MODERN ELECTRICAL AND ELECTRONICS TECHNOLOGIES: Assignment 1 (11th August, 2017)

1. Show that 1 Joule energy is approximately equal to 277.78 micro-watt-hour.
2. A 200V DC source is feeding a 78-ohm resistor. Calculate the energy consumed in the resistor over a 2-hour period.
3. Repeat 2 with a 1mH inductor.
4. Repeat 2 with a 1 nF capacitor.
5. Repeat 2 if the resistor is replaced by a series combination of 78-ohm resistor, 1 mH inductor, and 1 nF capacitor.
6. A 220 V AC source feeds a 1000-W geyser. What current would flow?
7. What is power factor of the geyser mentioned in 6?
8. How much reactive power is consumed by the geyser mentioned in 6?
9. What is the peak and average value of an a.c. current given by $i\ (t) = 100\cos\ (314t + 45^0)$ mA?
10. For the current in 9, calculate the RMS and peak-to-peak vales. Also calculate the frequency, the time-period, and the phase-shift of the signal wave-form.
11. A single-phase a.c. voltage $v\ (t) = 311.13\cos\ (314t + 37^0)$ volts is applied across a load containing a 50-Ω resistor in series with a 200mH inductor and a 50mF capacitor. Compute the approximate numerical values (including units) of a) the RMS value of the applied voltage (answer: 220 volts), b) the average value of the applied voltage (answer: 0 volts), c) the angular frequency of the applied voltage (answer: 314 radians/second), d) the frequency of the applied voltage (answer: 50 Hz or 50 c/s) and e) the time-period of the applied voltage (answer: 20 mSec).
12. For the situation described in 11, compute the approximate numerical value of the power-factor angle (answer 0.95^0) and the power-factor (answer 0.9998). Is the power-factor leading or lagging?
13. For the situation described in 11, compute the approximate numerical values (including units) of a) the RMS value of the load current (answer 4.4 Amperes), b) the average value of the load current (answer 0 Amperes), c) the angular frequency of the load current (answer 314 radians/second), d) the peak value of the load current, and e) the peak-to-peak value of the load current. Is the current leading or lagging the voltage?
14. For the situation described in 11, compute the approximate numerical value of the consumed power in load, and the reactive power in load. Do not forget to mention the units. Sketch the power triangle.

MODERN ELECTRICAL AND ELECTRONICS TECHNOLOGIES: Assignment 2 (1st September 2017)

1. Name and briefly describe the three main parts used in the construction of a typical Cathode Ray Oscilloscope (CRO).
2. An ac voltage waveform as seen on the CRO screen is shown in Fig. 2. The time-base is set to 2ms/div and the voltage-scale is set to 1V/div. Calculate the time-period, the frequency, the peak-to-peak value, the peak value, the RMS value (also known as effective value), and the average value (also known as DC value) of the waveform. Also write the mathematical equation describing the time-dependence of the voltage. ANS: $T = 6.6 \times 10^{-3}$ sec, f = 151.5 Hz, RMS value=1.414 V.
3. For the calculations made in Problem 2, estimate the percentage error in frequency measurement. MY OWN ANSWER: 2% max. (You may claim some other answer based on how good your eye-sight is).
4. For the calculations made in Problem 2, estimate the percentage error in voltage measurement. MY OWN ANSWER: 5% max. (You may claim some other answer based on how good your eye-sight is).

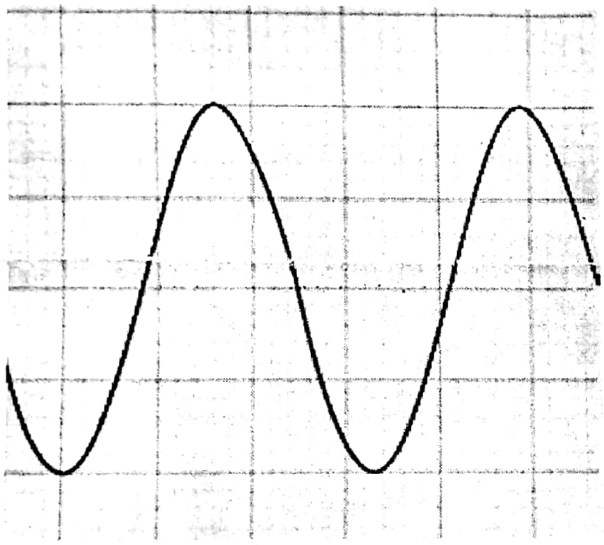


FIG 2. Snapshot of CRO Screen

5. A moving-coil galvanometer is known to produce full deflection for 100 micro-ampere current. Using this galvanometer, design (a) an ammeter capable of measuring 10 mA current, b) a voltmeter capable of measuring 10 V voltage.
6. Using the ammeter designed in 5, design an ohm-meter using a 6V battery.
7. Design a Wheatstone Bridge capable of measuring resistance values over the range 1mΩ-1Ω.
8. How do the following work? a) dynamometer-type wattmeter, b) electrostatic-type wattmeter, and c) induction-type wattmeter. Discuss their relative merits and demerits.
9. Briefly describe how an induction-type energy meter works.
10. Briefly describe how a VAR meter works.

MODERN ELECTRICAL AND ELECTRONICS TECHNOLOGIES: Assignment 3 (8th September 2017)

1. Write a brief note on the various methods of classifying transformers.
2. A voltage-transformer has primary voltage of 480 volts and secondary voltage of 120 volts. If the primary winding has 700 turns, how many turns are there in the secondary winding? (ANS : 175)
3. For the transformer considered in Problem 2, if a purely-resistive load of 240-ohm is connected across the two terminals of the secondary winding, calculate the resulting currents in primary and secondary windings. Also calculate the power factor of the load and the total power consumed in primary winding. Determine the AWG size of wires that you would recommend for primary and secondary windings. (ANS: I_p=125 mA, I_s=500 mA, PF=1, P_p=P_s=60 Watt, AWG 30 and 24).
4. A single-phase transformer has 1000 turns on its primary winding and 200 turns on its secondary winding. The maximum value of the flux-density is 1.1 Tesla (that is, 1.1 Weber/m^2) when 2200 volts, 50 Hz is applied to the primary winding. Calculate the cross-sectional area of the core. ANS : 90 cm^2
5. Write a brief note (not exceeding 200 words) discussing the main components used in constructing a typical transformer.
6. A single-phase transformer has turns-ratio of 10. If applied primary voltage is 100 volts, how much will be the numerical value of the secondary voltage? Neglect all losses.
7. For the transformer in Q 6, assume that the resistance of the primary windings is 2 Ω, that of the secondary winding is 0.2 Ω, and the inductive/capacitive effects in both windings are negligible. Under no-load conditions, the transformer draws 0.1 A current when 100 V is applied to its primary winding. How much current would flow in primary and secondary windings when a purely-resistive load of 50 Ω is connected across the secondary winding?
8. Calculate the efficiency and voltage regulation for the transformer in Q 7.
9. Show that the efficiency of a transformer is maximum when iron loss = copper loss.
10. 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 3,000 watts. Calculate the copper loss and the full-load efficiency of the transformer. ANS: Cu Loss = 1,626 watts, 99.3%).
11. For the transformer in 10, calculate the all-day efficiency if the daily load is 3 hours at full-load, 5 hours at 75% load, and 7 hours at 25% load. ANS: 97%.
12. Write a brief note on the various guidelines used in installing transformers.
13. A doorbell requires 400 mA at 6 V. It is connected to a transformer whose primary contains 2000 turns and is connected to a 110-V household outlet. How many turns should be there in the secondary? What is the current in the primary? How many watts does the bell require from the transformer? ANS: 109 turns, 22 mA, 2.4 watts.

A.W.G.	Diameter	Area	Weight		Length		Resistance	
B. & S.	Mm.	Sq. Mm.	Kg. per M.	Kg. per Ohm	M. per Kg.	M. per Ohm	Ohms per Kg.	Ohms per M.
0000	11.7	107.2	.953	5940	1.05	6,230	.000168	.000161
000	10.4	85.0	.756	3730	1.32	4,940	.000268	.000202
00	9.27	67.4	.599	2350	1.67	3,920	.000426	.000255
0	8.25	53.5	.475	1480	2.10	3,110	.000677	.000322
1	7.35	42.4	.377	929	2.65	2,460	.00108	.000406
2	6.54	33.6	.299	584	3.35	1,950	.00171	.000512
3	5.83	26.7	.237	367	4.22	1,550	.00272	.000645
4	5.19	21.2	.188	231	5.32	1,230	.00433	.000814
5	4.62	16.8	.149	145	6.71	975	.00688	.00103
6	4.11	13.3	.118	91.4	8.46	773	.0109	.00129
7	3.67	10.6	.0938	57.5	10.7	613	.0174	.00163
8	3.26	8.37	.0744	36.2	13.5	486	.0277	.00206
9	2.91	6.63	.0590	22.7	17.0	386	.0440	.00259
10	2.59	5.26	.0468	14.3	21.4	306	.0699	.00327
11	2.31	4.17	.0371	8.99	27.0	242	.111	.00413
12	2.05	3.31	.0294	5.66	34.0	192	.177	.00520
13	1.83	2.62	.0234	3.56	42.9	153	.281	.00656
14	1.63	2.08	.0185	2.24	54.1	121	.447	.00827
15	1.45	1.65	.0147	1.41	68.2	95.9	.711	.0104
16	1.29	1.31	.0116	.885	86.0	76.0	1.13	.0132
17	1.15	1.04	.00922	.556	108	60 3	1.80	.0166
18	1.02	.823	.00732	.350	136	47.8	2.86	.0209
19	.912	.653	.00580	.220	172	37.9	4.54	.0264
20	.812	.518	.00460	.138	217	30.1	7.23	.0333
21	.723	.410	.00365	.0871	274	23.9	11.5	.0419
22	.644	.326	.00289	.0548	346	18.9	18.3	.0529
23	.573	.258	.00229	.0344	436	15 0	29.1	.0667
24	.511	.205	.00182	.0217	550	11.9	46.2	.0841
25	.455	.162	.00144	.0136	693	9.43	73.4	.106
26	.405	.129	.00114	.00856	874	7.48	117	.134
27	.361	.102	.000908	.00538	1,100	5.93	186	.169
28	.321	.081	.000720	.00339	1,390	4.70	295	.213
29	.286	.0642	.000571	.00213	1,750	3.73	470	.268
30	.255	.0510	.000453	.00134	2,210	2.96	747	.338
31	.227	.0404	.000359	.000842	2,790	2.35	1,190	.426
32	.202	.0320	.000285	.000530	3,510	1.86	1,890	.537
33	.180	.0254	.000226	.000333	4,430	1.48	3,000	.678
34	.160	.0201	.000170	.000210	5,590	1.17	4,770	.855
35	.143	.0160	.000142	.000132	7,040	.928	7,590	1.08
36	.127	.0127	.000113	.0000829	8,880	.736	12,100	1.36
37	.113	.0101	.0000893	.0000521	11,200	.584	19,200	1.71
38	.101	.00797	.0000708	.0000327	14,100	.463	30,600	2.16
39	.0897	.00632	.0000562	.0000206	17,800	.367	48,500	[illegible] 73
40	.0799	.00501	.0000445	.0000130	22,500	.291	77,100	3 44

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

MODERN ELECTRICAL AND ELECTRONICS TECHNOLOGIES: Assignment 4 (15th September 2017)

1. What is the main difference between a DC Generator and a DC Motor?
2. Write the mathematical formula expressing Rotary Mechanical Power in terms of Torque and RPM. P = WT
3. Briefly discuss the main parts used in constructing DC generators.
4. Briefly discuss the main parts used in constructing DC motors.
5. Summarize the equations needed for analyzing DC generators with series, shunt and compound windings.
6. Summarize the equations needed for analyzing DC motors with series, shunt and compound windings.
7. Briefly discuss the need for a starter in a DC motor.
8. What are the main performance characteristics of a DC generator?
9. What are the main performance characteristics of a DC motor?
10. What are the main reasons for power losses in DC machines? Discuss in brief.
11. A 100-KW, 250 Volt DC Shunt Generator has armature-winding resistance = 0.05Ω and field-winding resistance = 60Ω. With the generator operating at rated voltage, determine the induced e.m.f. in the armature at a) full-load and b) half-full load. ANS: 270.2 Volts at full-load and 260.2 Volts at half-full load.
12. Calculate the full-load and half-load values of the percentage voltage regulation for the DC Shunt Generator in Q 11.
13. Repeat Problems 11 and 12 assuming that brush drop is 1V per brush. 1/2 · I_L
14. Repeat Problems 11,12, and 13 assuming that stray losses (iron losses plus mechanical losses) in the Generator are equal to 647 Watts. out
15. Consider a shunt-wound DC motor, running at full rated speed, with the following parameters: out + cu, br stray
    a. Supply Voltage (V) = 440 volts
    b. Armature Resistance (R_a) = 0.5 ohm V = sup
    c. Field Resistance (R_f) = 100 ohm
    d. No. of Conductors on Armature (Z) = 3000
    e. No. of Parallel Paths on Armature (A) = 2
    f. No. of poles (P) = 4
    g. Armature Revolutions Per Minute (N) = 3000
    h. Flux per pole (ϕ) = 1.4 mWb

Calculate the following:

a. Back emf E_b
b. Armature Current (I_a)
c. Field Current (I_f)
d. Total Current drawn by the Motor (I_L)
e. Efficiency of the Motor
f. Input Electrical Power
g. Output Mechanical Power
h. Power Loss in Armature
i. Power Loss in field windings, and
j. The torque produced by the Motor.

16. What are the main assumptions you have tacitly made in solving Problem 15?
17. How would you define the efficiency of a DC Generator?
18. How would you define the efficiency of a DC Motor?
19. In the context of DC Machines, briefly explain the role played by a) Rotor, b) Armature, c) Yoke, d) Stator, e) Bushes, f) Commutator, g) Field Windings, and h) Armature Windings.
20. What is the main difference between a lap-wound armature and a wave-wound armature?
21. Why is the rotor in a DC Machine built using laminations (instead of solid construction)?
22. What is the essential difference between self-excited DC Motors and Separately-Excited DC Motors?
23. Briefly discuss the torque vs. load characteristics of DC Motor vis-à-vis the type of field excitation.
24. Briefly discuss the speed vs. load characteristics of DC Motor vis-à-vis the type of field excitation.
25. Briefly discuss the torque vs. speed characteristics of DC Motor vis-à-vis the type of field excitation.
26. Briefly discuss the various methods of speed control in a DC Motor.

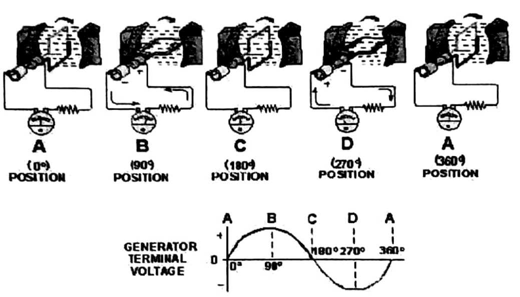


FIG 1a. A single loop rotating in the magnetic field of a permanent magnet

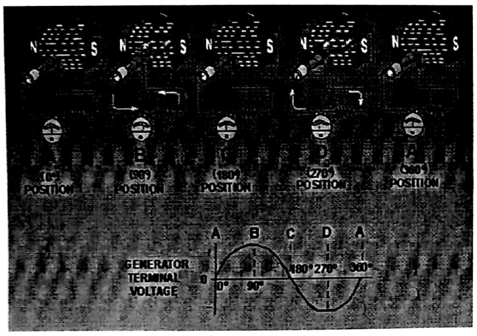


FIG 1b. A single loop rotating in the magnetic field of a permanent magnet

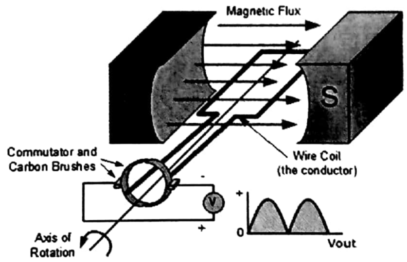


FIG 2. FIG 1 PLUS Commutator and brushes

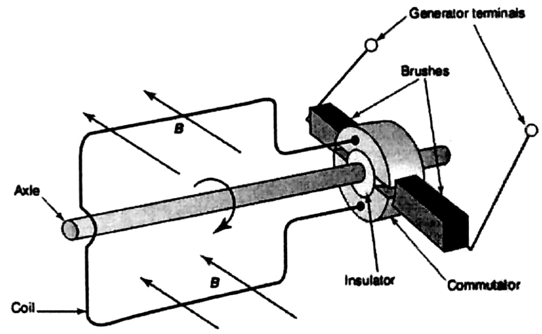


FIG 3. 3D for FIG 2

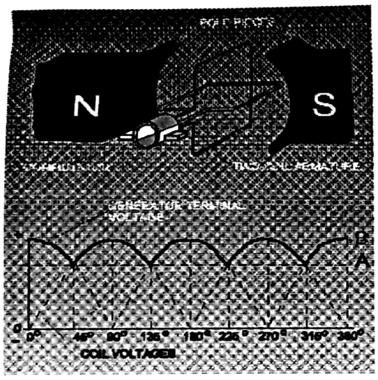


FIG 4. Effects of additional loops

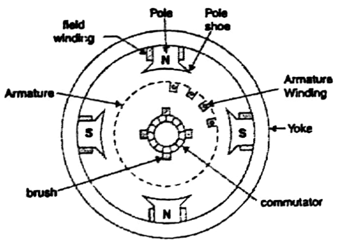


FIG 5. CONSTRUCTION OF A DC GENERATOR (CROSS-SECTIONAL VIEW)

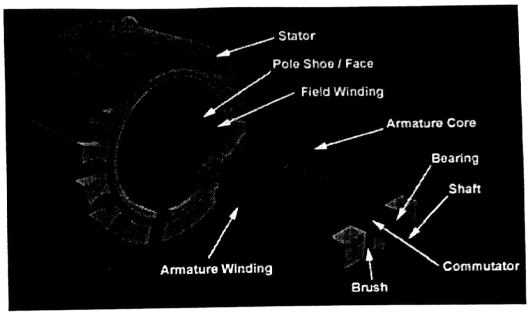


FIG 6. CONSTRUCTION OF A DC GENERATOR (3D)

MODERN ELECTRICAL AND ELECTRONICS TECHNOLOGIES: Assignment 5 (17th October 2017)

1. Magnetic induction occurs when there is relative motion between what two elements?
2. What is the part of an alternator in which the output voltage is generated?
3. What are the two basic types of alternators?
4. Why is it not easy to generate dc voltages using electromechanical machines?
5. What is the main advantage of the rotating-field alternator?
6. Most large alternators have a small dc generator built into them. What is its purpose?
7. How alternators are usually rated?
8. What type of prime mover requires a specially-designed high-speed alternator?
9. Salient-pole rotors may be used in alternators driven by what types of prime movers?
10. What does the term 'single-phase' indicate?
11. In a three-phase alternator, what is the phase relationship between the individual output voltages?
12. What are the two methods of connecting the outputs from a three-phase alternator to the load?
13. What two factors determine the frequency of the output voltage of an alternator?
14. What is the frequency of the output voltage of an alternator with four poles if the alternator is rotated at 2800 rpm?
15. If the no-load output voltage of an alternator is 250 V and the full-load output voltage is 200 V, calculate the % voltage regulation.
16. How is the output voltage controlled in practical alternators?
17. What generator characteristics must be considered when alternators are synchronized for parallel operation?
18. A 60-Hz alternator has two poles. What is the speed of the alternator?
19. A 60-Hz alternator is running at 2 RPS. How many poles has it got?
20. A three-phase alternator is rated at 110 KVA, 11 KV. Assuming unity power factor of the load, how much power would it produce at full load?
21. Repeat problem 20 with P.F. = 0.8.
22. Discuss in brief the various reasons why the efficiency of a practical alternator is never equal to 100%.
23. What requirement is the synchronous motor specifically designed to meet?
24. Why are the ac induction motors used more often than other types of ac motors?
25. In an induction motor, the speed of the rotor is always somewhat less than the speed of the rotating field. Why?
26. In an induction motor, the speed of the rotor is always somewhat less than the speed of the rotating field. What is the difference called?
27. What determines the amount of slip in an induction motor? .
28. A 208-volt, 10-horsepower, four-pole, 60-Hz, Y-connected induction motor has a full-load slip of 5%. What is the synchronous speed of this motor?
29. For the motor considered in 28, what is the rotor speed?
30. For the motor considered in 29, what is the rotor frequency at the rated load?
31. 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.
32. For the motor considered in 31, calculate the rotor speed.
33. For the motor considered in 32, calculate the frequency of the rotor current.
34. A three-phase, 460-volt, 100-hp, 60-Hz, four-pole induction machine delivers rated output power at a slip of 0.10. Calculate the synchronous speed.
35. A three-phase, 460-volt, 100-hp, 60-Hz, four-pole induction machine delivers rated output power at a slip of 0.10. Calculate the motor speed.
36. A three-phase, 460-volt, 100-hp, 60-Hz, four-pole induction machine delivers rated output power at a slip of 0.10. Calculate the frequency of the rotor circuit.
37. What are the main parts used in the construction of synchronous motors?
38. What are the main parts used in the construction of single-phase asynchronous motors?
39. What are the main parts used in the construction of three-phase induction motors?
40. What are the main parts used in the construction of universal motors? How does this kind of motor work?
41. What are the main parts used in the construction of stepper motors? How does this kind of motor work?
42. What are the main parts used in the construction of brushless DC motors? How does this kind of motor work?
43. What are the main parts used in the construction of hysteresis motors? How does this kind of motor work?
44. What are the main parts used in the construction of reluctance motors? How does this kind of motor work?
45. For the same power output, will a synchronous motor be more efficient than the induction motor? Justify your answer.

MODERN ELECTRICAL AND ELECTRONICS TECHNOLOGIES: Assignment 6 (8th November 2017)

1. Briefly discuss the main advantages and disadvantages of Electric Heating over other methods of heating used for domestic and industry needs.
2. Why is artificial production of heat so important in day-to-day life? Illustrate using suitable examples from both industry and domestia.
3. Briefly discuss the three modes of heat transfer.
4. What is the essential difference between 'oven' and 'furnace'?
5. Determine the rate of heat transfer by conduction per unit area, by means of conduction for a furnace wall made of fire clay. The thickness of the furnace wall is half a foot. The thermal conductivity of the furnace wall clay is 0.3 W/mK. The furnace wall temperature can be taken to be the same as furnace operating temperature which is 650 degrees C. The temperature of the outer wall of the furnace is 150 degrees C.
6. The wall of an industrial furnace is constructed using 0.15 m thick fireclay brick having thermal conductivity of 1.7 W/mK. Measurements made during steady-state operation reveal temperatures of 1400K and 1150K at the inner and outer surfaces, respectively. Calculate the rate of heat loss through a wall which is 0.5 m by 3 m on a side.
7. What is the main difference between 'direct' and 'indirect' methods of heating?
8. What are the main requirements that a good resistive heating element should satisfy?
9. What are the main advantages and disadvantages of arc-furnace heating?
10. How does the IR heater work?
11. How does the Electron Bombardment type of heater work?
12. What is the main advantage of high-frequency heating methods over low-frequency heating methods?
13. Write a brief note on the various core-type induction furnaces.
14. Write a brief note on coreless-type induction heating.
15. Write a brief note on dielectric heating (including its advantages, its disadvantages, and its typical application).
16. Write a brief note on microwave oven.
17. A 220-V, 50-Hz supply is connected across a 100-Ω resistor for a continuous period of 1 hour. Assuming that the electricity-consumption charge is Re 6 per unit, how much will be the charge for operation mentioned in the previous sentence?
18. A slab of insulating material 130 centimeter-squared in area and having 1 cm thickness is to be heated by dielectric heating. The power required is 380 watts. The operating frequency is 30 MHz. The relative permittivity (also known as dielectric constant) of the material to be heated is 5. The power-factor of the material to be heated is 0.05. Determine the numerical value of the necessary voltage.
19. A power of 200 watts at a frequency of 30 MHz is required for dielectric heating of a slab 2 cm thick and 150 centimeter-squared in area. The material's relative permittivity is 5 and the material's power factor is 0.05. Determine the necessary voltage and the current which will flow through the material during heating.
20. For the case considered in 19, if the voltage is limited to 600 volts, to what value would the frequency have to be raised, to ensure the same amount of heating?
21. A wooden board of dimensions 30cm x 20 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%.

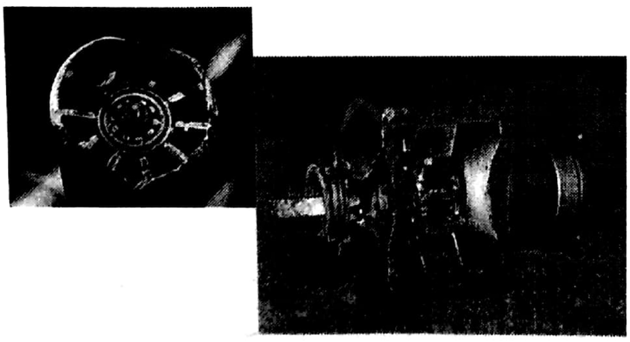
Magnetron

- Empty tube with magnets around it. The copper wire receives electric current from transformer and capacitor. Magnets create magnetic field which make electricity flow out of wire in beams of electrons.
- Each time electrons hit edge of wall, they return back in a circulation motion. This results in microwaves
  - Antenna inside magnetron send out microwaves to waveguide
  - Basically converts electrical energy to radiation.

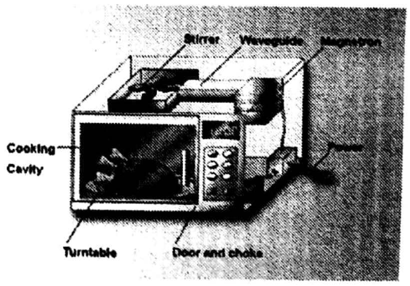
Parts of Microwave

- Waveguide=Guides microwaves into cooking chamber. Does this by confining the space of the releasing microwaves from the magnetron
- Cooking chamber=Chamber that confines the output radiation so that food can get heated up.

Magnetron



Another look at a microwave



Microwave Oven

- First made by Percy Spencer who was a self taught engineer.
- Worked for Raytheon, and discovered use for heating food by working in lab.
- Works by passing non-ionizing microwave radiation.
- In Electromagnetic spectrum lie between radio and infrared frequencies.

Parts of Microwave

- Control Panel=Allows electric current to flow to transformer.
- Transformer and Capacitor=supercharge electricity, and feed electricity to magnetron
  - Transformer=changes current and/or voltage into desired level.
  - Capacitor=Stores electricity, but in this case soothes current.

Microwave Oven

- Food, water and other things to eat absorb microwaves and heat up by dielectric heating.
- Dielectric heating=When radiation heats up a dielectric material. Temperature is raiesd by subjecting material to high frequency electromagnetic field.
  - Vibrates polarized molecules which heat up food.
  - Radiation causes dielectric heating.

Pictures

- Control panel
- Inner parts of a Microwave

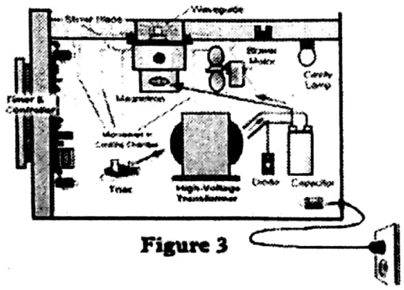


Figure 3

MODERN ELECTRICAL AND ELECTRONICS TECHNOLOGIES: Assignment 7 (17th November 2017)

1. Briefly discuss the main components used in a typical mechatronic system.
2. Why is the OPAMP so critical to mechatronic product development?
3. Name the main circuit applications for which the OPAMP is commonly used.
4. What is the meaning of the term 'concurrent engineering'?
5. What is the main difference between embedded systems and control systems?
6. What is the main difference between a microprocessor and a microcontroller?
7. What are the main steps in the product development cycle of a typical mechatronic system?
8. Briefly explain the meaning of the following: open architecture, real-time computing, and VDI?
9. What are code generators and how do they speed up the product development?
10. What is the essential difference between simulation and modeling?
11. What are the characteristics of a good system-level test plan?
12. What is root-cause analysis?
13. What are the main functions of a typical mechatronic system?
14. Define an Electric Drive.
15. How are electric drives superior to diesel-driven drives?
16. What are the disadvantages of electric drives?
17. What are the main components used in a typical electric drive?
18. Discuss and give the relative comparison chart for the three types of electric drives?
19. What are the main criteria used in selecting drives for various applications?
20. Discuss which types of motors are better suited to the following applications: Cranes, Textile Mills, Paper Mills, Sugar Mills, Steel Rolling Mills, and Cement Mills.