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Serial No.

100082

Question Booklet

Paper—VI

ELECTRICAL ENGINEERING

(Objective)

Time Allowed : 1 Hour

Maximum Marks : 100

Read the following instructions carefully before you begin to answer the questions.

IMPORTANT INSTRUCTIONS

1. This Question Booklet contains **50** questions in all.
2. **All** questions carry equal marks.
3. Attempt **all** questions.
4. **Immediately after commencement of the examination, you should check up your Question Booklet and ensure that the Question Booklet Series is printed on the top right-hand corner of the Booklet. The Booklet contains 12 printed pages and no page or question is missing or unprinted or torn or repeated. If you find any defect in this Booklet, get it replaced immediately by a complete Booklet of the same series.**
5. You must write your Roll Number in the space provided on the top of this page. Do not write anything else on the Question Booklet.
6. An Answer Sheet will be supplied to you separately by the Invigilator to mark the answers. **You must write your Name, Roll No. and other particulars on the first page of the Answer Sheet provided, failing which your Answer Sheet will not be evaluated.**
7. You will encode your **Roll Number** and the **Question Booklet Series A, B, C or D** as it is printed on the top right-hand corner of this Question Booklet with **Black/Blue ballpoint pen** in the space provided on **Page-2** of your Answer Sheet. **If you do not encode or fail to encode the correct series of your Question Booklet, your Answer Sheet will not be evaluated correctly.**
8. Questions and their responses are printed in English only in this Booklet. Each question comprises **four** responses—(A), (B), (C) and (D). You are to select **ONLY ONE** correct response and mark in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each question. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.
9. In the Answer Sheet, there are **four** brackets—(A), (B), (C) and (D) against each question. To answer the questions you are to **mark with Black/Blue ballpoint pen ONLY ONE** bracket of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. **Any erasure or change is not allowed.**
10. You should not remove or tear off any sheet from the Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the examination. **After the examination has concluded, you must hand over your Answer Sheet to the Invigilator.** Thereafter, you are permitted to take away the Question Booklet with you.
11. Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.

SEAL

1. A 20 kVA, 2.5 kV/250 V, single-phase transformer gave the following test results :

Open-circuit test : 250 V, 0.8 A, 90 W

Short-circuit test : 80 V, 6 A, 60 W

The kVA output at maximum efficiency of the transformer will then be

- (A) 24.49
(B) 18.37
(C) 23.70
(D) 16.87
2. The effective resistance of a 2200 V, 50 Hz, 440 kVA, single-phase alternator is 0.5Ω . On short circuit, a field current of 40 A gives full-load current. The voltage induced on open circuit for the same excitation is 1200 V. Then the synchronous reactance of the machine is
- (A) 30Ω
(B) 55Ω
(C) 5.98Ω
(D) 11Ω
3. In a transformer, the phasor relationship of the loss component of no-load current with the mutual flux is
- (A) it lags flux by 90°
(B) it leads flux by 90°
(C) it is out of phase with the flux
(D) it is in phase with the flux

4. The voltage applied to a transformer is increased by 20% and the frequency is reduced by 20%. Assuming that the magnetic circuit is unsaturated, the maximum core density will be

- (A) 3 times the original value
(B) 1.5 times the original value
(C) 0.67 times the original value
(D) 4 times the original value

5. A motor is used to drive a hoist. The motor characteristics are given by $T = (100 - 0.1N)$ in quadrants I, II and IV. In quadrants II, III and IV, the characteristics are given by $T = (-100 - 0.1N)$, where N is the speed in r.p.m. The net load torque is 50 N-m, when the hoist is fully loaded and -30 N-m, when unloaded. The equilibrium speed of the drive in r.p.m. in all the four quadrants will be

- (A) 500, 1300, -700, -1500
(B) 500, 1500, -1300, -700
(C) 1300, 500, -1500, -700
(D) 500, 1300, -1500, -700

6. A 220 V d.c. machine has an armature resistance of $1\ \Omega$. If the full-load current is 20 A, the difference in the induced voltages when the machine runs as motor and as generator is

(A) 20 V
(B) 40 V
(C) 10 V
(D) 0 V

7. A single-phase motor takes 50 A at a power factor angle of 30° lagging from a 250 V, 50 Hz a.c. supply. What should be the value of capacitive reactance of shunting capacitor in order to raise the power factor to unity?

(A) $100\ \Omega$
(B) $10\ \Omega$
(C) $25\ \Omega$
(D) $1\ \Omega$

8. A two-wire d.c. distributor cable, 1000 m long, is loaded with 0.5 A/m. The resistance of each conductor is $0.05\ \Omega/\text{km}$. If the distributor is fed from both ends with equal voltages of 220 V, the maximum voltage drop will be

(A) 5.2 V
(B) 6.25 V
(C) 4.8 V
(D) 2.4 V

9. A generating station supplies the following loads to various consumers :

Industrial consumer = 750 MW

Commercial establishment
= 350 MW

Domestic power = 10 MW

Domestic light = 50 MW

The maximum demand on the station is 1000 MW. What is its diversity factor?

(A) 1.16
(B) 0.86
(C) 1.1
(D) 0.91

10. The maximum demand on a power generating station is 500 MW. If the annual load factor is 50%, what is the total energy generated annually?

(A) $1825 \times 10^5\ \text{kWh}$
(B) $438 \times 10^7\ \text{kWh}$
(C) $219 \times 10^7\ \text{kWh}$
(D) $9125 \times 10^5\ \text{kWh}$

11. A 20 kV, 400 MVA generator has the reactance of 0.2 pu. The value of reactance on the new base of 25 kV and 200 MVA will be

(A) 0.064 pu

(B) 0.058 pu

(C) 0.08 pu

(D) 0.32 pu



12. A three-phase induction motor rated for 500 kW, 400 V, 50 Hz, 6 poles runs at a speed of 960 r.p.m. when fully loaded. The slip of the machine will be

(A) 0.02

(B) 0.03

(C) 0.01

(D) 0.04

13. The angle between the rotor poles and stator poles in a synchronous motor is called

(A) power factor angle

(B) torque angle

(C) synchronizing angle

(D) retarding angle

14. In a synchronous generator, the effect of armature reaction is completely magnetizing if the power factor of the load is

(A) zero leading

(B) zero lagging

(C) unity

(D) 0.5 lagging

15. A synchronous condenser is virtually

(A) induction motor

(B) under-excited synchronous motor

(C) over-excited synchronous motor

(D) d.c. motor

16. For a unity feedback system, the open-loop transfer function is given by

$$G(s) = \frac{50}{(1 + 0.1s)(1 + 2s)}$$

Its position error constant is

(A) 0

(B) 50

(C) 1

(D) 25

17. A feedback control system is described as

$$G(s) = \frac{50}{s(s+2)(s+5)}, \quad H(s) = \frac{1}{s}$$

For a unit step input, the steady-state error is

(A) infinity

(B) 5

(C) 0

(D) 1

18. A unity feedback system has the open-loop transfer function

$$G(s) = \frac{K_1(2s+1)}{s(4s+1)(s+1)^2}$$

The input $R(t) = 1 + 5t$ is applied to the system. It is required that the steady-state error should be less than or equal to 0.1. The minimum value of K_1 to satisfy this condition is

(A) $K_1 \geq 10$

(B) $K_1 \geq 50$

(C) $K_1 \geq 20$

(D) $K_1 \geq 5$

19. The slope of the asymptote in Bode plot for a second-order system is

(A) 6 dB per octave

(B) 12 dB per octave

(C) 18 dB per octave

(D) 3 dB per octave

20. In the Nyquist method for analysis of stability, stability is analyzed by counting the number of encirclements around

(A) $1 + j0$

(B) $0 + j1$

(C) $-1 + j0$

(D) $0 - j1$

21. The characteristic equation of a feedback control system is given by

$$3s^4 + 10s^3 + 5s^2 + 5s + 2 = 0$$

Check the stability of the system.

(A) Stable

(B) Unstable

(C) Marginally stable

(D) Conditionally stable



22. A system has a forward path transfer function given by

$$G(s) = \frac{K}{s(s+2)(s+3)}$$

Root locus of the above system will have intersection of asymptotes with centroid at which of the following coordinates?

- (A) $(-2.6, j0)$
- (B) $(-1.7, j0)$
- (C) $(-3.7, j0)$
- (D) $(-0.6, j0)$

23. A unity feedback system is characterized by an open-loop transfer function

$$G(s) = \frac{K}{s(s+10)}$$

The value of K required in order to have a damping ratio of 0.5 is

- (A) 10
- (B) 100
- (C) 50
- (D) 20

24. Gain margin is the factor by which gain of the system can be increased to make it

- (A) oscillatory
- (B) damped
- (C) stable
- (D) unstable

25. A lag compensator is essentially a

- (A) high-pass filter
- (B) band-pass filter
- (C) band-stop filter
- (D) low-pass filter

26. A system is defined as marginally stable when

- (A) one or more poles lie in the real axis
- (B) one or more poles lie in the imaginary axis
- (C) all poles are in the right half of s -plane
- (D) one or more zeros are in the imaginary axis

27. If the damping factor of a control system is unity, its response will be

- (A) critically damped
- (B) undamped
- (C) oscillatory
- (D) under-damped

28. In a negative feedback amplifier, open-loop gain is 100, feedback ratio is 0.04 and input voltage is 50 mV. Then the feedback factor and feedback voltage are

- (A) 0.04 and 4 V
- (B) 4 and 0.04 V
- (C) 2 and 4 V
- (D) 4 and 2 V

29. A 24 V, 600 mW Zener diode is to be used for providing a 24 V stabilized supply to a variable load. If the input voltage is 32 V, the value of the series resistance required is

- (A) 960 Ω
- (B) 426 Ω
- (C) 320 Ω
- (D) 1280 Ω

30. In common-emitter configuration of transistor circuit, the common-emitter forward amplification factor is given by the ratio

- (A) $\frac{I_C}{I_B}$
- (B) $\frac{I_E}{I_B}$
- (C) $\frac{I_C}{I_E}$
- (D) $\frac{I_B}{I_E}$

31. Which of the following devices does not require a continuous base drive?

- (A) BJT
- (B) MOSFET
- (C) IGBT
- (D) SCR

32. The following Boolean expression

$$Y = (A + \bar{B} + \bar{C})(A + \bar{B} + C)$$

can be realized using

- (A) one NOT gate and one OR gate
- (B) one NOT gate and one AND gate
- (C) one AND gate
- (D) one OR gate

33. The simplified form of the Boolean expression

$$Y = \bar{A}\bar{B}\bar{C} + \bar{A}(B)\bar{C} + (A)\bar{B}\bar{C}$$

is



- (A) $Y = C(\bar{A} + \bar{B})$
- (B) $Y = \bar{C}(\bar{A} + \bar{B})$
- (C) $Y = \bar{C}(\bar{A} + B)$
- (D) $Y = \bar{C}(A + \bar{B})$

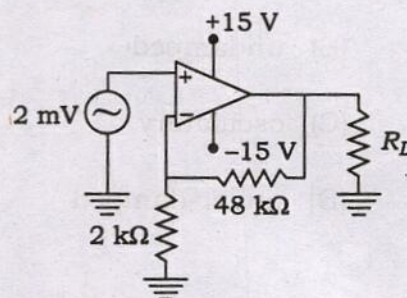
34. Which of the following devices is a best choice for high-frequency switching applications?

- (A) IGBT
- (B) MOSFET
- (C) BJT
- (D) SCR

35. The Q-factor of a tuned amplifier is 50. If the resonant frequency of the amplifier is 5000 Hz, what are the values of upper and lower cut-off frequencies in Hz respectively?

- (A) 5050 and 4950
- (B) 5200 and 4800
- (C) 5100 and 4900
- (D) 5200 and 5100

36. In the circuit shown in the figure below, if the open-loop gain is 2×10^5 , what is the error voltage?



- (A) $0.5 \mu\text{V}$
- (B) $0.75 \mu\text{V}$
- (C) $0.25 \mu\text{V}$
- (D) $1.25 \mu\text{V}$

37. Which of the following requirements must be met for fast communication?

- (A) High channel density
- (B) High signal to noise ratio
- (C) Large bandwidth
- (D) Low bandwidth

38. In a communication system, noise is likely to affect the signal

- (A) in the transmitter
- (B) in the channel
- (C) in the formation source
- (D) in the destination

39. A communication equipment has a signal power of $45 \mu\text{W}$ and noise power of 4.5 nW at its input. Its signal to noise ratio (SNR) is

- (A) 80
- (B) 40
- (C) 60
- (D) 20

40. Magnetizing current of an induction motor is much larger than a two-winding transformer of same rating. The reason for this is the presence of which of the following?

- (A) Air gap
- (B) Laminations
- (C) Rotating parts
- (D) Small leakage

41. Slip test is conducted on synchronous generator to determine

- (A) slip
- (B) positive and negative sequence reactance
- (C) direct and quadrature axis reactance
- (D) subtransient reactance

42. The contents of the program counter specify which of the following?

- (A) The count of number of instructions executed so far
- (B) The address of the instruction being executed
- (C) The address of the instruction executed last
- (D) The address of the next instruction to be executed

43. A program that can be used repeatedly throughout a major program is called

- (A) template
- (B) program module
- (C) subroutine
- (D) loop



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44. The first machine cycle of an instruction is always
- (A) memory write cycle
 - (B) memory read cycle
 - (C) fetch cycle
 - (D) I/O read cycle
45. A carrier is modulated by 4 signals of frequencies 5 kHz, 10 kHz, 15 kHz and 20 kHz. What is the bandwidth of the signal?
- (A) 40 kHz
 - (B) 20 kHz
 - (C) 10 kHz
 - (D) 80 kHz
46. In a frequency modulation system, the maximum deviation allowed is 1000 and modulating frequency is 2 kHz. What is the modulation index?
- (A) 0.5
 - (B) 2
 - (C) 4
 - (D) 0.25
47. Among the following, which is the digital modulating system?
- (A) PPM
 - (B) PCM
 - (C) PWM
 - (D) PFM
48. What is the effect of increase in transmission bandwidth on the received signal power in AM and FM respectively?
- (A) Increase, increase
 - (B) Remain same, increase
 - (C) Increase, remain same
 - (D) Remain same, remain same
49. Which one of the following systems offers the best trade-off between the bandwidth and S/N ratio?
- (A) PAM
 - (B) PDM
 - (C) PPM
 - (D) PCM
50. Turn-off of GTO is achieved by negative gate current I_{GN} such that
- (A) $I_{GN} = I_A / \beta_{off}$
 - (B) $I_{GN} > I_A / \beta_{off}$
 - (C) $I_{GN} < I_A / \beta_{off}$
 - (D) Any I_{GN}

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