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EEL842 Power Conditioning/EEL746 Power Quality

TIME-TWO HOURS **MAJOR TEST** **MAXIMUM MARKS: 300**

1. Draw the circuits of (i) passive shunt tuned, (ii) passive shunt damped, (iii) passive series tuned, (iv) passive series damped, (v) active shunt, (vi) active series, (vii) hybrid of passive shunt and active series, (viii) hybrid of passive series and passive shunt, (ix) hybrid of passive series and active series, (x) hybrid of active shunt and active series filters for power quality improvements in single-phase AC systems. [40]
2. Draw the circuits of (i) single-phase DSTATCOM, (ii) single-phase DVR, (iii) single-phase left side UPQC, (iv) single-phase right side UPQC, (v) three-phase three-wire DSTATCOM, (vi) three-phase three-wire DVR, (vii) three-phase three-wire left side UPQC, (viii) three-phase three-wire right side UPQC, (ix) three-phase four-wire DSTATCOM, (x) three-phase four-wire left side UPQC for power quality improvements in AC systems. [40]
3. Draw the circuits of (i) boost-PFC single-phase, (ii) VSC single-phase, (iii) buck-PFC single-phase, (iv) buck-CSC single-phase, (v) buck-boost-PFC single-phase, (vi) boost-PFC three-phase, (vii) VSC three-phase, (viii) buck-PFC three-phase, (ix) buck-CSC three-phase, (x) buck-boost bidirectional three-phase improved power quality AC-DC converters. [40]
4. A dc load of 220V, 500 A is to be supplied by a 12-pulse diode bridge rectifier. Calculate (a) the required voltage and current ratings of the diode and transformer secondary windings voltages with primary applied 3-phase supply voltage of 440 V at 50 Hz for converter series connections, (b) current in each winding of transformer, (c) kVA rating of the transformer, and (d) supply rms current and its THD. [20]
5. A single-phase shunt active power filter (SAPF) is employed for harmonics currents and reactive power compensation for a single-phase 220V, 50 Hz system. It has a thyristor bridge converter drawing 25 A constant dc current operating at 30° firing angle of its thyristors. Calculate the current, voltage rating of the SAPF to provide (a) only harmonic compensation, (b) only reactive power compensation and (c) harmonic and reactive power compensation at unity power factor. Let the supply is stiff enough so that the distortion in voltage at point of common coupling is negligible. [30]
6. A three-phase diode bridge is used to convert 415 V ac to dc voltage, the load on dc side is 50kW and a capacitor filter is used at the output of the rectifier to reduce the ripple. Along with this rectifier, an inductive load of 30 kVAR is connected to the ac same bus. Design a set of tuned passive shunt filters for this system to compensate the reactive power and 5^{th} and 7^{th} harmonics. [30]
7. In a three-phase, line voltage of 415 V, 50 Hz, 4-wire distribution system, three single-phase loads (connected between phases and neutral) having diode bridge converter drawing equal constant 40A dc current. A four leg VSI with dc bus capacitor is issued as APF. Calculate (a) load neutral current, (b) APF phase current, and (c) kVA rating of the APF to provide harmonic compensation at unity power factor. Let the supply is stiff enough so that the distortion in voltage at the point of common coupling is negligible. [30]
8. Find optimum values of DC side inductor and capacitor for a single-switch boost PFC ac-dc converter with following specification. (i) rated power 2000W, (ii) output voltage 380V, (iii) output voltage ripple<.05 pu, (iv) output current ripple<.05pu, (v) line frequency 50Hz, (vi) supply voltage 220V (rms), (vii) switching frequency 20kHz. [20]
9. A single-phase, series active power filter (VSI with ac series inductor and dc bus capacitor) is used in series with single-phase ac supply of 230 V, 50 Hz feeding diode rectifier charging a battery of 168 V at 20A average current to reduce the harmonics in ac mains current and to maintain almost UPF. Calculate (a) rms voltage at the input of diode rectifier, (b) line current, and (c) VA rating of APF. [20]
10. A three-phase four wire unbalanced non-isolated star connected load (Z_a=6.0+j3.0 pu, Z_b=3.0+j1.5 pu and Z_c=7.5+j1.5 pu) has an input line-line voltage of 415V, 50Hz, AC supply and base impedance of 4.15 ohms per phase. It is to be realized as a balanced unity power factor load on three-phase supply system using four-leg PWM based DSTATCOM. Calculate (a) the values of compensator line currents (in Amperes), (b) its kVA rating, (c) its neutral current (in Amperes) (d) supply line currents (in Amperes) and (e) equivalent per phase resistance (in ohms) of compensated load. [30]

*******Best of Luck*******