

# GU-RET 2016

GAUHATI UNIVERSITY RESEARCH ELIGIBILITY TEST

## ELECTRICAL ENGINEERING

Booklet Series : **A**

Invigilator's Name and Signature
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BOOKLET NO.

OMR SHEET NO.

ROLL NO.

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TIME : 2 HOURS 20 MINUTES

TOTAL MARKS : 80

Number of Pages in this Booklet : 18

### Instructions for Candidates

1. Write your Roll No. and OMR Sheet No. in the boxes provided above.
2. This paper consists of two sections : **Section B** with 50 (fifty) multiple choice questions (MCQ) and **Section C** with 7 (seven) descriptive questions. Each MCQ has 4 (four) answers, out of which **ONLY** one is correct. You have to darken the circle (on the OMR Sheet) for the correct answer corresponding to the question given in this booklet.

Example : (A) (B) (C) (D)

where (C) is the correct answer. No marks will be given for markings made in this booklet. The descriptive questions in **Section C**, **MUST** be answered in the space provided in this booklet. **No extra pages will be provided in any case.**

3. Use a BLACK ball point pen in your OMR Sheet.
4. Read the instructions given inside this booklet before attempting to answer any questions.
5. **DO NOT** write your name, roll no, phone no, or anything, or put any marks anywhere in this booklet, otherwise your candidature will be disqualified.
6. If you are found to resort to any kind of unfair means such as carrying extra material other than pen, pencil, watch, eraser, and scale, or copying from somebody or from external material, your candidature will be disqualified.
7. Use of mobile phones, programmable calculators, log tables or any other tables, wearable smart devices such as smart Android watches or objects of similar nature **CAN NOT** be used inside the examination hall. **Simple and scientific calculators can be used.**
8. At the end of the examination, you have to return this booklet and the OMR Sheet back to the invigilator.
9. There is no negative marks for incorrect answer.

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## Section B (50 Marks)

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1. The current flowing in a series circuit having four equal resistances is  $I$  A. What is the magnitude of the current if the four resistances are connected in parallel?  
(A)  $0.25I$  A  
(B)  $I$  A  
(C)  $4I$  A  
(D)  $16I$  A
2. According to Faraday's law of electromagnetic induction, an emf is induced in a conductor whenever it  
(A) lies in a magnetic field  
(B) lies perpendicular to the magnetic field  
(C) cuts the magnetic flux  
(D) lies parallel to the magnetic field
3. When the plate area of a parallel plate capacitor is increased keeping the capacitor voltage constant, the force between the plates  
(A) increases  
(B) decreases  
(C) remains constant  
(D) may increase or decrease depending on the metal
4. Piezoelectric effect is  
(A) Conversion of electric potential into mechanical stress  
(B) conversion of mechanical stress into electric potential  
(C) it can be both (A) or (B)  
(D) None of these
5. A load is connected to an active network. At the terminals to which the load is connected,  $R_{th} = 10\ \Omega$  and  $V_{th} = 60\text{ V}$ . The maximum power supplied to the load is  
(A) 360 W  
(B) 90 W  
(C) 60 W  
(D) 10 W
6. During one time constant, current through an RL circuit  
(A) rises by 63% of its initial value  
(B) rises by 37% of its final steady value  
(C) decays 63% of its initial value  
(D) rises to 63% of its final steady value
7. The parallel circuit resonance magnifies  
(A) current  
(B) voltage  
(C) both current and voltage  
(D) power
8. In series RLC circuit, resonance occurs when  
(A)  $L = C$   
(B)  $R = C$   
(C)  $R = L$   
(D)  $X_L = X_C$
9. Which of the followings is used for the Nyquist plot?  
(A) pole zero plot  
(B) closed-loop function  
(C) open loop function  
(D) characteristic equation
10. The characteristic equation of a second order system is given by  $s^2 + 2\xi\omega_0s + \omega_0^2 = 0$ . If  $\xi = 1$ , the poles of the transfer function is  
(A) real and equal  
(B) imaginary and equal  
(C) complex and conjugate  
(D) equal to  $-1$
11. A system is given by  $s^2 + 2\xi\omega_0s + \omega_0^2 = 0$ . If  $\xi > 1$ , the system is  
(A) under-damped  
(B) over-damped  
(C) absolutely damped  
(D) critically damped

12. The main application of transfer function is in the study of
- steady-state behaviour of systems
  - steady state as well as transient behaviour of systems
  - only transient behaviour of systems
  - None of these
13. A program that translates symbolically represented instructions into their binary equivalents is called
- loader
  - assembler
  - linker
  - autoloader
14. Eddy current loss is proportional to
- frequency
  - frequency<sup>2</sup>
  - frequency<sup>3</sup>
  - None of the above
15. An air gap is usually inserted in magnetic circuits to
- increase the flux
  - prevent saturation
  - increase the m.m.f.
  - None of these
16. Which logic gates are designated as universal gates?
- NOT, OR and AND gates
  - XNOR, NOR and NAND gates
  - NOR and NAND gates
  - XOR, NOR and NAND gates
17. The impedance of an a.c. circuit is  $10\angle 60^\circ$ , the resistance of the circuit is
- $5\Omega$
  - $10\Omega$
  - $8.66\Omega$
  - None of these
18. In a circuit having a resistance and a reactance, and a power factor angle  $\phi$ , the power absorbed by the circuit is maximum when  $\phi$  is equal to
- $90^\circ$
  - $45^\circ$
  - $0^\circ$
  - None of these
19. Zener diodes are commonly used as
- rectifiers
  - voltage regulators
  - amplifiers
  - None of these
20. Tungsten is used as the filament material in electric lamp because it has
- high temperature coefficient
  - high mechanical strength
  - high melting point
  - high resistance
21. For a d.c. voltage, an inductor
- is virtually a short circuit
  - is an open circuit
  - behaviour is determined by the voltage applied
  - None of these
22. A coil having a resistance of  $5\Omega$  and inductance of  $0.1\text{ H}$  connected in series with a condenser of capacitance  $50\ \mu\text{F}$ . A constant alternating voltage of 200 volts is applied to this circuit. The voltage across the coil at resonance is
- 200 Volts
  - 1788 Volts
  - 1800 Volts
  - 2000 Volts
23. As compared to a closed-loop system, an open-loop system is
- more stable as well as more accurate
  - less stable as well as less accurate
  - more stable but less accurate
  - less stable but more accurate

24. A fixed step-by-step procedure for finding a solution of a problem on computers is called
- (A) hardware
  - (B) software
  - (C) logic
  - (D) algorithm
25. An ideal OP-AMP has
- (A) infinite open-loop gain
  - (B) infinite input resistance
  - (C) zero output resistance
  - (D) All of these
26. Out of the following devices, the fastest switching device is
- (A) JEFT
  - (B) BJT
  - (C) MOSFET
  - (D) triode
27. Three 100 W, 220 V lamps are connected in star across a 3-phase,  $220 \times \sqrt{3}$  Volts supply, the power consumed by the lamp load in watts will be
- (A) 100/3
  - (B)  $100/\sqrt{3}$
  - (C)  $100 \times \sqrt{3}$
  - (D) 300
28. The display consuming minimum power is
- (A) light emitting diode
  - (B) liquid crystal display
  - (C) neon tube
  - (D) photo diode
29. A half-wave rectified sinusoidal waveform has a peak voltage of 12 V. Its average value and RMS value of the fundamental components are, respectively
- (A)  $15/\pi$  V, 7.5 V
  - (B)  $20/\pi$  V, 10 V
  - (C)  $12/\pi$  V, 6 V
  - (D) None of these
30. Two voltage sources can be connected in parallel when they have equal
- (A) magnitude
  - (B) frequency
  - (C) phase
  - (D) All of the above
31. In a conductor the static electric field is
- (A) unity
  - (B) zero
  - (C) always perpendicular to the surface
  - (D) always parallel to the surface
32. To extend the range of voltmeter ' $n$ ' times, the ratio of series resistance required to meter resistance is
- (A)  $n$
  - (B)  $n - 1$
  - (C)  $1/n$
  - (D)  $1/(n - 1)$
33. In digital telemetry, commonly used modulation is
- (A) PCM
  - (B) PPM
  - (C) PWM
  - (D) PAM
34. In an open loop control system
- (A) output signal has no control on the input signal
  - (B) system variables affect the output signal
  - (C) none of the variables have any effect on the input signal
  - (D) All of these
35. Norton's theorem gives
- (A) an equivalent current source in parallel with an equivalent impedance
  - (B) an equivalent current source in series with an equivalent impedance
  - (C) an equivalent voltage source in parallel with an equivalent impedance
  - (D) an equivalent voltage source in series with an equivalent impedance

36. LVDT is an
- (A) Electromagnetic device
  - (B) Electromechanical device
  - (C) Electrostatic device
  - (D) Electrodynamic device
37. The maximum number of 3-input gates in a 16-pin IC is
- (A) 2
  - (B) 3
  - (C) 4
  - (D) 5
38. Which one will be the next Hex number in the following series  $1D, 1E, 1F, \dots$ ?
- (A) 1G
  - (B) 2F
  - (C) 20
  - (D) 11F
39. In a dc generator, interpoles are used to neutralize
- (A) reactance voltage
  - (B) cross magnetising effect of armature reaction
  - (C) Both of the above
  - (D) current unbalance at the pole tip
40. The all-day efficiency of a transformer is
- (A) less than its power efficiency
  - (B) equal to its power efficiency
  - (C) more than its power efficiency
  - (D) not related to its power efficiency
41. When one of three series resistors is removed from a circuit and the circuit is reconnected, the current
- (A) increases
  - (B) increases by one-third
  - (C) decreases by one-third
  - (D) decreases by the amount of current through the removed resistor
42. The average value of a 12 V peak sine wave over one complete cycle is
- (A) 0 V
  - (B) 1.27 V
  - (C) 7.64 V
  - (D) 6.37 V
43. A pulse waveform has a high time of 8 ms and a pulse width of 32 ms. The duty cycle is
- (A) 25
  - (B) 50
  - (C) 1
  - (D) 100
44. In a series RC circuit, 12 V (rms) is measured across the resistor and 15 V (rms) is measured across the capacitor. The rms source voltage is
- (A) 3 V
  - (B) 27 V
  - (C) 19.2 V
  - (D) 1.9 V
45. In a  $\Delta$ -connected generator, all of the phase voltages are
- (A) zero
  - (B) equal in magnitude
  - (C) one-third of total
  - (D) one-sixth of total
46. If there is 6 A of current flows through the filament of a lamp, how many coulombs of charge move through the filament in 1.75 s?
- (A) 10.5 C
  - (B) 105 C
  - (C) 3.4 C
  - (D) 34 C
47. When the current through a 12 k $\Omega$  resistor is 8 mA, the power is
- (A) 7.68 mW
  - (B) 768 mW
  - (C) 7.68 W
  - (D) 76.8 W

48. In a two-source circuit, one source acting alone produces 12 mA through a given branch. The other source acting alone produces 10 mA in the opposite direction through the same branch. The actual current through the branch is

- (A) 22 mA
- (B) 12 mA
- (C) 10 mA
- (D) 2 mA

49. What is the magnetomotive force (mmf) of a wire with 8 turns carrying three amperes of current?

- (A) 2,400 At
- (B) 240 At
- (C) 24 At
- (D) 2.4 At

50. To decrease the time constant of the control system one should decrease

- (A) inertia
- (B) steady state error
- (C) damping constant
- (D) viscous damping

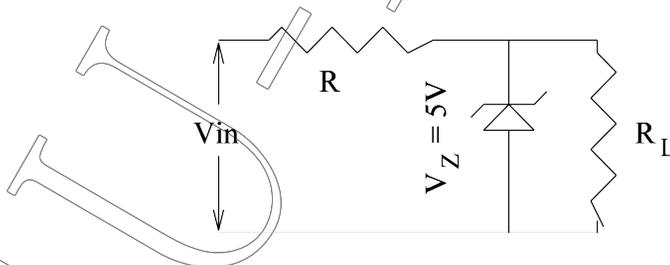
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**Section C (30 Marks)**

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**Answer any 5 (five) from the following**

1. State and prove 'maximum power transfer theorem'. If the impedance of a source is  $R + jX$ , what is the load impedance for the maximum power transfer to occur, and what will be the value of the load power? (Marks : 4 + 2 = 6)
2. What do you understand by 'resonance in an AC circuit'? Distinguish between resonance in series circuit and resonance in parallel circuit. (Marks : 2 + 4 = 6)
3. Draw and describe the  $V$ - $I$  characteristics of a pn junction diode. Also explain the phenomena 'Zener Breakdown' and 'Avalanche Breakdown'. (Marks : 4 + 2 = 6)
4. What are the advantages of a 3-phase system over a single-phase system? Show that for a symmetrical, balanced system, the circulating current in a closed delta is always zero. (Marks : 3 + 3 = 6)
5. Explain the concept of source transformation with a suitable example. Establish that the maximum power is absorbed from a voltage source when the load impedance can be freely varied and it is the complex conjugate of the source impedance. (Marks : 2 + 4 = 6)
6. The power absorbed by the load resistance of the circuit shown below is 500 mW. If the input voltage is 14 V, determine the value of the resistance  $R$ . Assume that the minimum zener current is 10 mA. (Marks : 6)



7. Design a logic circuit with output, given by the following Boolean expressions

(A)  $(A + B) \cdot \overline{AB}$

(B)  $(A + \overline{BC})$

(Marks : 6)

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Space for Answers (Section C) : for Questions 1 to 7 (10 pages)

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