV (for the equivalent mono-polar link).

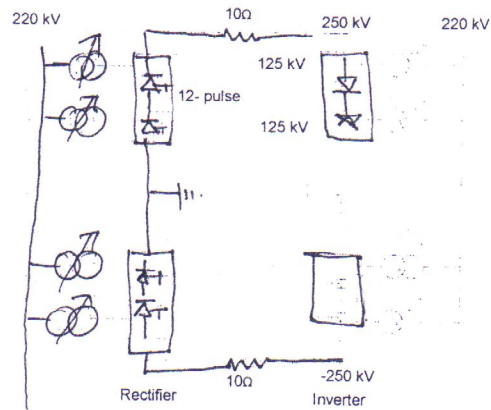


Fig. 11

For above operating condition compute the following:

- i. Power factor and the reactive power at inverter HT bus.
- ii. Inverter communications overlap angle μ .
- iii. RMS values of the line-to-line alternating voltage, fundamental component of the line current and the reactive power at rectifier HT bus. (10)

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COLLEGE OF ENGINEERING, PUNE- 05
M. Tech. (Electrical_Power Systems)

Subject:- Special Topics in Power Systems

Date:- 14th May2012

Max. Marks:- 50

Time:- 03 Hours

Instructions to the candidates:

1. Marks to the right indicate full marks.
2. Assume suitable data wherever necessary
3. Draw neat diagrams wherever necessary.
4. Answer any three questions out of Q1-Q4, Q.5 and Q.6 are compulsory.

Q1 a) What are the various Technical and Commercial issues in the Deregulated power industry? Discuss in brief. 05

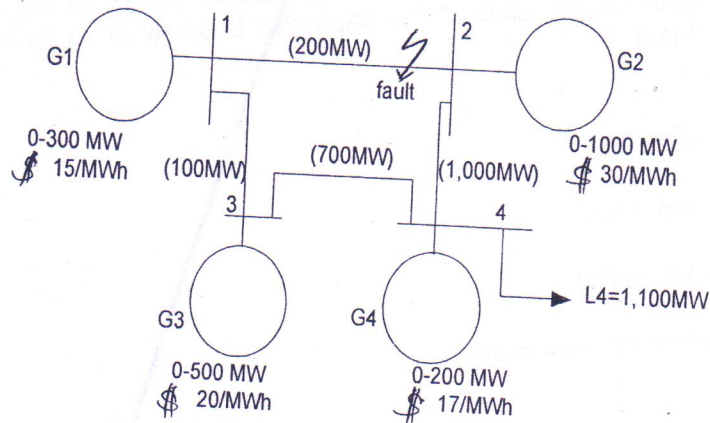
OR

a) What is Ancillary Service management in the Deregulated power market? Justify its need. 05

b) Write on the main features of
i) PJM deregulated market 05
ii) Norwegian deregulated market

Q.2 a) Dynamic pricing of electricity has brought GRID DISCIPLINE in India. Justify the statement. Draw necessary diagrams. 05

b) Calculate the HHI in the following case. Also explain with effective electricity price calculation, how 'market power' could be exercised in the following network. 05



Q.3 a) Five-core cable is suggested by the Electrical consultant for an industry with NL loads. Justify this suggestion. 05

b) Define the following terms and state their relevance in the context of Indian power system 05
i) SAIFI
ii) SAIDI
iii) CAIDI
iv) CAIFI

Q.4 a) Discuss the effects of harmonics on Capacitors and effects of reactive power compensation capacitors on the power system in the presence of harmonics. 05

b) Explain in detail the procedure to conduct Harmonic Audit of the utility system. What are the important equipments required for the Audit? 05

Q.5 Design an L.T. system for an industry having following loads 10

- i) 50kW-compressor feeder
- ii) 25kW-water pump
- iii) 40 kW-heating load
- iv) 25 kW-illumination and fan load
- v) Two spare feeders of 25 kW and 50 kW capacity.

Diversity is 0.7
Suggest the Single-line diagram, transformer, LT breaker capacities. Assume 11kV supply is available for the campus. Also suggest sizes of various cables. Assuming that the average power factor of the industry is 0.8lagging, suggest the size of the capacitor in kVAR of Automatic power factor control unit.

Q.6 Write short notes on 10

- a) Earth resistance tester
- b) Clamp on Power meter
- c) Lightning arrestor technologies