MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR
JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE, P&E CADRE (ELECTRICAL WING)
UNDER POWER & ELECTRICITY DEPARTMENT,
GOVERNMENT OF MIZORAM, JULY-2023

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. Introduction of negative feedback in a system does not lead to reduction in
   - (a) bandwidth.
   - (b) distortion.
   - (c) instability.
   - (d) overall gain.

2. In the s-plane, the unstable region is
   - (a) Second and third quadrants including imaginary axis.
   - (b) First and fourth quadrants including imaginary axis except the origin.
   - (c) First and second quadrants including real axis.
   - (d) Second and fourth quadrants including real axis except the origin.

3. In Routh-Hurwitz criterion, if there are changes of signs in the elements of the first column, then the number of sign changes indicates
   - (a) the number of roots with negative real parts.
   - (b) the number of roots with positive real parts.
   - (c) the number of pair of roots of opposite sign.
   - (d) the number of pair of roots with same sign.

4. The best method for determining the stability and transient response is
   - (a) bode plot.
   - (b) Nyquist plot.
   - (c) root locus.
   - (d) none of these.

5. A step function is applied to the input of a system and output is of the form y=t, the system is
   - (a) stable.
   - (b) unstable.
   - (c) not necessary stable.
   - (d) always unstable.

6. In the above system if x>1, the system will exhibits
   - (a) large overshoot.
   - (b) medium overshoot.
   - (c) small overshoot.
   - (d) no overshoot.

7. Gain margin is the reciprocal of gain at the frequency at which the phase angle becomes
   - (a) 0°
   - (b) 90°
   - (c) 180°
   - (d) 270°

8. The damping ratio of the characteristic equation $s^2+2s+8=0$ is
   - (a) 0.353
   - (b) 0.453
   - (c) 0.5
   - (d) $\sqrt{2}$

9. For the system shown, the transfer function C(s)/R(s) is equal to
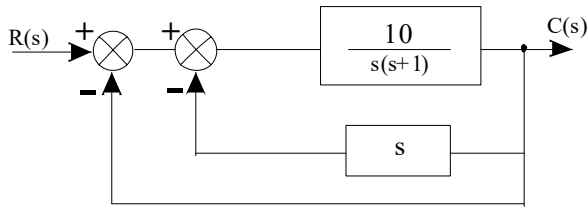
(a) $10/(s^2 + s + 10)$

(b) $10/(s^2 + 11s + 10)$

(c) $10/(s^2 + 9s + 10)$

(d) $10/(s^2 + 2s + 10)$

10. The speed of a d.c motor is

(a) directly proportional to back e.m.f and inversely proportional to flux.

(b) inversely proportional to back e.m.f and directly proportional to flux.

(c) directly proportional to e.m.f as well as flux.

(d) inversely proportional to e.m.f as well as flux.

11. A simplest method of increasing the voltage of a d.c generator is

(a) to decrease the air gap flux density.

(b) to increase the speed of rotation.

(c) to decrease the speed of rotation.

(d) to increase the length of armature.

12. The speed of series motor at no load is

(a) zero

(b) 1500 rpm.

(c) 3000 rpm.

(d) Infinity.

13. If the back e.m.f in a d.c motor is absent, then

(a) motor will run at a very high speed.

(b) motor will run at a very slow speed.

(c) motor will not run at all.

(d) motor will burn.

14. In a synchronous motor, minimum armature current occurs at

(a) zero power factor.

(b) unity power factor.

(c) lagging power factor.

(d) leading power factor.

15. When the load of an alternator is thrown off, the terminal voltage will

(a) increase.

(b) decrease.

(c) remain same.

(d) None of these

16. An alternator running at 3000 r.p.m generates voltage at 50Hz. The number of poles of the alternator will be

(a) 8 poles

(b) 6 poles

(c) 4 poles

(d) 2 poles

17. The advantage of synchronous motor as compared to induction motor are that

(a) it runs at constant speed.

(b) it can run over wide range of power factor both lagging and leading.

(c) its torque is less sensitive to change in supply voltage.

(d) all of these.

18. In a capacitor start motor, the capacitor is connected

(a) in series with the main winding.

(b) in parallel with the auxiliary winding.

(c) in series with the auxiliary winding.

(d) none of above.

19. A transformer has negative voltage regulation when its load factor is

(a) zero.

(b) unity.

(c) leading.

(d) lagging.

20. Transformers are rated in kVA instead of kW because
    (a) load power factor is often not known.
    (b) kVA is fixed whereas kW depends on load p.f.
    (c) total transformer loss depends on volt-ampere.
    (d) it has become customary.

21. Which of the following connections is best suited for 3-phase, 4-wire service?
    (a) $\Delta - \Delta$
    (b) $Y - Y$
    (c) $\Delta - Y$
    (d) $Y - \Delta$

22. Of the following statements concerning parallel operation of transformers, the one which is not correct is
    (a) transformers must have equal voltage ratings.
    (b) transformers must have same ratio of transformation.
    (c) transformers must be operated at the same frequency.
    (d) transformers must have equal kVA ratings.

23. What is the advantage of hydro-electric power stations over thermal power stations?
    (a) The initial cost of hydro-electric power stations is low.
    (b) Their operating cost is low.
    (c) Hydro-electric power stations can supply same power throughout the year.
    (d) Hydro-electric power stations can be constructed where electric energy is required.

24. The corona effect can be minimised by increasing
    (a) the length of the conductors.
    (b) spacing between conductors.
    (c) diameter of the conductors.
    (d) both spacing between conductors and diameter of the conductors.

25. Ferranti effect on transmission line means
    (a) rise in receiving end voltage on lagging load.
    (b) rise in receiving end voltage on leading load.
    (c) rise in receiving end voltage on no load.
    (d) decrease in receiving end voltage on no load.

26. Zero sequence component always flows through
    (a) phase wire.
    (b) neutral wire.
    (c) earth wire.
    (d) any of the above.

27. The value of diversity factor is
    (a) less than one.
    (b) more than one.
    (c) equal to one.
    (d) none of these.

28. The power factor improvement equipment is always placed
    (a) at the generating station.
    (b) near transformer.
    (c) near the apparatus responsible for low power factor.
    (d) near the bus bar.

29. Which fault give rise to symmetrical fault current?
    (a) Single line to ground fault.
    (b) Line to line fault.
    (c) Double line to ground fault.
    (d) Three phase fault.

30. The grounding is generally done at the
    (a) receiving end.
    (b) supply end.
    (c) the middle of receiving and supply end.
    (d) none of these.

31. Load flow study is used for
    (a) fault calculation.
    (b) stability studies.
    (c) system planning.
    (d) plug setting.

32. Distance relay operation is dependent upon
    (a) ratio of current to current.
    (b) ratio of voltage to current.
    (c) ratio of voltage to voltage.
    (d) ratio of power to voltage.

33. The number of roots of $s^3 + 5s^2 + 7s + 3 = 0$ in the right half of the s-plane is
    (a) zero
    (b) one
    (c) two
    (d) three

34. A plant has the following transfer function:
$$G(s) = \frac{1}{(s^2 + 0.2s + 1)}$$
From a step input it is required that the response settles to within 2% of its final value. The plant setting time is
    (a) 20 sec
    (b) 40 sec
    (c) 35 sec
    (d) 45 sec

35. For a feedback control system of type-2, the steady state error for a ramp input is
    (a) Zero
    (b) Infinite
    (c) Constant
    (d) Indeterminate

36. In the Bode-plot of a unity feedback control system, the value of phase of G(jw) at the gain cross over frequency is -125°. The phase margin of the system is
    (a) -125°
    (b) -55°
    (c) 55°
    (d) 125°

37. In the derivative error compensation, damping
    (a) decrease and settling time decreases
    (b) increase and settling time increases
    (c) increase and settling time decreases
    (d) decrease and settling time increases

38. A 2/1 ratio, two-winding transformer is connected as an auto transformer. Its kVA rating as an auto transformer compared to a two-winding transformer is
    (a) same
    (b) 1.5 times
    (c) 2 times
    (d) 3 times

39. Starting current of an inductor motor is five times the full-load current while full-load slip is 4%. The ratio of starting torque to full-load torque is
    (a) 0.6
    (b) 0.8
    (c) 1.0
    (d) 1.2

40. Phase splitting can be accomplished in a single-phase induction motor by
    (a) adding a capacitor in series with auxiliary winding
    (b) causing auxiliary winding to have high resistance
    (c) both (a) and (b)
    (d) none of these

41. The applied voltage of a certain transformer is increase 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

42. Approximate value of the efficiency of a three phase induction motor running at a slip 's' is given by,

(a) $\dfrac{1}{1+s}$

(b) $\dfrac{s}{1+s}$

(c) $\dfrac{1-s}{1+s}$

(d) $\dfrac{s}{1+s}$

43. For a single phase capacitor start induction motor which of the following statements is valid?

(a) the capacitor is used for power factor improvement

(b) the direction of rotation can be changed by reversing the main winding terminals

(c) the direction of rotation cannot be changed

(d) the direction of rotation can be changed by interchanging the supply terminals

44. A consumer consumes 600 kWh per day at a load factor of 0.40. If the consumer increases the load factor of 0.70 without increasing the maximum demand, what is the consumption of energy in kWh?

(a) 1050 kWh

(b) 950 kWh

(c) 1000 kWh

(d) 1100 kWh

45. In the optimum generator scheduling of different power plants, the minimum fuel cost is obtained when

(a) only the incremental fuel cost of each plant is the same

(b) the penalty factor of each plant is the same

(c) the ratio of the incremental fuel cost to the penalty factor of each plant is the same

(d) the incremental fuel cost of each plant multiplied by it penalty factor is the same

46. The plug setting of a negative sequence relay is 0.2 A. The current transformer ratio is 5:1. The minimum value of line to line fault current for the operation of the relay is

(a) 1 A

(b) 1/1.732 A

(c) 1.732 A

(d) 0.2/1.732 A

47. The positive, negative and zero sequence impedance of a solidly grounded system under steady state condition always follow the relation

(a) $Z_1 > Z_2 > Z_0$

(b) $Z_1 < Z_2 < Z_0$

(c) $Z_0 < Z_1 < Z_2$

(d) None of these

48. A synchronous generator connected to an infinite bus delivers power at a lag pf. If its excitation is increased

(a) the terminal voltage increases

(b) voltage angle ä increases

(c) current delivered increases

(d) all of these

49. In pump storage hydropower plant, the electrical machine is made to work alternately as generator and motor. The efficiency of the generator working at the same electrical power level is

(a) greater that that as motor

(b) equal to that as motor

(c) less than that as moor

(d) greater or less than that as motor depending on the type of the machine.

50. When bundle conductors are used in place of single conductors, the effective inductance and capacitance will respectively

(a) increase and decrease

(b) decrease and increase

(c) decrease and remain unaffected

(d) remain unaffected and increase

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. (a) What is frequency response? What are the advantages of frequency response analysis?   **(3)**

    (b) What is phase and gain cross-over frequency?   **(2)**

2. (a) What is Bode plot? What are its advantages?   **(1+2=3)**

    (b) How closed loop frequency response is determined from the open loop frequency response using Nichols chart?   **(2)**

3. What is root locus? How will you find root locus on real axis?   **(2+3)**

4. Differentiate between open loop and close loop systems with suitable examples.

5. Briefly explain how open-circuit test is perform on a single-phase transformer. What is the purpose of this test?   **(4+1=5)**

6. What is armature reaction? What are its effects?   **(2+3=5)**

7. (a) What will happen if the field of a d.c shunt motor is opened?   **(1.5)**

    (b) What happens if the direction of current at the terminals of a series motor is reversed?   **(1.5)**

    (c) When is the armature of a d.c motor likely to get over-heated.   **(2)**

8. (a) What is, in brief, the basic of operation of a 3-phase induction motor?   **(3)**

    (b) How does the slip vary with load?   **(2)**

9. List the advantages of using per unit value in power system calculations.

10. Determine the positive-sequence component of the three current $I_a = 10\lfloor\_0^o\,A$, $I_b = 10\lfloor\_230^o\,A$ and $I_c = 10\lfloor\_130^o\,A$.

11. (a) What is the difference between a circuit breaker and isolator?   **(2)**

    (b) What is plug-setting multiplier? Find the value of plug setting multiplier for a fault current of 2400A on the primary side of 400/5 C.T and an inverse time over current relay whose plug setting is 150% is connected on the secondary side of the C.T.   **(1+2=3)**

12. Explain briefly the various starting methods of synchronous motor.

13. Draw and explain the characteristics of DC shunt Motor.

14. Describe the method of speed control of a 3-phase squirrel cage induction motor by changing the number of stator poles and state the applications of this method.

15. Explain the principle and purpose of a pump-storage scheme in a power system. What are the requirements of the site for the selection of such a scheme?

16. Write criteria for selection of circuit breaker.

17. What are the methods of voltage control? Explain any one voltage control method in detail with neat diagram.

18. What is load flow study? What kind of information is obtained from load flow study?

19. What is automatic controller? What are the basic components of an automatic control system? What is the need for a controller?

20. What do you mean by feedback? Which feedback is employed in control system and why? Distinguish between open loop and closed loop system.

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