17ume 067

MODERN ELECTRICAL AND ELECTRONICS TECHNOLOGIES

Mid Term Examination, 1st October 2018 (2:30 to 4:00 PM)

Duration: 90 minutes Max. Marks: 30

NOTE: You are allowed to bring one A4 size formula sheet to the Examination Hall.

1. A single-phase a.c. voltage v (t) = 311.13cos (314t + 37^0) volts is applied across a load containing a 10-Ω resistor in series with a 20 mH inductor and a 5 mF capacitor. How much current would flow in the circuit? Sketch the power triangle. [5]
2. A 100-V DC source is connected across a 20-Ω resistor. How much energy would the resistor consume over a 30-minute period? [5]
3. A. Briefly describe the nature of various losses in a typical transformer. How are the terms 'Voltage Regulation' and 'All Day Efficiency' defined? Illustrate through numerical examples. [3]

   B. Mathematically prove that the best efficiency of a voltage transformer is obtained when iron losses and copper losses are almost equal to each other. [2]
4. A. The nameplate of the electrical transformer shown in FIGURE 4A reads 66-KVA, 11-KV/2200-V, 50-Hz. Calculate the turns-ratio of the transformer. What AWG size wires, in your humble opinion, are being used for primary and secondary windings Use Table 1. [1]

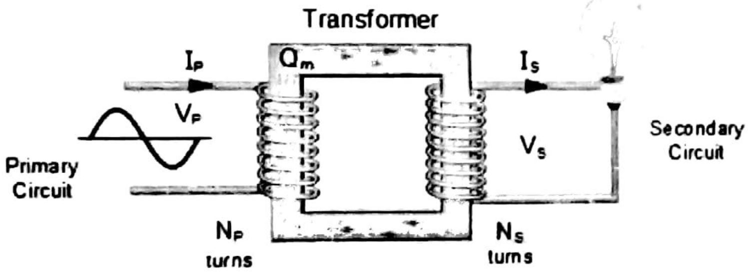

FIGURE 4A

B. A 2300-VA, 230/115-V, 50 Hz voltage transformer has primary winding resistance = 1 Ω and secondary winding resistance = 0.1 Ω. The winding inductances are negligible and so are the core losses. Calculate a) full-load primary current, b) full-load secondary current, c) turns ratio of the transformer, d) Percentage voltage regulation, and e) full-load efficiency. [2]

C. An ideal lossless voltage transformer's core is being subjected to the magnetic flux variation sketched in FIGURE 4C. The number of turns in the primary winding is 1000 and that in the secondary winding is 100. Sketch the behavior of primary electromotive force (e.m.f.) with time. [2]

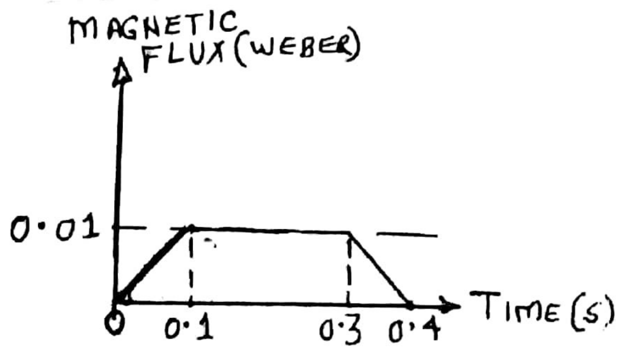

FIGURE 4C

5. A. A moving-coil galvanometer is known to produce full deflection for 100 micro-ampere current. Using this galvanometer, design a voltmeter capable of measuring 20 V maximum. The resistance of the galvanometer is 10 Ω. [2]

B. Design a Wheatstone Bridge capable of measuring resistance values over the range 1mΩ-1Ω. [3]

6. Through the use of a circuit diagram, explain how a power meter works. Also explain how a house-hold energy meter works. [5]

Table 1: American Wire Gauge (AWG) Cable / Conductor Sizes and Properties

AWG	Diameter [inches]	Diameter [mm]	Area [mm^2]	Resistance [Ohms / 1000 ft]	Resistance [Ohms / km]	Max Current [Amperes]	Max Frequency for 100% skin depth
0000 (4/0)	0.46	11.684	107	0.049	0.16072	302	125 Hz
000 (3/0)	0.4096	10.40384	85	0.0618	0.202704	239	160 Hz
00 (2/0)	0.3648	9.26592	67.4	0.0779	0.255512	190	200 Hz
0 (1/0)	0.3249	8.25246	53.5	0.0983	0.322424	150	250 Hz
1	0.2893	7.34822	42.4	0.1239	0.406392	119	325 Hz
2	0.2576	6.54304	33.6	0.1563	0.512664	94	410 Hz
3	0.2294	5.82676	26.7	0.197	0.64616	75	500 Hz
4	0.2043	5.18922	21.2	0.2485	0.81508	60	650 Hz
5	0.1819	4.62026	16.8	0.3133	1.027624	47	810 Hz
6	0.162	4.1148	13.3	0.3951	1.295928	37	1100 Hz
7	0.1443	3.66522	10.5	0.4982	1.634096	30	1300 Hz
8	0.1285	3.2639	8.37	0.6282	2.060496	24	1650 Hz
9	0.1144	2.90576	6.63	0.7921	2.598088	19	2050 Hz
10	0.1019	2.58826	5.26	0.9989	3.276392	15	2600 Hz
11	0.0907	2.30378	4.17	1.26	4.1328	12	3200 Hz
12	0.0808	2.05232	3.31	1.588	5.20864	9.3	4150 Hz
13	0.072	1.8288	2.62	2.003	6.56984	7.4	5300 Hz
14	0.0641	1.62814	2.08	2.525	8.282	5.9	6700 Hz
15	0.0571	1.45034	1.65	3.184	10.44352	4.7	8250 Hz
16	0.0508	1.29032	1.31	4.016	13.17248	3.7	11 k Hz
17	0.0453	1.15062	1.04	5.064	16.60992	2.9	13 k Hz
18	0.0403	1.02362	0.823	6.385	20.9428	2.3	17 kHz
19	0.0359	0.91186	0.653	8.051	26.40728	1.8	21 kHz
20	0.032	0.8128	0.518	10.15	33.292	1.5	27 kHz
21	0.0285	0.7239	0.41	12.8	41.984	1.2	33 kHz
22	0.0254	0.64516	0.326	16.14	52.9392	0.92	42 kHz
23	0.0226	0.57404	0.258	20.36	66.7808	0.729	53 kHz
24	0.0201	0.51054	0.205	25.67	84.1976	0.577	68 kHz
25	0.0179	0.45466	0.162	32.37	106.1736	0.457	85 kHz
26	0.0159	0.40386	0.129	40.81	133.8568	0.361	107 kHz
27	0.0142	0.36068	0.102	51.47	168.8216	0.288	130 kHz
28	0.0126	0.32004	0.081	64.9	212.872	0.226	170 kHz
29	0.0113	0.28702	0.0642	81.83	268.4024	0.182	210 kHz
30	0.01	0.254	0.0509	103.2	338.496	0.142	270 kHz
31	0.0089	0.22606	0.0404	130.1	426.728	0.113	340 kHz
32	0.008	0.2032	0.032	164.1	538.248	0.091	430 kHz
33	0.0071	0.18034	0.0254	206.9	678.632	0.072	540 kHz
34	0.0063	0.16002	0.0201	260.9	855.752	0.056	690 kHz
35	0.0056	0.14224	0.016	329	1079.12	0.044	870 kHz
36	0.005	0.127	0.0127	414.8	1360	0.035	1100 kHz
37	0.0045	0.1143	0.01	523.1	1715	0.0289	1350 kHz
38	0.004	0.1016	0.00797	659.6	2163	0.0228	1750 kHz
39	0.0035	0.0889	0.00632	831.8	2728	0.0175	2250 kHz
40	0.0031	0.07874	0.00501	1049	3440	0.0137	2900 kHz