

EN 313 - Power Electronics

Assignment-4

Date: 08-10-2018

Due: 16-10-2018

1. A fully-controlled three-phase bridge converter operates from a 3-phase AC supply. Rating of the AC supply is 415V RMS line-to-line, 50Hz. The thyristors are fired symmetrically and the converter supplies a resistive load of 50Ω at a firing angle 90° . Determine the power supplied to the load.
2. An adjustable speed DC motor drive is proposed to be supplied from a three-phase controlled bridge rectifier. The three-phase AC line voltage is 440V.
 - (a) What will be the highest rating of the DC motor to be selected so that the bridge can be used without the need for a transformer?
 - (b) What will be the RMS line current drawn from the three-phase AC bus when the motor is drawing 60A? Assume ideal inductive smoothing of current.
 - (c) Determine the RMS, average and peak current ratings of the thyristors, if the full load motor current is 60A. What should be the voltage rating of the thyristors, on the basis of a safety factor of 2.2? (Available voltage ratings are 1kV, 1.2kV, 1.6kV and 1.8kV)
3. A battery with a nominal e.m.f. of 300V and internal resistance of $10m\Omega$ has to be charged at a constant current of 40A from a 3-phase 400V (RMS line-to-line), 50Hz power supply. Two converters are being considered for this application: (i) 3-ph fully-controlled converter (ii) 3-ph semi-controlled converter.
 - (a) Which converter draws more reactive power from the AC mains?
 - (b) Which converter causes more distortion at the point of common coupling?
 - (c) Which converter is better in terms of the overall power factor?
4. A 220V, 1500RPM, 50A, separately-excited DC motor with armature resistance of 0.5Ω is operated from a 3-ph semi-controlled rectifier. The field current is kept constant. Line voltage of the 50Hz AC source available is 415V. A star-delta connected transformer is used to feed the phase-controlled rectifier so that the motor terminal voltage equals rated voltage when the firing angle of the rectifier is zero.
 - (a) Calculate the turns ratio (secondary to primary) of the transformer.
 - (b) Determine the firing angle of the converter when the motor runs at 1200RPM and develops the rated load-torque (Hint: The terminal voltage and armature current of the motor equal their rated values, when the motor supplies full-load at rated speed).
 - (c) What is the firing angle of the converter when the motor runs at 1500RPM and delivers half the rated load-torque?