LNMIIT
The LNM Institute of Information Technology

The LNM Institute of Information Technology, Jaipur

Department of Mechanical-Mechatronics Engineering

Modern Electrical and Electronics Technologies (TBD)

Mid Term Examination

Academic Year: 2017-18 **Mid Term-2017**

Degree: *B. Tech*, **Program:** ME,MTRE

Time: 90 minutes **Date:** 22/09/2017 **Maximum Marks:** 30

Instructions: *THIS QUESTION PAPER CONTAINS TWO PAGES. All questions carry equal marks. You can bring in one A4 size 'cog-sheet' to the examination hall. You can write anything on both sides of this cog-sheet that, in your own opinion, may help you in performing better in the exam.*

1. Derive the mathematical equation for a 50-cycle-voltage-sine wave, having an RMS value of 30 volts. What is the value of the voltage when the time is 5 msec.? What fraction of a cycle has such a wave gone through in 5 msec.? Assume that the wave crosses the time axis in a negative direction when the time is equal to zero.
2. If the voltage in Q 1 is connected across a load containing one lossless inductor of 135 mH value, calculate a) the consumed power in the load, b) the reactive power in the load, c) the apparent power in the load, and d) the power factor of the load.
3. If the voltage in Q 1 is connected across a load containing one 10-ohm resistor, calculate a) the consumed power in the load, b) the reactive power in the load, c) the apparent power in the load, and d) the power factor of the load.
4. Name and briefly describe the three main parts used in the construction of a typical Cathode Ray Oscilloscope (CRO).
5. Briefly describe how an induction-type energy meter works.
6. a. What is the essential difference between deflection-type and null-type measuring instruments?
   b. A moving coil galvanometer of resistance 100Ω is used as an ammeter using a shunt resistance of 0.1Ω. The maximum deflection current in the galvanometer is 100 micro-amperes. Calculate the numerical value of the maximum current that this ammeter can measure.
7. a. The output voltage (that is, secondary voltage) of a transformer falls from 120 volts at no-load to 100 volts at full-load. Calculate the percentage voltage regulation.
   b. A step-up voltage-transformer has primary voltage of 48 volts and secondary voltage of 120 volts. If the primary winding has 700 turns, how many turns are there in the secondary winding?
8. a. Briefly discuss the various factors that lead to loss of power in a typical transformer.
   b. A 500KVA, single-phase, 13.8/4.160kV, 60 Hz transformer has primary resistance equal to 0.8 ohm and secondary resistance equal to 0.04 ohm. The iron loss is equal to 6,000 watts. Calculate the copper loss and the full-load efficiency of the transformer.
9. a. Derive the condition for maximum efficiency in a transformer.
   b. If the maximum primary current in a step-down transformer is expected to be 10 Amperes, which AWG size would you recommend for the primary windings? If the turns ratio of the transformer is 10:1, which AWG size would you recommend for the secondary windings?

10. A four-pole shunt-wound DC motor is fed from a 440-volts supply and takes an armature current of 50 amperes. The resistance of the armature circuit is 0.28 ohm. The armature winding is wave-connected with 888 conductors and flux per pole of 0.023 Wb. At what speed would the motor run?

11. A 100-KW, 250-V DC shunt generator has armature winding resistance = 0.05 Ω and field winding resistance = 60 Ω. With the generator operating at rated voltage, determine the numerical value of the induced e.m.f. in the armature at full-load.

12. A 4-pole D.C. Shunt Generator has an armature resistance of value 0.018 Ω. The armature has 520 conductors. The useful flux per pole is approximately equal to 32 mWb. The rotor is driven at 12.5 RPS. When the terminal voltage is set to 200 V, the armature current is measured to be approximately equal to 400 A. Determine the nature of the armatue windings (wave-wound or lap-wound?).

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

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End Term Examination

Academic Year: 2017-18 **End Term-2017**

Degree: *B. Tech.* **Program:** ME,MTRE

Time: 180 minutes **Date:** 28/11/2017 **Maximum Marks:** 50

Instructions: THIS QUESTION PAPER CONTAINS TWO PAGES. THE FIRST FIFTEEN QUESTIONS ARE MULTIPLE-CHOICE TYPE, FOR WHICH YOU SHOULD WRITE THE CORRECT CHOICE (A, B, C, OR D) IN THE ANSWER-BOOK.
THE FIRST FIFTEEN QUESTIONS ARE WORTH ONE (1) MARK EACH AND THE REMAINING QUESTIONS ARE WORTH FIVE (5) MARKS EACH. You can bring in TWO A4 size cog-sheets to the Examination Hall.

1. **The ratio of the power factor of a 100 Ω resistor to the power factor of a 1 MΩ resistor is A). 10,000, B) 0.0001, C) 1.0000, D) None of the previous answers.**
2. **A 100 Ω resistor is connected to a 100 V DC supply. The energy consumed by the resistor over a 1-hour period will be A) 0.1 KWh, B) 1KWh, C) Zero, D) None of the previous answers.**
3. **A 220V/110V transformer has the turns ratio equal to A) 220, B) 110, C) 2, D) None of the previous answers.**
4. **The starter is a device that is essential for the safe operation of A) a DC generator, B) an alternator, C) a DC motor, D) None of the previous answers.**
5. **The most preferred value of voltage regulation is A) 0%, B) 100%, C) 50%, D) None of the previous answers.**
6. **A 60-Hz alternator is running at 2 RPS. How many poles has it got? A) 2, B) 4, C) 8, D) None of the previous answers.**
7. **A three-phase, 460-volt, 100-hp, 60-Hz, four-pole induction machine delivers rated output power at a slip of 0.10. The motor speed is A) 0, B) 1620 RPM, C) 3240 RPM, D) None of the previous answers.**
8. **Most large alternators have a small dc generator built into them. The purpose is A) to reduce maintenance efforts, B) to provide dc current for the rotating field, C) to improve the power factor, D) to improve the efficiency.**
9. **What is the main advantage of high-frequency heating methods over low-frequency heating methods? A) Slower Heating, B) Faster Heating, C) Reduced Losses, D) None of the previous answers.**
10. **Is the microwave oven an example of induction heating? A) Yes, B) No, C) Not Sure, D) No-one knows.**

11. What is the meaning of the term 'concurrent engineering'? A) Do all steps in parallel, B) Do all steps in sequence, C) Do some steps in parallel and some sequentially, D) None of the previous answers.
12. Are electric drives superior to diesel-driven drives? A) Yes, B) No, C) Not Always, D) No-one knows.
13. Which types of motors are better suited for use in Textile Mills? A) DC Motors, B) Synchronous Motors, C) Induction Motors, D) Servomotors.
14. The biggest advantage of mechatronic systems is A) the ability to save costs, B) the ability to do things that other systems cannot, C) faster time-to-market, D) All of the previous answers.
15. Which one of the following is a good example of a Mechatronic System? A) Office Printer, B) Office PC, C) The Washing Machine, D) The LAPTOP Computer.
16. Summarize the various equations needed for analyzing DC motors with series, shunt and compound windings.
17. Write a brief note on the various core-type induction furnaces.
18. Briefly discuss the main differences between synchronous machines and induction machines (including their construction-related differences).
19. Name and briefly discuss the various steps used in developing a typical mechatronic system.
20. An ideal loss-less transformer has a 150-turn primary and a 750-turn secondary. The primary is connected to a 240-V, 50-Hz source. The secondary winding supplies a load current of 4 Amperes at a lagging power factor of 0.8. Determine (a) the turns ratio, b) the current in the primary, c) the power supplied to the load, and d) the magnetic flux in the core.
21. A three-phase, 20-hp, 208-volt, 60-Hz, six-pole, wye-connected induction motor delivers 15 KW at a slip of 5%. Calculate the synchronous speed.
22. A wooden board of dimensions 100 cm x 50 cm x 2 cm is to be heated from 25 degree Celsius to 175 degree Celsius in 10 minutes by using dielectric heating. A 30 MHz supply is being used. The specific heat of wood is equal to 0.35 Calories per gram per degree C. The density of wood is equal to 0.5 gram/cc. The dielectric constant of wood is equal to 5. The power factor of wood is equal to 0.05. How much voltage will be needed across the specimen? How much current would be drawn during heating? Assume that the loss of heat energy due to radiation, convection, conduction, etc. is 5%.