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EEL743 POWER-ELECTRONICS DEVICES AND DC CONVERTERS

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

Q.1 (a) 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. [20]

(b) Draw the circuits and state relation in input AC and output DC voltages of (i) half wave- uncontrolled three-phase, (ii) half wave semi-controlled three-phase, (iii) half wave fully controlled three-phase, (iv) full wave (mid point)- uneontrolled three-phase, (v) full wave (mid point) semi-eontrolled three-phase, (vi) full wave (mid point) fully controlled three-phase, (vii) bridge-uncontrolled three-phase, (viii) bridge-semi-controlled three-phase, (ix) bridge controlled three-phase, and (x) dual controlled three-phase AC-DC converters. [20]

(c) Draw the circuits and state relation in input and output DC voltages of (i) buck, (ii) boost, (iii) buck-boost, (iv) Cuk, (v) buck-half-bridge, (vi) buck-bridge, (vii) Zeta, (viii) boost-half-bridge, (ix) boost-bridge and (x) SEPIC nonisolated DC-DC converters using MOSFET as switching device. [20]

(d) 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 eonverters. [20]

(e) Draw the circuits of three-phase (i) 12-pulse nonisolated autotransformer based uneontrolled bridge, (ii) 18-pulse nonisolated autotransformer based uncontrolled bridge, (iii) 24-pulse nonisolated autotransformer based uncontrolled bridge, (iv) 12-pulse isolated transformer based uncontrolled bridge, (v) 18-pulse isolated transformer based uncontrolled bridge, (vi) 24-pulse isolated transformer based uncontrolled bridge, (vii) 12-pulse isolated transformer based uncontrolled full-wave, (viii) 18-pulse isolated transformer based uncontrolled full-wave, (ix) 24-pulse isolated transformer based uncontrolled full-wave, (x) 36-pulse isolated transformer based controlled bridge ae-de converters for power quality improvements at AC mains. [20]

Q.2 (a) Consider single-phase controlled bridge converter with sinusoidal input supply. Calculate firing angle, DPF, DF, PF, %THD for $V_d=0.60*V_{d0}$ where V_{d0} is the dc output at $\alpha=0°$. [25]

(b) A single-phase unidirectional boost PFC converter draws 3.0 kW from 230V; 50Hz mains for a small variable frequency drive application. The switching frequency is 20 kHz. The power-factor is corrected close to unity. Determine the value of boost induetor for the eurrent ripple of 2.5% of maximum inductor current and an output capaeitanee sufficient to make output dc voltage of 400V with the ripple of 5.0 percent. [25]

(c) A three-phase controlled bridge eonverter is employed to charge a battery with an emf 300 V. The supply rms line voltage is 415 V and sufficient inductance having a resistance of 0.50 ohm is included in the output circuit to maintain the dc current virtually constant at 25 A. Determine crest factor of ac source current (CF), power factor (PF), ac source rms current (I_s), thyristor rms current (I_T), and input activc power (P_{in}). [25]

(d) A step-down dc chopper feeds power to an RLE load with R=2 ohm, L=50 mH, E=120 V. If this chopper is operating at a chopping frequency of 1 kHz and with a duty cycle of 75% from a 220 V dc source, compute the maximum, minimum and average currents taken by the load and device peak and average current. [25]

Q.3 (a) In a nonisolated Cuk convertcr, DC supply voltage is 300 V dc and required output voltage is 120V at 10A de. The operating frequency is 50 kHz. If the peak-peak current variation in L_1 and L_2 is 20% of their respective average current and peak-to-peak ripple voltage of C_1 and C_2 are 500mV respectively calculate, (i) values of L_1 and L_2, (ii) values of C_1 and C_2. [25]

(b) A de step up chopper has input dc source voltage and eurrent of 120 V and 10 A. The duty cycle is 45%. The input filter inductor has very high induetance and resistance of 1.25 ohms. The output of the chopper has an ideal CL filter. Caleulate (i) output voltage, (ii) output current, and (iii) values of peak, rms, and average eurrent of the solid state switeh and diode. [25]

(e) An uncontrolled three-phase rectifier bridge circuit is fed by a line voltage of 415 V, 50 Hz with AC source reactance of 0.50 ohms/phase. Assuming a continuous load current of 30 A, calculate (i) the mean DC load voltage, (ii) rms ac supply current, (iii) load power, (iv) DF, (v) DPF, (vi) THD, (vii) PF, (viii) overlap angle, (ix) rms diode current, and (x) average diode current. [25]

(d) A three-phase bi-direetional boost PFC eonverter (VSC) draws 25000 W from 254V per phase, 50Hz mains for a resistive load. The switching frequency is 20 kHz and ac inductor is 5.0mH. The power-faetor is corrected close to unity and PWM modulation index is 0.9. Determine an output dc voltage, value of resistance of load and phase shift in fundamental component of PWM voltage and supply voltage. Draw phasor diagram of supply voltage, supply eurrent, inductor voltage and converter fundamental voltage. [25]

*****BEST OF LUCK*****