Duration:3hrs Max marks:80

1. **Q.1 is compulsory.**
2. **Answer any three out of the remaining questions.**
3. **Assume additional data if needed.**

I Answer the following

i) Derive the voltage ratio of a Buck converter in DCM and draw the voltage across the inductor and current through the inductor. **05**

ii) Briefly explain any one voltage mode control method of dc to dc converter. **05**

iii) From the steady state characteristics of Parallel loaded resonant converter state its main features. **05**

iv) What is the need for multilevel inverter. List any three applications of multi-level inverter. **05**

II **A)** With a neat diagram explain ZVS resonant s/w converter and draw the resonant inductor current and resonant capacitor voltage waveforms. **10**

B) Describe briefly any two applications of Power electronic converters. **10**

III (A)With neat diagrams and waveforms of inductor current and diode currents explain Push Pull dc to dc converter and derive the voltage ratio. **10**

(B) The forward converter has the following parameters: V_d=30V, N_1/N_2=2, D=0.3, L_f=0.5mH, R_L=6Ω, C=50μF, f_s=10kHz.Find (i) V_o (ii)input current (I_d) (iii) max & min currents in output inductor (iv)voltage across the switch and (v)peak to peak ripple in output voltage. **10**

IV Illustrate a Buck converter. Write the state space model equations, find the state space averaged model, do the small signal analysis and find the expression for the control to output transfer function of an Ideal Buck dc to dc converter in CCM. **20**

V **A)** Explain five level CHB multilevel inverter with switching sequence and output voltage waveform? **10**

B) Draw the block diagram of dc link voltage control loop of grid connected inverter and explain briefly. **10**

VI Illustrate the diagram of a Boost dc to dc converter and derive the voltage ratio when it is operated in CCM. Design the input inductor if the Boost converter converts 5V to 12V and supplies a load of 1A at a switching frequency of 100kHz. Take peak to peak current ripple as 20% of the input inductor current, B_m=0.2T, K_w=0.6, K_c=1, J= 3A/mm^2. **20**

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APPENDIX - I

Physical, Electrical and Magnetic characteristics of ferrite cores

CORES without air gap	mean length per turn l_t mm	mean magnetic length l_m mm	core cross section area $A_c \times 100$ mm^2	window area $A_w \times 100$ mm^2	area product $A_p \times 10^4$ mm^4	effective relative permeability $\mu_r \pm 25\%$	A_L nH/turns^2 $\pm 25\%$
POTCORES - CEL HP_3C grade, (*Philip 3B7 grade)							
P 18/11	35.6	26	0.43	0.266	0.114	1480	3122
P 26/16	52	37.5	0.94	0.53	0.498	1670	5247
P 30/19	60	45.2	1.36	0.747	1.016	1760	6703
P 36/22	73	53.2	2.01	1.01	2.010	2030*	9500*
P 42/29	86	68.6	2.64	1.81	4.778	2120*	10250*
P 66/56	130	123	7.15	5.18	37.03		
EE - CORES - CEL HP_3C grade							
E 20/10/5	38	42.8	0.31	0.478	0.149	1770	1624
E 25/9/6	51.2	48.8	0.40	0.78	0.312	1840	1895
E 25/13/7	52	57.5	0.55	0.87	0.478	1900	2285
E 30/15/7	56	66.9	0.597	1.19	0.71		
E 36/18/11	70.6	78.0	1.31	1.41	1.847	2000	4200
E 42/21/9	77.6	108.5	1.07	2.56	2.739	2100	2613
E 42/21/15	93	97.2	1.82	2.56	4.659	2030	4778
E 42/21/20	99	98.0	2.35	2.56	6.016	2058	6231
E 65/32/13	150	146.3	2.66	5.37	14.284	2115	4833
UU - CORES							
UU 15	44	48	0.32	0.59	1.190		1100
UU 21	55	68	0.55	1.01	0.555		1425
UU 23	64	74	0.61	1.36	0.823		1425
UU 60	183	184	1.96	11.65	22.83		1900
UU 100	29.3	308	6.45	29.14	187.95		3325
TOROIDS - CEL HP_3C							
T 10	12.8	23.55	0.062	0.196	0.012	2300	765
T 12	19.2	30.40	0.12	0.442	0.053	2300	1180
T 16	24.2	38.70	0.20	0.785	0.157	2300	1482
T 20	25.2	47.30	0.22	0.950	0.213	2300	1130
T 27	34.1	65.94	0.42	1.651	0.698	2300	1851
T 32	39.6	73.00	0.61	1.651	1.010	2300	2427
T 45	54.7	114.50	0.93	6.157	5.756	2300	2367

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APPENDIX - II

Wire Size Table

SWG	Dia with enamel mm	Area of bare conductor mm²	R/Km @20°C ohms	Weight Kg/km
45*	0.086	0.003973	4340	0.0369
44	0.097	0.005189	3323	0.0481
43	0.109	0.006567	2626	0.0610
42	0.119	0.008107	2127	0.0750
41	0.132	0.009810	1758	0.0908
40*	0.142	0.011675	1477	0.1079
39	0.152	0.013700	1258	0.1262
38*	0.175	0.018240	945.2	0.1679
37	0.198	0.023430	735.9	0.2202
36	0.218	0.029270	589.1	0.2686
35*	0.241	0.035750	482.2	0.3281
34	0.264	0.04289	402.0	0.3932
33	0.287	0.05067	340.3	0.4650
32*	0.307	0.05910	291.7	0.5408
31	0.330	0.06818	252.9	0.6245
30	0.351	0.07791	221.3	0.7121
29*	0.384	0.09372	184.0	0.8559
28	0.417	0.11100	155.3	1.0140
27	0.462	0.13630	126.5	1.2450
26*	0.505	0.16420	105.0	1.4990
25	0.561	0.20270	85.1	1.8510
24*	0.612	0.24520	70.3	2.2330
23	0.665	0.29190	59.1	2.6550
22*	0.770	0.39730	43.4	3.6070
21	0.874	0.51890	33.2	4.7020
20*	0.978	0.65670	26.3	5.9390
19	1.082	0.81070	21.3	7.3240
18*	1.293	1.16700	14.8	10.5370
17	1.501	1.58900	10.8	14.3130
16	1.709	2.07500	8.3	18.6780
15	1.920	2.62700	6.6	23.6400
14*	2.129	3.24300	5.3	29.1500
13	2.441	4.28900	4.0	38.5600
12	2.756	5.48000	3.1	49.2200
11	3.068	6.81800	2.5	61.0000
10	3.383	8.30200	2.1	74.0000
9	3.800	10.5100	1.6	94.0000
8	4.219	12.9700	1.3	116.0000

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