

MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR PRINCIPAL, GOVT. INDUSTRIAL TRAINING INSTITUTE UNDER LABOUR, EMPLOYMENT, SKILL DEVELOPMENT & ENTREPRENEURSHIP 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.

- The steady state error due to a ramp input for a type two system is equal to
 - Zero
 - Infinite
 - Constant
 - Data is insufficient.
- A property of phase lead compensation is that the
 - Overshoot is increased
 - Bandwidth of closed loop system is reduced
 - Rise time of closed loop system is reduced
 - Gain margin is reduced
- The bode-plot is valid for
 - Minimum phase network
 - All phase network
 - Non-minimum phase network
 - None of the above
- The unit step response of a response of a particular control system is given by $c(t) = 1 - 10e^{-t}$, then its transfer functions is
 - $\frac{10}{s+1}$
 - $\frac{s-9}{s+1}$
 - $\frac{1-9s}{s+1}$
 - $\frac{1-9s}{s(s+1)}$
- Signal flow graph is used to find
 - Stability of the system
 - Controllability of the system
 - Transfer function of the system
 - Poles of the system
- In the bode-plot of a unity feed back control system, the value of phase of $G(j\omega)$ at the gain cross over frequency is -125° . The phase margin of the system is
 - -125°
 - -55°
 - $+55^\circ$
 - $+125^\circ$
- With negative feedback in a closed loop control system, the system sensitivity to parameter variations
 - increases
 - decreases
 - becomes zero
 - one fourth of original value

8. The system steady state error can be minimized by
- (a) Decreasing damped frequency
 - (b) Decreasing natural frequency
 - (c) Increasing damped frequency
 - (d) Increasing system gain constant.
9. The steel used for transformer core has
- (a) high silicon content
 - (b) high permeability
 - (c) low hysteresis loss
 - (d) all of the above
10. The magnetizing current drawn by a 3-phase induction motor is about _____ of full-load stator current
- (a) 5%
 - (b) 10 to 15%
 - (c) 15 to 20%
 - (d) 30 to 50%
11. A high starting torque can be obtained in a 3-phase induction motor by _____.
- (a) Increasing rotor resistance
 - (b) Decreasing rotor resistance
 - (c) Increasing rotor reactance
 - (d) None of the above
12. A 6-pole, 3-phase induction motor is connected to a 25 Hz supply and at full load the rotor emf makes 105 complete cycles in 2 minutes. The full load percentage slip is
- (a) 3.5%
 - (b) 7.5%
 - (c) 1.5%
 - (d) 2.5%
13. The voltage regulation of an alternator is large than that of a DC generator because of
- (a) large armature resistance
 - (b) large leakage reactance
 - (c) complex effects of armature reaction
 - (d) none of these
14. A 3-phase, 16 pole alternator has a star-connected winding with 144 slots and 10 conductors per slot. The flux per pole is 30mWb sinusoidally distributed and the speed is 375 rpm. The frequency of generated emf is
- (a) 25 Hz
 - (b) 50 Hz
 - (c) 100 Hz
 - (d) 200 Hz
15. The torque developed by a split phase motor is proportional to
- (a) Sine of angle between I_m and I_s
 - (b) Cosine of angle between I_m and I_s
 - (c) Main winding current, I_m
 - (d) Auxiliary winding current, I_s
16. When the supply voltage for an induction motor is reduced by 10%, which of the following will not decrease
- (a) Full load speed
 - (b) Starting torque
 - (c) Percentage slip
 - (d) All of these
17. If the input to the prime mover of an alternator is kept constant but the excitation is changed, then the
- (a) Reactive component of the output is changed
 - (b) Active component of the output is changed
 - (c) Power factor of the load remains constant
 - (d) Power factor of the load reduces
18. The magnetizing current of a transformer is usually small because it has
- (a) Laminated silicon steel core
 - (b) Small airgap
 - (c) Fewer rotating parts
 - (d) Large leakage flux
19. The applied voltage of a certain transformer is increased by 50% while the frequency is reduced to 50%. The maximum core flux density will
- (a) become three times
 - (b) become 1.5 times
 - (c) become half
 - (d) remain the same

20. If a power transformer is operated at very high frequencies, then
(a) primary reactance is too much increased (b) primary will draw large power
(c) core losses will be excessive (d) none of these
21. Transmission efficiency increases as
(a) Voltage and power factor both increase (b) Voltage and power factor both decrease
(c) Voltage increases but power factor decreases (d) Voltage decreases but power factor increases
22. Capacity factor and load factor become identical when
(a) Peak load is equal to the capacity of the plant
(b) Average load is half the capacity of the plant
(c) Average load is same as peak load
(d) Group diversity factor is equal to peak diversity factor
23. Corona effect can be detected by
(a) hissing sound (b) faint luminous flow of bluish colour
(c) presence of ozone detected by odour (d) all of the above (correct)
24. A relay used on long transmission lines is
(a) Mho's relay (b) Reactance relay
(c) Impedance relay (d) No relay is used
25. In a power station, the cost of generation of power reduces most effectively when
(a) diversity factor alone increase (b) both diversity factor and load factor increases
(c) load factor alone increases (d) both diversity factor and load factor decreases
26. For a fault at the terminals of a synchronous generator, the fault current is maximum for a
(a) 3-phase fault (b) 3-phase to ground fault
(c) Line to ground fault (d) Line to line fault
27. The steady state stability limit of a synchronous generator can be increased by
(a) an increase in its reactance
(b) an increase in the excitation of the machine
(c) a decrease in the moment of inertia of the machine
(d) an increase in the moment of inertia of the machine
28. A 500 MVA, 11 kV synchronous generator has 0.2 pu synchronous reactance. The pu synchronous reactance on the base values of 100 MVA and 22kV is
(a) 0.16 (b) 0.01
(c) 4.0 (d) 0.25
29. A 8 pole, 3 phase, 50 Hz induction machine is operating at 700 rpm, frequency of rotor current is
(a) 3.75 Hz (b) 3.33 Hz
(c) 2.5 Hz (d) 3.5 Hz
30. 20. A 240 V dc series motor takes 40A when giving its rated output at 1500 rpm its resistance is 0.3 ohm. The value of resistance which must be added to obtain rated torque at 1000 rpm is
(a) 1.9 ohm (b) 5.7 ohm
(c) 2.2 ohm (d) 6 ohm
31. The insulation of the modern EHV lines is designed based on
(a) the lightning voltage (b) the switching voltage
(c) corona (d) RI

32. The Buchholz relay protects a transformer from
- (a) winding to winding fault
 - (b) A turn-to-turn fault
 - (c) all type of internal fault
 - (d) none of these
33. A dc shunt motor is running at 1200rpm when excited with 220v dc .Neglecting the losses and saturation, the speed of the motor when connected to a 175V dc supply is
- (a) 750 rpm
 - (b) 900rpm
 - (c) 1200 rpm
 - (d) 1050 rpm
34. Mho relay is normally used for the protection of
- (a) No length criterion
 - (b) medium length lines
 - (c) Short length lines
 - (d) long transmission lines
35. The leakage flux of a transformer depends upon
- (a) the applied voltage
 - (b) the load current
 - (c) the frequency
 - (d) the mutual flux
36. A dc shunt motor having un saturated magnetic circuit runs at 1000rpm with rated voltage. If the applied voltage is reduced to half of the rated voltage the motor will run at
- (a) 1000 rpm
 - (b) 2000 rpm
 - (c) 750 rpm
 - (d) 500 rpm
37. If the speed of a dc shunt motor is increased above its rated speed, then its counter emf
- (a) increases
 - (b) remain unchanged
 - (c) decreases
 - (d) first increases and then decreases
38. A 240V dc shunt motor with armature resistance of 0.5 ohm has a full load current of 40 A. Find the ratio of stalling torque to the full load torque when the resistance of 1 ohm is connected in series with the armature
- (a) 6
 - (b) 12
 - (c) 4
 - (d) 8
39. If the penalty factor of a plant is unity, its incremental transmission loss is
- (a) 0
 - (b) -1.0
 - (c) 1.0
 - (d) 0.5
40. For a two pole, 50 Hz, 3 phase synchronous motor the speed of rotating magnetic field is
- (a) 1000 rpm
 - (b) 2000 rpm
 - (c) 3000 rpm
 - (d) 3500 rpm
41. For a given power system, its zero and maximum regulation will occur at the impedance angle of
- (a) 45°
 - (b) 60°
 - (c) 35°
 - (d) 50°
42. For a transformer with primary turns 400, secondary turns 100, if 20A current is flowing through primary, we will get _____
- (a) 800A at secondary
 - (b) 40A at secondary
 - (c) 80A at secondary
 - (d) 5A at secondary
43. If the field of the synchronous motor is overexcited then its power factor will be
- (a) Lagging
 - (b) Unity
 - (c) Leading
 - (d) Zero

44. Transmission line insulators are made of
(a) Glass (b) Porcelain
(c) Iron (d) P.V.C.
45. A control system whose step response is $-0.5(1+e^{-2t})$ is cascaded to another control block whose impulse response is e^{-t} . What is the transfer function of the cascaded combination?
(a) $1/(s+1)s$ (b) $0.5/(s+1)(s+2)$
(c) $1/(s+2)(s+1)$ (d) $1/(s+3)$
46. Effect of feedback on sensitivity is minimum in:
(a) Closed loop control system (b) Open and closed loop control systems
(c) Open loop control system (d) None of the mentioned
47. The skin effect of a conductor reduces with the increase in
(a) Supply frequency (b) X-section of conductor
(c) Resistivity of the conductor material (d) Permeability of conductor material
48. If all the stator coils of an induction motor are connected for the same magnetic polarity, there will be formed an equal number of
(a) Rotor poles with same polarity (b) Rotor poles with opposite polarity
(c) Consequent pole with opposite polarity (d) Consequent poles with same polarity
49. Transformer core are laminated in order to
(a) Reduce copper loss (b) Minimize eddy current loss
(c) Reduce eddy current and hysteresis loss (d) Reduce hysteresis loss
50. A 3-phase squirrel cage induction motor drawn 10 kW from mains when loaded at a slip of 0.05. The stator losses are 1 kW and 550 W respectively. Its efficiency is
(a) 60% (b) 90%
(c) 80% (d) 70%

SECTION - B (100 Marks)

All questions carry equal marks of 10 each.

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

1. (a) A unity feedback control system is characterized by the open loop transfer function

$$G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$$

Using Routh Criterion,

- (i) Calculate the range of values of K for the system to be stable.
(ii) What is the marginal value of K for stability?
(ii) Check if for K=1, all the roots of the characteristic equation of the above system have the damping factor greater than 0.5. (3+1+3=7)
- (b) What do you mean by automatic control system? What are the basic components of an automatic control system? (1+2=3)

2. (a) Derive an expression for the e.m.f. induced in a transformer winding. Show that emf per turn in primary is equal to emf per turn in the secondary. (4+1=5)
- (b) A 600 KVA, 1-phase transformer has an efficiency of 92% both at full load and half load at unity power factor. Determine its efficiency at 60% of full load at 0.8 power factor lag. (5)
3. (a) Explain hunting phenomenon of a synchronous machine. What are the various causes of hunting? How can it be reduced? (4+1+1=6)
- (b) Explain, briefly, the phenomenon of crawling and cogging in a 3-phase induction motor. (2+2=4)
4. (a) What are the losses that occur in DC machines? Derive the condition for maximum efficiency of a DC generator. (2+3=5)
- (b) Describe the construction and working of a shaded-pole motor. (5)
5. (a) What are the advantages and disadvantages of dc transmission over ac transmission? (5)
- (b) Give the comparison of steam power plant, hydro-electric power plant, diesel power plant and nuclear power plant on the basis of operating cost, initial cost, efficiency, maintenance cost and availability of source of power. (5)
6. (a) Explain the transient and steady state stability of power system. (5)
- (b) Explain the working of minimum oil circuit breaker with a neat diagram. (5)
7. (a) Explain the parallel operations of 3-phase transformer. (5)
- (b) A transformer on no-load takes 4.5A at a power factor of 0.25 lagging when connected to a 230V,50Hz supply. The number of turns of the primary winding is 250. Calculate (i) the magnetising current (ii) the core loss (iii) the maximum value of the flux in the core. (5)
8. With a neat schematic diagram explain the working of a hydro power plant. (10)
9. (a) What are the different types of steam turbines? Briefly discuss about their use and characteristics. (5)
- (b) Explain about open cycle and closed cycle gas turbine plants. (5)
10. (a) The forward path transfer function of a unity feedback control system is $G(S) = \frac{100}{S(S+6.54)}$
- Find the resonant peak, resonant frequency and bandwidth of the closed loop system. (6)
- (b) Write a short note on the different types of control system components. (4)

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