EE/KSSK/SUN/09052021/Test2 **Name:…….....**
Roll No:…….....

DEPARTMENT OF ELECTRCAL ENGINEERING
National Institute of Technology Calicut

TEST 2- WINTER SEMESTER MAY 2021

EE6308DSWITCHED MODE & RESONANT CONVERTERS

Time : 2 Hrs **Maximum : 20 Marks**

Answer All Questions

1. Show that area product of the core needed to design an inductor with DC bias is proportional to the magnetic energy storage in the inductor at DC bias current. (2 Marks)

2. A half-bridge converter running from 400V DC employs 70µH inductance and 220µF capacitor as filter components at output and the switches switch at 25kHz. 400V DC is split into two 200V sources by means of two 3.3µF capacitors. The output voltage is maintained at 12V. Turns ratio of primary winding to one-half of secondary winding is 11. Primary winding has 2.7mH self inductance.

   (a) Find and plot the currents flowing through the 3.3 µF input splitting capacitors when the converter is delivering 10A at its output. Assume ideal components.
   (b) If the transformer has 3% leakage inductance, find the duty ratio required in the converter to maintain 12V at output while delivering 10A load. You may ignore all other non-idealities.. (1 ½ + 1 ½ = 3 Marks)

3. Compare a DCM mode flyback design and CCM mode flyback design when both designs are carried out for same specifications. (2 Marks)

4. Derive the relation between output power and area product of transformer for a full bridge converter. (2 Marks)

5. Explain Flux-walking problem in a push-pull converter ? What are the different reasons leading to this problem? How can the problem be solved? (1 ½ Marks)

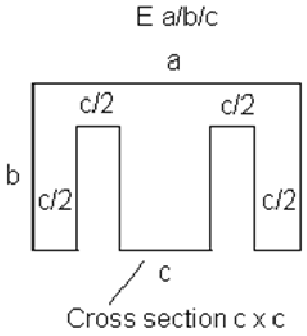
6. Design a Push-Pull Converter to satisfy the following specifications
   Input : 200V – 280V, Output: 48V, 2A – 5A, Output Ripple : <1% peak to peak, Inductor Current Ripple : <1A peak to peak, Magnetising current in Transformer : < 25% of load component (peak), Switching frequency : 50kHz. Specify the MOSFETs and Diodes completely. Use 30us Electrolytic capacitors and specify the capacitor completely including ripple rms current rating. Design **the transformer and inductor** using ferrite EE cores and round enameled copper wire and use bifilar secondaries. Use B_m = 0.2 Wm/sq.m, J = 3A/sq.mm, k_s = 0.35 for transformer and 0.4 for inductor. Take the coil former thickness as 1mm and creepage distance as 2mm. *Design steps should be explained clearly with relevant waveforms. Copper loss estimation is not needed.* (6 ½ Marks)

7. A Push-Pull Converter operating from an input voltage that is between 180V to 240V to generate 12V at the output uses a transformer with turns ratio 6 and magnetizing inductance of 1mH and switches at 20kHz. It uses 80µH inductance 680µF capacitor of 40µs family at the output. The load current can vary

between 4A and 10A. Design a CT using toroidal ferrite core to sense the current in the input line with a sensing gain of 0.4 V/A. Explain the design considerations and design equations clearly. (3 Marks)

(Use the data file provided earlier if this table is insufficient)

Core	Ac (mm^2)	Aw (mm^2)	Ap (mm^4)	AL ($nH/Turn^2$)	Volume (mm^3)
E30/15/7	60	49	2940	1700	4000
E32/16/9	83	81.4	6756	2100	6140
E36/18/11	120	112	13440	2900	9720
E40/16/12	149	143	21307	3800	11500
E42/21/15	178	175	31150	3500	17300
E47/20/16	233	226	52658	5100	20700
E56/28/19	340	327	111180	6300	36400



Core	Ac (mm^2)	Aw (mm^2)	Ap (mm^4)	AL ($nH/Turn^2$)
T10	6.2	19.6	2940	765
T12	12	44.2	6756	1180
T16	20	78.5	13440	1482
T20	22	95	21307	1130
T27	42	165	31150	1851
T32	61	165	52658	2427
T45	93	616	111180	2367

SWG	Dia with enamel (mm)	Area of copper (sq.mm)	R/km @ 20°C (Ohms)
40	0.142	0.012	1477
38	0.175	0.018	945
34	0.264	0.043	402
30	0.351	0.078	221
28	0.417	0.111	155
26	0.505	0.164	105
24	0.612	0.245	70.3
22	0.77	0.397	43.4
20	0.978	0.657	26.3
19	1.082	0.811	21.3
18	1.293	1.167	14.8
17	1.501	1.589	10.8
15	1.92	2.627	10.8
14	2.129	3.243	5.3

==========