Department of Electrical Engineering IIT Delhi

EL842 Power Conditioners

Max Marks 50 Major Test (03/05/09) Time 120 mts

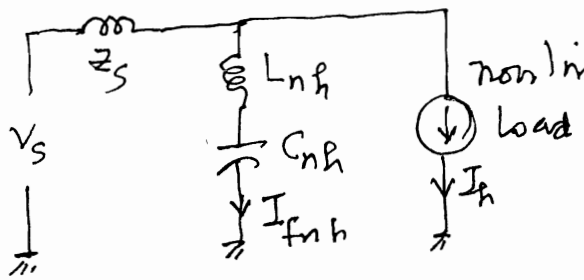
Q1. (a) Give layout of a series cascaded thyristorised 12-pulse converter and describe its operation. [4]

(b) The above converter is fed from a 380 V, 50 Hz supply with $L_s = 0$ has a continuous ripple free load on its dc bus having $R_{dc} = 50\,\Omega$. 6-pulse converter with λ-λ input has $\alpha = 30°$ and the other has $\alpha = 45°$.

(i) Draw the resultant current waveform at primary input of the 12-pulse converter transformer. [4]

(ii) obtain the amplitude of fundamental component of resultant primary input current in phase A and phase angle. [2]

Q2. A power network is having the following filter configuration shown in the figure. Each filter is tuned to resonant frequency n_h and the harmonic frequency order due to nonlinear load be h (5, 7, 11, 13..). Due to detuning of the filter parmetus $n_h \neq h$.



Derive the expression for per unit impedance shown by the detuned n_h^{th} filter to the h^{th} harmonic current at fundamental base impedance Z_b as $\frac{S_b}{Q_{nh}} \frac{(h^2 - n_h^2)}{h(n_h^2 - 1)}$, where S_b is the fundamental base VA of the system and Q_{nh} is the fundamental VAr loading of the n_h^{th} filter. Give layout for 5^{th}, 7^{th}, 11^{th} and 13^{th} filter. [7+3]

Q3. Give layout of a parallel hybrid active filter for 5^{th} and 7^{th} harmonics. Describe its operation on the basis of use of SRF controller for parallel hybrid active filter inductor variation with mistuned passive filter configuration. [5+5]

Q4. (a) Draw the layout of a half bridge converter/inverter based 1-phase UPS, which has battery charging by stepup/down chopper. Give details of the devices. Explain the rectifier operation [5]

(b) Draw the layout of isolated dual redundant UPS system with double throw switch. Explain its operation in preferred on line mode of UPS operation. Give the necessary protection. [5]

Q5. Explain the operating principle of an UPFC. Derive expressions for the transmitted power P and the reactive power at the receiving end Q_r as a function of supply and receiving end voltages $V_s\angle\delta^\circ$, $V_r\angle 0^\circ$, transmission line reactance X and UPFC voltage $V_{pq}\angle f$. Where P is measured with respect to $V_s\angle\delta$.

When the transmission line has a series capacitor compensation with $X_c = \frac{X}{4}$, obtain P and Q_r for $\delta = 45^\circ$. Get $V_{pq}\angle f$ for transmission line operating with UPFC for corresponding P and Q_r as achieved with series capacitor compensator. [3+3+4]