

Seat No.	
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M.Phil / Ph.D. Entrance Examination, September - 2019
ELECTRICAL ENGINEERING

Day and Date : Wednesday, 18 - 09 - 2019

Total Marks : 100

Time : 10.00 a.m. to 12.00 p.m.

- Instructions :**
- 1) All questions are compulsory.
 - 2) Each question carries 2 marks.
 - 3) Answer should be marked in the given OMR answer sheet by darkening the appropriate option.
 - 4) Use black ball point pen only for marking the circle. Do not make any stray mark on the OMR Answer Sheet.
 - 5) Follow the instructions given on OMR Sheet.
 - 6) Rough work shall be done on the sheet provided at the end of question paper.
 - 7) Only non-programmable calculators are allowed.

- 1) Calculate the values of two resistances which when connected in series gives 50Ω and 8Ω when connected in parallel.
 - a) 40Ω and 10Ω
 - b) 36Ω and 14Ω
 - c) 30Ω and 20Ω
 - d) None of the above

- 2) Two conductors one of copper and one of iron, are connected in parallel and at 20° carry equal currents. What proportion of current will pass through each, if the temperature is raised to 100° ? Assume α for copper as 0.0042 and for iron as 0.006 per $^\circ\text{C}$ at 20° .
 - a) 50% and 50%
 - b) 42% and 58%
 - c) 53% and 47%
 - d) 100% and 0%

- 3) A factory has 240V supply from which following loads are taken
Lighting: three hundred 150W, four hundred 100W and five hundred 60W lamps
Heating: 100kW
Motors: A total of 44.76kW output with an average efficiency of 75%
Misc: Various loads taking a current of 40A
A lighting load is on for a period of 4 hours/day, the heating load for 10 hours/day and remaining for 2 hours/day, the weekly unit consumption of a factory when working on 5 days a week is
- a) 5555 kWh
 - b) 7993 kWh
 - c) 4476 kWh
 - d) Cannot be calculated from given data
- 4) A hydroelectric generating station is supplied from a reservoir of capacity 6 million m³ at a head of 170 meters. The available energy in kWh if the hydraulic efficiency be 80% and electric efficiency 90% is
- a) 4.8 MWh
 - b) 6 MWh
 - c) 4.32 MWh
 - d) 2MWh
- 5) Three identical point charges, each Q coulombs, are placed in free space at the vertices of an equilateral triangle 10 cm in side. The force on each charge is
- a) $9\sqrt{3} \times 10^{11} Q^2 \text{ newton}$
 - b) $3\sqrt{9} \times 10^{11} Q^2 \text{ newton}$
 - c) $11\sqrt{3} \times 10^9 Q^2 \text{ newton}$
 - d) $11\sqrt{9} \times 10^3 Q^2 \text{ newton}$
- 6) Find the radius of an isolated sphere capable of being charged to 1MV before sparking into the air, given that breakdown voltage of air is 30,000 V/cm
- a) r = 3.3 meter
 - b) r = 33.3 meter
 - c) r = 0.33 meter
 - d) r = 0.033 meter

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- 7) The magnetic susceptibility of oxygen gas at 20°C is $167 \times 10^{-11} \text{ H/m}$. The absolute permeability of oxygen is
- a) $16.7 \times 10^{-11} \text{ H/m}$ b) $12.59 \times 10^{-7} \text{ H/m}$
c) $167 \times 4\pi \times 10^{-7} \text{ H/m}$ d) $5.988 \times 10^8 \text{ H/m}$
- 8) The rms value of $i = 12\sin \omega t + 6 \sin(3\omega t - \pi/6) + 4 \sin(5\omega t + \pi/3)$
- a) 4.69 A b) 14 A
c) 15.5 A d) 9.74 A
- 9) A circuit offers a resistance of 20Ω in one direction and 100Ω in the reverse direction. A sinusoidal voltage of maximum value 200 V is applied to the above circuit. The current measured by moving iron ammeter and moving coil ammeter are _____ and _____ respectively.
- a) 5.1 A, 2.55 A b) 10 A, 2 A
c) 2 A, 10 A d) 10 A, 0.0 A
- 10) The instantaneous power in an ac circuit varies with the frequency _____ that of supply frequency.
- a) two times b) three times
c) equal to d) four times
- 11) A circuit with $R = 1\Omega$ and $L = 2 \text{ H}$ is connected to e.m.f. of 3V at $t = 0 \text{ sec}$, find the rate of storage of energy in the inductor at $t = 2 \text{ sec}$.
- a) 2.0 J/s b) 1.0 J/s
c) 2.1J/s d) 1.1J/s
- 12) A $5.0\mu\text{F}$ capacitor is discharged suddenly through a coil having an inductance of 2.0 H and a resistance of 200Ω . The capacitor is initially charged to 10V. The value of additional resistance required to give critical damping is _____.
- a) $10 \text{ M}\Omega$ b) 1065Ω
c) 1225Ω d) $20 \text{ M}\Omega$

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- 13) The negative and zero sequence components of the following set of three unbalanced voltages are _____.

$$V_A = 10 \angle 30^\circ, V_B = 30 \angle -60^\circ, V_C = 15 \angle 145^\circ$$

- a) $V_2 = 8.24 \angle -276.2^\circ$ b) $V_2 = 17.6 \angle 165^\circ$
 $V_0 = 17.6 \angle 165^\circ$ $V_2 = 8.24 \angle -276.2^\circ$
- c) $V_2 = 5.6 \angle -47.4^\circ$ d) $V_2 = 8.24 \angle -276.2^\circ$
 $V_0 = 17.6 \angle 165^\circ$ $V_0 = 5.6 \angle -47.4^\circ$

- 14) A long shunt compound generator delivers a load current of 50A at 500V and has armature, series field and shunt field resistance of 0.05 Ω , 0.03 Ω , and 250 Ω respectively. The generated voltage is _____ if contact drop is IV per brush.

- a) 502.16 V b) 508.16 V
c) 506.16 V d) 504.16 V

- 15) The output of a shunt generator is 24 kW at a terminal voltage of 200V. Armature resistance is = 0.05 Ω , shunt field resistance is = 40 Ω . If the iron and friction losses equals the copper losses at this load, the output of the prime mover driving the generator is _____.

- a) 24.245 kW b) 27.562 kW
c) 48 kW d) 40 kW

- 16) Two shunt generators each with armature resistance of 0.01 Ω and field resistance of 20 Ω run in parallel and supply a total load of 4000 A. The e.m.f.s are respectively 210V and 220V. The common busbar voltage is _____.

- a) 210 V b) 189.4 V
c) 220 V d) 184.9 V

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- 17) Two series motors run at a speed of 500 rpm and 550 rpm respectively when taking 50 A at 500V. The terminal resistance of each motor is 0.5Ω . The speed of the combination when connected in series and coupled mechanically is _____. The combination is taking 50 A on 500V supply.
- a) 248 rpm b) 525 rpm
c) 262.5 rpm d) 50 rpm
- 18) The primary of a 1000/250 V step down transformer has a resistance of 0.15Ω and leakage reactance of 0.8Ω . The primary induced emf is _____ when the primary current is 60 A at 0.8 pf lagging.
- a) $870.5 \angle -1.2^\circ$ b) $970.5 \angle -1.6^\circ$
c) $990.0 \angle -2.5^\circ$ d) $900.0 \angle +6.6^\circ$
- 19) The regulation of a transformer in which percentage resistance drop is 1.0% and percentage reactance drop is 5.0% at 0.8 pf lagging and 0.8 pf leading is _____ and _____ respectively.
- a) 5% and -5% b) 0.8% and -8%
c) 3.8% and -2.2% d) 6% and -6.0%
- 20) Two identical single phase transformers are connected in open delta across 3-phase mains and deliver a balanced load of 3000 kW at 11 kV and 0.8 p.f. lagging. The power factor at which two transformers are working is _____.
- a) unity b) 0.866 lagging
c) 0.693 lagging d) 0.866 leading
- 21) The starting torque of
- a) Squirrel-cage IM is better than Slip ring IM
b) Fix for Squirrel-cage IM and can be varied for Slip ring IM
c) Depends on stator slots
d) Depends on number of poles

- 22) The maximum torque of IM occurs when
- a) Rotor reactance equals its resistance
 - b) pf is unity
 - c) cu losses are minimum
 - d) rotor slots are even in number
- 23) A three phase 440V, 50 Hz 4-pole Y connected IM has rotor resistance of 0.1Ω and reactance of 0.9Ω per phase. The ratio of stator to rotor turns is 3.5. Gross output at the slip of 5% is
- a) 7250 W
 - b) 5250 W
 - c) 6250 W
 - d) 8250 W
- 24) What modification is necessary if an IM is required to operate on a voltage different from that for which it is designed.
- a) No modification required
 - b) Number of conductors per slot have to be changed in the same ratio as the change in voltage
 - c) Load should be changed
 - d) None of the above
- 25) Induction motors are called asynchronous because _____.
- a) They are rotating transformers
 - b) They work on principles of induction
 - c) Synchronously rotating field is absent
 - d) Their rotor can never run at synchronous speed

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- 26)** A three phase 800 kVA, 11 kV, star connected alternator has resistance of $1.5\Omega/\text{phase}$ and synchronizing reactance of $25\Omega/\text{phase}$. The % regulation for a load of 600 kW at 0.8 leading pf is _____.
- a) 5.52% b) -5.52%
c) -7.72% d) 7.72%
- 27)** Two readings obtained on a 440V (2-wire) system with a voltmeter having resistance of 60 $M\Omega$ were i) 75 V between positive mains and earth and ii) 25V between negative main and earth. The insulation resistance of each main is _____ and _____ respectively.
- a) 0.816 $M\Omega$ and 0.272 $M\Omega$
b) 0.45 $M\Omega$ and 0.15 $M\Omega$
c) 80 $M\Omega$ and 240 $M\Omega$
d) 75 $M\Omega$ and 25 $M\Omega$
- 28)** An analog voltmeter uses external multiplier settings. With a multiplier setting of 20 k Ω , it reads 440V and with a multiplier setting of 80 k Ω it reads 352 V. For a multiplier setting of 40 k Ω , the voltmeter reads _____.
- a) 371 V b) 383 V
c) 394 V d) 406 V
- 29)** The Laplace transform of a function $f(t)$ is
- $$F(s) = \frac{1}{s(s+1)}$$
- As t tends to infinity, $f(t)$ approaches _____.
- a) 1/2 b) zero
c) 1 d) infinity
- 30)** In s-domain representation, the transfer function of a system is _____.
- a) Laplace transform of unit step response of a system
b) Laplace transform of OC test/Laplace transform of SC test
c) Zeros/poles
d) Output/Input

31) The transfer function of a compensator is given by

$$G_c(s) = \frac{(s+a)}{(s+b)}$$

$G_c(s)$ is a lead compensator if _____.

- a) $a = 1, b = 2$ b) $a = 3, b = 2$
 c) $a = 7, b = 5$ d) $a = 3, b = 1$

32) Nichol's chart is used to determine _____

- a) transient response
 b) closed loop frequency response
 c) open loop frequency response
 d) settling time due to step input

33) The function $f(x) = 2x - x^2 + 3$ has _____.

- a) a maximum at $x = 1$ and a minimum at $x = 5$
 b) a maximum at $x = 1$ and a minimum at $x = -5$
 c) only a maximum at $x = 1$
 d) only a minimum at $x = 1$

34) Following is not a performance specification for transient response of a system.

- a) Settling time b) Peak overshoot
 c) Steady state error d) Rise time

35) The resonant frequency of a second order system is given by

- a) $\omega_r = \frac{1}{2\zeta\sqrt{1-\zeta^2}}$ b) $\omega_r = \frac{\omega_n}{2\zeta}$
 c) $\omega_r = \frac{\omega_n}{2\zeta\sqrt{1-2\zeta^2}}$ d) $\omega_r = \omega_n \sqrt{1-2\zeta^2}$

- 36) Among the following four, the slowest ADC is _____.
- a) parallel-comparator (i.e. flash) type
 - b) successive approximation
 - c) integrating type
 - d) counting type
- 37) A digital to analog converter with a full scale output voltage of 3.5 V has a resolution close to 14 mV. Its bit size is _____.
- a) 4
 - b) 8
 - c) 16
 - d) 32
- 38) A 3-phase diode bridge rectifier is fed from a 400V (rms), 50 Hz, 3-phase ac source. If the load is purely resistive, then peak instantaneous output voltage is equal to _____.
- a) 400 V
 - b) $400\sqrt{2}$
 - c) $400\sqrt{(2/3)}$
 - d) $400/\sqrt{3}$
- 39) A single phase fully controlled bridge converter supplies a load drawing constant and ripple-free load current. If the triggering angle is 30° , the input p.f. will be _____.
- a) 0.65
 - b) 0.78
 - c) 0.85
 - d) 0.866
- 40) A series RLC circuit is connected to a 25 V source of variable frequency. The circuit current is found to be maximum of 0.5 A at a frequency of 400 Hz and the voltage across C is 150 V. Assuming ideal components, the values of R and L are respectively _____.
- a) 50 Ω and 300 mH
 - b) 12.5 Ω and 0.119 H
 - c) 50 Ω and 0.119 H
 - d) 12.5 Ω and 300 mH

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- 41) A series R-L-C circuit has $R = 50 \Omega$; $L = 100 \mu\text{H}$ and $C = 1 \mu\text{F}$. The lower half power frequency of the circuit is _____.
- a) 30.55 kHz b) 3.055 kHz
c) 51.92 kHz d) 1.92 kHz
- 42) The equivalent capacitance of two capacitors in parallel is four times their equivalent capacitance in series. This means that _____.
- a) the capacitances of two capacitors are equal
b) the capacitances are $1 \mu\text{F}$ and $4 \mu\text{F}$
c) the capacitances are $6 \mu\text{F}$ and $9 \mu\text{F}$
d) none of the above
- 43) Power consumed by a balanced 3-phase, 3-wire load is measured by two-wattmeter method. The first wattmeter reads twice that of second. Then the load impedance angle in radians is _____.
- a) $\pi/12$ b) $\pi/8$
c) $\pi/6$ d) $\pi/3$
- 44) The average power delivered to an impedance $(4-j3) \Omega$ by a current $5\cos(100\pi t + 100)$ A is _____.
- a) 44.2 W b) 50 W
c) 62.5 W d) 125 W
- 45) For a specified input voltage and frequency, if the equivalent radius of the core of a transformer is reduced by half, the factor by which the number of turns in primary should change to maintain the same no load current is _____.
- a) $1/4$ b) $1/2$
c) 2 d) 1
- 46) The two voltage surges are defined as $1/50 \mu\text{s}$ and $3/50 \mu\text{s}$. Which surge is more harmful?
- a) $1/50 \mu\text{s}$ b) $3/50 \mu\text{s}$
c) both equally d) none of the above

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- 47) If the fault current is 2000 A, the relay setting 50% and CT ratio is 400/5, the P.S.M is _____.
- a) 23
 - b) 50
 - c) 15
 - d) None of the above
- 48) NAND and NOR gates are called ‘universal gates’ primarily because _____.
- a) they are available everywhere
 - b) they are wisely used in IC packages
 - c) they can be easily combined to produce AND, OR and NOR gates
 - d) they can be manufactured easily
- 49) The counter circuit is called ripple counter
- a) When it counts ripples as input
 - b) Because it is asynchronous counter
 - c) When output of one flipflop drives another flipflop
 - d) Because it does not contain any flipflop
- 50) A 6-bit DAC produces $V_{\text{out}} = 0.25\text{V}$ for a digital input of 000010. Determine resolution and V_{out} for an input of 110110.
- a) 0.125, 6.75 V
 - b) 0.125, 7.875V
 - c) 0.25, 5V
 - d) 0.25, 8V



Rough Work