

DEE-24106 ELECTRIC POWER SYSTEMS

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11th of April, 2016

Attempt ALL questions

The numbers in square brackets in the right-hand margin indicate the marks allotted to the part of the question against which the mark is shown. These marks are for guidance only.

An electronic calculator may be used provided that it does not have a facility for either textual storage or display, or for graphical display.
If a calculator is used, intermediate steps in the calculation should be indicated.

Q1 (a) State briefly what is the main objective of a conventional power flow study. [1]

(b) State the three types of nodes used in a conventional power flow solution, the two specified variables and the two calculated variables associated with each type of node. [1]

(b) For the circuit shown in Fig. 1 determine the nodal voltage solution using one iteration of the power flow Newton-Raphson method. Select bus 1 to be the slack bus, with a voltage magnitude of 1.05 p.u. and 0 phase angle. The voltage magnitudes at buses 2 and 3 are kept at 1 p.u. each. To start the iterative solution, assume 0 phase angles in buses 2 and 3. [4]

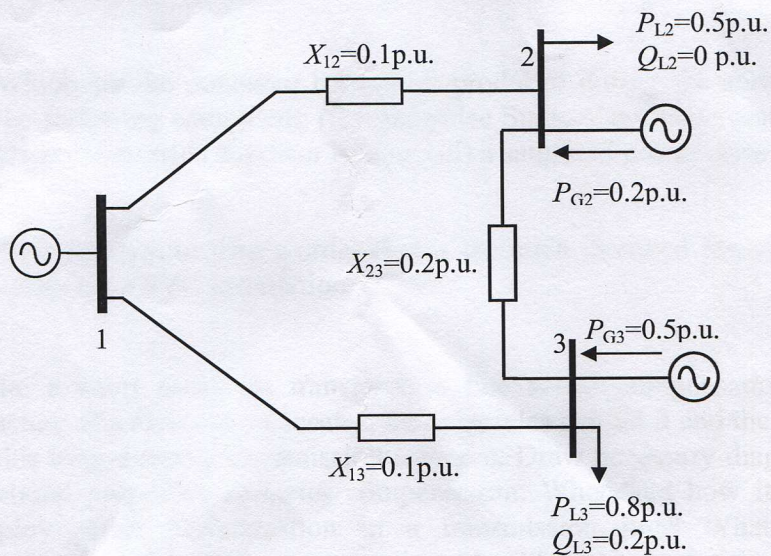


Fig. Q1

Q2 The power circuit shown in Fig. 2 undergoes a two-phase short-circuit fault in bus 3.

(a) Calculate the short-circuit fault currents (positive and negative) assuming a flat voltage profile of 1 p.u. in all buses just before the fault occurs and zero fault impedance, i.e. $Z_f = 0 + j0$. [3]

(b) Determine the faulted nodal voltages in all five buses, in sequence quantities. [3]

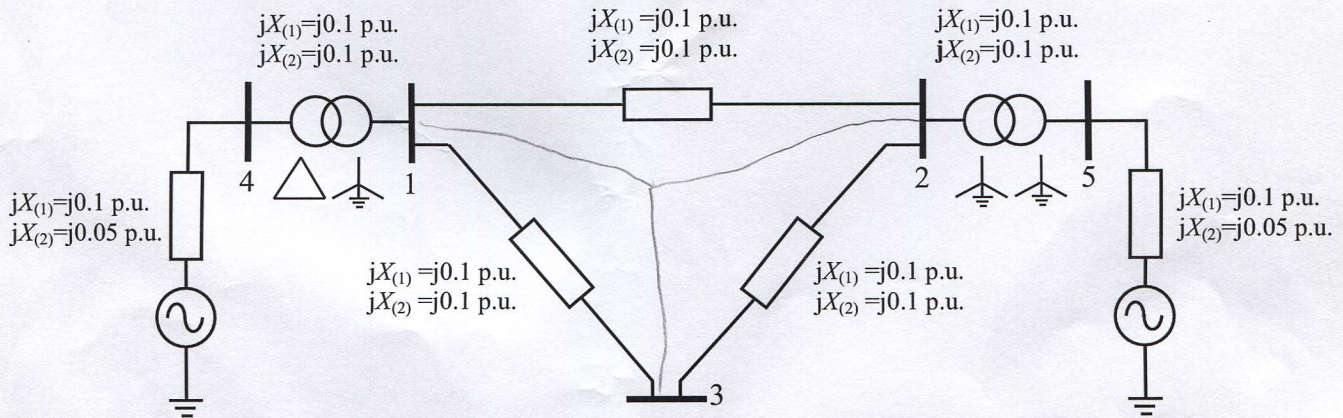


Fig. Q2

Q3 (a) State using your own words what is Power Quality. [1]

(b) State using your own words what is harmonic distortion of the current and voltage waveforms. [1]

(c) Which are the dominant harmonics produced during the normal operation of the following equipment: (i) a six-pulse Static Var Compensator (SVC); (ii) a six-pulse rectifier thyristor bridge; (iii) a saturated power transformer. [3]

(d) State using your own words what is the main intended function of a filtering system in a SVC installation. [1]

Q4 Write a short essay on transmission line series compensation: describe the structure of a series compensator, the principles behind it and the main objectives of this long-distance transmission resource. Draw necessary diagrams to explain electrical properties of series compensation. When and how it is advisable to employ series compensation in a transmission line? What special issues associated with series compensation should be considered carefully at the planning stage? [6p]

Q5 Describe in chronological order what it is expected to happen in a well-functioning power system, during and immediately after the sudden disconnection of a large synchronous generator. [6p]