



Jordan University of Science & Technology  
Electrical Engineering Department  
Final Examination

EE 332

Electrical Machines I

4.6.2003

Name:

Univ. #:

Section:

Note : Write the Best answer in the Answer Box at the Bottom of the next page.

A 3-phase, 24 kVA, 400 V, 50 Hz,  $\Delta$ -connected salient pole synchronous motor has  $X_d = 8 \Omega$  and  $X_q = 4 \Omega$ . The motor operates at full-load current at 0.8 power factor leading.

1. The quadrature axis current  $I_q$  is:
  - a) 17.53 A
  - b) 14.14 A
  - c) 30.36 A
  - d) 19.21 A
2. The excitation voltage is:
  - a) 267 V
  - b) 305 V
  - c) 448 V
  - d) 509 V
3. The developed reluctance power is:
  - a) 6266 W
  - b) 8400 W
  - c) 10800 W
  - d) 2800 W

A 3-phase, 400 V, 50 Hz, 4 pole, Y-connected induction motor has  $R_1 = 0.25 \Omega$ ,  $X_1 = X_2' = 0.6 \Omega$ ,  $R_2' = 0.21 \Omega$ ,  $X_m = 20 \Omega$ ,  $P_r = 1.6$  kW. The motor is operated at 1455 rpm.

4. The input power is:
  - a) 19.4 kW
  - b) 23.1 kW
  - c) 31.6 kW
  - d) 20.5 kW
5. The output horse power is :
  - a) 37.2 hp
  - b) 23.4 hp
  - c) 24.5 hp
  - d) 40.8 hp
6. The slip at maximum torque is:
  - a) 0.172
  - b) 0.124
  - c) 0.214
  - d) 0.157

A 3-phase, 2300 V, 250 hp, 60 Hz synchronous motor has  $X_s = 11 \Omega$ /phase. When the input power is 165.8 kW the power angle is  $15^\circ$  electrical. Neglect all losses.

7. The excitation voltage is:
  - a) 3064 V
  - b) 1683 V
  - c) 1769 V
  - d) 2915 V
8. The input current to the motor is:
  - a) 75.3 A
  - b) 54.2 A
  - c) 31.3 A
  - d) 43.5 A
9. The power factor is:
  - a) 0.804 lag
  - b) 0.804 lead
  - c) 0.769 lead
  - d) 0.769 lag
10. If the mechanical load is disconnected, the input current is:
  - a) 40.1 A
  - b) 22.2 A
  - c) 10.5 A
  - d) 38.5 A

A 600 V dc shunt motor drives a load which requires a constant torque of 300 Nm. The motor rotates at 1500 rpm.  $R_a = 0.5 \Omega$ .

11. The armature current  $I_a$  is:
  - a) 78.6 A
  - b) 62.8 A
  - c) 56.5 A
  - d) 84.5 A

If the shunt field flux of the above motor is reduced by 10% then:

12. The new armature current  $I_a$  is:
  - a) 69.1 A
  - b) 62.8 A
  - c) 93.9 A
  - d) 88.5 A
13. The speed of the motor is:
  - a) 1653 rpm
  - b) 1456 rpm
  - c) 1667 rpm
  - d) 1310 rpm



A 150 kVA , 2400 / 240 V single phase transformer has  $R_1 = 0.2 \Omega$  ,  $R_2 = 0.002 \Omega$  ,  $X_1 = 0.45 \Omega$  ,  $X_2 = 0.0045 \Omega$  ,  $R_{c(11V)} = 10 \text{ k}\Omega$  ,  $X_{m(11V)} = 1.55 \text{ k}\Omega$ . The secondary is delivering rated load current at rated voltage and 0.8 power factor lagging.

14. The voltage regulation is:

- a) 2.9%                      b) 2.68%                      c) 2.2%                      d) 3.1%

15. The efficiency at full load is:

- a) 98.2%                      b) 97%                      c) 97.5%                      d) 98.8%

16. The primary input voltage at full load is:

- a) 2400 V                      b) 2498 V                      c) 2380 V                      d) 2453 V

17. The maximum efficiency will occur at a percentage of full load equal to:

- a) 70%                      b) 62%                      c) 74%                      d) 85%

A 3-phase, 60 Hz, 6 pole double cage induction motor has a full-load speed of 1170 rpm. The rotor impedances at standstill are: Inner Cage =  $(0.3 + j1.5) \Omega$  , Outer Cage =  $(1.5 + j0.3) \Omega$ .

18. The ratio of the inner cage current to the outer cage current at full-load is:

- a) 4.96                      b) 0.202                      c) 7.53                      d) 5.62

A 3-phase, 10 kVA , 380 V synchronous generator has  $X_s = 10 \Omega/\text{phase}$ . The machine delivers full load current at rated voltage and 0.8 power factor lagging.

19. The excitation voltage is:

- a) 432 V                      b) 177 V                      c) 334 V                      d) 310 V

20. The power angle is:

- a) 43.5°                      b) 16.5°                      c) 29.2°                      d) 20°

Answers:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20



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25.1.2001

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*Note : Write the Best answer in the Answer Box at the Back of the page.*

A 230 V dc shunt motor has  $R_a = 0.4 \Omega$  and  $R_f = 115 \Omega$ . At no-load the motor draws 7 A and runs at 1200 rpm. At full-load the motor draws 52 A. The armature reaction at full-load reduces the flux by 10%.

- The rotational losses are:  
a) 1150 W      b) 1140 W      c) 1590 W      d) 1130 W
- The motor speed at full-load is:  
a) 1303 rpm      b) 1448 rpm      c) 1228 rpm      d) 1105 rpm
- The shaft torque at full-load is:  
a) 93.1 Nm      b) 68.6 Nm      c) 74.5 Nm      d) 72.8 Nm
- The armature current at starting is 100 A. The starting electromagnetic torque is:  
a) 163 Nm      b) 154 Nm      c) 173 Nm      d) 146 Nm

~~A~~ A 3-phase, 20 kVA, 380 V, 50 Hz, Y-connected salient pole synchronous machine has  $X_d = 4 \Omega$  and  $X_q = 2 \Omega$ . The machine operates as a motor and draws full-load current at 0.8 power factor leading.

- The quadrature axis current  $I_q$  is:  
~~a) 20.5 A~~      b) 13 A      c) 27 A      d) 22.5 A
- The excitation voltage is:  
a) 297.5 V      ~~b) 305.5 V~~      c) 202.5 V      d) 309.4 V
- The developed reluctance power is:  
a) 19935 W      b) 6645 W      c) 10762 W      d) 13290 W

The above synchronous machine is operated as a synchronous generator delivering full-load current at 0.8 power factor leading.

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The power angle is:



B

13. The output horse power is:  
a) 54.5 hp      b) 31.6 hp      c) 18.2 hp      d) 33.5 hp
14. The speed at which maximum torque occurs is:  
a) 524 rpm      b) 771 rpm      c) 629 rpm      d) 925 rpm
15. The maximum electromagnetic torque is:  
a) 1604 Nm      b) 828 Nm      c) 802 Nm      d) 267 Nm

A 40 kVA, 2000 / 200 V single phase transformer has  $R_{eq(11V)} = 3.5 \Omega$  and  $X_{eq(11V)} = 6 \Omega$ . The core loss is 200 W. The transformer delivers 75% rated kVA to a load at rated secondary voltage and 0.85 power factor lagging.

$$V_x = V_1 - I_1 R_{eq(11V)}$$

16. The voltage applied to the primary side is:  
a) 2104 V      b) 1907 V      c) 2093 V      d) 2122 V
17. The efficiency of the transformer is:  
a) 97.91%      b) 98.7%      c) 95.2%      d) 96.27%
18. The load power factor that would give maximum voltage regulation is:  
a) 0.864 lag      b) 0.504 lead      c) 0.864 lead      d) 0.504 lag

A 230 V, 60 Hz, 4 pole, 1728 rpm single phase induction motor has :  $R_1 = 5 \Omega$ ,  $R_2 = 5.6 \Omega$ ,  $X_m = 120 \Omega$ ,  $X_1 = X_2 = 7 \Omega$ ,  $P_r = 35 W$ .

19. The air gap power at rated speed is:  
a) 445 W      b) 621 W      c) 489 W      d) 650 W
20. The shaft torque is:  
a) 2.2 Nm      b) 3.14 Nm      c) 2.04 Nm      d) 3.3 Nm

### Answers

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20