

National Institute of Technology, Hamirpur (H.P.)

Examination: B.Tech. End-Semester Examination, Dec-2020

Branch : Electrical Engineering

Semester : VIIIth

Course : Power Quality and Harmonics

Code : EE-453

Time: 02:00 Hours

Maximum Marks: 50

Instructions: Write your Name, Roll No, Subject Name and Subject Code on top of first sheet and put Signature with Date at the bottom of each sheet of the answer booklet.
All questions are compulsory.

- [1] Define power quality. List the various voltage-based power quality problems and define them. [7]
- [2] What are the reasons for developing power quality and EMC standards? [7]
- [3] An uncontrolled three-phase bridge rectifier is fed by a line voltage of 415 V at 50 Hz. If a continuous constant load current is of 15 A in RL load, calculate (a) mean DC load voltage, (b) load resistance, (c) load power, (d) rms value of supply current, (e) DF, (f) DPF, (g) PF, (h) THD. [7]
- [4] Derive an expression for the total mmf of a three phase induction machine, considering fundamental, third and fifth-space harmonics. Also give the rotating directions of each non-sinusoidal mmf. [7]
- [5] Define grounding. What are the reasons for grounding? Show the basic elements of a properly grounded electrical system. [7]
- [6] A single-phase 230V, 50 Hz diode bridge rectifier with a dc capacitor filter feeding a dc of 400 V at 10 A average current to variable frequency 3-phase VSI fed induction motor drive in an air conditioner. A single-phase series active power filter (VSC with ac series inductor, coupling transformer and dc bus capacitor) is used in series of this rectifier-inverter system to reduce the harmonics in ac mains current, to almost maintain UPF and to regulate the dc bus voltage of rectifier to 400 V. Calculate (a) rms voltage at the input of single-phase diode rectifier, (b) line current, (c) rms current of the APF, (d) rms voltage across the APF, and (e) VA rating of APF. [7]
- [7] A three-phase three-branch shunt passive filter (tuned fifth, seventh, and high-pass) is employed to reduce the THD of the supply current and to improve the displacement factor to unity for a three-phase 415 V, 50 Hz fed six-pulse thyristor bridge converter drawing 60 A constant DC current at 30° firing angle of its thyristors. Calculate (a) fundamental active power drawn by the load, (b) fundamental reactive power drawn by the load, (c) values of filter elements—R, L, C. (Consider $Q_5 = Q_7 = 30$, $Q_H = 5$). Let the supply has 5% source impedance mainly inductive. [8]
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