Dr Ashrafi (201) 8/12/2022 (12)

National Institute of Technology, Hamirpur (HP)

Name of the Examination: B.Tech.

Branch : Electrical Semester : 7th

Course Name : Power Quality & Harmonics Course Code : EE-453

Maximum Marks: 50

Time: 3 Hours

Note : Attempt all questions. Assume any missing data.

Q1. (a) Give the details of the different types of power quality variations and events. What different equipments are employed by the utilities for monitoring these PQ variations? (5)

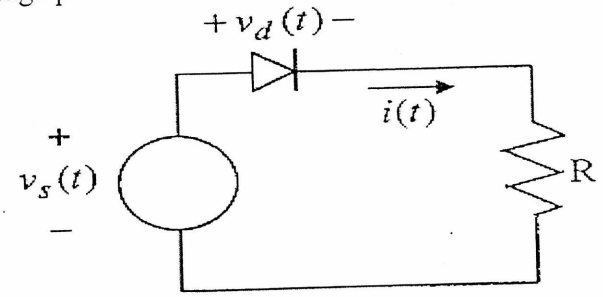
(b). Enlighten the following terms in details with mathematical expressions and examples.(i) Total harmonic distortion (ii) Distortion power factor in harmonic domain (iii) Telephone influence factor (iv) K-factor (v) Flicker factor (vi) C-message factor . (5)

Q2 (a) Explain the modeling of various Harmonic sources, networks and loads for carrying out the harmonic studies. (5)

(b) What purpose harmonic filtering serves? Outline the salient features of passive filtering and give the design basis of a tuned passive filter. (5)

Q3. (a) For three-phase balanced circuit, derive the expressions for instantaneous active and reactive powers. (5)

(b) A single phase ac voltage source $v_s(t) = V\cos(wt)$ volts energizes a series diode resistor circuit as shown in figure. Sketch $v_s(t)$, $i(t)$ and $v_d(t)$ for both inputs. Justify with the help of waveforms that the average power consumed by a lossless diode is always zero. (5)



Q4. (a) Consider the following voltage and current in single phase system

$$v_s(t) = \sqrt{2}\times 230\sin(wt) + \sqrt{2}\times 40\sin(5wt - 45^0) + \sqrt{2}\times 15\sin(7wt - 30^0) + \sqrt{2}\times 10\sin(9wt - 15^0)$$

$$i(t) = 1 + \sqrt{2}\times 15\sin(wt - 30^0) + \sqrt{2}\times 5\sin(5wt - 75^0) + \sqrt{2}\times 3\sin(7wt - 60^0) + \sqrt{2}\times 1\sin(9wt - 45^0)$$

Determine the following: Active power, (P), Reactive power, (Q), Apparent power, (S), True, distortion and displacement power factors. (5)

(b) Explain in details different measurement methods of substation soil resistivity. (5)

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Q5. (a) What are the essentials of a grounded system and why grounding is essential? With a diagram explain the effect of soil moisture and the content of salt on the soil resistivity. (5)

(b) Design an earthing grid of a 132 kV substation. Data are as given below.
Soil resistivity 55 Ω-m, substation area = 45*30 m^2. Max. grid current = 5000A. Fault clearing time is 0.5 sec. Resistivity of the soil at surface is 3000 Ω-m. Use steel conductors with welded joints. The earthing rods are evenly space in the substation. Show the grid layout also.
Assume D = 5m and h=0.5m