University of Mumbai

Examinations Summer 2022

Time: 2hour 30 minutes Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	Choose the advantage of switched mode power supply as compared to linear power supply.
Option A:	Higher size
Option B:	Higher efficiency
Option C:	Lesser efficiency
Option D:	Less electromagnetic interference
2.	Choose an application that **does not** use bidirectional converter for battery charging.
Option A:	Incandescent lamp intensity control from AC supply
Option B:	Micro-grid
Option C:	Electric Vehicle
Option D:	Stand-alone Photovoltaic application
3.	In forward converter the primary and demagnetizing windings having equal number of turns, the maximum duty cycle is ……..
Option A:	0.5
Option B:	1
Option C:	0.7
Option D:	0.9
4.	Resonant converters use some form of ……. resonance.
Option A:	RC
Option B:	LC
Option C:	R
Option D:	L
5.	As the frequency increases, size of the magnetic component ……..
Option A:	decreases
Option B:	increases
Option C:	does not change
Option D:	Can increase or decrease
6.	Inductor current is always greater than zero in …… conduction mode.
Option A:	Continuous
Option B:	Discontinuous
Option C:	Boundary
Option D:	Just continuous
7.	……. dc-dc converter is preferred for 1000W power level.
Option A:	Flyback
Option B:	Forward
Option C:	Full bridge
Option D:	Non isolated Boost

8.	Output inductor is not present in ……. DC-DC converter
Option A:	Half bridge
Option B:	Full bridge
Option C:	Forward
Option D:	Flyback
9.	Among the following …….. is a second order converter
Option A:	Boost
Option B:	Flyback
Option C:	Forward
Option D:	Full bridge
10.	The function of output filter capacitor is to reduce ripple in ------
Option A:	Output voltage
Option B:	Input voltage
Option C:	Output power
Option D:	Input power

Q2	**Solve any Two Questions out of Three 10 marks each**
A	Draw the block diagram feedback control loop of DC-DC converter and explain briefly. What is linearized feedback control ?
B	Describe the working of a Forward DC-DC converter.
C	With neat block diagrams compare linear power supply and switched mode power supply.

Q3	**Solve any one Question - 20 marks**
A	Illustrate the diagram of a Flyback dc to dc converter. Design a transformer for the Flyback converter for the following specifications: V_d=24V, V_o=5V P_o=30W, f_s=40kHz, L_1=1mH. Assume K_w=0.4, ΔB=0.1T, J=3A/mm^2, D_{max}=0.45, η =80%, V_D=1.5. Assume any other data if needed and state it.
B	Find the expression for control to output transfer function of an Ideal Boost converter in CCM using state space averaging technique and small signal analysis.

Q4	**Solve any Two Questions out of Three 10 marks each**
A	Describe the working of Zero Current Switching in Dc-Dc converters
B	Explain working of three level Diode clamped Multilevel Inverter
C	In a step down converter, consider all components to be ideal. Calculate the minimum inductance required to keep the converter operation in CCM under all conditions if Vd =10-40V, Po ≥ 5W, fs =50kHz, and Vo=5V.

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_e 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 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	705
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

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