BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: PG **SEMESTER: 2ND**

BRANCH: Power Electronics (MESRA) **SESSION: SP22**

SUBJECT: EE603 Power Electronics System Design

TIME: 2Hrs **FULL MARKS:50**

INSTRUCTIONS:
1. The question paper contains 10 questions.
2. All questions are compulsory.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.

Note: - All questions are compulsory Marks

Q1.	Design GATE driver circuit for MOSFET	**[4]**
Q2.	Design an inductor for boost converter for the following specifications. Output voltage, V_O=20V, Output current, I_O=5A, switching frequency, f_S=20kHz, and input voltage Vi=10V±10% **(See Appendix II and III for required data)**	**[6]**
Q3.	How the current and voltage sensors are selected for power electronics application. Design appropriate current and voltage sensing arrangement for closed loop operation of PV system.	**[5]**
Q4.	State and explain the step-by-step design procedure of single-phase rectifier with capacitor input filter	**[5]**
Q5.	Explain the operation of Flyback converter and illustrate the designing procedure using governing equations.	**[5]**
Q6.	The buck regulator has an input voltage *Vs=12V*. The required average output voltage is $V_a=5V$ at *R=500*ohm and peak-to-peak output ripple voltage is *20mV*. The switching frequency is 25kHz. If the peak-to-peak ripple current of inductor is limited to *0.8A*, determine (a) the duty cycle, (b) the filter inductance (c) filter capacitance, and (d) the critical values of *L* and *C*.	**[5]**
Q7.	Define the performance parameters of inverter.	**[5]**
Q8.	Find the output voltage and current of a three-phase bridge inverter using Fourier series analysis.	**[5]**
Q9.	Explain the operation and design of SMPS	**[5]**
Q10.	Discuss the thermal problems in power electronics and explain the procedure for heat sink design.	**[5]**

Appendix II

Properties of Few Ferrite Cores

Cores without air gap	Mean length per turn (mm)	Mean magnetic length l_m (mm)	Core cross-section area A_c (mm^2)	Window area, A_w (mm^2)	Area product A_p (mm^4)
Pot Cores					
P18/11	35.6	26	43	27	1161
P26/16	52	37.5	94	53	4982
P30/19	60	45.2	136	75	10200
P36/22	73	53.2	201	101	20301
P42/29	86	68.6	264	181	47784
P66/56	130	123	715	518	370370
EE Cores					
E20/10/5	38	42.8	31	47.8	1481
E25/9/6	51.2	48.8	40	78	3120
E25/13/7	52	57.5	55	87	4785
E30/15/7	56	66.9	59.7	119	7104.3
E36/18/11	70.6	78	131	141	18471
E42/21/9	77.6	108.5	107	256	27392
E42/21/15	93	97.2	182	256	46592
E42/21/20	99	98	235	256	60160
E65/32/13	150	146.3	266	537	142842
UU Cores					
UU 15	44	48	32	59	1888
UU 21	55	68	55	101	5555
UU 23	64	74	61	136	8296
UU 60	183	184	196	1165	228340
UU 100	29.3	308	645	2914	1879530
Toroids					
T 10	12.8	23.55	6.2	19.6	121.52
T 12	19.2	30.4	12	44.2	530.4
T 16	24.2	38.7	20	78.5	1570
T 20	25.2	47.3	22	95	2090
T 27	34.1	65.94	42	165.1	6934.2
T 32	39.6	73	61	165.1	10071.1
T 45	54.7	114.5	93	615.7	57260.1

Appendix III

Wire Size Table

SWG	Diameter with enamel (mm)	Area of bare conductor (mm^2)	*R*/km @20ºC Ω	Weight (kg/km)
45	0.086	0.003973	4,340	0.0369
44	0.097	0.005189	3,323	0.0481
43	0.109	0.006567	2,626	0.061
42	0.119	0.008107	2,127	0.075
41	0.132	0.009810	1,758	0.0908
40	0.142	0.011675	1,477	0.1079
39	0.152	0.013700	1,258	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	0.042890	402	0.3932
33	0.287	0.050670	340.3	0.465
32	0.307	0.059100	291.7	0.5408
31	0.33	0.06818	252.9	0.6245
30	0.351	0.07791	221.3	0.7121
29	0.384	0.09372	184	0.8559
28	0.417	0.11100	155.3	1.014
27	0.462	0.13630	126.5	1.245
26	0.505	0.16420	105	1.499
25	0.561	0.20270	85.1	1.851
24	0.612	0.24520	70.3	2.233
23	0.665	0.29190	59.1	2.655
22	0.77	0.39730	43.4	3.607
21	0.874	0.51890	33.2	4.702
20	0.978	0.65670	26.3	5.939
19	1.082	0.81070	21.3	7.324