For problems 1-25, write the letter of the ONE BEST ANSWER in the blank to the left of the question.

1. For the transformer below, the equivalent impedance seen by the voltage source (between points a & b) is

   ![Transformer Diagram]

   A. $200 + j0$ Ohms  
   B. $20 + j1000$ Ohms  
   C. $0.50 + j9.98$ Ohms  
   D. $20 + j1$ Ohms

2. What is the starting current for a 500 V, 3-phase induction machine with $X_m = \infty$, $R_1 = R_2^' = 2$ Ohms, and $X_1 = X_2^' = 3$ Ohms?

   A. $69 / -56^\circ$ A  
   B. $40 / -56^\circ$ A  
   C. 0 A  
   D. $46 / -72^\circ$ A

3. Which type of machine needs extra help starting?

   A. DC machine  
   B. 3-phase synchronous machine  
   C. 3-phase induction machine  
   D. 1-phase induction machine

4. This waveform most represents the output voltage of which type of machine?

   ![Waveform]

   A. DC machine  
   B. transformer  
   C. induction machine  
   D. synchronous machine

5. How do we control a synchronous generator?

   A. Vary the rotor external resistance  
   B. Change the rotor excitation voltage  
   C. Change the armature current  
   D. Vary the terminal voltage

6. We CANNOT assume constant flux for DC machines connected in which way?

   A. separately excited motor  
   B. separately excited generator  
   C. compound motor  
   D. shunt motor
7. Three 550/110 volt, 1-phase transformers are to be connected to form a 953/110 volt 3-phase transformer bank. They should be connected
   A. Y - Delta       B. Y - Y       C. Delta - Y       D. Can’t be done

8. Which type of machine may have a leading power factor?
   A. DC machine       B. 3-phase synchronous machine
   C. 3-phase induction machine       D. 1-phase induction machine

9. Which point below indicates a typical operating point for an induction motor?
   ![Diagram]

10. The currents on the rotor of a induction machine are
    A. AC       B. DC

11. A 208 V, 1-phase induction motor has $X_m = \infty$, $R_1 = R_2' = 2$ Ohms, $X_1 = X_2'$ = 5 Ohms, and a slip of 5 percent. Find the developed power.
    A. $P_d = 1388$ W       B. $P_d = 1425$ W       C. $P_d = 762$ W       D. $P_d = 1319$ W

12. Which type of machine do we NOT have a circuit model for?
    A. salient-pole rotor synchronous       B. wound-rotor induction
    C. separately excited DC       D. short-shunt compound DC

13. This is the circuit model for which type of device?
    ![Diagram]
    A. shunt DC motor       B. 3-phase induction motor
    C. 3-phase synchronous motor       D. power transformer

14. What is the equation for the input power of a separately-excited DC motor?
    A. $P_{in} = E I_a + P_{loss}$       B. $P_{in} = V_T I_a + E I_a$
    C. $P_{in} = V_T I_a^2$       D. $P_{in} = V_T I_a + V_f I_f$
15. What is the equation for the output power of a series-connected DC motor?

A. \( P_{\text{out}} = V I_a \)
B. \( P_{\text{out}} = I_a^2 R_a + P_{\text{loss}} \)
C. \( P_{\text{out}} = E I_a - P_{\text{loss}} \)
D. \( P_{\text{out}} = E I_a + P_{\text{loss}} \)

16. Which type of core loss is illustrated in the figure below?

A. eddy currents
B. hysteresis
C. saturation
D. linearity

17. If a \( \Delta \)-connected capacitor bank is added to a 30 + j25 kVA, 500V load, to give a combined power factor of unity, the required Capacitance per phase is

A. 88 \( \mu \)F
B. 265 \( \mu \)F
C. 106 \( \mu \)F
D. 47 \( \mu \)F

18. For which device do we use the blocked rotor and no load tests to find the circuit parameters?

A. DC machine
B. transformer
C. induction machine
D. synchronous machine

19. Which parameters can we get from the open circuit test?

A. \( R_s \) and \( X_s \)
B. \( R_c \) and \( X_m \)
C. \( R_a \) and \( X_d \)
D. \( R_2' \) and \( X_2' \)

20. If the primary voltage of a 5:1 transformer is \( v_1(t) = 5 + 3 \cos 10t \), what is the secondary voltage?

A. \( 25 + 15 \cos 10t \)
B. \( 1 + (3/5) \cos 10t \)
C. \( (3/5) \cos 10t \)
D. \( 5 + 3 \sin 10t \)

21. Two types of 3-phase synchronous machines are

A. shaded-pole & wound rotor
B. cylindrical & salient-pole rotor
C. cylindrical & squirrel cage rotor
D. wound & squirrel cage rotor
22. The torque vs. speed curve below is for a

\[ T \quad n \]

A. 1-phase induction machine  B. 3-phase synchronous machine  
C. 3-phase induction machine  D. shunt-connected DC machine

23. Which of the following are characteristics of the magnetic field caused by the stator windings inside of a 3-phase induction machine?

A. Constant magnitude & constant $\omega$  
B. Varying magnitude & $\omega$  
C. Constant magnitude & constant direction  
D. Varying magnitude & constant $\omega$

24. The part labeled "A" is from what type of device?

A. DC machine  
B. transformer  
C. induction machine  
D. synchronous machine

25. The part labeled "B" is from what type of device?

A. DC machine  
B. transformer  
C. induction machine  
D. synchronous machine

Happy Summer!