

MIZORAM PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF INSPECTOR OF LEGAL METROLOGY UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS DEPARTMENT, GOVERNMENT OF MIZORAM, DECEMBER, 2018

ELECTRICAL ENGINEERING

PAPER - II

Time Allowed : 2 hours

Full Marks : 200

*All questions carry equal marks of two (2) each.
Attempt all questions.*

- In order to use the Routh's Hurwitz criterion for determining the stability of sampled data system the characteristics equation $1+G(z)H(z)=0$, should be modified by using bilinear transform of
 - $z = r + 1$
 - $z = r - 1$
 - $z = \frac{r-1}{r+1}$
 - $z = \frac{r+1}{r-1}$
- A minimum phase unity feedback system has a Bode plot with a constant slope of -20 db/decade for all frequencies. What is the value of maximum phase margin for the system?
 - 0°
 - 90°
 - -90°
 - 180°
- The initial slope of the bode plot gives an indication of
 - type of the system
 - nature of the system time response
 - system stability
 - gain margin
- What is the effect of phase lead compensator on gain cross over frequency (w_{cg}) and on the bandwidth (w_b)?
 - both are increased
 - w_{cg} is increased but w_b is decreased
 - w_{cg} is decreased but w_b is increased
 - both are increased
- Which of the following methods is not used for the analysis of nonlinear control systems?
 - phase plane method
 - describing function method
 - Liapunov's method
 - Piecewise linear method
- A second order control system has $M(j\omega) = \frac{100}{100 - \omega^2 + 10\sqrt{2}j\omega}$. Its M_p (peak magnitude) is
 - 0.5
 - 1
 - $\sqrt{2}$
 - 2
- Nichols chart is useful for detailed study and analysis of
 - closed loop frequency response
 - open loop frequency response
 - closed loop and open loop frequency responses
 - none of these
- The unit step response of a system is $1 - e^{-(1+t)}$. Which is this system?
 - Unstable
 - Stable
 - Critically stable
 - Oscillatory

9. The close loop transfer function of control system is given $\frac{C(s)}{R(s)} = \frac{1}{1+s}$. For the input $r(t) = -\sin t$, the steady state value of $C(t)$ is equal to
- (a) $\frac{1}{\sqrt{2}} \cos t$ (b) 1
(c) $\frac{1}{\sqrt{2}} \sin t$ (d) $\frac{1}{\sqrt{2}} \sin\left(t - \frac{\pi}{4}\right)$
10. A system is critically damped. Now if the gain of the system is increased, the system will behave as
- (a) over damped (b) under damped
(c) oscillatory (d) critically damped
11. The bode-plot is valid for
- (a) minimum phase network (b) all phase network
(c) non-minimum phase network (d) none of these
12. The damping ratio and natural frequency of a second order system are 0.6 and 2 rad/s respectively. Which one of the following combination gives the correct values of peak and setting time, respectively for the unit step response of the system?
- (a) 3.33s and 1.95s (b) 1.95s and 3.33s
(c) 1.95s and 1.5s (d) 1.5s and 1.95s
13. Consider a system with the transfer function $G(s) = \frac{s+2}{ks^2 + s + 6}$. Its damping ratio will be 0.5 when the value of k is
- (a) 2/6 (b) 3
(c) 1/6 (d) 6
14. The transfer function is $\frac{1+0.5s}{1+s}$. It represents a
- (a) lead network (b) lag network
(c) lag-lead network (d) proportional network
15. As compared to closed loop system, an open loop 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
16. The intersection of asymptotes of root loci of a system with open loop transfer function is
- $$G(s).H(s) = \frac{K}{s(s+1)(s+3)}$$
- (a) 1.44 (b) 1.33
(c) -1.44 (d) -1.33
17. The response $c(t)$ to a system is described by the differential equation $\frac{d^2c(t)}{dt^2} + \frac{4dc(t)}{dt} + 5c(t) = 0$, the system response is:
- (a) undamped (b) underdamped
(c) critically damped (d) oscillatory

18. The forward-path transfer function of unity feedback system is $G(s) = \frac{K(s+2)}{(s^2+1)(s+4)(s-1)}$

The range of K, for which will be only two closed loop RHP poles, is

- (a) $-33 < K < -12$
- (b) $K < -33$
- (c) $K < 2$
- (d) $0 < K < 2$

19. In position control systems, the device used for providing rate feedback is called

- (a) potentiometer
- (b) synchro
- (c) tachogenerator
- (d) servomotor

20. The Nyquist plot of $G(j\omega)H(j\omega)$ of a closed loop control system encloses the point $(-1, j0)$ in GH plane. The gain margin of the system in DB is,

- (a) greater than zero
- (b) less than zero
- (c) zero
- (d) infinite

21. Addition of open-loop poles results into which of the following?

- (a) Root locus shifts towards imaginary axis
- (b) Root locus shifts away from imaginary axis
- (c) System stability increases
- (d) System becomes less oscillatory

22. Given a badly underdamped control system, the type of cascade compensator to be used to improve its damping is

- (a) phase-lead
- (b) phase-lag
- (c) phase-lag-lead
- (d) notch filter

23. The Nyquist plot for the closed loop control system with the loop transfer function

$$G(s).H(s) = \frac{100}{s(s+10)}$$

is plotted. The critical point $(-1, j0)$ is

- (a) never enclosed
- (b) enclosed under certain conditions
- (c) just touched
- (d) enclosed

24. A transfer function of a control system does not have pole-zero cancellation. Which one of the following statements 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

25. An open loop transfer function of an unity feedback control system has two finite zeros, two poles at origin and two pairs of complex conjugate poles, the slope of high frequency asymptote is bode magnitude plot will be

- (a) +40 dB/decade
- (b) 0 dB/decade
- (c) -40 dB/decade
- (d) -80 dB/decade

26. The characteristic equation of a control system is given by $s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$. The number of the roots of the equation which lie in the imaginary axis of s-plane is

- (a) zero
- (b) 2
- (c) 4
- (d) 6

27. For the network function $T(s) = \frac{s}{s^2 + 2s + 100}$, the resonant frequency and bandwidth are respectively

- (a) 10, 1
- (b) 10, 2
- (c) 100, 1
- (d) 100, 2

28. Consider unity feedback system $G(s) = \frac{K}{s(1+sT_1)(1+sT_2)(1+sT_3)}$. The angle of asymptote which the Nyquist plot approaches as $\omega \rightarrow 0$, is
- (a) -90° (b) 90°
(c) 180° (d) -45°
29. If the gain margin of a certain feedback system is given as 20 dB, the Nyquist plot will cross the negative real axis at the point
- (a) $s = -0.05$ (b) $s = -0.2$
(c) $s = -0.1$ (d) $s = -0.01$
30. The transfer function of a compensating network is of form $(1+aT_s)/(1+T_s)$. If this is a phase lag network, the value of a should be
- (a) greater than 1 (b) between 0 and 1
(c) exactly equal to 1 (d) exactly equal to 0
31. When a transfer function model is converted into state space model, the order of the system may be reduced during which one of the following conditions?
- (a) Some of the variables are not considered (b) Some of the variables are hidden
(c) Pole, zero cancellation takes place (d) The order of the system will never get changed
32. In a single-phase transformer, the magnitude of leakage reactance is twice that of resistance of both primary and secondary. With secondary short-circuited, the input power factor is
- (a) $\frac{1}{\sqrt{2}}$ (b) $\frac{1}{\sqrt{5}}$
(c) $\frac{2}{\sqrt{5}}$ (d) $\frac{1}{3}$
33. In a three phase induction motor, the resultant flux is constant and is
- (a) equal to \hat{f}_m
(b) 1.5 times the maximum value of flux due to any phase
(c) $\frac{\sqrt{3}}{2}$ times the maximum value of flux due to any phase
(d) None of these
- Here, \hat{f}_m is maximum value of flux due to any phase.
34. Main advantage of using fractional-pitch winding is to reduce
- (a) amount of copper in the winding (b) size of the machine
(c) harmonics in the generated emf (d) cost of the machine
35. The voltage regulation of an over compound d.c. generator is always
- (a) positive (b) negative
(c) zero (d) high
36. The counter e.m.f. of a d.c. motor
- (a) often exceeds the supply voltage (b) aids the applied voltage
(c) help in energy conversion (d) regulates its armature voltage

37. If a sinusoidal voltage source is connected to a power transformer, its no-load current would be
- (a) sinusoidal and lagging the voltage by 90°
 - (b) sinusoidal and lagging the voltage by less than 90°
 - (c) rich in third harmonic and its fundamental would lag the voltage by 90°
 - (d) rich in third harmonic and its fundamental would lag the voltage by less than 90°
38. In dc machines, the space waveform of the air gap flux distribution affects
- (a) torque but not the voltage
 - (b) voltage but not the torque
 - (c) neither the voltage nor the torque
 - (d) both the torque and voltage
39. The direction of rotation of a dc shunt motor can be reversed by interchanging the
- (a) supply terminals
 - (b) field terminals only
 - (c) armature terminals only
 - (d) none of these
40. The chording angle for eliminating 5th harmonics should be
- (a) 30°
 - (b) 34°
 - (c) 36°
 - (d) 35°
41. Transformer cores are laminated in order to
- (a) simplify its construction
 - (b) minimize eddy current loss
 - (c) reduce cost
 - (d) reduce hysteresis loss
42. The primary and secondary windings of an ordinary 2-winding transformer always have
- (a) different number of turns
 - (b) same size of copper wire
 - (c) a common magnetic circuit
 - (d) separate magnetic circuits
43. Sludge in transformer oil is due to
- (a) decomposition of oil
 - (b) decomposition of insulation
 - (c) moisture content in oil
 - (d) none of these
44. Hysteresis and eddy current losses in electric machines depend on
- (a) flux density
 - (b) speed
 - (c) speed and flux density
 - (d) none of these
45. No load test on a transformer is carried out to determine
- (a) copper loss
 - (b) magnetizing current
 - (c) magnetizing current and no load loss
 - (d) efficiency of the transformer
46. The effect of increasing the length of air-gap in an induction motor will be to increase the
- (a) power factor
 - (b) speed
 - (c) magnetizing current
 - (d) air-gap flux
47. In a three phase induction motor, the rotor field rotates at synchronous speed with respect to
- (a) stator
 - (b) rotor
 - (c) stator flux
 - (d) none of the above
48. The power factor of a squirrel cage induction motor is
- (a) low at light loads only
 - (b) low at heavy loads only
 - (c) low at light and heavy loads both
 - (d) low at rated load only
49. The phenomenon of crawling in a 3-phase cage induction motor may be due to
- (a) unbalanced supply
 - (b) 7th space harmonic of air-gap field
 - (c) 7th time harmonic of voltage wave
 - (d) 5th space harmonic

50. A 440 volts shunt motor has an armature resistance of 0.5Ω shunt field resistance of 650Ω . If the no load current is 3 A, then current in the armature will be
- (a) 2.32 A (b) 3 A
(c) 0.68 A (d) 880 A
51. A separately excited dc generator is feeding a dc shunt motor. If the load torque on the motor is reduced to half, then
- (a) the armature current of both motor and generator are reduced to half
(b) the armature current of motor is halved and that of generator remains unchanged
(c) the armature current of generator is halved and that of motor remains unchanged
(d) the armature current of both machines remains unchanged.
52. A dc series motor is running at rated speed and rated voltage, feeding a constant power load. If the speed has to be reduced to 0.25 pu, the supply voltage should be reduced to
- (a) 0.75 pu (b) 0.5 pu
(c) 0.25 pu (d) 0.075 pu
53. When speed of an alternator is changed from 3600 r.p.m. to 1800 r.p.m., the generated e.m.f./phase will become
- (a) one-half (b) twice
(c) four times (d) one-fourth
54. The air-gap between the yoke and armature in a dc motor is kept small
- (a) to achieve a stronger magnetic field (b) to avoid overheating of the machine
(c) to avoid locking of the armature (d) to avoid transverse motion
55. How many segments will be there for the commutator of a 6 pole dc machine having a simple wave wound armature with 72 slots?
- (a) 73 (b) 72
(c) 71 (d) 70
56. A two-winding transformer is used as an auto transformer. The kVA rating of the auto-transformer compared to the two-winding transformer will be
- (a) 3 times (b) 2 times
(c) 1.5 times (d) same
57. If the applied voltage to a dc machine is 230 V, then the back emf for maximum power developed is
- (a) 115 V (b) 200 V
(c) 230 V (d) 460 V
58. If the speed of a d.c. motor increases with load torque, then it is a
- (a) series motor (b) permanent magnet motor
(c) differentially compounded motor (d) cumulatively compounded motor
59. A 400/200 v transformer has total resistance 0.02 p.u. on its l.v. side. The resistance when referred to h.v. side would be
- (a) 0.02 (b) 0.04
(c) 0.001 (d) 0.08
60. Armature reaction AT of a synchronous generator supplying power at rated voltage with zero power factor lagging is
- (a) Magnetising (b) Demagnetizing
(c) Cross-magnetizing (d) Both magnetizing and cross-magnetizing

61. Power factor of an alternator driven by constant prime mover input can be changed by changing its
- (a) Speed
 - (b) Load
 - (c) Field excitation
 - (d) Phase sequence
62. When will a slip ring induction motor run at super synchronous speed?
- (a) If a voltage is injected in the rotor circuit in phase opposition to the rotor induced emf
 - (b) If an emf is injected in the rotor circuit in phase with the rotor induced emf
 - (c) If motor is coupled with active load
 - (d) If motor is coupled with passive load
63. Capacitor in a single phase induction motor is used for
- (a) improving the power factor
 - (b) improving the starting torque
 - (c) starting the motor
 - (d) reducing the harmonics
64. The leakage reactance of a three phase alternator determined by performing
- (a) Open circuit and zero power factor tests
 - (b) Zero power factor and slip tests
 - (c) Open circuit and short circuit tests
 - (d) Short circuit and slip tests
65. Ferranti effect on long overhead line is experienced when it is
- (a) lightly loaded
 - (b) on full load at u.p.f.
 - (c) on full load at 0.8 p.f.
 - (d) on full load at z.p.f.
66. The positive sequence reactance will be equal to the negative sequence reactance, if the equipment is
- (a) Transformer
 - (b) Transmission line
 - (c) Generator
 - (d) both (a) and (b)
67. Which of the following material is best suitable in construction of the armature of a dc machine?
- (a) silicon steel
 - (b) wrought iron
 - (c) cast steel
 - (d) soft iron
68. As compared to DOL starting, a cage induction motor with star-delta starting shall have
- (a) more starting torque
 - (b) more starting time
 - (c) reduced starting current
 - (d) smoother acceleration
69. Which is the main relay for protecting up to 90% of the transmission line length in the forward direction?
- (a) Directional over-current relay
 - (b) Mho relay
 - (c) Carrier current-protective relay
 - (d) Impedance relay
70. In hydro power stations, what is an enlarged body of water just above the intake and used as a regulating reservoir, called?
- (a) Spillways
 - (b) Forebay
 - (c) Reservoir
 - (d) Penstock
71. In coal-fired thermal power stations, what are the electrostatic precipitators used for?
- (a) To remove dust particles settling on the bus bar conductors in the station switch yard
 - (b) To condense steam by electrostatic means
 - (c) To keep the air heaters clean
 - (d) To collect the dust particles from the flue gases
72. Which of the following statements is/are correct?
In pumped storage power plants
- (a) water is recirculated through water turbines
 - (b) reversible turbines are used which operates as turbines for power generation during peak load hours and as pumps for pumping water during peak-off hours
 - (c) plain Francis turbines are used
 - (d) both (a) and (c) above are employed

73. In HVDC transmission there are predominant
- (a) Voltage harmonics on dc side and current harmonics ac side of converters
 - (b) Current harmonics on dc side and voltage harmonics on ac side of converters
 - (c) Current harmonics only on the dc side of converters
 - (d) Voltage harmonics only on the ac side of converters
74. What is the preferred type of CB to be installed in extra high voltage ac system?
- (a) Bulk oil type CB
 - (b) Air blast CB
 - (c) Vacuum CB
 - (d) Sulphur hexafluoride (SF₆) CB
75. Which relay is used to detect and protect internal faults of a transformer?
- (a) Buchholz relay
 - (b) Directional relay
 - (c) Thermal relay
 - (d) Distance relay
76. Taking the density of water to be 1000 kg/m³, how much power would be developed by a hydroelectric generator unit, assuming 100% efficiency, with 1.0 m head and 1.0 m³/s discharge?
- (a) 2.90 kW
 - (b) 4.45 kW
 - (c) 9.80 kW
 - (d) 19.60 kW
77. A power station consists of two areas connected via a tie line. While entering the data for load flow the tie line parameters and its connectivity data were inadvertently left out. If the load flow program is run with this incomplete data, then the load flow calculations will converge only if
- (a) One slack bus is specified in the first area
 - (b) One slack bus is specified in the second area
 - (c) One slack bus is specified in either of the two areas
 - (d) Two slack buses, one in each area, are specified
78. When a 'pumped station' power plant is operated in conjunction with a steam power plant
- (a) The operating cost of the steam plant becomes optimum
 - (b) Load factor of the steam plant is increased
 - (c) Chances of the tripping of the system decrease because of the use of two heterogeneous types of plants
 - (d) Operation of the storage plant in the pumping improves the steam-plant stability
79. For which one of the following types of motors, is the equal-area criterion of stability applicable?
- (a) Three-phase synchronous motor
 - (b) Three-phase induction motor
 - (c) DC series motor
 - (d) DC compound motor
80. Gauss-Seidel iterative method can be used for solving a set of
- (a) linear differential equations only
 - (b) linear algebraic equation only
 - (c) both linear and nonlinear equations only
 - (d) both linear and nonlinear differentialequations
81. Power transmission lines are transposed to reduce
- (a) Skin effect
 - (b) Ferranti effect
 - (c) Transmission loss
 - (d) Interference with neighbouring communication lines

82. What is the preferred type of CB to be installed in extra high voltage ac system?
(a) Bulk oil type CB (b) Air Blast CB
(c) Vacuum CB (d) Sulphur hexafluoride (SF₆) CB
83. 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
84. The steady state stability 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
85. The use of high speed CB
(a) reduces the short circuit current (b) improves system stability
(c) decreases system stability (d) increases the shorter circuit current
86. The electrical stiffness of a synchronous generator connected to a very large system can be increased by
(a) increasing the excitation or power angle of the machine
(b) reducing the excitation of the synchronous reactance of the machine
(c) increasing the synchronous reactance of the machine
(d) operating the generator at a much lower MW level compared to the steady state limit
87. The critical clearing time of a fault in power system is related to
(a) reactive power limit (b) short-circuit limit
(c) steady state stability limit (d) transient curves
88. For what value of damping parameter, the transient stability is assured by equal area criterion?
(a) Independent of systems damping (b) If only damping is exactly zero
(c) For all values of damping parameters (d) If only damping is positive and finite.
89. For a fault in a power system, the term critical clearing time is related to
(a) reactive power limit (b) transient stability limit
(c) short circuit current limit (d) steady state stability limit
90. If a combination of HRC fuse and circuit breaker is used, the CB operate for
(a) low overload currents (b) short circuit current
(c) under all abnormal current (d) the combination is never used in practice
91. Bundled conductors are used for EHV transmission lines primarily for reducing the
(a) corona loss (b) surge impedance of the line
(c) voltage drop across the line (d) I²R losses
92. If in a short transmission line, resistance and inductance are found to be equal and regulation appears to be zero, then the load will
(a) have unity power factor (b) have zero power factor
(c) be 0.707 leading (d) be 0.708 lagging
93. Whenever the conductors are dead-ended or there is a change in the direction of transmission line, the insulators used are of the
(a) Pin type (b) Suspension type
(c) Strain type (d) Shackle type

94. If the positive, negative and zero sequence reactances of an element of a power system are 0.3, 0.3 and 0.8 respectively, then the element would be a
- (a) synchronous generator (b) synchronous motor
(c) static load (d) transmission line
95. Load flow study is carried out for
- (a) fault calculation (b) stability studies
(c) system planning (d) load frequency
96. Consider the following statements regarding HVDC transmission:
1. The modern HVDC systems use 12-pulse converter
 2. DC systems never use ground or sea return
 3. Most of present day d.c. schemes are two-terminal links
- Which of the statements given above is/are correct?
- (a) 1, 2 and 3 (b) 1 only
(c) 2 and 3 only (d) 1 and 3
97. In a nuclear power station using Boiling Water Reactor (BWR), water is used as
- (a) a moderator but not as a coolant (b) a constant but not as a moderator
(c) both moderator and coolant (d) neither moderator nor coolant
98. For stability and economic reasons we operate the transmission line with power angle in the range
- (a) 10° to 25° (b) 30° to 45°
(c) 60° to 75° (d) 65° to 80°
99. In a power station, the cost of generation of power reduces most effectively when
- (a) diversity factor alone increases (b) both diversity factor and load factor increase
(c) load factor alone increases (d) both diversity factor and load factor decrease
100. A power station consists of two synchronous generators A and B of rating 250 MVA and 500 MVA with inertia 1.6 p.u. and 1 p.u. respectively on their own base MVA ratings. The equivalent p.u. inertia for the system on 100 MVA common base will be
- (a) 2.6 (b) 0.615
(c) 1.625 (d) 9.0

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