

MIZORAM PUBLIC SERVICE COMMISSION
TECHNICAL COMPETITIVE EXAMINATIONS FOR
JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (AE/SDO)
UNDER PUBLIC HEALTH ENGINEERING DEPARTMENT,
GOVERNMENT OF MIZORAM, JANUARY-2024

ELECTRICAL ENGINEERING
PAPER-II

Time Allowed : 3 hours

FM : 200

SECTION - A (Multiple Choice questions) (100 Marks)

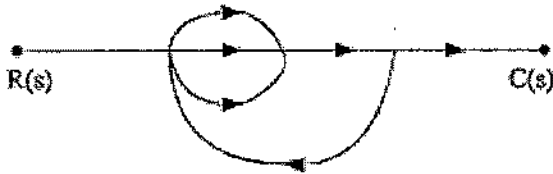
All questions carry equal mark of 2 each. Attempt all questions.

This Section should be answered only on the OMR Response Sheet provided.

1. The Nyquist plot of a loop transfer function $G(j\omega)H(j\omega)$ of a system encloses the $(-1, j0)$ point. The gain margin of the system is
 - (a) less than zero
 - (b) zero
 - (c) greater than zero
 - (d) infinity
2. The characteristics equation of a closed-loop control system is given as $s^2 + 4s + 16 = 0$. The resonant frequency in radians/sec. of the system is
 - (a) 2
 - (b) $2\sqrt{3}$
 - (c) 4
 - (d) $2\sqrt{2}$
3. A phase-lag compensation will
 - (a) improve relative stability
 - (b) increase the speed of response
 - (c) increase bandwidth
 - (d) increase overshoot
4. The main drawback of a feedback system is
 - (a) inaccuracy
 - (b) inefficiency
 - (c) insensitivity
 - (d) instability
5. The ON-OFF controller is a
 - (a) linear device
 - (b) nonlinear device
 - (c) discontinuous device
 - (d) none of these
6. In force-current analogy, mass is analogous to
 - (a) Inductance
 - (b) Current
 - (c) Voltage
 - (d) Capacitance
7. A transformer has negligible resistance and a pu reactance of 0.1. Its voltage regulation on full load will a leading pf angle of 30° leading is
 - (a) -10 %
 - (b) 10 %
 - (c) 5 %
 - (d) -5 %

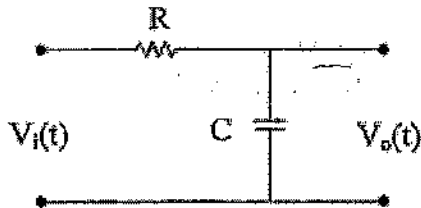
8. In a transformer, the magnetic coupling between the primary and secondary circuit can be increased by
 - (a) increasing the number of turns
 - (b) using soft material for windings
 - (c) using the magnetic core of low reluctance
 - (d) using transformer oil of better quality
9. Two alternators A and B are sharing an inductive load equally. If the excitation of alternator A is increased
 - (a) Alternator B will deliver more current and alternator A will deliver less current
 - (b) Alternator B will deliver less current and alternator A will deliver more current
 - (c) Both will continue to share load equally
 - (d) Both will deliver more current
10. The negative phase sequence in a three phase synchronous motor exists when the motor is
 - (a) under loaded
 - (b) over loaded
 - (c) supplied with unbalanced voltage
 - (d) hot
11. Which of the following single phase motors will operate at high power factor?
 - (a) Shaded pole motor
 - (b) Capacitor run motor
 - (c) Split phase motor
 - (d) Capacitor start motor
12. A DC shunt generator delivers 95 A at 250 V and the resistance of the shunt field and armature are $50\ \Omega$ and $0.05\ \Omega$ respectively. The generated emf will be
 - (a) 270 V
 - (b) 265 V
 - (c) 255 V
 - (d) 275 V
13. For extra high voltage lines which circuit breaker is preferred
 - (a) Bulk oil circuit breaker
 - (b) Vacuum circuit breaker
 - (c) SF_6 gas circuit breaker
 - (d) Minimum oil circuit breaker
14. If the fault current is 2000 A, the relay setting is 50 % and CT ratio is 400:5, then plug setting multiplier will be
 - (a) 25 A
 - (b) 15 A
 - (c) 50 A
 - (d) 10 A
15. The transient stability of the power system can be effectively improve by
 - (a) excitation control
 - (b) phase shifting transformer
 - (c) single pole switching of circuit breakers
 - (d) increasing the turbine valve opening
16. In pumped storage
 - (a) power is produced by means of pumps
 - (b) water is stored by pumping to high pressures
 - (c) downstream water is pumped up-stream during off load periods
 - (d) water is recirculated through turbine
17. Steady state stability limit is
 - (a) greater than transient stability limit
 - (b) equal to transient stability limit
 - (c) less than the transient stability limit
 - (d) none of these

18. The number of loops in the following signal flow graph is/are



- (a) one (b) two
(c) three (d) four

19. What will be the transfer function of the circuit shown below? Where, $\alpha = \frac{1}{RC}$



- (a) $\frac{\alpha}{s + \alpha}$ (b) $\frac{s}{s + \alpha}$
(c) $\frac{1}{s + \alpha}$ (d) $\frac{1}{s - \alpha}$

20. An element of a system is said to be linear if it obeys the principle of

- (a) superposition only (b) homogeneity only
(c) both superposition and homogeneity (d) reciprocity

21. As compared to closed loop system, an open loop system is

- (a) more stable as well as more accurate (b) less stable as well as less accurate
(c) more stable but less accurate (d) less stable but more accurate

22. The phase cross-over frequency for the transfer function $G(s)H(s) = \frac{1}{s(s+1)(s+0.5)}$ is

- (a) 0.5 rad/sec (b) 0.707 rad/sec
(c) 1.732 rad/sec (d) 2 rad/sec

23. The complex conjugate poles of a transfer function lie on the left half of the s-plane, the system is

- (a) stable (b) marginally stable
(c) unstable (d) may be stable or unstable

24. The system for the characteristic equation $s^3 + 3s^2 + 3s + K = 0$ is stable for which value of K?

- (a) -6 (b) 5
(c) 12 (d) 15

25. A transfer function of a control system does not have pole-zero cancellation, which one of the following statement is true?

- (a) System is neither controllable nor observable
(b) System is completely controllable and observable
(c) System is observable but uncontrollable
(d) System is controllable but unobservable

26. A single-phase step up transformer is having the winding turns ratio of 1:20. The primary side supply frequency is f , the frequency at the secondary side of the transformer will be
- (a) $f/20$ (b) f
(c) $2f$ (d) $20f$
27. The hysteresis power loss in a transformer does not depend upon
- (a) applied voltage (b) applied frequency
(c) transformer oil (d) material of the transformer core
28. What is incorrect statement about a power transformer?
- (a) It is designed to have maximum efficiency at or near full load
(b) It is designed to have considerably greater leakage reactance
(c) It isolates the generating plant from the transmission line electrically
(d) It is designed to have maximum efficiency at or near half load
29. What material is used in the breather of a transformer to absorb moisture content of air entering into the transformer's oil contact area?
- (a) Calcium carbonate (b) Silica gel
(c) Sodium chloride (d) Carbon crystals
30. The series field winding of a series wound DC machine generally
- (a) connected in parallel with the armature winding of the machine
(b) made of fine conductor wire
(c) made of large number of turns of wire
(d) carry same amount of current as armature current
31. How the torque produced by a DC series motor depends upon the armature current?
- (a) directly proportional to the armature current
(b) directly proportional to the square of armature current
(c) inversely proportional to the armature current
(d) inversely proportional to the square of armature current
32. A 6-poles synchronous motor is supplied by a 50 Hz, 440 V supply. At what speed the motor does run?
- (a) 750 r.p.m. (b) 1000 r.p.m.
(c) 1500 r.p.m. (d) 3000 r.p.m.
33. At what condition a synchronous motor is called a synchronous condenser?
- (a) The motor runs at unity power factor
(b) The motor field is operated at under excitation
(c) The motor is operated at full load and under excitation
(d) The motor is operated at no load and over excitation
34. A 3-phase, 50 Hz, 4-pole, induction motor runs at 1455 r.p.m. Frequency of the current flowing in the rotor coil is
- (a) 1.5 Hz (b) 15 Hz
(c) 50 Hz (d) 150 Hz
35. An induction machine behaves as a generator when the slip 's' is
- (a) $s = 0$ (b) $0 < s < 1$
(c) $s = 1$ (d) $s < 0$

36. The relation between electrical angle and mechanical angle for an electrical machine, where P is the number of poles is
- (a) Electrical angle = $(P/2) \times$ Mechanical angle
 - (b) $(P/2) \times$ Electrical angle = Mechanical angle
 - (c) Electrical angle = Mechanical angle
 - (d) Electrical angle = $2 \times$ Mechanical angle
37. Which of the following DC generators at load condition offers poorest voltage regulation?
- (a) Cumulative compounded generator
 - (b) Series generator
 - (c) Shunt generator
 - (d) Differential compounded generator
38. Which condition is correct for a salient pole rotor machine?
- (a) Small diameter and small axial length
 - (b) Small diameter and long axial length
 - (c) Large diameter and large axial length
 - (d) Large diameter and small axial length
39. Which type of fault is most frequent fault on a transmission line?
- (a) Single-line to ground fault
 - (b) Double-line to ground fault
 - (c) Three-phase to ground fault
 - (d) Three-phase short circuit fault
40. The magnitude of voltage at the sending end of a long transmission line becomes higher than the voltage magnitude at the receiving end, this phenomena is called
- (a) Hunting effect
 - (b) Corona effect
 - (c) Ferranti effect
 - (d) Voltage instability effect
41. If the reactance 'X' of the line could be varied and the resistance 'R' remaining constant, the maximum steady state power that could be transmitted over the line would be greatest when
- (a) $X = \sqrt{3} R$
 - (b) $R = \sqrt{3} X$
 - (c) $X = R$
 - (d) $R = X / \sqrt{3}$
42. The corona loss in a three-phase transmission line does not depend upon the parameter
- (a) thickness of the conductor
 - (b) power frequency
 - (c) distance between the conductors
 - (d) phase-sequence
43. What is an element in an electrical circuit which serves as a protection against overload?
- (a) Fuse
 - (b) Mica
 - (c) Resistor
 - (d) Semiconductor
44. Under which condition usually circuit breakers operate?
- (a) Transient state of short-circuit current
 - (b) Sub-transient state of short-circuit current
 - (c) Steady state of short-circuit current
 - (d) When there is no DC current component
45. The current zero interruption, in oil and air blast circuit breakers is achieved by
- (a) lengthening of the gap between the contact terminals
 - (b) cooling and blast effect
 - (c) deionizing the oil with forced air
 - (d) both (a) & (b)
46. The winding short-circuit fault protection of a transformer can be achieved by
- (a) mho relay
 - (b) distance relay
 - (c) directional relay
 - (d) differential relay

47. AC network analyzer is used to solve the problem of
- (a) load-flow (b) load-flow and short-circuit
(c) load-flow and stability (d) load-flow, short-circuit, and stability
48. The diversity factor of a specific group of electrical consumers is
- (a) always greater than 1 (b) always less than 1
(c) may be less or greater than 1 (d) may be higher than 100
49. An under-excited alternator operates at
- (a) lagging power factor (b) leading power factor
(c) unity power factor (d) leading or unity power factor
50. Which of the following power plant takes least time in starting from cold condition to full load condition?
- (a) Nuclear power plant (b) Thermal power plant
(c) Hydroelectric power plant (d) Gas power plant

SECTION - B (Short answer type question) (100 Marks)

All questions carry equal marks of 5 each.

This Section should be answered only on the Answer Sheet provided.

1. What is meant by open loop and closed loop control systems? Differentiate both.
2. Why do you need a feedback controller? Justify your answer with an example. List the advantages of negative feedback in control system.
3. What are Bode plots? What are its advantages? How is stability determined from Bode plots?
4. Find the efficiency of a 150 kVA transformer at 25% full load at 0.8 pf lagging if copper losses are 1600 W at full load and iron losses are 1400 W.
5. Explain why parallel operation of transformer is necessary.
6. What are the different types of losses in a transformer? Write an expression for efficiency and development a condition for maximum efficiency.
7. Describe briefly the process of voltage build up in a self-excited dc machine. What are the conditions for build-up in a DC machines?
8. Draw and explain briefly the speed-current, torque-current and speed-torque characteristics of a DC shunt motor.
9. What do you mean by hunting of a synchronous motor? How do you prevent hunting?
10. Briefly explain the operation of a single phase inductor motor (split phase type).
11. Define per unit representation of electrical quantities? List out its advantages.
12. List the methods for improving transient stability of a power system. Explain any one method briefly.
13. Check the stability of the system by applying the Routh-Hurwitz criterion having the characteristic equation $s^5 + 7s^4 + 6s^3 + 31s^2 + 25s + 4 = 0$.
14. Discuss the open-circuit and short-circuit tests of a single phase transformer. What are the parameters are to be calculated through these testes?
15. Differentiate an auto transformer with a normal single phase two winding transform.

16. A 4-pole, 3-phase, 50 Hz induction motor develops a maximum torque of 25 Nm at 1440 r.p.m. Determine the torque exerted by the motor at 5% slip. The rotor resistance per phase is 0.5Ω .
17. A three-phase 132 kV transmission line is connected to a 40 MW load at a power factor of 0.85 lagging. The line constants of the 100 km long line are $Z = 90 \angle 80^\circ \Omega$ and $Y = 0.001 \angle 90^\circ \text{ S}$. Calculate (i) A, B, C, D line parameters and (ii) sending end voltage.
18. The star point of a 3 kV, 3 MVA three-phase synchronous generator is solidly grounded. Its positive, negative and zero sequence reactances are 2.4, 0.45, and 0.30Ω respectively. The generator, operating unloaded, sustains a resistive phase to ground fault. This fault has a resistance of 1.2Ω . Calculate the fault current and the voltage to the ground of this phase.
19. What is the concept of corona formation in a transmission line? What are the factors affect the corona formation? Explain in brief.
20. Draw and explain the equivalent circuit of a single-phase induction motor based on permanent-split capacitor motor principle.

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