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SSC-JEn 2009
(Question Paper with Solutions)
1. The value of current I flowing in the 1Ω resistor in the circuit shown in the figure below will be

- (a) 10A
- (b) 6A
- (c) 5A
- (d) zero

2. In the figure shown below, if we connect a source of 2V, with internal resistance of 1Ω at AA' with positive terminal at A, then current through R is

- (a) 2A
- (b) 1.66A
- (c) 1A
- (d) 0.625A

3. The curve representing Ohm's law is

- (a) Linear
- (b) Hyperbolic
- (c) Parabolic
- (d) Triangular

4. Specific resistance of a conductor depends upon

- (a) Dimension of the conductor
- (b) Composition of conductor material
- (c) Resistance of the conductor
- (d) Both (a) and (b)

5. Superposition theorem is essentially based on the concept of

- (a) Reciprocity
- (b) Linearity
- (c) Duality
- (d) Non-linearity
6. If a 500 KVA, 200 Hz transformer is operated at 50 Hz, its KVA rating will be
   (a) 2000 KVA (b) 125 KVA
   (c) 250 KVA (d) 1000 KVA

7. The angle between induced emf and terminal voltage on no-load for a single phase alternator is
   (a) 180° (b) 90°
   (c) 0° (d) 270°

8. A salient pole synchronous generator connected to an infinite bus power will deliver maximum power at power angle of
   (a) δ = 0 (b) δ = 90°
   (c) δ = 45° (d) δ = 30°

9. Starting torque of synchronous motor is
   (a) very low (b) zero
   (c) very high (d) half-full load torque

10. The power factor at which transformer operates
    (a) is unity
    (b) is 0.8 lag
    (c) is 0.8 lead
    (d) Depends upon the power factor of the load

11. The efficiency of a 100 KVA transformer is 0.98 at full as well as half load. For this transformer at full load the copper loss
    (a) is less than core loss
    (b) is equal to core loss
    (c) is more than core loss
    (d) All the above

12. Which of the following will improve the mutual coupling between primary and secondary circuit?
    (a) Transformer oil of high break down voltage
    (b) High reluctance magnetic core
    (c) Winding material of high resistivity
    (d) Low reluctance magnetic core

13. High leakage transformers are of
    (a) Small voltage ampere rating
    (b) High voltage ampere rating
    (c) High voltage rating
    (d) Low voltage rating

6. यदि 500 KVA, 200 Hz ट्रांसफोर्मर 50 Hz पर कार्य करता है, तो उसका KVA निर्णय होगा
   (a) 2000 KVA (b) 125 KVA
   (c) 250 KVA (d) 1000 KVA

7. एकल फेज वाले प्रत्यक्षविद्युत के लिए शून्य लोड पर प्रेरित विभ. वा बल (emf) और दौरान बील्डर के बीच कोण होता है
   (a) 180° (b) 90°
   (c) 0° (d) 270°

8. अंतर्गत बस के साथ संबंधित समुच्चय ब्रह्म तुल्यकालिक जनरेटर एक शक्ति कोण पर अधिकतम शक्ति प्रदान करेगा
   (a) δ = 0 (b) δ = 90°
   (c) δ = 45° (d) δ = 30°

9. तुल्यकालिक मोटर का प्रवृत्त बल-आयुर्ण होता है
   (a) बहुत न्यून (b) शून्य
   (c) बहुत ऊचा (d) अर्थ-पूर्ण लोड बल-आयुर्ण

10. यह शक्ति गुणक विश्वसनीय से ट्रांसफोर्मर कम करता है
    (a) हकीकी
    (b) 0.8 पवन
    (c) 0.8 आया
    (d) भार के शक्ति गुणक पर निर्भर करता है

11. एक 100 KVA ट्रांसफोर्मर की दशता पूरी भार पर भी और अभी भार पर भी 0.98 है। इस ट्रांसफोर्मर के लिए पूरी भार पर टाइम हानि है
    (a) कोड हानि से कम
    (b) कोड हानि के बराबर
    (c) कोड हानि से अधिक
    (d) उपयुक्त समी

12. प्राथमिक और उच्चतम परिप्रेक्ष्य के बीच पारस्परिक युग्मन का सुयात्मक निर्माण भूमिकामत तिथि करने का?
    (a) उच्च भंडार बील्डर वाला ट्रांसफोर्मर तेल
    (b) उच्च प्रतिस्थापन (reluctance) चुम्बकीय कोड
    (c) उच्च प्रतिस्थापक वाला कुंडली द्वारा
    (d) न्यून प्रतिस्थापन (reluctance) चुम्बकीय कोड

13. उच्च धरण ट्रांसफोर्मर होते है
    (a) लघु बील्डर-ऐप्प्रियर निर्णय वाले
    (b) उच्च बील्डर-ऐप्प्रियर निर्णय वाले
    (c) उच्च बील्डर निर्णय वाले
    (d) न्यून बील्डर निर्णय वाले
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A.I.R 15 (EE)  
A.I.R 16 (ME)  
A.I.R 18 (EE)  

Our IES Toppers

A.I.R 2 (EC)  
A.I.R 8 (EE)  
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A.I.R 1 (CE)  

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14. The starting torque of a 3-phase induction motor varies as
(a) $V^2$
(b) $V$
(c) $\sqrt{V}$
(d) $\frac{1}{V}$

15. In a 3-phase induction motor, the mechanical power developed, in terms of air gap power $P_g$ is
(a) $(1 - s)P_g$
(b) $P_g$
(c) $\frac{P_g}{1 - s}$
(d) $\frac{P_g}{s}$

16. The negative phase sequence in a 3-phase synchronous motor exists when the motor is
(a) underloaded
(b) overloaded
(c) supplied with unbalanced voltage
(d) hot

17. A centre zero ammeter connected in the rotor circuit of a 6-pole, 50 Hz induction motor makes 30 oscillations in one minute. The rotor speed is
(a) 670 rpm
(b) 1000 rpm
(c) 1010 rpm
(d) 1030 rpm

18. The permissible variation of frequency in power system $f_s$ is
(a) ± 1%
(b) ± 3%
(c) ± 5%
(d) ± 10%

19. For cooling of large size generators hydrogen is used because
(a) it offers reduced fire risk
(b) it is light in weight
(c) it is of high thermal conductivity
(d) all the above

20. The connected load of a consumer is 2 kW and his maximum demand is 1.5 kW. The demand factor of the consumer is
(a) 0.75
(b) 0.375
(c) 1.33
(d) 1
21. To meet the reactive power requirements of load centres usually
   (a) Shunt capacitors are used
   (b) Series capacitors are used
   (c) Shunt reactors are used
   (d) Tap changing transformers are used

22. The power factor will be leading in case of
   (a) dielectric heating
   (b) resistance heating
   (c) induction heating
   (d) all the above

23. Which instrument has the lowest resistance?
   (a) Ammeter
   (b) Voltmeter
   (c) Megger
   (d) Frequency meter

24. The moving coil in a dynamometer wattmeter is connected
   (a) in series with the fixed coil
   (b) across the supply
   (c) in series with the load
   (d) any one of the above

25. In an R-L-C circuit susceptance is equal to
   (a) \( \frac{1}{X} \)
   (b) \( \frac{1}{R} \)
   (c) \( \frac{R}{Z^2} \)
   (d) \( \frac{X}{Z^2} \)

26. The current read by the ammeter A in the AC circuit shown in following figure is

![Diagram](image)

   (a) 9 A
   (b) 5 A
   (c) 3 A
   (d) 1 A

27. A 4-pole generator with 16 coils has a two layer lap winding. The pole pitch is
   (a) 32
   (b) 16
   (c) 8
   (d) 4
28. Two coupled coils with \( L_1 = L_2 = 0.6 \text{H} \) have a coupling coefficient of \( K = 0.8 \). The turn ratio \( \frac{N_1}{N_2} \) is
(a) 4        (b) 2
(c) 1        (d) 0.5

29. The voltage across the various elements are marked, as shown in the figure given below. The input voltage is
(a) 27 V    (b) 24 V
(c) 10 V    (d) 5V

30. The principle of dynamically induced emf is utilised
(a) Choke
(b) Transformer
(c) Thermocouple
(d) Generator

Answer Key

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1. (c) 5-Volt will appear across current source and 1 ohm resistor both. Therefore

\[ V = I \times R = \frac{5}{1} = 5 \text{A} \]

2. (d) Applying Nodal analysis at B and C

\[ V_A + V_A - V_B = 1 \]
\[ 2V_A - V_B = 1 \]  …(1)

\[ V_A - \frac{V_B}{2} + \frac{V_B - 2}{1} \]
\[ 2V_A - 4V_B = 4 \]  …(2)

From equation (1) and (2)

\[ V_A = 1.2125 \text{ Volt} \]
\[ V_B = 1.25 \text{ Volt} \]

Current through resistor R,

\[ I_R = \frac{V_B}{2} \]
\[ = \frac{1.25}{2} = 0.625 \text{A} \]

3. (a) Ohm's law,

\[ V = I \times R \]

\[ V = IR = \text{Linear} \]

(Area, Length temp should be constant i.e., no changes in these conditions).

6. (b) For the same load (constant load)

\[ S \propto E_{\text{ind}} \]
\[ S \propto f \]

As 
\[ E_{\text{ind}} = 4.44 fN \phi \]

\[ S_1 f_1 \]
\[ S_2 f_2 \]

\[ S_2 = \frac{f_2}{f_1} \]

\[ = 500 \times \frac{50}{200} = 125 \text{ KVA} \]

7. (c) At no load

\[ I_n = 0 \]
\[ V = E_i \]
\[ V = E_i \]
\[ \delta = 0^\circ \]

8. (b) For \( P_{\text{max}} \)

\[ \sin \delta = 1 \]
\[ \delta = 90^\circ \]

\[ P_{\text{max}} = \frac{VE_i}{X} \]

11. (c) \( \eta = \frac{P_{\text{out}}}{P_{\text{out}} + P_{\text{co}} + P_{\text{cu,ns}}} \)

\[ \eta_{\text{at full load}} = \eta_{\text{at half load}} = 0.98 \]

\[ \eta_{\text{at full load}} = 0.98 = \frac{P_{\text{out}}}{P_{\text{out}} + P_{\text{co}} + P_{\text{cu,ns}}} \]
Let unity Pf load,
\[ P_{\text{co}} + P_{\text{cu}} = 2.0408 \]  
\[ \eta \text{ at half load} = 0.98 \]
\[ P_{\text{co}} + \frac{1}{4} P_{\text{cu}} = 1.02408 \]  
From equation (1) and (2)
\[ P_{\text{co}} = 0.6802 \text{ kW}, \]
\[ P_{\text{cu}} = 1.3605 \text{ kW} \]
\[ P_{\text{cu}} > P_{\text{co}} \]

14. (a)
\[ T_{\text{st}} = \frac{3}{\omega_s} \frac{V^2}{R^2 + X_s^2} \]
\[ T_{\text{st}} \propto V^2 \]

15. (a)
\[ P_m = (1 - s)P_g \]

17. (b)
Ammeter has 30 oscillations in one minute. So, rotor current has a frequency
\[ f' = \frac{30}{60} = 0.5 \text{ Hz} \]
\[ \gamma \text{ Rotor Frequency} \]
\[ f' = sf \]
\[ s = \frac{f'}{f} = \frac{0.5}{50} = \frac{1}{100} = 0.01 \]
\[ N_s = \frac{120 \times f}{P} = \frac{120 \times 50}{6} = 1000 \text{ rpm} \]
\[ s = \frac{N_s - N_r}{N_s} \]
\[ 0.01 = \frac{1000 - N_r}{1000} \]
\[ N_r = 990 \text{ rpm} \]

18. (b)
Ideal Range
\[ f = 50 \pm 1\% \]
\[ \Rightarrow 49.5 \text{ to } 50.5 \text{ Hz} \]
Practical permissible Range
\[ f = 50 \pm 3\% \]
\[ \Rightarrow 48.5 \text{ to } 51.5 \text{ Hz} \]

20. (a)
Demand factor
\[ D.F. = \frac{P_{\text{max}}}{\text{Sum of connected load}} \]
\[ = \frac{1.5}{2} = \frac{3}{4} = 0.75 \]

25. (a), (d)
For series RLC circuit,
\[ Z = R + jX \]
\[ \frac{1}{Z} = \frac{1}{R + jX} \]
\[ Y = \frac{1}{R + jX} \times \frac{R + jX}{R - jX} \]
\[ = \frac{R - jX}{R^2 + X^2} \] (Conductance)
\[ \text{Susceptance} = \frac{R}{R^2 + X^2} - \frac{jX}{R^2 + X^2} \]

For Parallel RLC circuit
\[ \frac{1}{Z} = \frac{1}{R + j \left( \frac{1}{X_L} + \frac{1}{X_C} \right)} \]
\[ = \frac{R}{R^2 + X^2} + \frac{jX}{R^2 + X^2} \] (Susceptance)
\[ \text{Susceptance} = \frac{X}{R^2 + X^2} = \frac{X}{Z^2} \]

Hence Susceptance \[ = \frac{1}{X} \]

26. (b)
\[ L_{\text{rms}} = \sqrt{3^2 + (5 - 1)^2} = 5 \text{A} \]
27. (d) 

\[
Pole\ pitch = \frac{Slots}{Pole}
\]

For two layer winding 
Number of Armature slots = Number of coils 

\[
Slots = 16
\]

\[
Pole\ Pitch = \frac{16}{4} = 4
\]

28. (c) 

29. (d) 

\[
L = \frac{\mu_0 N^2 A}{L}
\]

\[
L \propto N^2
\]

\[
\frac{L_1}{L_2} = \frac{N_1^2}{N_2^2}
\]

\[
\frac{N_1}{N_2} = \sqrt{\frac{L_1}{L_2}} = \sqrt{\frac{0.6}{0.6}} = 1
\]

\[
V_{max} = \sqrt{3^2 + (10 - 14)^2}
\]

\[
V_{max} = 5V
\]
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